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Contemporary Project Management

Plan-Driven and Agile Approaches

Fifth Edition

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Contemporary Project Management

Organize | Lead | Plan | Perform

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PART 4 Performing Projects

Preface

While project managers today still use many techniques that have stood the test of several decades, they must also recognize the business need for a project, sort through multiple conflicting stakeholder demands, and know how to deal with a rapid change. Additionally, project managers manage a myriad of communication issues in traditional, global and virtual project teams, adapt modern approaches to quality improvement, tailor their project management approach to include methods and behaviors from Agile as and when necessary, and deal with many other issues that are more challenging than those in projects of the past.

Contemporary project management utilizes the tried-and-true project management techniques along with modern improvements such as the Microsoft® Project Professional 2016, both the sixth and seventh editions of the *Guide to the Project Management Body of Knowledge (PMBOK Guide),* and many approaches derived from adaptive (Agile) project management. Contemporary project management methodology also uses many tools and understandings that come from modern approaches to quality and communications, effective and proven team development strategies, expanded role definitions, contemporary leadership theories, human strengths, and other sources. Contemporary project management is scalable, using simple versions of important techniques on small projects and more involved versions on major and complex projects.

New to This Edition

- **Agile**. This book covers Agile practice extensively and currently. Each chapter includes one or more learning objectives specific to Agile projects and a section late in each chapter that covers what is different in the Agile method for the chapter topic. The Agile section starts with a table highlighting key chapter questions and how traditional and Agile project management address each. Then we introduce Agile terms and definitions (well over 100 in the book) and describe both the mindset and techniques of Agile for the chapter topics. Finally, we have a large, integrated Agile case that spans all fifteen chapters with information on how a real Agile project is managed, along with key questions for students. Suggestions for teaching and grading this case are provided in the instructor's manual. The coauthors have earned multiple Agile credentials, have published a book on Agile, and have served as scrum master on an Agile project.
- ***PMBOK Guide 6e* and *7e*.** PMI has introduced the new official standard for project management, *PMBOK Guide 7e*, which is expected to be used along with the previous edition; *PMBOK Guide 6e*, which has been the standard for several years. *PMBOK Guide 6e* is organized as a process approach to project management and is prescriptive in nature. A master flowchart that depicts the total of this is included in this book along with individual flowcharts for each chapter showing the processes, flows, and outputs that concern chapter topics. The recently released *PMBOK Guide 7e*, which has a completely different orientation, is also covered in every chapter of the book. We describe how its principles and domains impact each chapter.

- **PMP Exam Content 2021**. In 2021, PMI changed the PMP exam radically. Prior to this change, the exam was tied closely to the *PMBOK Guide*. Now there is an exam content outline that specifies thirty-five tasks that must be completed on projects, with questions on all thirty-five tasks. The questions are grouped into three areas: process (50%), people (42%), and business environment (8%). The process questions mostly come from *PMBOK 6e* while the others come primarily from *PMBOK 7e*. Further, the breakdown is 50% traditional, plan-driven project management and the other 50% is Agile or hybrid. A student needs to understand both versions of the *PMBOK Guide* and Agile practices to do well on the exam. We have all of those well covered in the book.
- **Tagged Questions**. We have included 150 PMP-style questions (10 per chapter) in the book. Each is tagged to a PMP exam content outline task. We also have an extensive test bank for instructors with questions tagged by PMP exam content outline task, Bloom's taxonomy, and chapter.
- **Relevant new expert examples**. We have included many new and updated examples at the beginning of each chapter to engage students, within each chapter to demonstrate specific concepts, and at the end of each chapter to demonstrate how organizations combine multiple specific ideas from the chapter in real-world settings. What makes many of these examples special is the people who contributed and created them have decades of project management experience, one or often more than one project management credential, and have authored one or more professional books on that particular aspect of project management. Most of the examples come from true experts. The chapter content was shared with these contributors in advance to ensure that examples would integrate seamlessly with the text.

Distinctive Features

- **Videos.** The authors have created twenty-three videos showing how to perform many of the project management techniques. Fifteen videos are for activities such as creating charters, and the remaining eight are for Microsoft Project. These videos appear only in the MindTap product.
- **Coverage of Microsoft Project prepares students to work with the most recent tools.** Discussion of Microsoft Project demonstrates how to automate the project management techniques addressed in each chapter. The authors introduce all concepts using a step-by-step presentation that's consistent with *PMBOK* work processes. Students learn additional MS Project functionality as they practice techniques such as identifying and overcoming resource overloads and crashing project schedules. Full-color screenshots and multiple videos make the content more realistic and easier to follow.
- **Student-oriented, measurable objectives guide learning.** Each chapter begins with core and Agile-specific learning outcomes. We include one set of glossary definitions that correspond with the *PMBOK Guide* and other PMI standards and guides, as well as a second set that corresponds with Agile practice. These help students who would like to prepare for earning a Project Management Professionals (PMP) or Certified Associate in Project Management (CAPM) credential.
- **Actual project as learning vehicle.** A section at the end of each chapter lists deliverables for students to create (in teams or individually) for a real project. These assignments have been refined over the last two decades while working with the local PMI® chapter, which provided a panel of PMP judges to evaluate projects from a practical point of view. Included in the instruction manual (IM) are extensive tools and suggestions

developed over the last twenty years for instructors, guiding them to help students learn in the best possible way—with real projects. Students are encouraged to keep clean copies of all deliverables so they can demonstrate their project skills in job interviews. A listing of these deliverables is included in Appendix D.

- **Blend of traditional and modern methods.** Proven methods developed over the past half-century are combined with exciting new methods, including Agile, that have emerged from both industry and research. This book covers the responsibilities of many individuals who can have an impact on projects both as they are practiced in traditional and Agile environments, so aspiring project managers can understand not only their own roles but also those of people with whom they need to interact and work with.
- **Chapter-specific example projects.** A variety of experienced project leaders from around the world have contributed examples to demonstrate many of the techniques and concepts throughout the book. These highly experienced and credentialed managers (many of whom have written professional books on their specific project niche) have worked closely with the authors to ensure that the examples demonstrate the ideas discussed in the chapter.
- **Integrated example projects.** We have two continuing case study projects that are included at the end of all fifteen chapters. One is for a traditional, plan-driven project and the other is for an Agile project. Both include information regarding the project that is relevant to each chapter and then pose questions for students to answer. Suggestions for instructors to teach and evaluate student answers are in the test bank. One of the authors serves as scrum master on the Agile project.

Organization of Topics

The book is divided into four major parts. Part 1, **Organizing Projects,** deals with getting a project officially approved.

- Chapter 1 introduces contemporary project management by first tracing the history of project management discipline and then discussing what makes a project different from an ongoing operation. Various frameworks that help understand projects—such as the *PMBOK 6e* and *7e Guides* and Agile—are introduced in this chapter, and the relevant information of both *PMBOK Guides* and Agile are shown in all remaining chapters. Finally the executive-, managerial-, and associate-level roles in both plan-driven and Agile projects are introduced.
- Chapter 2 discusses projects support role as an outgrowth of strategic planning, portfolio of projects is selection and prioritization, how a client company selects a contractor company to conduct a project, and how a contractor company secures project opportunities from client companies.
- Chapter 3 presents project charters in a step-by-step fashion. Short, charters help all key participants to develop a common understanding of key project issues and components at a high level with an intent to formally commit to the project. Charters have become nearly universal in initiating projects in recent years. Microsoft Project Professional is utilized to show milestone schedules within charters.

Part 2, **Leading Projects**, deals with understanding the project environment and roles and dealing effectively with team members and stakeholders.

- Chapter 4 centers around organizational capability issues of structure, life cycle, culture, and roles. The choices parent organizations make in each of these provide both opportunities and limitations to how projects can be planned and executed.

- Chapter 5 deals with leading and managing the project team. It includes acquiring and developing the project team, assessing both potential and actual performance of team members and the team as a whole, various types of power a project manager can use, how to deal productively with project conflict, and the importance of leadership role of project managers.
- Chapter 6 introduces methods for understanding and prioritizing various stakeholder demands and for building constructive relationships with stakeholders. Since many projects are less successful than they could be due to poor communications, detailed communication planning techniques are introduced for managing stakeholder expectations, along with suggestions for managing meetings, a crucial channel of communication.

Part 3, **Planning Projects**, deals with all aspects of project planning as defined in the *PMBOK 6e Guide* and *PMBOK 7e Guide*. It proceeds in the most logical order possible to maximize effectiveness and stress continuity so that each chapter builds on the previous ones, and students can appreciate the interplay between the various knowledge areas and processes.

- Chapter 7 helps students understand how to determine the amount of work the project entails. Specifically covered are methods for determining the scope of both the project work and outputs, the work breakdown structure (WBS) that is used to ensure nothing is left out, and how the WBS is portrayed using Microsoft Project Professional. We show how scope is gradually defined in Agile projects, as opposed to fully developed in plan-driven projects.
- Chapter 8 is the first scheduling chapter. It shows how to schedule project activities by identifying, sequencing, and estimating the duration of each activity. Then, critical path project schedules are developed and the methods are shown for dealing with uncertainty in time estimates, Gantt charts are introduced for easier communications, and Microsoft Project Professional is used to automate the schedule development and communications.
- Chapter 9 is the second scheduling chapter, dealing with resourcing projects and accelerating delivery if needed. Once the critical path schedule is determined, staff management plans are developed, project team composition issues are considered, resources are assigned to activities, and resource overloads are identified and handled. Schedule compression techniques of crashing and fast-tracking are demonstrated, and multiple alternative scheduling techniques including Agile are introduced. Resource scheduling is demonstrated with Microsoft Project Professional.
- Chapter 10 deals with project budgeting. Estimating cost, budgeting cost, and establishing cost controls are demonstrated. Microsoft Project Professional is used for developing both bottom-up and summary project budgets.
- Chapter 11 demonstrates project uncertainty planning. It includes risk management planning methods for identifying risks, establishing a risk register, qualitatively analyzing risks for probability and impact, quantitatively analyzing risks if needed, and deciding how to respond to each risk with contingency plans for major risks and awareness for minor risks.
- Chapter 12 starts by covering project quality planning. This includes explaining the development of modern quality concepts and how they distill into core project quality demands. Next, the chapter covers how to develop a project quality plan. It then ties all of the planning chapters together with discussions of a project kickoff meeting, a baselined project plan, and the ways Microsoft Project Professional can be used to establish and maintain the baseline.

Part 4, **Performing Projects,** discusses the various aspects that must be managed simultaneously while the project is being conducted.

- Chapter 13 deals with project procurement and partnering issues. Some of these issues, such as developing the procurement management plan, qualifying and selecting vendors, and determining the type of contract to use are planning issues, but for simplicity, they are covered in one chapter with sections on how to conduct and control procurements and to improve project partnerships.
- Chapter 14 is concerned with determining project results. This chapter starts with a balanced scorecard approach to controlling projects. Internal project issues covered include uncertainty, change, and communication. Quality is also covered, with an emphasis on achieving client satisfaction. Financial issues discussed are scope, cost, and schedule, including how to use Microsoft Project Professional for control.
- Chapter 15 deals with how to end a project—either early or on time. This includes validating to ensure all scope is complete, formally closing procurements and the project, knowledge management, and ensuring the project participants are rewarded and the clients have the support they need to realize intended benefits when using the project deliverables.

MindTap

MindTap is a complete digital solution for your project management course. It has enhancements that take students from learning basic concepts to actively engaging in critical thinking applications, while learning Project skills for their future careers.

The MindTap product for this book features videos from the authors that explain tricky concepts, videos that explain the finer points of what you can do with Project, and quizzes and homework assignments with detailed feedback so that students will have a better understanding of why an answer is right or wrong.

Instructor Resources

Additional instructor resources for this product are available online. Instructor assets include an Instructor's Manual, PowerPoint® slides, Solutions Answer Guide, and a test bank powered by Cognero®. Sign up or sign in at **www.cengage.com** to search for and access this product and its online resources.

Student Resources

Student resources for this product are available online. Student assets include Excel and Word Project templates, data sets for selected chapters, and instructions for how to get access to a trial version of Microsoft Online Professional Trial. (Note that while we are happy to provide instructions for accessing this trial, Microsoft controls that access and we are not responsible for it being removed in the future.) Sign up or sign in at **www.cengage.com** to search for and access this product and its online resources.

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- PMI's Global Accreditation Center
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- The Cincinnati and Louisville sections of the Center for Quality of Management
- Project Management Executive Forum
- Agile Cincinnati

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Kathryn (Kate) N. Wells, MEd., PMP, has over a decade of experience in project management education, having served as lead or co-author of five project management books. She has created project management training material that has been used around the world and has used her language abilities to translate (Spanish to English) project management training materials created abroad. Kate has spent most of her career in education, having taught high school, college (University of Cincinnati and Thomas More University), and adult students in a variety of settings. In addition to writing, Kate currently serves as a regional Project Manager for Pike Engineering. In this role, she creates and provides project management education throughout the Midwest region and is helping to start a PMO.

Part 1

Organizing Projects

Organize | Lead | Plan | Perform

Organizing for success in project management includes several basic frameworks for understanding projects and tools to select, prioritize, resource, and initiate projects. Basic frameworks described in Chapter 1 include how the work of project management can be categorized by knowledge areas and processes (*PMBOK® Guide 6e*), principles, and performance domains (*PMBOK Guide 7e*), how project success is determined, and how both plan-driven and adaptive approaches are frequently used. Chapter 2 describes how projects are investments meant to help achieve organizational goals. Tools are demonstrated to select, prioritize, and resource projects. Chapter 3 describes how charters are essential to initiating projects and then demonstrates how to construct each portion of a charter.

Chapter 1

Introduction to Project Management

Chapter Objectives

Core Objectives:

1-1 Define a project and project management in your own words, using characteristics that are common to most projects.
1-2 Describe major activities and deliverables at each project life cycle stage.
1-3 List and define twelve principles and the eight performance domains of the project management body of knowledge (*PMBOK 7e*).
1-4 Delineate measures of project success and failure, and reasons for both.
1-5 Identify project roles and distinguish key responsibilities for project team members.

Agile Objectives:

1-6 Define the twelve Agile principles and four Agile values from the Agile Manifesto.
1-7 Describe when and why Agile is sometimes a more useful approach.
1-8 Briefly define and describe "Be Agile" and "Do Agile."
1-9 Describe the four Agile metrics for success (viability and value, predictability, quality, and happiness) in each phase of the project.

All Canada Photos/Superstock

I have returned from a successful climb of Mount Aconcagua in Argentina; at 22,841 feet, it is the highest peak in the world outside of the Himalayas. While there, seven other climbers died; we not only survived, but our experience was so positive that we have partnered to climb together again.

During the three decades that I've been climbing mountains, I've also been managing projects. An element has emerged as essential for success in both of these activities: the element of discipline. By discipline, I am referring to doing what I already know needs to be done. Without this attribute, even the most knowledgeable and experienced will have difficulty avoiding failure.

The deaths on Aconcagua are an extreme example of the consequences associated with a lack of discipline. The unfortunate climbers, who knew that the predicted storms would produce very hazardous conditions, decided to attempt the summit instead of waiting. They did not have the discipline that we demonstrated to act on our earlier decision to curtail summit attempts after the agreed-to turn-around time or in severe weather.

PMBOK Guide 6e Coverage	
PMBOK Guide 6e	**Outputs**
1.2 Foundational Elements	Project Customer Trade-Off Matrix
2.4 Organizational Systems	Project Success Definition
3.3 The Project Manager's Sphere of Influence	
3.4 Project Manager Competencies	
3.5 Performing Integration	
Note: Refer to Appendix A to view the entire *PMBOK Guide 6e* flowchart.	

PMBOK Guide 7e

Delivery Principles:

- **Stewardship**
- **Team**
- **Stakeholders**
- **Value**
- **System**
- **Leadership**
- **Tailoring**
- **Quality**
- **Complexity**
- **Optimize risk**
- **Adaptability and resilience**
- **Enable change**

Performance Domains:

- **Stakeholder**
- **Team**
- **Development approach**
- **Planning**
- **Project work**
- **Delivery performance**
- **Measurement**
- **Uncertainty**

I've experienced similar circumstances in project management. Often I have found myself under pressure to cast aside or shortcut project management practices that I have come to rely on. For me, these practices have become the pillars of my own project management discipline. One of these pillars, planning, seems to be particularly susceptible to challenge. Managing projects at the Central Intelligence Agency for three decades, I adjusted to the annual cycle for obtaining funding. This cycle occasionally involved being given relatively short notice near the end of the year that funds unspent by some other department were up for grabs to whoever could quickly make a convincing business case. While some may interpret this as a circumstance requiring shortcutting the necessary amount of planning in order to capture some of the briefly available funds, I understood that my discipline required me to find a way to do the needed planning and to act quickly. I understood that to do otherwise would likely propel me toward becoming one of the two-thirds of the projects identified by the Standish Group in their 2021 Voice America report[1] as not successful. It is well known that the most successful project managers spend much more time planning than the vast majority of other project managers do. The approach that I took allowed me to maintain the discipline for my planning pillar. I preplanned a couple of projects and had them ready at the end of the year to be submitted should a momentary funding opportunity arise.

A key to success in project management, as well as in mountain climbing, is to identify the pillars that will be practiced with discipline. This book offers an excellent set of project management methods from which we can identify those pillars that we will decide to practice with the required levels of discipline. I believe that project management is about applying common sense with uncommon discipline.

—Michael O'Brochta, PMP, founder of Zozer Inc. and previously senior project manager at the Central Intelligence Agency

1.1 What Is a Project?

Frequently, a business is faced with making a change, such as improving an existing work process, constructing a building, installing a new computer system, merging with another company, moving to a new location, developing a new product or service, entering a new market, etc. These changes are driven by its strategic plan direction and objectives and are best planned and managed as projects.

Often, these changes are initiated due to operational necessity or to meet strategic goals, such as the following:

- Market demand
- Customer request
- Technological advance
- Legal requirements or regulatory compliance
- Replacement of obsolete equipment, technology, system, or physical facility
- Crisis situation
- Social need

So, what is a project?

A **project** is a unique, temporary effort that has a definite beginning and a definite ending with several related and/or interdependent tasks to create a product or service that adds business value and helps customers accomplish their desired goals.

The *PMBOK Guide* uses *temporary* to describe project work in terms of project duration. However, it does not mean that project duration is short; in fact, it can range from a few weeks to several years. *Temporary* also does not necessarily apply to the project deliverable or outcome, although project teams are certainly temporary.

A project requires an organized and planned effort with a level of detail that is progressively elaborated when more information is discovered. Project plans and goals become more specific after early work. Projects are subject to limitations of time and resources such as funding and people and they should follow a planned and organized approach with a defined beginning and end. The project output often is a collection of a primary deliverable along with supporting deliverables, such as a house as the primary deliverable and warranties and instructions for use as supporting deliverables.

Taking all these issues into consideration, a project can be defined as *a time-bound effort constrained by performance specifications, resources, and budget to create a unique product or service that adds value and meets desired outcomes.*

Each project typically has a unique combination of stakeholders. **Stakeholders** are people and groups who can impact the project or might be impacted by either the work or results of the project. Furthermore, projects require a group of people to work together, and they all must understand that completing the project will require focused effort in addition to their other assigned routine work. These people become members of the project team and usually represent diverse functions, skills, and disciplines.

Project management is the art and science of using knowledge, skills, tools, and techniques to meet stakeholder needs and expectations efficiently and effectively. This includes initiating, planning, executing, controlling, and closing the project. During these processes, trade-offs must be made among the following factors:

- Scope (size and features)
- Quality (acceptability of the results)
- Cost
- Schedule
- Resources
- Risks

When project managers successfully make these trade-offs, the project outcomes meet the agreed-upon requirements, are useful to the customers, and promote the organization. Project management includes both administrative and technical/managerial tasks for planning, documenting, and controlling work, as well as leadership tasks for visioning, motivating, and promoting work associates. *The underlying principle of project management discipline is to make effective and efficient use of all resources, and it is this principle that influences some of these trade-off decisions*. Project management models, methods, and artifacts can be applied and modified for all projects regardless of size or application.

1.2 History of Project Management

Projects of all sizes have been undertaken throughout history. Early construction projects included the ancient pyramids, medieval cathedrals, Indian cities, and Native American pueblos. Other early, large projects involved waging wars and building empires. In the development of the United States, projects included laying railroads, developing farms, and building cities. Many smaller projects consisted of building houses and starting businesses. Projects were conducted throughout most of the world's history, but there was very little documentation of processes, techniques, and procedures. Therefore, there is no evidence of systematic planning and control. It is known that some early projects were accomplished at great human and financial cost and that others took exceedingly long periods of time to complete. For example, the Panama Canal was started in 1881 and was not completed until 1914 because it faced many challenges.

Project management eventually emerged as a formal discipline. In the 1950s and 1960s, techniques for planning and controlling schedules and costs were developed, primarily on huge aerospace and construction projects. During this time, project management was primarily involved in determining project schedules based on understanding the order in which work activities had to be completed. Many large manufacturing, research and development, government, and construction projects used and refined management techniques. In the 1980s and 1990s, several software companies offered more effective and easier ways to plan and control project costs and schedules. Risk management techniques that were originally developed on complex projects are applied in a simplified form to less complex projects.

Rapid growth and changes in the information technology and telecommunications industries fueled massive growth in the use of project management in the 1990s and early 2000s. In the last few years, the major roles of project teams, communication, and leadership have been recognized as critical factors of project success. At the same time, systems and processes were developed for electronic documentation of the historical data of projects using information systems (IS) and knowledge management (KM) tools.

People who are engaged in a wide variety of industries, including banking, insurance, retailing, hospital administration, healthcare, many other service industries, government, and nonprofit organizations, are now turning to project management to plan and manage efforts in meeting their unique demands.

Further, in today's global economy, geographically dispersed virtual project teams are becoming the norm in many organizations. COVID-19 has accelerated this change. Managing a project is challenging in the current global economy due to the exponential growth of information technology and ever-increasing market demands that compel organizations to offer high-quality, affordable products and services quickly. Understanding the characteristics of global projects for improving global project performance is of critical importance.

The application of project management techniques and tools has grown quite rapidly and it is likely to continue. With increased international competition and a borderless

global economy, customers want their products and services developed and delivered better, faster, and cheaper. Because project management techniques are designed to manage scope, quality, cost, and schedule, they are ideally suited to this purpose.

Agile Throughout this book, we will present concepts and techniques that are unique to Agile projects. We will group these ideas and methods in one section near the end of each chapter. We will also use a table format to highlight differences between the traditional (plan-driven) and Agile approaches, such as in Exhibit 1.6.

However, many ideas that stem from Agile can be used to improve practices on plan-driven projects and are included in the text where the relevant topic is discussed.

1.3 How Can Project Work Be Described?

Project work can be described in the following ways:

- Projects are temporary and unique, while other work—commonly called operations—is more continuous.
- Project managers need certain "soft skills" and "hard skills" to be effective.
- Project managers frequently have more responsibility than authority.
- Managing a project requires identifying requirements; establishing clear and achievable objectives; balancing competing demands of quality, scope, cost, and time; and meeting customer expectations by making adjustments to all aspects of the project. The unique nature of a project often encompasses uncertainties and unknowns that present challenges to managing project work.
- Projects are managed with competing constraints of time, cost, scope, and quality
- Projects progress through predictable stages referred to as a life cycle.

1.3a Projects versus Operations

All work can be described as fitting into one of two types: projects or operations. Projects, as stated above, are temporary, and no two projects are completely identical. Some projects may be extremely different from any other work an organization has performed up to that time. Other projects may have both routine and unique aspects, like building a house; such projects can be termed *process-oriented*, and they are associated with fewer unknowns and uncertainties.

Operations, on the other hand, consist of the ongoing work necessary to ensure that an organization continues to function effectively. Operations managers can often use checklists to guide much of their work. However, project managers rarely have checklists that identify all the project management activities. Some work may be difficult to classify as totally project or totally operations; if project management methods and concepts help one to better plan and manage work, it does not really matter how the work is classified.

Both projects and operations are associated with processes. A **process** is described as a series of actions designed to bring about a consistent and similar result or service. A process is usually designed to improve productivity. Thus, processes are repetitive and produce consistent and similar results, whereas projects are unique: each project delivers results that are distinct from other projects. Nonetheless, one must remember that project management discipline includes various planning processes such as scope definition, scope management, risk management, communication management, and quality management.

1.3b Soft Skills and Hard Skills

To effectively manage and lead in a project environment, a person must develop both "soft" and "hard" skills. **Soft skills** include the ability to work in teams and with the teams,

interpersonal skills, communication, conflict resolution, negotiation, and leadership. **Hard skills** can include proficiency in planning and other project management techniques, risk analysis, quality assurance, and control, scheduling, budgeting, change control, and project execution. Soft and hard skills go hand in hand, and a project manager and the project team need to develop both, along with the judgment about when each is needed. A wise project manager may purposefully recruit an assistant who excels in his area of weakness. Training, experience, and mentoring can also be instrumental in developing necessary skills.

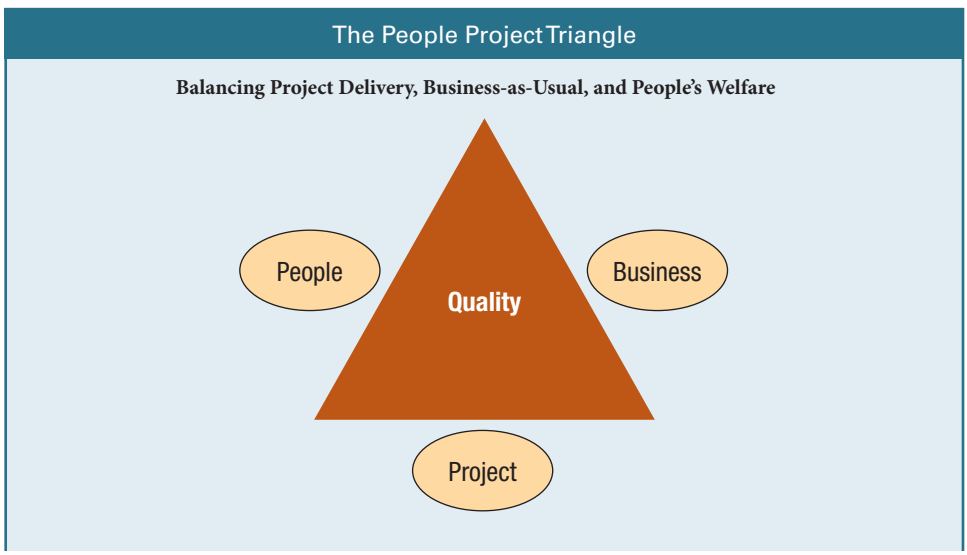
Soft skills such as interpersonal relations, conflict resolution, and communication are of critical importance in leading people. As such, of all the resources, managing human resources presents a major challenge. Managing and leading people are the most difficult aspects of managing a project and the project team. These challenges underline the importance of soft skills.

1.3c Authority and Responsibility

A project manager will frequently be held accountable for work that she cannot order people to perform and projects are most effectively managed with one person being assigned accountability. However, that person (project manager) often needs to negotiate with a **functional manager**, who is "someone with management authority over an organizational unit."[2] Project managers negotiate for workers to perform the project work in a timely fashion. Since the workers know their formal manager often has other tasks for them and will be their primary decision-maker, they are tempted to concentrate first on the work that will earn rewards. Hence, a project manager needs to develop strong communication and leadership skills to extract cooperation from functional managers and to persuade project team members to focus on the project when other work also beckons. Often, it is the project manager's responsibility that the work is performed, but at the same time, they have no formal authority over the project team members.

Project team members are often under significant stress to complete both their project work and their functional work, both with quality as shown in the People Project Triangle example in Exhibit 1.1.

Exhibit 1.1



A UK company was midway through a vital program to improve its payment processes. One project proved to be very troublesome. We reached the user acceptance test (UAT) phase, which required two weeks' work from the payment managers, whose deep knowledge was critical.

Unfortunately, the software delivered by the supplier was very poor, despite the quality control process. Additional unplanned tests were required and while testers understood the need, they were exasperated. It meant more time away from their day jobs and late delivery of the new module.

Their managers were even less impressed, and we lost a great deal of support from the business. The leaders failed to recognize that the workers assigned to the project were also working full-time on their normal duties, and could not do it all. As a result, the project quality, worker morale, and business needs all suffered.

Source: Stuart Copeland, Project Consultant, working in the UK with large corporates.
Andy Coaton, Consultant and Visiting Lecturer in Project Management at Royal Holloway, University of London

1.3d Project Life Cycle

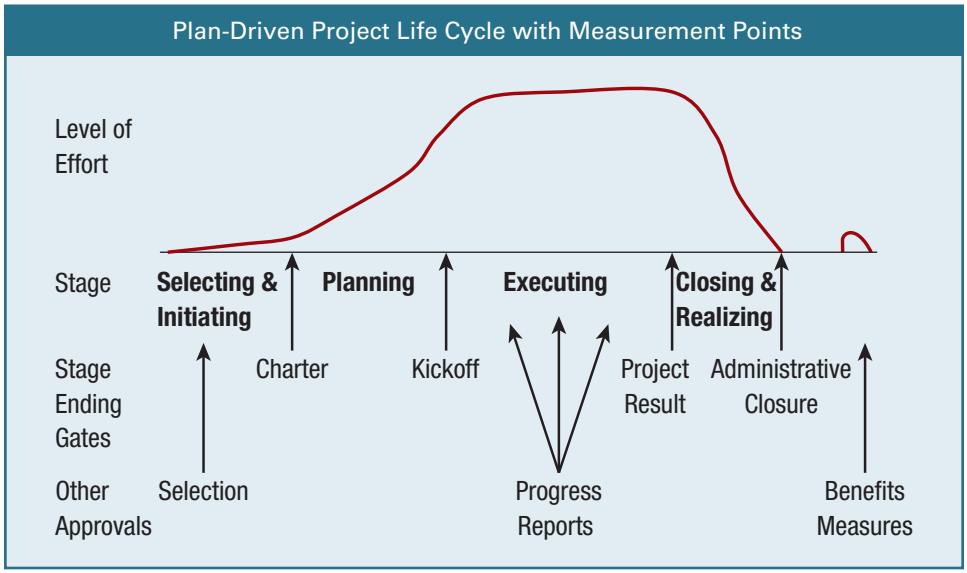
All projects go through predictable stages called a project life cycle. A **project life cycle** is "the series of phases that a project goes through from its initiation to its closure."[3] An organization demands that the work of the project is proceeding in a satisfactory manner, that the results are aligned with the project plan, and that they are likely to serve the customer's intended purpose. The customer is the person or organization that will use the project's product, service, or result. Customers can be internal or external to the organization.

Many different project life cycle models are used for projects executed in different types of organizations and industries. These variations will be explored in Chapter 4. In this book, we will use the following project phases:

- *Selecting and initiating*—starts when an idea for a project first emerges and the project is selected and planned at a high level and ends when key participants commit to it in broad terms.
- *Planning*—starts after the initial commitment, includes detailed planning, and ends when all key stakeholders accept the entire detailed plan.
- *Executing*—starts when the plan (or enough of it to proceed) is accepted and includes authorizing, executing, monitoring, and controlling the project work until the customer accepts the project deliverables.
- *Closing and realizing*—includes all activities after customer acceptance to ensure the project is completed, contracts are closed, lessons learned are documented, resources are reassigned, contributions are recognized, and benefits are realized.

The pace of work and the number of resources spent may vary considerably from one life cycle stage to another. Often, the *selecting* is performed periodically for all projects at a division or corporate level, and then *initiating* is rather quick—just enough to ensure that a project makes sense and key stakeholders will commit to it. The *planning* stage can become rather detailed and will require more work. The *execution* phase is when the majority of the project tasks are accomplished. *Closing* is a time when loose ends are tied up and the effort decreases significantly. *Realizing* benefits from the project occurs over time and may be measured months after project completion. It may be done by people other than those who performed the project. Often, some of these phases overlap with each other, depending on the project's complexity, the urgency of the deliverable, and ambiguity associated with the project scope. See Exhibit 1.2 for a plan-driven project life cycle.

Exhibit 1.2



Three other points should be made concerning the project life cycle. First, most companies with well-developed project management systems insist that a project must pass the approval of some kind to move from one stage to the next.[4] The approval to move from *selecting and initiating* to *planning,* for instance, is normally the approval of a charter. Second, in some industries, the project life cycle is highly formalized and very specific. For example, in the construction industry, the *executing* stage is often described as the stages of design and erection. Third, some organizations even have their own project life cycle model.

For clarity, this book will use the plan-driven model shown in Exhibit 1.2 when describing concepts, except when we discuss Agile with the adaptive or change-driven model. In addition to stage-ending approvals, frequently projects are measured at additional points such as selection, progress reporting, and benefits realization, as shown in Exhibit 1.2.

1.4 Understanding Projects

To better understand project management, we describe: the Project Management Institute (PMI); the *Project Management Body of Knowledge (PMBOK Guide);* methods of selecting and prioritizing projects, project goals, and constraints; project success and failure; use of Microsoft Project to help plan and measure projects; and various other ways to classify projects.

1.4a Project Management Institute

Project management has professional organizations, as do many other professions and industry groups. The biggest of these by far is PMI.

PMI was founded in 1969, grew at a modest pace until the early 1990s, and has grown quite rapidly since then. PMI has well over 600,000 members from 214 countries. PMI publishes and regularly updates over a dozen extensions, guides, and practice standards.

The best known is A *Guide to the Project Management Body of Knowledge (PMBOK Guide).* This guide has recently been updated in a completely novel manner. We refer both to the new seventh edition and to the previous sixth edition version in this book because the seventh edition builds on prior editions and does not negate anything that came before it. For example, we will still show *PMBOK Guide 6e* in flowcharts to emphasize how one work process flows into another. We show the new version of *PMBOK Guide 7e* in margin icons and we dedicate a section for relevant contents in each chapter. Definitions in this book that have specific nuances come from the most current edition of PMI standards and guides. Those definitions that are common knowledge are defined in typical terms. PMI has established eight professional certifications, with the most popular being Project Management Professional (PMP®). Currently, more than one million people hold the PMP certification. To be certified as a PMP, a person needs to have the required experience and education, pass an examination on the *PMBOK Guide,* and sign and be bound by a code of professional conduct. PMI has also established a second certification—Certified Associate in Project Management (CAPM)—that is geared toward junior people working on projects before they are eligible to become PMPs. PMI also has established multiple additional credentials plus more than twenty practice standards, guides, and extensions to the *PMBOK Guide* in areas such as program management, portfolio management, business analysis, risk management, and earned value management.[5]

1.4b Project Management Body of Knowledge (*PMBOK Guide 6e*)

A Guide to the Project Management Body of Knowledge, known as *PMBOK 6e,* consists of: five process groups; ten knowledge areas; and forty-nine processes. A **project management process group** is "a logical grouping of the project management processes to achieve specific project objectives."[6] The five process groups, paraphrased from the *PMBOK Guide 6e,* are as follows:

1. **Initiating**—define a project and obtain authorization
2. **Planning**—establish the project scope, refine objectives, and define plans to attain objectives
3. **Executing**—complete the work defined to satisfy project specifications
4. **Monitoring and controlling**—track performance, identify changes required, and initiate changes
5. **Closing**—formally complete or close project[7]

The ten knowledge areas from *PMBOK Guide 6e* are summarized below.

1. **Integration management**—processes and activities to, combine, and coordinate
2. **Scope management**—processes to ensure that the project includes all the work required, and only the work required
3. **Schedule management**—processes to manage timely completion
4. **Cost management**—processes involved in estimating, budgeting, controlling cost
5. **Quality management**—processes to plan, manage, and control quality
6. **Resource management**—processes to identify, acquire, and manage resources
7. **Communications management**—processes to ensure timely planning, creation, and distribution of project information
8. **Risk management**—processes of risk identification, analysis, response planning, response implementation, and monitoring
9. **Procurement management**—processes to purchase or acquire products, services, or results
10. **Stakeholder management**—processes to identify and analyze the people, or groups that could impact or be impacted by the project, and develop strategies for engaging them[8]

Project Processes There are forty-nine individual project work processes that are each in a process group and a knowledge area. The two-page flowchart inserted in Appendix A shows the general flow of when each process occurs during a project. For example, the first two processes are to develop the project charter and identify stakeholders. Both occur during project initiation. The charter development is part of integration management, while stakeholder identification is part of stakeholder management. These processes flow from one into another. These processes use inputs and create outputs. Many of the outputs are project charts and tools that are used to plan and control the project, as also shown on that complete flowchart. Other outputs are deliverables. A **deliverable** is any unique and verifiable product, result, or capability to perform a service that is produced to complete a process, phase, or project.[9]

One should remember that not all these processes might be required for all projects. These processes are designed to be all-inclusive and are meant for large and complex projects.

Due to rapidly changing methods for planning and executing projects, PMI decided to dramatically change the way it presents the body of knowledge. The newest version (*PMBOK Guide 7e*) is much shorter. We will present an overview of this new standard in Section 1.6 of this chapter and will briefly describe its impact in a section of each chapter.

1.4c The PMI Talent Triangle

PMI research shows that to be a successful project manager, one must develop knowledge and skills in technical areas, leadership, and strategic business management. The objectives in this book are grouped first with those core skills and knowledge that all project management classes would typically cover. Core objectives are those the authors firmly believe anyone who takes a course in project management should master. The core objectives include those that the Talent Triangle classifies as technical, behavioral, and strategic. Agile objectives are also included in many chapters for professors who wish to emphasize an Agile approach.

1.4d Selecting and Prioritizing Projects

During the selecting and initiating stage of a project, one of the leaders of the first task must do is to identify potential projects that can meet strategic or operational goals. Ideally, this is accomplished in a systematic manner—not just by chance. Some opportunities will present themselves, while other good opportunities need to be discovered.

Potential projects are identified based on business needs such as changes in strategic direction, capability enhancement, new business opportunities, contractual obligations, operational necessities, innovative business ideas, replacing obsolete equipment, or adopting new technology.

Once identified, organizations prioritize the potential projects. The best way to do this is to determine which projects align best with the major strategic goals of the organization. Regardless of the company's size and the level of formality used, the prioritization efforts should include asking the following questions:

- What value does each potential project bring to the organization?
- Are the demands of performing each project understood?
- Are the resources needed to perform the project available?
- Is there enthusiastic support both from the external customers and from one or more internal champions?
- Which projects will best help the organization achieve its goals?
- Given the resource constraints, which project brings a higher return on investment?

1.4e Project Goals and Constraints

All projects should be undertaken to accomplish specific goals. Those goals can be described both by **scope** and by **quality**. Scope is a combination of product scope and project scope. **Product scope** is the entirety of what will be present in the actual project deliverables. **Project scope** is the entirety of what will and will not be done to meet the specified requirements. Quality is "the characteristics of a product or service that bear on its ability to satisfy stated or implied needs."[10] Taken together, scope and quality are often called *performance* and should result in outputs that will satisfy customers. From a client's perspective, projects generally have time and cost constraints. Thus, a project manager is concerned with achieving desired scope and quality, within the constraints of time and cost. If the project were to proceed exactly according to plan, it would be completed on time, within budget, and with the agreed-upon scope and the agreed-upon quality.

However, many things can happen as a project is executed. Obstacles or challenges that may limit the ability to perform often arise, as do opportunities to exceed original expectations. A project manager, from the client's perspective, attempts to understand which of these four goals and constraints (scope, quality, time, budget) should take precedence and which can be sacrificed. The project manager helps the customer articulate how much she wants to enhance the achievement of one of these four dimensions. The customer must also state which dimension she is willing to sacrifice, by how much, and under what circumstances, to receive better achievement of the main goal. For example, on a research and development (R&D) project, a customer may be willing to pay an extra $5,000 to finish the project 10 days early. Understanding the customer's desires in this manner enables a project manager to make the best decisions. A project manager can use a project customer trade-off matrix such as the one in Exhibit 1.3 to reflect the research and development project trade-offs discussed above.

In addition, project plans undergo changes due to uncertainties and unknowns associated with the project. These changes must be assessed for their impact on the cost and duration of the project before implementing them.

From an internal perspective, a project manager also needs to consider two more constraints: the number of resources available and the decision-maker's risk tolerance.

1.4f Defining Project Success and Failure

Project success is creating deliverables that include all of the agreed-upon features (meet scope goals). The outputs should satisfy all specifications and the project's customers. The customers need to be able to use the outputs effectively as they do their work (meet quality goals). The project should be completed on schedule and on budget (meet time and cost constraints).

Exhibit 1.3

Project Customer Trade-Off Matrix

	Enhance	Meet	Sacrifice
Cost			Pay up to $5,000 extra if it saves 10 days
Schedule	Save up to 10 days		
Quality		Must meet	
Scope		Must meet	

Source: Adapted from Timothy J. Kloppenborg and Joseph A. Petrick, *Managing Project Qualify* (Vienna, VA: Management Concepts, 2002): 46.

Exhibit 1.4

Plan-Driven Project Success

- **Meeting Agreements**
  –Cost, schedule, and specifications met
- **Customer's Success**
  –Needs met, deliverables used, customer satisfied
- **Performing Organization's Success**
  –Market share, new products, new technology
- **Project Team's Success**
  –Loyalty, development, satisfaction

Source: Adapted from Timothy J. Kloppenborg, Debbie Tesch, and Ravi Chinta, "21st Century Project Success Measures: Evolution, Interpretation, and Direction," *Proceedings, PMI Research and Education Conference 2012* (Limerick, Ireland, July 2012).

Project success also includes other considerations. A successful project is one that is completed without heroics—that is, people should not burn themselves out to complete the project. Those people who work on the project should learn new skills and/or refine existing skills. Organizational learning should take place and be captured as explicit knowledge for future projects. Finally, the performing organization should reap business-level benefits such as the development of new products, increased market share, increased profitability, decreased cost, etc. A contemporary and complete view of project success is shown in Exhibit 1.4.

Project failure can be described as not meeting the success criteria listed in Exhibit 1.4. Many projects are fully successful in some ways but less successful in other aspects. The goal of excellent project management is to reach high levels of success on all measures on all projects. Serious project failure—when some of the success criteria are missed by a large amount and/or when several of the success criteria are missed—can be attributed to numerous causes. In each chapter of this textbook, more specific possible failure causes will be addressed, along with how to avoid them, but some basic causes of failure are as follows:

- Incomplete or unclear requirements
- Inadequate user involvement
- Inadequate resources
- Unrealistic time demands
- Unclear or unrealistic expectations
- Inadequate executive support
- Changing requirements
- Inadequate planning

1.4g Using Microsoft Project® to Help Plan and Measure Projects

A useful tool to capture and conveniently display a variety of important project data is Microsoft® (MS) Project. MS Project is demonstrated in a step-by-step fashion using screenshots from a single integrated project throughout the book, usually as one of the last sections of each chapter. If you're using the MindTap product for this book, you have access to short videos demonstrating how to use the software.

1.4h Types of Projects

Four ways to classify projects that help people understand the unique needs of each are by industry, size, understanding of project scope, and application.

Classifying by Industry Projects can be classified in a variety of ways. One method is by industry, which is useful in that projects in different industries often have unique requirements. Several industry-specific project life cycle models are in use, and various trade groups and special interest groups can provide guidance.

Classifying by Size Another method of classifying projects is by size. Large projects often require more detailed planning and control. Typically, most of the processes outlined in *PMBOK 6e* are relevant and applicable for large projects that require a few years and hundreds of project team members for execution. However, even the smallest projects require planning and control—just in a simpler form. For example, construction of a multistory building in China would require a highly detailed construction schedule, but even a much simpler construction project of building a one-car garage also needs to follow a schedule.

Classifying by Timing of Project Scope Clarity A third method of classifying projects deals with how early in the project the project manager and team can determine, with a high degree of certainty, what the project scope will be. For example, it may be rather simple to calculate the cubic feet of concrete that are required to pour a parking lot and, therefore, how much work is involved. At the opposite end of the spectrum, when developing a new pharmaceutical or developing a new technology, very little may be determined in the project until the results of some early experiments are reported. Only after analyzing these early experiment results is it possible to begin estimating cost and determining the schedule with confidence. For such projects, change is constant due to uncertainty and unknowns. Consequently, it is important to manage project risks. The planning becomes iterative. In the first (parking lot) case, plan-driven project techniques may work well. In the second case (new pharmaceutical or technology), adaptive or change-driven methods to iteratively determine the scope and plan for risks may be more important.

Classifying by Application For the purpose of this book, we will discuss many types of projects. Many projects include extensive cross-functional work, which contributes to the challenges associated with managing project teams and the triple constraints of scope, duration, and cost. Remember, all projects require planning and control. An important part of project management is determining when to use certain techniques, how much detail to use, and how to tailor the techniques to the needs of a specific project.

1.4i Scalability of Project Tools

Projects range tremendously in size and complexity. In considering construction projects, think of the range from building a simple parking lot to building a massive hydropower generation system. In both cases, one would need to determine the wants and needs of the customer(s), understand the amount of work involved, determine a budget and schedule, decide what workers are available and who will do which tasks, and then manage the construction until the owner accepts the project results. It should be easy to see that while both projects require planning and control, the level of detail for the parking lot is a tiny fraction of that for the hydropower generation project. In this book, we first demonstrate concepts and techniques at a middle level and then use a variety of project examples to demonstrate how to scale the complexity of the techniques up or down.

1.5 Project Roles

To successfully initiate, plan, and execute projects, a variety of executive, management, and associate roles must be accomplished. Plan-driven project roles are shown in Exhibit 1.5. In a large organization, a person often fills only one of these roles; sometimes, more than one person fills a particular role. In small organizations, the same person may fill more than one role. The titles or names of the roles also vary by organization. The work of each role must be accomplished by someone or the other. Project managers are successful when they build strong working relationships with the individuals who execute each of these roles. Project roles will be described fully in Chapter 4, but we briefly introduce each here.

1.5a Project Executive-Level Roles

The four plan-driven project executive-level roles are the sponsor, customer, steering team, and the project management office. The first executive-level project role is that of a **sponsor**. A modern definition of executive sponsor is "a senior manager serving in a formal role given authority and responsibility for successful completion of a project deemed strategic to an organization's success."[11]

The second executive-level project role is that of the customer. The **customer** needs to ensure that a good contractor for external projects or project manager for internal projects is selected, make sure requirements are clear, and maintain communications throughout the project.

The third executive role is the **steering or leadership team** for an organization. This is often led by the top leader (CEO or other officer) and their direct reports who select, prioritize, and resource projects.

The fourth executive-level project role is that of the **project management office (PMO)**, which is defined as "a management structure that standardizes the project-related governance processes and facilitates the sharing of resources, methodologies, tools, and techniques."[12]

1.5b Project Management-Level Roles

The most obvious management-level role is the project manager. The **project manager** is the person assigned by the performing organization to lead the team that is responsible for achieving the project objectives.[13] The project manager is directly accountable for the project results, schedule, and budget.

Another key management role is the functional manager (sometimes called a resource manager). Functional managers are the department or division heads—the ongoing functional managers of the organization.

Exhibit 1.5

Plan-Driven Project Roles

Executive Roles	Managerial Roles	Associate Roles
Sponsor	Project Manager	Core Team Member
Customer	Functional Manager	Subject Matter Expert (SME)
Steering Team	Facilitator	
Project Management Office		

A third managerial role is that of facilitator. If the project is complex and/or controversial, it sometimes makes sense to have a person help the project manager with the process of running meetings and making decisions.

1.5c Project Associate-Level Roles

The **project team** is composed of "*a selected group of individuals with complementary skills and disciplines who are required to work together on interdependent and interrelated tasks for a predetermined period to meet a specific purpose or goal.*"[14] In this book, these individuals are called core team members. The core team, with the project manager, does most of the planning and makes most of the project-level decisions.

The temporary members who are brought on board as needed are known as subject matter experts.

1.6 *PMBOK Guide 7e*

About every four or five years PMI updates their *Standard for Project Management* and their *Guide to the Project Management Body of Knowledge (PMBOK Guide)*.

These 2021 documents vary dramatically from those of 2017. The previous ones were very prescriptive, describing specific processes by their inputs and outputs. Those processes were grouped in the *Standard for Project Management* in process groups of initiating, planning, executing, monitoring and controlling, and closing. Those same processes were grouped in the *PMBOK Guide* in ten knowledge areas of managing integration, scope, schedule, cost, quality, resource, communication, risk, and stakeholder.

The *Standard for Project Management* is the officially recognized document approved by the American National Standards Institute (ANSI). The new version describes twelve principles that provide broad guidance for understanding project management.

The *PMBOK Guide 7e* (the 2021 document) operationalizes those principles by describing eight performance domains that more directly give guidance demonstrating how to plan and manage projects. It also includes a section on tailoring projects that provides more guidance.

The seventh edition of these documents was released in July 2021. In this introductory chapter, we will define briefly the twelve principles from the *Standard for Project Management* along with the eight performance domains and tailoring section from the *PMBOK Guide*. Since the *PMBOK Guide* is meant to help apply the principles from the Standard, in the remainder of this textbook, we will focus our coverage on the *PMBOK Guide*. A visual of the two documents is shown in Exhibit 1.6.

One final note is that the new version of both documents specifically states that everything in the old documents is still valid. For that reason, we will continue to use the flowcharts depicting the old *PMBOK Guide 6e* and *Standard*, but we will point out in each chapter the impact the new *PMBOK Guide 7e* has.

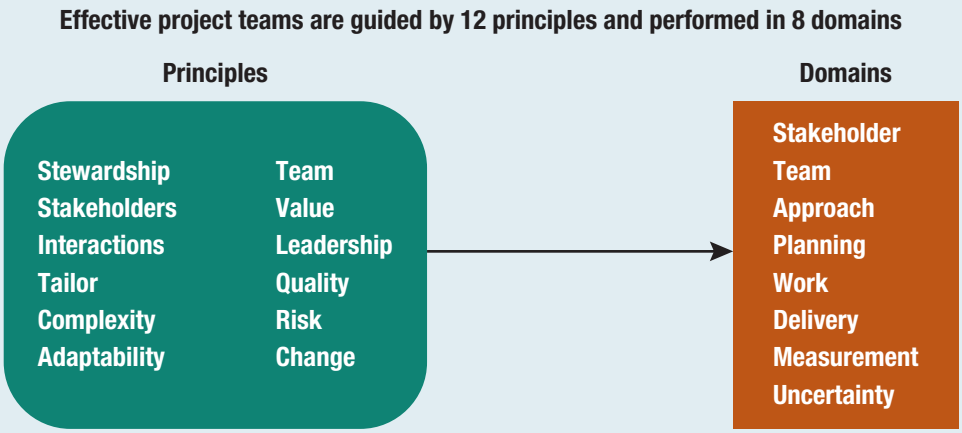
Standard for Project Management ANSI/PMI 99-001-2021

The first major section describes a system for value delivery. This states that projects are to create value for stakeholders. This is amplified later, but the idea here is that merely creating deliverables is not enough. The purpose of projects is to create value by helping to solve problems and achieve desired outcomes.

The remaining portion of the standard describes the twelve principles that provide general guidance for behavior on projects. They do not provide detailed, specific directions. The twelve principles are aligned with the *PMI Codes of Ethics and Professional Responsibility* that stresses responsibility, respect, fairness, and honesty. No principle violates another, but they may overlap.

Exhibit 1.6

Relationship of *Standard for Project Management* and *PMBOK Guide 7e*



The twelve principles from Section 3 are:

3.1. Be a diligent, respectful, and caring steward displaying integrity, care, trustworthiness, and compliance.

3.2. Create a collaborative project team environment by means of team agreements, organizational structures, processes, authority, accountability, and responsibility.

3.3. Effectively engage with stakeholders using a proactive, two-way engagement to improve project results and satisfaction.

3.4. Focus on value as understood by a successful outcome, solution to a need, or satisfaction of a business case. Value can be assessed in terms of worth, alignment, or delivering functionality and quality within risk and resource levels.

3.5. Recognize, evaluate, and respond to system interactions in a holistic and dynamic manner, integrating parts to create cumulative capabilities. Harness a diverse team for a common objective.

3.6 Demonstrate leadership behaviors by creating a desired environment and leading with vision. Use personal character, influence, motivation, role modeling, transparency, and multiple leadership styles to continuously improve. Foster shared responsibility and recognize that all people can display leadership.

3.7 Tailor your delivery approach based on context using just enough process, adapt to stakeholders, objectives, team, and environment.

3.8 Build quality into process and deliverables using both conformance to acceptance criteria and fitness for use. Improve the quality of deliverables and processes, maximize the probability of the desired outcome with little waste, focus on detection, and prevention.

3.9 Navigate complexity whether it comes from human behavior, system behavior, ambiguity, uncertainty, interactions, or technological innovation. Project teams may modify activities to address complexity impacts.

3.10 Optimize risk responses. Risk can be positive or negative, risk appetite is the degree an organization is willing to accept, while the risk threshold is a measure. Responses should be timely, cost effective, realistic, agreed to, and owned.

3.11 Embrace adaptability and resiliency. Be adaptable to changing conditions, resilient to setbacks or failure, and focus on outcomes. Use change control, short feedback loops, continuous learning, transparent and engaged planning, test ideas and approaches, and defer decision making.

3.12 Enable change to achieve the envisioned future state. Continually evaluate benefits to stakeholders and engage them, enable users and others, use motivational strategy rather than force, consider the speed of change, and reinforce change after implementation.

PMBOK Guide 7e

1.0 Introduction

The introduction makes clear three major changes to the *PMBOK Guide*. First, the focus is on delivering successful outcomes, not merely creating agreed-upon deliverables. This encourages project managers and teams to use a relationship approach rather than a transaction approach to their clients. Second, the structure describes project performance domains which are groups of critical, related, even overlapping activities that are needed on all projects throughout their life. Third, tailoring is the thoughtful adaptation of approach, governance, and processes that should be considered on all projects.

2.0 Project Performance Domains

2.1. Stakeholder Performance Domain

Desired outcomes include productive working relationships, agreement on objectives, supportive and satisfied stakeholders, and ensuring that opposition does not negatively impact the project. To achieve these desired outcomes: create alignment and engagement; ID, understand, analyze, prioritize, and engage stakeholders; and monitor their feelings, emotions, beliefs, and values.

2.2. Team Performance Domain

Desired outcomes include shared ownership, a high-performing team, leadership by all.

To achieve these outcomes: determine the appropriate amount of centralized or distributed management and leadership, facilitation, and servant leadership. Develop the project team by defining vision, objectives, roles, team operations, growth, transparency, integrity, and respect. Use a range of leadership skills, appropriate to the situation.

2.3. Development Approach and Life Cycle Performance Domain

Desired outcomes include the development approach, life cycle, and phases to deliver value. To achieve these outcomes choose a predictive, hybrid (iterative or incremental), or adaptive development approach based upon the desired product, service, or result; project; and organization. Phases should have exit criteria. If the primary risk is from regulations use a predictive approach, but if the primary risk is from stakeholder acceptance use an adaptive approach.

2.4. Planning Performance Domain

Desired outcomes include the project progressing as planned, a holistic approach being used, evolving information being elaborated, an appropriate amount of planning being

used, stakeholder expectations being met, and there is a process to adapt. To achieve these outcomes iterative or incremental projects use epics, features, stories, and backlogs while predictive projects use estimating, scheduling, fast-tracking, and crashing, dependencies, leads, lags, and budgets.

2.5. Project Work Performance Domain

Desired outcomes include efficient and effective performance and appropriate processes to manage stakeholder engagement, physical resources, procurement, change, and improvement. To achieve these outcomes, establish and tailor processes; use audits to make them efficient and effective; balance constraints and team and project needs; monitor and integrate new work, changes, and risk; and capture and share both explicit and tacit knowledge.

2.6. Delivery Performance Domain

Desired outcomes include projects contributing to business objectives, realizing intended outcomes and benefits at an appropriate time frame, the team having a clear understanding of requirements, stakeholders accepting and being satisfied with deliverables. To achieve these outcomes, define business value and determine where and how it can be measured; decompose scope; assure completion of deliverables; use quality costs; and monitor moving targets.

2.7. Measurement Performance Domain

Desired outcomes include a reliable understanding of project status, actionable data for decision making, actions to keep performance on track, achieving targets, and generating business value. To achieve these outcomes, use leading and lagging indicators. Metric types include deliverable, delivery, baseline performance, resources, business value, stakeholders, and forecast metrics. Adaptive projects also use throughput, dashboards, information radiators, and visual controls. Metrics should have thresholds beyond which corrective action is taken.

2.8. Uncertainty Performance Domain

Desired outcomes include environmental awareness, proactive responses to uncertainty, awareness of interdependencies, ability to anticipate risks, delivery with little negative impact, realized opportunities, and reserves used wisely. To achieve these outcomes, consider and manage uncertainty, ambiguity, complexity, volatility, and risk. Gather information, prepare for multiple outcomes, investigate alternative designs, and build in resilience. Deal with complexity by decoupling, simulating, viewing from diverse perspectives, balancing data used, iterating, engaging, and building in redundancy. Deal with threats (negative risk) by avoidance, escalation, transfer, mitigation, or acceptance. Deal with opportunity (positive risk) by exploiting, escalating, sharing, enhancing, or accepting.

3.0 Tailoring

While the larger part of *PMBOK Guide 7e* describes performance domains, one other key section describes tailoring. A project team should first select the developmental approach they wish to use and then tailor it for both the organization and project. Then the team should implement ongoing improvement. Tailoring can include a mix of Agile and predictive approaches. Process tailoring includes adding, modifying, removing, blending, and aligning.

Engagement tailoring includes people, empowerment, and integration. Tools, methods, and artifacts can also be tailored. Tailoring should consider deliverables to be produced, project team, and culture. Each performance domain can be tailored.

4.0 Models, Methods, and Artifacts (MMA)

4.1 Overview—This section demonstrates much of the "how to" of project management and may be a useful reference.

- A model is a thinking strategy.
- A method is a means.
- An artifact is a template, document, output, or deliverable (an output).
- Avoid using any MMA that is duplicative, not useful, or misleading.

4.2 Commonly used models

Categories include situational leadership, communication, motivation, change, complexity, team development, conflict, negotiation, planning, process groups, and salience.

4.3 Mapping models to performance domains

4.4 Commonly use methods

Categories include data gathering and analysis, estimating, meetings and events, prioritization, and others.

4.5 Mapping methods to performance domains

4.6 Commonly used artifacts

Categories include strategy, logs and registers, plans, hierarchy charts, baselines, visual data and information, reports, agreements and contracts, activity lists, bid documents, metrics, project calendar, requirements documents, project team charter, and user stories.

4.7 Mapping artifacts to performance domains

While there is not one single, easy way to exactly map the new *Standard for Project Management* and *PMBOK Guide*, an approximate approach is shown below. Stakeholders, risk, and tailoring match very well. Team and leadership principles map to the team performance domain. A few of the other principles seem to cluster in related groups. Stewardship, value, and quality can form one cluster. Interactions and complexity form a second cluster. Change and adaptability form a third cluster. On the *PMBOK 7e Guide*, the five domains of approach, planning, work, delivery, and measurement are all closely related with one generally flowing into the next. All three clusters of principles from the *Standard for Project Management* are partially operationalized by all five of the related domains. Exhibit 1.7 shows these relationships.

1.7 Agile Introduction

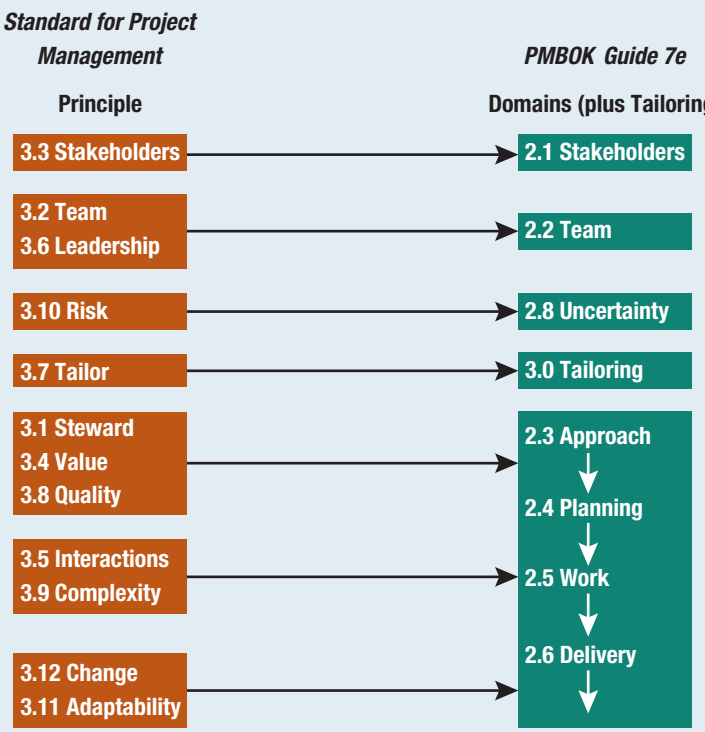
In 2001, a group of thought leaders became frustrated with the use of traditional (predictive, plan-driven) project management for software projects, so they wrote a document called *The Agile Manifesto*.[15] The four core values and twelve principles of Agile as shown below are completely consistent with our approach to Contemporary Project Management.

When the values and principles of Agile influence a leader's thoughts and beliefs they are "being Agile." When they use the tools and metrics that spawn from these values and principles, they are "doing Agile." To gain maximum benefit, one must both be Agile and do Agile.

1. Value individuals more than processes.
2. Value working software more than documentation.
3. Value customer collaboration more than negotiation.
4. Value response to change over following a plan.

Exhibit 1.7

Exhibit 1.7 Relations among Principles and Performance Domains



The *Agile Manifesto* twelve principles are:

1. Customer satisfaction is given the highest priority.
2. Unlike a plan-driven approach, changes in requirements are appreciated at any point in the project with a view to exploit competitive advantage for the customer.
3. Present working software to the client frequently during the project execution phase.
4. People representing business and development teams must work together constantly.
5. Project team comprised of motivated people must be engaged in the project; support and trust must be extended to the project team.
6. Face-to-face communication must be employed, which is considered effective and efficient. In other words, it is preferable to have a co-located project team.
7. Project progress is the progress made in developing working software.
8. Agile process is meant to create sustainable development, which demands sponsors, developers, and users work at the same pace for a long period.
9. Uninterrupted attention to technical excellence and good design boosts agility.
10. Simplicity—the art of maximizing the amount of work not done—is essential.
11. Self-managed teams help develop the best architectures, requirements, and designs.
12. If not daily, the team routinely considers how to improve effectiveness and amends its behavior accordingly.

In each chapter, we will present a table such as Exhibit 1.8 to show similarities and differences between projects conducted in a traditional (plan-driven) manner and those conducted in an Agile (adaptive) manner.

Exhibit 1.8

Comparison of Plan-Driven and Agile Approaches for Project Introduction

Project Introduction Questions	Plan-Driven	Agile (Adaptive)
What is the typical project timing issue?	Agreed end date	Time boxed, yet can be ongoing
What are the primary origins of this project approach?	Construction and aerospace 1950s	Information Technology 1990s
What primary source describes this approach?	*PMBOK 6e* and *7e*	Agile manifesto, multiple Agile approaches, *PMBOK Guide 7e*
What is the typical project life cycle?	Initiate, plan, execute, close	Initiate, either series of time-boxes or continuous delivery with continual planning and executing, transition
What are typical roles?	Sponsor, project manager, core team member, subject matter expert (SME)	Sponsor, product owner, scrum master, development team member
What project characteristics exemplify this approach?	Scope can be defined early, major changes not likely	Scope hard to define at the start, many changes expected
How is change handled?	Baseline plans with firm design, formal change control	Emergent design, no changes within time box, may pivot or stop at end of time box
What common metrics are used?	On-time, on-budget, meet agreed to specification	Viability and value, predictability, quality, happiness

1.7a Agile Terms Used in an Introduction to Project Management

Agile (aka change-driven)	A project method using iterative and continual processes, guided by an empowered mindset described in the Agile Manifesto and elaborated by many sources
Agile lifecycle	Iteration-based production of solutions including inception, construction, and transition phases
Iterative process	A method to plan the entire project at only a high level at the start and plan portions to be done soon in detail, updating plans as more becomes known.
Emergent design	Gradual understanding of the shape of a deliverable
Product owner	The person who represents the client or customer and other stakeholders, prioritizing work and making timely decisions, enabling an Agile project team.
Scrum master	The person who facilitates and guides the team to improve performance, removing roadblocks, so the members can focus on their work
Team member	A person who works on a project in cooperation with others to develop the solution for the stakeholder.

In this book, we use many Agile terms and definitions from Anantatmula V. and Kloppenborg T. (2021). *Be Agile Do Agile*. Business Expert Press: New York, NY.[16]

Much of plan-driven project management began in a formalized manner based upon construction and aerospace projects, while much of the **Agile** methods began based upon IT projects. On plan-driven projects, typically there is an agreed-upon date by which the project will be delivered. On Agile projects, there is often so much uncertainty that there is agreement on what will be delivered in a given timebox (say two weeks), but no agreement at the start regarding when the entire project will be completed.

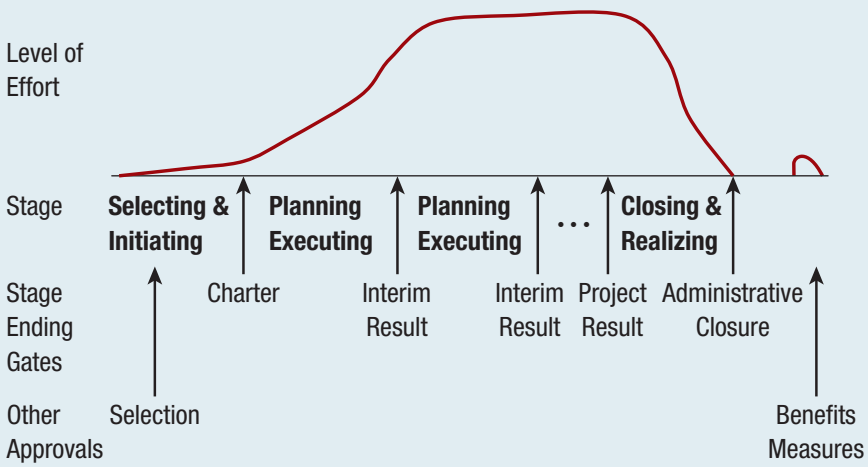
Both types of projects start with high-level initiation to get the project approved. Then the plan-driven projects do most of the planning before executing, while projects using an **agile lifecycle** alternate with a little planning and executing for each portion of work. Agile uses an **iterative process** to transition deliverables to users periodically as and when a prioritized customer requirement is complete.

When it is possible to define what the project work and outcomes will be early in the project, plan-driven methods work fine. When there is significant uncertainty at the start of a project and many changes are likely, Agile works better. On plan-driven projects, as scope is firmly planned early and plans are baselined, a formal change control system is used. Agile projects use **emergent design** and so, considerable change may be accepted, but not within the short time sprints. Exhibit 1.9 is an adaptive or change-driven project life cycle.

On plan-driven projects, the most typical success metrics include meeting agreements (cost, schedule, and performance) and customer success. On Agile projects, success is defined differently and it is measured in terms of adding value to the customer's business. Four typical measures of success on Agile projects are viability and value, predictability, quality, and happiness. Projects are only performed because some stakeholder needs' outcomes with value and viability measure the potential for that value as the project progresses while the value is measured when the customers use the project outputs. Decision-makers and clients have confidence in the team's ability to deliver if they are predictable. Agile projects test early and often to ensure the quality of all processes and deliverables. Team members who are happy produce well and avoid burnout and customers that are happy are successfully using project deliverables.

Exhibit 1.9

Adaptive or Change-Driven Project Life Cycle with Measurement Points



Source: Anantatmula, Vittal, *Project Teams: A Structured Development Approach* (New York, NY: Business Expert Press, 2016): 136–139.

Exhibit 1.10

Agile Project Roles

Executive Roles	Managerial Roles	Associate Roles
Product Owner	Product Owner	Team Member
Sponsor	Scrum Master	
Portfolio Team	Functional Manager	
Project Management/Scrum Office	Coach	

Although the same planning, performing, and governing work need to be conducted on any project, the roles are defined differently on agile projects with different titles and different expectations. Essentially, the desire for quick customer feedback and empowered team members lead to many of the differences. Agile project management roles are shown in Exhibit 1.10. Most of the same work still needs to be accomplished in organizations using Agile methods. Some of the work is performed by different people because of the emphasis on empowering teams, and some tasks are performed at different times as requirements and scope emerge gradually. Collaborative effort and communication, specifically with the client, are common features of Agile project teams.

On Agile projects, arguably the most essential role is the **product owner**. This person ensures that the needs and wants of the various constituents in the customer's organization are identified and prioritized and that project progress and decisions continually support the customer's desires. The product owner works with the team continuously, often performing some of the work a project manager might on a plan-driven project.

There also may be a designated sponsor who controls the budget. A portfolio team often performs much of the work of a plan-driven steering team, and a similar office may be titled differently such as Scrum office which performs much of the work of a project office.

The **Scrum Master** serves and leads in a facilitating and collaborative manner. This is a more limited, yet more empowering, role than the plan-driven project manager. The functional manager has a similar, but sometimes more limited, role than the plan-driven department head. Many organizations using Agile also have a coach who acts as a facilitator and trainer.

The **team members** in Agile projects are assigned full-time as much as possible, so there are few subject matter experts. The teams are self-governing, so they perform many of the planning and coordinating activities that a project manager would typically perform. Small and co-located teams who work closely together are the norm for Agile projects.

1.8 Overview of the Book

Contemporary project management blends traditional (predictive or plan-driven) and Agile approaches. It is integrative, iterative, and collaborative. Project management is integrative since it performs the processes outlined in the *PMBOK Guide 6e* and the

domains of *PMBOK Guide 7e* and it is desirable to integrate all of them into one coherent and ethical whole. Project management is iterative in that one starts by planning at a high level and then repeats the planning in greater detail as more information is available and the date for the work performance approaches. Project managers need to balance planning, control, and agility. It is collaborative since many stakeholders need to be satisfied and a team plans and completes the project. With these thoughts of integration, iteration, and collaboration in mind, this book has four major parts: Organizing and Initiating Projects, Leading Projects, Planning Projects, and Performing Projects.

1.8a Part 1: Organizing and Initiating Projects

Part 1 consists of three chapters that deal with organizing for and initiating projects. All the chapters in the book cover concepts related to both traditional (also known as plan-driven or predictive) projects and adaptive or change-driven (Agile) projects. In each chapter, other key drivers of project management—project teams and risks—are also discussed wherever and whenever appropriate.

Microsoft Project, a tool that facilitates effective project planning, controlling, and communicating, is introduced in Chapter 3. Microsoft Project is utilized in eight chapters to demonstrate how to automate various project planning and control techniques. If a person is using a competing project scheduling package, the intent remains the same, but the mechanics of how to create certain documents may differ.

Chapter 2 Chapter 2 covers project selection and prioritization. This includes both internal projects, which should be selected in a manner consistent with the strategic planning of the organization, and external projects. The selection criteria for internal and external projects are different. It also explains how to respond to requests for proposals.

Chapter 3 Chapter 3 discusses chartering projects. The charter is considered an agreement by which the project sponsor and project manager (and often the project core team) agree at a high level what the project is, why it is important, key milestone points in the schedule, major risks, and possibly a few other items. It allows the project manager and core team to understand and agree to what is expected of them.

1.8b Part 2: Leading Projects

Part 2 consists of three chapters on leadership aspects of projects.

Chapter 4 Chapter 4 focuses on organizational structure, organizational culture, project life cycle, and project management roles of the parent organization. The organizational structure and culture can significantly impact how a project is conducted. Organizations often select or customize a project life cycle model. The project roles covered include executive-, managerial-, and associate-level responsibilities that must be performed.

Chapter 5 Chapter 5 describes how to carry out the project work with a project team to accomplish the project objectives. The project manager must simultaneously champion the needs of the project, the team, and the parent organization. The project manager leads the project team through stages of project team development, assessing and building the team members' capability, supervising their work, improving their decision making, and helping them maintain enthusiasm and effective time management.

Chapter 6 Chapter 6 begins by identifying the various project stakeholders, their wants and needs, and how to prioritize decisions among them. Chapter 6 also includes communications planning for the project because poor communication can doom an otherwise well-planned and well-managed project. The information needs of each stakeholder group should be included in the communications plan.

1.8c Part 3: Planning Projects

Part 4 includes six chapters dealing with various aspects of project planning.

Chapter 7 Chapter 7 shows how to determine the project scope after seeking requirements and outline it in the **work breakdown structure (WBS)**. The WBS is a document that progressively breaks the project down so that each piece can be described as a deliverable for which one person can plan, estimate the costs, estimate the time, assign resources, manage, and be held accountable for the results. This is the foundation for most of the other planning and control activities. In the Agile section of the chapter, we show how to capture user requirements as stories; how to create a backlog; and how to progressively elaborate the scope.

Chapter 8 Chapter 8 deals with scheduling projects. This chapter starts with background information on project scheduling and then covers construction of schedules by defining activities, determining the order in which they need to be accomplished, estimating the duration for each, and then calculating the schedule. Chapter 8 also includes instructions on how to interpret a project schedule and clearly communicate it using a bar chart called a Gantt chart. On Agile projects, the product owner prioritizes stories in the backlog and the team slices them for understanding and then commits to the amount of work they can do.

Chapter 9 Chapter 9 demonstrates how to schedule resources on projects: determining the need for skilled people, materials, and tools, understanding who is available, and assigning them. All of the techniques of resourcing projects are integrated with the behavioral aspects of how to deal effectively and ethically with the people involved. Resource needs are shown on a Gantt chart developed in Chapter 8, the responsibilities are shown as they change over time, conflicts and overloads are identified, and methods for resolving conflicts are introduced. Alternative approaches for creating and compressing schedules are shown.

Chapter 10 Chapter 10 discusses the project budget, which is dependent on both the schedule and the resource needs developed in the previous two chapters. The **project budget** is "The sum of work package cost estimates, contingency reserve, and management reserve.[15] Cost planning, estimating, budgeting, establishing cost control, and using MS Project for project budgets are all included.

Chapter 11 Chapter 11 starts with establishing a risk management plan. It covers methods to identify potential risks and determine which risks are big enough to justify specific plans for either preventing the risk event from happening or dealing effectively with risk events that do happen. Finally, in risk response planning, strategies for dealing with both positive risks (opportunities) and negative risks (threats) are discussed.

Chapter 12 Chapter 12 describes the core project quality demands of stakeholder satisfaction, empowered performance, fact-based management, and process management. Then the chapter describes how to plan, manage, and control quality.

Since Chapter 12 is the last planning chapter, it concludes with a method of integrating the various sections developed in the previous chapters into a single, coherent project plan.

1.8d Part 4: Performing Projects

Part 4 includes three chapters that deal with performing the project.

Chapter 13 Chapter 13 begins by introducing make-or-buy analysis and contract types lead the reader through acquiring needed goods and service. Identifying and selecting sellers lead to managing contracts to assure receipt of promised supplies and services according to contractual terms. The chapter includes the advantages and requirements of effective project partnering and collaboration.

Chapter 14 While the project work is being performed, the project manager needs to determine that the desired results are achieved—the subject of Chapter 14. This starts with gathering performance data; comparing it to the desired performance data so that both corrective and preventive actions can be used to ensure that the amount and quality of the project work meet expectations.

Earned value analysis is used to determine exactly how actual cost and schedule progress are compared with planned progress. Overcoming obstacles, managing changes, resolving conflicts, reprioritizing work, and creating a transition plan all lead up to customer acceptance of the project deliverables.

Chapter 15 Chapter 15 deals with finishing projects and realizing benefits. This chapter includes a section on terminating projects early and a section on timely termination of successful projects. Topics include how to secure customer feedback and use it along with the team's experiences to create lessons learned for the organization; reassign workers and reward those participants who deserve recognition; celebrate success; perform a variety of closure activities; and provide ongoing support for the organization that is using the results of the project. Finally, after the project deliverables have been used for some time, an assessment should determine if the promised benefits are being realized.

Summary

A project is an organized set of work efforts undertaken to produce a unique output subject to limitations of time and resources such as materials, equipment, tools, and people. Since the world is changing more rapidly now, many people spend an increasing amount of their working time on projects. Project management includes work processes that initiate, plan, execute, monitor, control, and close project work. Throughout, trade-offs must be made among the scope, quality, cost, and schedule, so that the project results meet the agreed-upon requirements, are useful to the customers, and promote the organization.

All projects, regardless of size, complexity, or application, need to be planned and managed. While the level of detail and specific methods vary widely, all projects need to follow generally accepted methods.

PMI is a large professional organization devoted to promoting and standardizing project management understanding and methods. *PMBOK 6e* and *7e* provide different perspectives (prescriptive and descriptive) on project management and both are considered useful references.

To successfully initiate, plan, and execute projects, two more things are needed. One is to understand what project success is and what drives it, along with what project failure is and its major causes. The other is an understanding of the various executive-, managerial-, and associate-level roles in project management.

This book is organized to be useful to students who will enter a variety of industries and be assigned to projects of all sizes and levels of complexity.

Microsoft Project is used in eight chapters to illustrate how to automate various planning, scheduling, resourcing, budgeting, and controlling activities. All definitions used are consistent with those in *PMBOK Guide,* sixth and seventh editions, and a variety of other PMI standards and guides. This book follows a chronological approach throughout a project's life cycle, emphasizing knowledge and skills that lead to project success.

Key Terms Consistent with PMI Standards and Guides

The glossary in this book uses terms as defined in various Project Management Institute guides and standards where they are distinct. The glossary also uses terms commonly used in Agile practice.

project, 4
stakeholders, 4
project management, 4
process, 6
soft skills, 6
hard skills, 7
functional manager, 7
project life cycle, 8
project management process group, 10
initiating processes, 10
planning processes, 10
executing processes, 10
monitoring and controlling processes, 10
closing processes, 10
integration management, 10
scope management, 10
schedule management, 10
cost management, 10
quality management, 10
resource management, 10
communications management, 10
risk management, 10
procurement management, 10
stakeholder management, 10
project processes, 11
deliverable, 11
scope, 12
product scope, 12
project scope, 12
quality, 12
sponsor, 15
project management office (PMO), 15
customer, 15
steering or leadership team, 15
project manager, 15
project team, 16
work breakdown structure (WBS), 26
project budget, 26

Key Terms Consistent with Agile Practice

Agile, 23
Agile lifecycle, 23
iterative process, 23
emergent design, 23
product owner, 24
scrum master, 24
team members, 24

Chapter Review Questions

1. What is a project?
2. What is project management?
3. How are projects different from ongoing operations?
4. What types of constraints are common to most projects?
5. What are the three components of the Talent Triangle?
6. At what stage of a project life cycle is the majority of the "hands-on" tasks completed?
7. During which stage of the project life cycle are loose ends tied up?
8. What are the twelve project delivery principles?
9. What are the eight performance domains, according to the *PMBOK 7e*?

10. What are the four core values of Agile?
11. What are Agile's twelve principles?
12. How do you define project success?
13. How do you define project failure?
14. List four common causes of project failure.
15. What are three common ways of classifying projects?
16. What is predictive or plan-driven planning, and when should it be used?
17. What is adaptive or change-driven planning, and when should it be used?
18. What makes someone a project stakeholder?
19. What are the three project executive-level roles?
20. List and describe each of the managerial and associate project roles.

Discussion Questions

1. Using an example of your own, describe a project in terms that are common to most projects.
2. Why are more organizations using project management? If you were an executive, how would you justify your decision to use project management to the board of trustees?
3. Explain how to scale up or down the complexity of project planning and management tools and what effect, if any, this might have on the project life cycle.
4. List and describe several issues that pertain to each stage of the project life cycle.
5. Name the ten project management knowledge areas, and briefly summarize each.
6. Discuss how a project could be successful in terms of some measures yet unsuccessful in others.
7. What does project failure mean? What are some examples?
8. Compare and contrast advantages and disadvantages of predictive/plan-driven and adaptive/change-driven project life cycle approaches.
9. You are given a project to manage. How do you decide whether to use a plan-driven or adaptive approach?
10. Contrast project managers and functional managers.
11. List as many project roles as you can, and identify what each one is responsible for in terms of the project.

PMP Exam Study Questions

The purpose of these questions is to help visualize the type of questions on PMP and CAPM exams.

1. Which project role provides resources or support for the project, promotes and protects the project at higher levels of management, and takes an active role in the project from the chartering stage through project closure?
   a. functional manager
   b. project manager
   c. project team member
   d. project sponsor
2. Which *PMBOK Guide* Principle pertains to people affected by either the work of the project or the project outcome?
   a. tailoring
   b. stakeholders
   c. leadership
   d. stewardship
3. To be successful, the project team must be able to assess the needs of stakeholders and manage their expectations through effective communications. At the same time, they must balance competing demands among project scope, schedule, budget, risk, quality, and resources, which are also known as project _____.
   a. plan elements
   b. deliverables
   c. constraints
   d. targets
4. Projects pass through a series of phases as they move from initiation to project closure. The names and number of these phases can vary significantly depending on the organization, the type of application, industry, or technology employed. These phases create the framework for the project, and are referred to collectively as the _____.
   a. project life cycle
   b. project management information system (PMIS)
   c. product life cycle
   d. Talent Triangle
5. Based on PMI's definition, which of these is a good example of a project?
   a. manufacturing a standard commodity
   b. following policies and procedures for procuring an item
   c. designing and launching a new website
   d. using a checklist to perform quality control

6. When would a plan-driven project life cycle be the preferred approach?
   a. when the high-level vision has been developed, but the product scope is not well defined
   b. when the environment is changing rapidly
   c. when the product to be delivered is well understood
   d. when the product will be created through a series of repeated cycles
7. To be effective, a project manager needs to possess all of the following competencies except _____.
   a. personal effectiveness—attitudes, core personality traits, leadership
   b. authority—power or right granted by the organization
   c. performance—what project managers can accomplish while applying their project management knowledge
   d. knowledge of project management—understanding of project management tools and techniques
8. In Adaptive Life Cycles (change-driven or Agile methods), _____.
   a. the overall scope of the project is fixed, and the time and cost are developed incrementally
   b. the overall cost is fixed, and the project scope and schedule are developed iteratively
   c. the time and cost are fixed, but the scope is developed iteratively
   d. change control is very important
9. The two plan-driven project management associate-level roles are different in each of the following ways *except* _____.
   a. duration of time spent on project
   b. ability to work within project constraints
   c. degree of input contributed to project planning
   d. skill set
10. A freelance project manager is brought in by Company X to lead a large, expensive project. This project manager has excellent leadership skills and a strong technical understanding of the project. For her to optimize every component of the Talent Triangle, what might be a good activity for the project manager at the start of her time with Company X?
    a. familiarize herself with the long-term objectives of Company X
    b. negotiate for a different project team
    c. attend a seminar on advanced leadership techniques
    d. send an email including her résumé to all SMEs to ensure they are aware of her technical background

Integrated Example Projects

We will use two example projects throughout all fifteen chapters of this book. One will be a construction project suited to mostly plan-driven project planning and management. The other will be a development project suited more toward Agile project planning and management. In this chapter, we will introduce both of them. In subsequent chapters, we will choose one to demonstrate techniques and concepts from the chapter and ask leading questions of the other one. We will alternate chapters so professors can choose to use the questions as assignments if they wish.

Suburban Homes Construction Project

Purchasing a new home is the single largest investment most of us will make in our lifetime. You can either purchase the home from a reputed real estate building company or manage the construction of your home using project management principles that you have mastered. The latter approach can save significant amounts of money over the

life of a typical 30-year mortgage. Additionally, it is likely to provide you with one of the most satisfying experiences in your life because you will get an opportunity to see the results of the choices you made in building your home. However, on the downside, if you manage the project poorly, it also has the potential on many levels to be a disaster.

The experience of managing the construction of a single-family home provides a coherent account of costs, benefits, other considerations related to construction, risks, hazards, and critical decisions. The experience also has the potential for joy if the project is a successful endeavor.

Suburban Homes is a medium-sized, fast-growing construction company in the Midwest region of the United States. Due to its significant growth and good reputation for building quality single-family homes and townhomes, the company decided to expand its business to several Southern states in the United States. However, Suburban Homes recognized the scope for managing resources effectively and efficiently to increase profits. It has decided to formalize project management practices by developing and implementing standard and promising processes, tools, and techniques. For this purpose, the company was looking for a competent project manager to manage its projects. They hired Adam Smith as their new project manager.

Adam Smith had worked for several years in the construction industry and supplemented his experience with project management education. Consequently, he gained considerable experience and developed expertise in managing construction projects. Adam believes in managing projects by adhering to various project management processes, tools, and techniques. In his new position as the project manager, Adam's primary task is to improve the performance of project management and increase the project success rate.

What Advice Would You Offer to Adam Smith?

Heritage Arboretum Development Project

Arboretum Introduction

An arboretum is a garden containing trees, shrubs, and other plants that are cultivated for visual enjoyment and educational purposes.

The Interactive Community of Arboreta (ArbNet) Arboretum Accreditation Program provides standards and guidelines for creating and developing an arboretum. The ArbNet Arboretum Accreditation Program is sponsored and supported by The Morton Arboretum, Botanic Gardens Conservation International (BGCI), and the American Public Gardens Association (APGA).

Different levels of accreditation have been established to recognize arboreta at varying degrees of development, capacity, and professionalism. All levels require planning, maintenance, and educational components. Level one requires twenty-five species of trees and woody plants, while levels three and four require five-hundred species. Many other requirements become more demanding as an arboretum proceeds through various levels. This project is to create, maintain, and enhance a Level One arboretum.

Anderson Township and Green Space Introduction

One type of limited self-government in Ohio is the township. A township is an unincorporated portion of a county that has more decision-making authority than a portion of a county that is not a township, but less authority than an incorporated city. At about 45,000 residents, Anderson Township, located in the southeastern corner of Hamilton County, Ohio, is one of the most heavily populated townships in the State of Ohio. Founded in 1793, Anderson Township remained fairly undeveloped until the suburbanization that followed World War II. Anderson Township is dominated by rolling, wooded topography that creates scenic vistas of the beautiful natural environment. Anderson Township preserves these features while witnessing significant growth.

Anderson Township has taken the lead in Ohio in acquiring and protecting Greenspace through the implementation of a Greenspace levy. As Ohio's first Greenspace Township, the community has protected nearly seven-hundred acres of property that by law will remain in a natural state.

The portion of land where the Heritage Center Arboretum is taking shape is just under five acres, of which approximately half is protected green space. There is a building on site that was built around 1820 with room additions in the 1860s. The site includes a gazebo, patio, drives, and parking lots. Some of the ground is lawn while the remainder is tree-covered.

Courtesy of Timothy J. Kloppenborg

Vision for Heritage Center Arboretum

The hope is to promote native species of trees, enhance the beauty of the area, increase the value and desirability of the Heritage Center, increase rental prices and days, and educate citizens regarding more tree species.

Related Links:
http://www.arbnet.org
https://www.mortonarb.org
https://www.bgci.org
https://www.publicgardens.org

Student Questions

1. What are several reasons why this project might best be planned and managed in an Agile fashion?
2. What Agile principles and values do you feel will be important for this project? Why?
3. What additional information about arboreta, Anderson Township, green space law, or the specific site and vision would you like to know as you start this project?

Semester Project Instructions

This book is designed to give your professors the option to have you practice the concepts and techniques from each chapter on a real project. Often, the project chosen will be for a nonprofit group of some kind such as a United Way agency, a church, or a school. The project could, however, be for a company or a part of the university. The semester project can often be one that several students will be assigned to work on as a team.

Each chapter provides suggested assignments to practice project management skills on the real or potential project you are using. Depending on the emphasis your professor chooses, you may need to perform some, most, or all of these assignments. At a minimum, your professor will probably assign the charter, work breakdown structure (or backlog if using Agile), and schedule.

In any case, each of the following chapters prompts you to perform various activities to plan and execute the project. At some point in the first couple of weeks, your professor will probably invite at least one representative from each organization to your class to introduce their project and to meet you. We will call these people *sponsors* and define their role more fully in Chapter 3. Since this first chapter is a broad introduction to project management, your task for the Chapter 1 sample project may be just to familiarize yourself with your new student team, your sponsor's organization, and the overall direction of your project. If you have enough input from your sponsor, your professor may also ask you to create a customer trade-off matrix, as shown in Exhibit 1.3 and/or a definition of success for your project, as in Exhibit 1.4. Your professor also may ask you to answer certain specific and/or open-ended questions concerning your newly assigned project.

Subsequent chapters give you more in-depth tools to acclimate you to your project, the organization you will be working for, and the various stakeholders who have an interest in the project. For example, in the next chapter, you learn how project selection flows from an organization's strategic planning, and you should seek to learn why this project was chosen and how it supports the strategic goals of the organization.

Project Management *in Action*

Combining Plan-Driven and Agile Project Approaches in One Project

In this example, we will explain how we can use both plan-driven and Agile approaches together to more effectively realize the benefits of a project. A Midwest regional hospital undertook a $350-million expansion project with lofty goals to be patient-centric and environmentally sensitive. The way they went about this major project is innovative as they used at least three different approaches described in this text.

In the early stages of the project, they used iterations of two weeks to do the design and requirements gathering working with stakeholders from every aspect of the hospital staff. They would build first simple approaches and then progressively more detailed prototypes to show. From surgeons to plant engineers to ensure that everyone's desires were heard. Every two weeks the architectural design team would come to the hospital and demonstrate the changes they had made to the design drawing based on previous feedback. They would meet with the stakeholders and then decide what to prioritize next. These cycles lasted a little over a year and are shown by the first section of the life approach shown below.

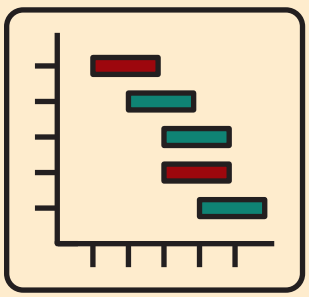
When it came time to begin construction, they used a very plan-driven approach to ensure that when thirty cement trucks showed up to pour concrete, they would be able to get to where they needed to be. This was the way the bulk of the two plus years were managed during the construction phase. This is shown as the middle section of the approach as a type of bar chart called a Gantt Chart.

As the construction phase ended, much still had to be done to gain occupancy of the complex. The items were small in most cases, however critical because the grand opening ceremony date was set and invitations had already been sent. This is when the team shifted to a KanBan approach to ensure that the highest priority punch list items were prioritized first. Of greatest importance was the fire marshal's sign-off. Until that happened only people with construction safety training could be in the building without an escort.

The approaches used were very effective and saved time and money to deliver this state-of-the-art to the patients in the region.

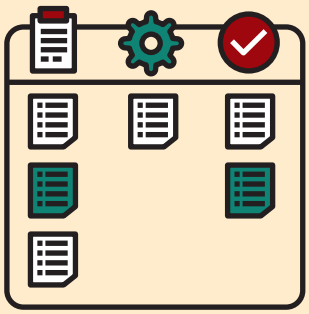
Iteration- Based

- Design Sessions
- Stakeholder Feedback
- Requirements Deconflicting



Plan-Driven

- Physical Construction
- Critical Path Activities



KanBan

- Punch List Corrections
- Last Minute Items
- Final Prep

Source: Frank M. Forte, President, Forte Leadership Technology, LLC and author of *A.G.I.L.E. Thinking Demystified.*

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Chapter 2

Project Selection and Prioritization

Chapter Objectives

Core Objectives:

2-1 Explain the strategic planning and portfolio management processes in your own words.

2-2 Describe selection, prioritization, and resource allocation of projects as strategic planning outgrowth.

2-3 Describe how to secure projects from a contractor's viewpoint.

2-4 Describe value and delivery performance from a customer's viewpoint as per *PMBOK 7e*.

2-5 Compare strengths and weaknesses of the financial and scoring models for project selection.

2-6 Demonstrate selection and prioritization of projects using a scoring model and organizational priorities.

Agile Objective:

2-7 Describe the project selection process in an Agile environment.

Albert Shakirov/Alamy Stock Photo

With the development of a new five-year strategic plan, significant financial growth, and a major reorganization, Living Arrangements for the Developmentally Disabled (LADD) found itself overwhelmed with tasks and at a point that required the thoughtful selection and prioritization of projects. Prior strategic plans were largely dictated by the former executive director, created in a silo of sorts. It was through the introduction of a new executive director to LADD and completely new leadership at the management level that an opportunity presented itself for new, cross-department collaboration, innovative methods to carry out established practices, and the ability to identify and draw on the strengths of the individual members of the team.

LADD is a medium-sized nonprofit corporation that is mission-focused and considered a leader in the field of supporting individuals with developmental disabilities. Its efforts reach beyond day-to-day functions and extend in large part to awareness, advocacy, and action. With the sponsorship of a national film festival focused on disabilities and its work in the civic and government sectors at local and national levels, LADD has been able to influence positive change in legislation and the inclusion of people with disabilities at all levels of society.

PMBOK Guide 6e Coverage	
PMBOK Guide 6e	**Outputs**
1.2 Foundational elements	Elevator Pitch
Selecting Projects	Project Selection and Prioritization Matrix
Note: Refer to Appendix A to view the entire *PMBOK Guide 6e* flowchart.	Project Resource Assignment Matrix

PMBOK Guide 7e
Domains:
- **Stakeholders**
- **Team**
- **Development approach**
- **Planning**
- **Uncertainty**

Project selection and prioritization were exactly what LADD needed because they were trying to maintain pace with a large program and revenue growth curve, new leadership at the helm, and federal changes in the way services were to be delivered to those with developmental disabilities. Projects from the strategic plan were scored based on established value sets that included criteria such as if the project met the mission, was financially feasible, or strengthened personal or community relationships.

LADD's strategic plan contains thirty-two primary goals and many more objectives. The project selection and prioritization process was a key tool to build a framework that would inspire agency success over the next five years. It is also anticipated to be a method to reduce program competition and increase understanding within the management team as occasions for team development and departmental collaboration occur. In the end, each step of the process will lead the agency to achieve its vision of propelling the inclusion and success of people with disabilities forward with a positive impact throughout the community.

—Amy Harpenau, Vice President, Living Arrangements for the Developmentally Disabled.

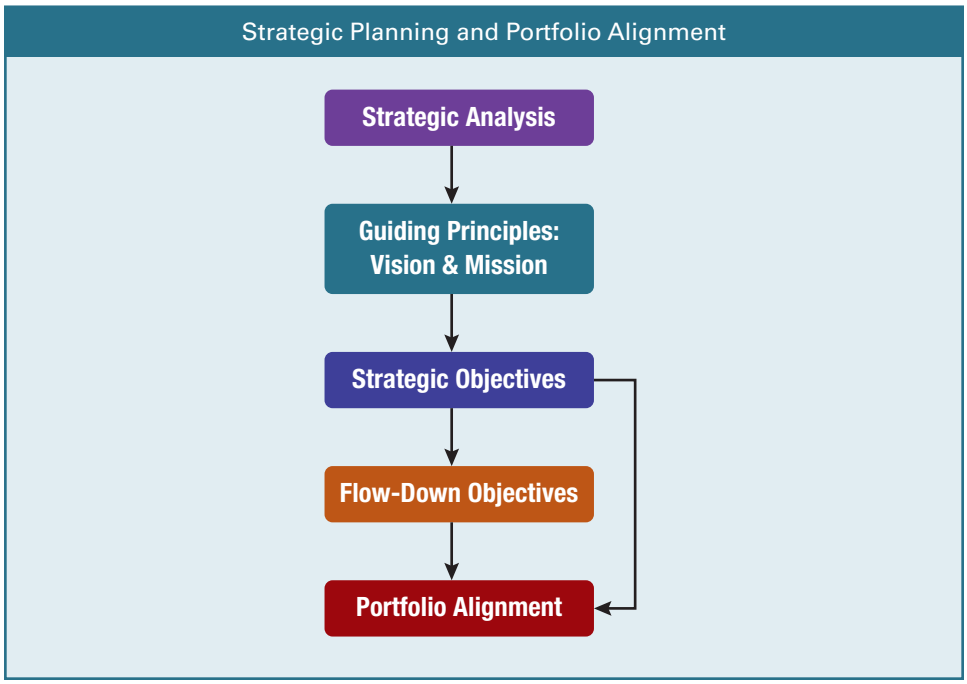
2.1 Strategic Planning Process

One of the tasks of a company's senior leadership is to set the firm's strategic direction. Setting direction occurs in part when an organization is young or is being revamped, but part of it needs to occur repeatedly. Exhibit 2.1 depicts the steps in strategic planning and how portfolio management should be an integral part.

2.1a Strategic Analysis

The first part of setting strategic direction is to analyze both the external and internal environments and determine how they will enhance or limit the organization's ability to perform. This strategic analysis is often called SWOT (strengths, weaknesses, opportunities, and threats) Analysis. The internal analysis (elements within the project team's control) consists of asking what strengths and weaknesses the organization possesses. The external analysis (elements over which the project team has little or no control) consists of opportunities and threats that are posed by external players such as competitors, suppliers, customers, regulatory agencies, and technologies. The leaders of an organization often need to be humble and open to ideas that are sometimes unpleasant and contradictory to their beliefs when conducting this analysis. Performed correctly, a strategic analysis can be illuminating and can lead to a new direction for an organization.

Exhibit 2.1



An example of SWOT analysis for ForwardVu is found in Exhibit 2.2. ForwardVu is a Canadian management consulting firm specializing in digital transformation.

2.1b Guiding Principles

With the completion of SWOT analysis, the organization's leadership should establish guiding principles such as the vision and mission. Some organizations may further refine the analysis by adding separate statements concerning the purpose and/or values. Often, they are included in the mission. For simplicity's sake, they will be treated as part of the mission in this book. It is more important to understand the intent of each part and achieve it rather than worry about the exact format or names of individual parts.

Vision The **vision** is a one-sentence statement describing the clear and inspirational long-term, desired change or direction resulting from an organization or program's work.[1] A clear and compelling vision will help all members and all stakeholders of an organization understand and desire to achieve it. Visions often require extra effort to achieve but are considered to be worth the effort. Visions are often multiyear goals that, once achieved, suggest the need for a new vision.

One of the visions most often cited was President John F. Kennedy's aspiration of placing a man on the moon before the end of the 1960s. Kennedy set this vision after Russia launched Sputnik and the United States found itself behind in the space race. His vision was very effective in mobilizing people to achieve it; further, it rapidly transformed a huge suburban area near Houston into a developed and sustainable economic and technology zone.

Exhibit 2.2

ForwardVu Solutions SWOT Analysis

SWOT Analysis for a Management Consulting Firm Focused on Digital Transformation

	Strengths	Weaknesses
Internal Environment	**CX/UX experts:** Highly qualified and certified management consultants, who as former practitioners, bring real-world skills and experience to CX/UX transformation projects.	**Diversification:** The firm has a diversified range of consulting services with potential for a broad range of clientele, though heavily dependent on the public sector.
	Loyal clientele and Reputable Brand: High customer satisfaction translating into referenceable clients and brand equity.	**Marketing and business development:** No in-house salesforce and little proactive marketing efforts.
	Primary Research: Ongoing investment in primary research in the CX/UX field to stay up to date on leading global practices.	**Technology:** Extensive investment in technology is required to emulate the in-person facilitation experience.
	Strong Financials: Low company overhead resulting in competitive pricing, offering good value to clients.	**Skills deficit:** Shortage of skilled and experienced workforce to support future growth efforts.
	Opportunities	**Threats**
External Environment	**Strategic partnerships:** Diversification through strategic partnerships with downstream service providers.	**Competitive rivalry:** Intense competition causing erosion of market share for many industry incumbents.
	Market expansion: Expand penetration of large private sector clients and target expansion into the medium enterprise market.	**Buyer power:** Buyers' market with intense competition causing downward price pressure impacting profitability.
	Geographical expansion: Geographic expansion into the United States, which allows for market growth and foreign exchange arbitrage.	**New entrants:** New technologies opening markets to global players who can offer similar services remotely for lower costs.
	New revenue streams: Opportunity to diversify into new product categories with monthly recurring revenue.	**Economy:** Economic recession due to pandemic fallout may reduce business potential.

ForwardVu has a great depth of expertise, a reputable brand, and strong financials; however, they must address several weaknesses (e.g., limited focus on marketing and business development) to leverage external opportunities, such as the establishment of strategic partnerships, expansion into new markets, and productization of existing services. There are also significant threats that the firm must mitigate to grow, such as market share erosion from intense rivalry, buyer power forcing downward price pressure, and new global players using enabling conference technology, which reduce barriers to entry.

Source: Mark Alpern, Partner, ForwardVu Solutions, https://www.forwardvu.ca

Increasingly, businesses are incorporating social, environmental, and economic health aspects into their vision statements. This stated desire to be a good, socially responsible corporate citizen with a long-term view of the world can motivate efforts that achieve both economic return for shareholders and other positive benefits for many other indirect stakeholders.

Mission Statement The vision should lead into the **mission statement**, a high-level intent to accomplish the vision. The mission statement briefly describes what your organization does (primary business and customers), why you do it (purpose and core values), and how you do it (beliefs and culture). Several of these sections may flow together in the mission statement and, sometimes, an overall statement is formed with expanded definitions for illustration. The rationale for including each section (either as one unified statement or as separate statements) is as follows:

- By including the primary business areas, everyone will know in what business the organization wishes to engage.
- By identifying the primary customers, everyone will understand which groups of people need to be satisfied and who is counting on the organization.
- By including the organization's purpose, the mission statement communicates why the organization exists.
- By including the organization's core values, a mission statement communicates how decisions will be made and the way people will be treated. True organizational values describe deeply held views concerning how everyone should act—especially when adhering to those values is difficult.
- By including beliefs, a mission statement communicates the ideals. Beliefs are deeply held and slow to change, so it is quite useful to recognize them, as they can either help or hinder an organization's attempt to achieve its vision.
- By including information about the organization's culture, the mission statement instructs and expects members to act in the desired manner.

The mission needs to be specific enough in describing the business areas and customers to set direction, but not so specific that the organization limits imagination. An example of a vision and mission statement from Cincinnati Children's Hospital Medical Center is shown in Exhibit 2.3.

Exhibit 2.3

Cincinnati Children's Hospital Medical Center Vision and Mission

Cincinnati Children's Hospital Medical Center

Vision

Cincinnati Children's Hospital Medical Center will be the leader in improving child health.

Mission Statement

Cincinnati Children's will improve child health and transform delivery of care through fully integrated, globally recognized research, education, and innovation. For patients from our community, the nation and the world, the care we provide will achieve the best:

- Medical and quality of life **outcomes**
- Patient and family **experiences** and
- **Value**

today and in the future.

Source: Cincinnati Children's Hospital Medical Center, https://www.cincinnatichildrens.org/about (accessed February 26, 2021).

2.1c Strategic Objectives

With the strategic analysis, mission, and vision in place, **strategic objectives** are developed, which are used to achieve the mission and vision. The objectives describe both short- and long-term results that are desired, along with measures to determine achievement. Organizations that embrace the triple bottom line of profit, people, and planet in their guiding values will have objectives promoting each one of them, and projects that are selected will contribute toward each.

Often, strategic alignment of objective setting occurs annually and occasionally, in shorter intervals. While the planning is normally performed annually, many of the strategic objectives identified will take more than a year to achieve. These objectives should provide focus on decisions regarding project selection and prioritization. Strategic objectives help in developing action plans, and these action plans lead to the identification of potential projects.

For objectives to be effective, they should be "**SMART**—that is, specific, measurable, achievable, results based, and time specific."[2] An example of strategic objectives from Tesla is shown in Exhibit 2.4.

2.1d Flow-Down Objectives

Once an organization's strategic objectives are identified, they must be implemented. Some objectives may be implemented through ongoing operations. However, projects tend to be the primary means for implementing many objectives. If the organization is relatively small, leaders may proceed directly to selecting projects at this point. However, if the organization is large, it is impractical for the leaders to make all project selection decisions, and they might delegate those decisions to various divisions or functions with the stipulation that the decisions should be aligned with the organization's strategic planning and objectives. Regardless of whether the organization is small or large, some of the decisions are cascaded one or more levels down, and several methods of project selection may be used.

2.2 Define Portfolio Management

Companies that use a strategic project selection process to carefully align projects with their organizational strategic plan and goals tend to be more successful in completing their projects and deriving the expected benefits. **Portfolio management** is the centralized management of one or more portfolios to achieve strategic objectives.[3] "The goal of portfolio management is to achieve the maximum benefit toward the strategic goals of the company. To accomplish this, executives need to identify, select, prioritize, resource,

Exhibit 2.4

Tesla
Vision: To accelerate the world's transition to sustainable energy. **Mission Statement:** To create the most compelling car company of the 21st century by driving the world's transition to electric vehicles. *Source:* https://www.tesla.com/about (accessed on February 17, 2021). Retrieved on 02/17/21.

and govern an appropriate portfolio of projects and other work."[4] Governing a portfolio will be covered in Chapter 14, and all other portfolio management topics will be covered in this chapter. Project success at these companies is measured by how much the project contributes to the organization's objectives (business needs) in addition to the traditional measures of staying within budget and schedule and achieving the specified technical goals to obtain the desired return on investment.

For ease of understanding, many organizations utilize an approach of classifying portfolios, programs, projects, and subprojects. Not all companies use all four classifications, but an understanding of how they are related is useful.

2.2a Portfolios

Organizations perform many activities, including both ongoing operational work and temporary project work. Operational improvements also lead to projects. Large organizations often have many ongoing projects. A **portfolio** is comprised of "projects, programs, sub-portfolios, and operations managed as a group to achieve strategic business objectives."[5]

Project portfolios are similar to financial portfolios. In a financial portfolio, efforts are made to diversify investments in various divisions and market sectors as a means of limiting risk. However, every investment is selected with the hope that it will yield a positive return. The return on each investment is evaluated individually, and the entire portfolio is evaluated as a whole. Likewise, each project in the portfolio should have a direct positive impact on the organization. Put another way, an organization's leaders should identify the organization's future direction through strategic planning. Then multiple possible initiatives (or projects) can be identified that might help further the organization's goals. The leaders need to sort through the various possible projects and prioritize them based on a set of criteria. Projects with the highest priority should be undertaken first. Organizations typically try to have a sense of balance in their portfolios; that is, an organization includes in its portfolio:

- Some large and some small projects
- Some high-risk, high-reward projects, and some low-risk projects
- Some projects that can be completed quickly and some that take substantial time to finish
- Some projects that serve as efforts to enter new markets and create new products or services and some to improve current products or operations

2.2b Programs

A **program** is "related projects, subsidiary programs, and program activities managed in a coordinated manner to obtain benefits not available from managing them individually."[6] The projects within a program are related and often share the same goal and require similar resources.

Program management is a systematic approach of aligning multiple components of the program to achieve the program goals while optimizing the integrated cost, schedule, and effort required to execute the program. Programs and program management are of great importance, specifically for the government and large and multinational corporations.

Programs often last as long as the organization lasts, even though specific projects within a program are of limited duration. For example, the U.S. Air Force has an engine procurement program. As long as the Air Force intends to fly aircraft, it will need to acquire engines. Within the engine program are many individual projects. Some of these projects are for basic

research, some are for the development of engines, some are for purchasing engines, and a few others are for maintaining and improving the performance of engines in use.

Each project has a project manager, and the entire program has a program manager. While the project managers are primarily concerned with the trade-offs associated with cost, schedule, scope, and quality on their individual projects, the program manager is concerned with making trade-offs between projects to maximize the benefit of the entire program. To avoid confusion, programs deal with a specific group of related projects, while a portfolio deals with all the projects of an organization. A portfolio can include multiple programs as well as multiple projects.

A program may include components such as projects and subprograms. It is important to understand comparative analysis of projects, programs, and portfolios.

While the leadership group of a company may make portfolio decisions and delegate the program management decisions to a program manager, both portfolios and programs are managed at a level above the typical project manager. For practical purposes, project managers should attempt to understand how both portfolio and program decisions impact their projects and with this information in mind, then spend most of their efforts focused on their project.

Some of the unique responsibilities of a program manager are leading program activities in a coordinated way, communicating with internal and external stakeholders, resolving cost, scope, schedule, risk, and quality issues across all projects within the program using shared governance, and managing external and internal factors such as culture and socioeconomic issues. See Exhibit 2.5 for a comparison of projects, programs, and portfolios.

2.2c Projects and Subprojects

Just as a program is made up of multiple projects, a large project may be composed of multiple subprojects. A **subproject** is a part of a larger project organized as a project itself to make it easier to plan and manage. If the project is quite large, individuals may be

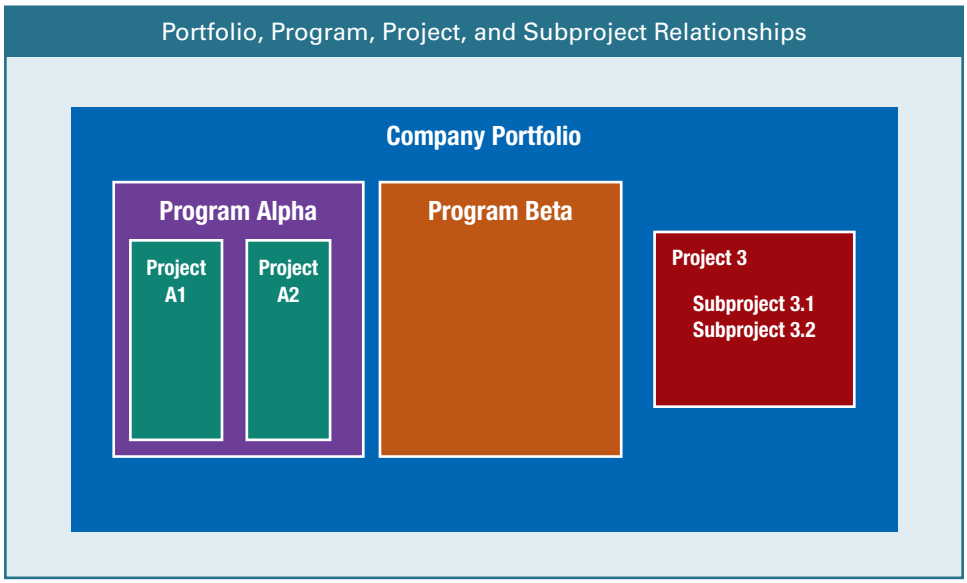
Exhibit 2.5

Portfolio, Program, Project, and Subproject Relationships

	Projects	Programs	Portfolios
Scope	• Defined scope • Progressive elaboration	• Larger scope • Significant benefits	• Organizational scope • Changes with strategic goals
Change	• Change is the norm • Change management	• Internal and external changes	• Changes due to external and internal environment
Plan	• Detailed plans	• High-level program plan • Detailed component plan	• Create processes • Maintain processes
Monitor	• Project deliverables	• Progress of program components	• Strategic changes, risk • Resource allocation
Success	• Scope quality, cost, time • Customer satisfaction	• Needs and benefits of the program	• Investment performance • Benefit realization
Manage	• Project deliverables • Project team	• Program staff and PM • Vision and leadership • Benefits management	• Portfolio staff • Balance portfolio

Adopted from PMI, *Standard for Program Management*, 4th ed. (2017): p. 11.

Exhibit 2.6



assigned as subproject managers and asked to manage their subproject as a project. Some of those subproject managers may even work for another company. The project manager needs to coordinate the various subprojects and make decisions that are best for the overall project. Sometimes this may compel a decision maker to sacrifice a particular subproject for the greater good of the project. The relationships among a portfolio, programs, projects, and subprojects are illustrated in Exhibit 2.6.

Because projects are frequently performed in a fast-paced environment, it is helpful if they can be guided by organizational priorities.

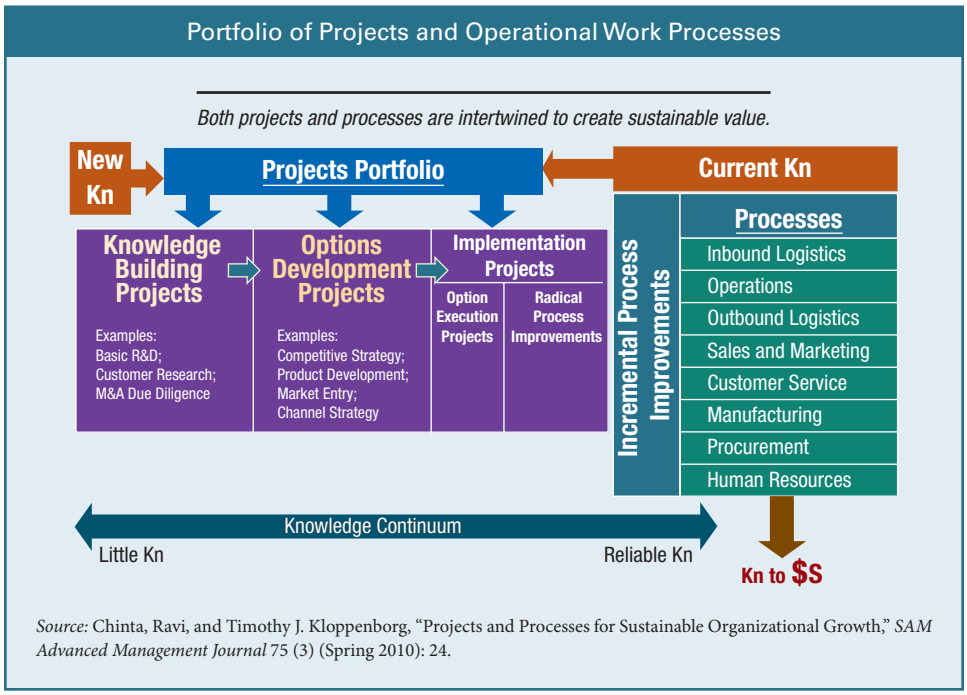
The first step is to carefully align potential projects with the parent organization's goals. While many companies are motivated to align projects with organizational goals for these benefits, an additional reason for companies that sell products or services to the government is that the Federal Chief Information Officer (CIO) Roadmap states, "CIOs are responsible for effective implementation of IT management responsibilities … to ensure that information technology is acquired and information resources are managed for the executive agency in a manner that implements the priorities established by the head of the executive agency."[7]

This was introduced in the Sarbanes–Oxley requirements. All publicly traded companies must now follow certain guidelines that require some sort of financial decision model for selecting projects for execution.

When managers assess the organization's ability to perform projects and then identify, select, prioritize, resource, and govern a portfolio of projects and other work that they believe will help the organization achieve its strategic goals, they are performing portfolio management. While a team of senior executives may conduct many of the portfolio management activities, project managers should understand how their specific projects are aligned with the organization's objectives since they will need to either make or provide input on many decisions.

When organizations consider their entire portfolio of work, they sometimes envision projects as means of developing knowledge that can be capitalized upon in ongoing work processes to provide profit, as shown in Exhibit 2.7. Furthermore, new knowledge encourages organizations to be creative and develop new project ideas and knowledge-building projects.

Exhibit 2.7



Source: Chinta, Ravi, and Timothy J. Kloppenborg, "Projects and Processes for Sustainable Organizational Growth," *SAM Advanced Management Journal* 75 (3) (Spring 2010): 24.

In times when the economy is poor, many companies struggle to get enough business. In such an economic environment, some firms might accept almost any work they can get. However, even during bleak economic times, one should be careful about internal project selection, since selecting one project limits resources (money, people, etc.) available to other projects. During good economic times, people should take the same diligence and prudence with external projects and ensure that they are aligned with the organization's goals.

2.3 Perform Portfolio Management

Now that we understand how to define a portfolio management system and the components within it, we turn our attention to using it.

2.3a Assessing an Organization's Ability to Perform Projects

Assessing an organization's strengths and weaknesses is an essential part of aligning projects with the organization. If an organization does not have the right capabilities, a project that may otherwise support organizational goals may be too difficult to complete successfully. Some questions regarding a firm's ability to support projects are as follows:

- Do we have the right skills, capabilities, technical knowledge, and resources that are required for potential projects? If we do not have them, can we acquire them easily?
- Do we have teams with the right attitude to work together, use free and open communication, be creative, and be empowered to make decisions?

- Do we have clearly defined project management processes?
- Do our associates have the right attitudes, skills, and competencies to use the project management processes?
- Are our leaders at each level willing to take appropriate risk?
- Does senior leadership establish a strong foundation for leadership development?
- Do individuals and teams exhibit leadership at their respective levels?
- Do we monitor and understand our external environment?

2.3b Identifying Potential Projects

The second part of aligning projects with the firm's goals is to identify potential projects. In general, some potential projects are meant to capitalize upon a strategic opportunity or technological advance. Others may serve a social need, an environmental consideration, a customer request, improving operational efficiencies, or a legal requirement. Ideally, this is accomplished in a systematic manner—not just by chance. Some opportunities will present themselves to the organization. Other good opportunities will have to be discovered.

All divisions of the organization should be involved. This means people at all levels, from frontline workers to senior executives and people from all functional areas, participate in identifying potential projects. For example, salespeople can uncover many opportunities by maintaining open discussions with existing and potential customers, and operations staff may identify potential productivity-enhancing opportunities as projects. Everyone in the firm should be aware of industry trends. Many industries have trade journals such as *Elevator World* or *Aviation Week and Space Technology* that can be reviewed regularly for potential project ideas.

One reasonable goal is to identify approximately twice as many potential projects as the organization has time and resources to perform. The reason is simple: under close examination, some potential projects may not be a good fit. Any company that accepts practically every potential project will probably waste some of its resources on projects that do not support its organizational goals or do not use its limited resources effectively and efficiently. Exhibit 2.8 describes how projects for developing autonomous vehicles are identified for Chinese automobile manufacturer NIO.

Once potential projects are identified, the next step is to develop a brief description of each. The leadership team that will select and prioritize projects must understand the nature of the projects they are considering. While the level of documentation different firms require varies greatly, a bare minimum can be called the elevator pitch.

The elevator pitch is like when a person meets another waiting for an elevator and asks, "I hear you are on XYZ Project. What is it all about?" The responder may have only a brief time to give a reply before the elevator arrives and must be prepared to answer quickly with simple statements about the project work and why it is important to the organization.

The work is often summarized in a brief **statement of work**, which is a "narrative description of products, services, or results to be supplied."[8] The importance of a project is often summarized as a **business case**, which is "the benefits of a selected component … used as a basis for the authorization of further project management activities."[9]

The business case generally includes both why the project is needed and, if the firm uses financial justification as part of project selection, an estimate of costs and benefits.

Armed with this elevator pitch, the series of processes that are collectively used to select, prioritize, and initiate projects begins.

Exhibit 2.8

Autonomous Vehicle Project Identification

Chinese automobile manufacturer NIO produces smart, electric, and autonomous vehicles in close cooperation with first-tier suppliers, including IFLYTEK for vehicle firmware. Design and improvement projects for NIO products continuously upgrade features to improve the car user's experience. One focus of improvement is the firmware that impacts a vehicle's control, power, and assisted driving. Each key upgrade becomes a project, responsible for sorting through the massive data collected from vehicle usage and working with IFLYTEK to produce the next software upgrade. In turn, IFLYTEK draws critical learning from the partnership and produces a better firmware release for NIO that, in turn, the upgrade project leverages for a better product and product image. Since 2108, the partnership between NIO and IFLYTEK resulted in 39 firmware iterations to include 280 performance optimizations installed in over 350,000 vehicles.

Mark Andrews/Alamy Stock Photo

Provided by the authors of *Projects, Programs, and Portfolios in Strategic Organizational Transformation.*

Methods for Selecting Projects The people in charge of selecting projects should ensure overall organizational priorities are understood, agreed upon, and communicated. Once this common understanding is in place, it is much easier to prioritize potential projects. The degree of formality used in selecting projects varies widely. In a smaller organization, it can be straightforward. The prioritization should consider criteria derived from project management, finance, and strategic aspects and should include asking questions such as these:

- What value does each potential project bring to the organization?
- Are the demands of performing each project understood?
- Are the resources needed to perform the project available?
- Is it feasible to complete the project within the expected time and at the projected cost while managing associated risks?
- Is the project financially beneficial and compatible with other investment decisions?
- Is there enthusiastic support both from external customers and from one or more internal champions?
- Which projects will best help the organization achieve its strategic goals?

There are several different methods of systematically selecting projects. The methods include both financial and scoring models. The primary reason for including financial analysis—either to make the project selection decisions directly or to at least assist in the decision making—is that, from management's perspective, projects are investments. Therefore, proper selection should yield a portfolio of projects that collectively contribute to organizational profit.

Three different approaches are commonly used to ensure both financial and nonfinancial factors are considered when selecting projects.

- First, financial analysis is the primary means of determining which projects are selected, and management merely tempers this with informal inclusion of nonfinancial factors.
- Second, financial models are used as screening devices to qualify projects or even just to offer perspective; qualified projects then go through a selection process using a scoring model.
- Third, financial justification is one factor used in a multifactor scoring model.

The common thread in all three of these project selection approaches is that both financial and nonfinancial factors are considered in varying degrees. Let us consider both financial and scoring models. In this chapter, financial models will be covered in concept, but the calculations will not be shown since they are explained in depth in undergraduate and graduate finance courses.

2.3c Using a Cost-Benefit Analysis Model to Select Projects

Cost-benefit analysis is "a financial analysis tool used to determine the benefits provided by a project against its costs."[10] These models compare expected project costs to expected project benefits. Several models can be used in making project selection decisions.

Net Present Value (NPV) Net present value (NPV) is the most widely accepted model. When using net present value, the analyst first discounts the expected future value of both the project costs and benefits, recognizing that a dollar in the future is worth less than a dollar today. Then the analyst subtracts the stream of discounted project costs from the stream of discounted project benefits. The result is the net present value of the potential project. If the net present value is positive, then the organization can expect to gain from the project. Higher net present values predict higher profits. See the summary in Exhibit 2.9.

Benefit-Cost Ratio (BCR) A second financial model is the benefit-cost ratio (BCR). The ratio is obtained by dividing the cash flow by the initial cash outlay. A ratio above 1.0 means the project expects to make a profit, and a higher ratio value than 1.0 is better. The cash flow can be determined for the life of the project using net present or discounted value principles.

Internal Rate of Return (IRR) The third financial model is the internal rate of return (IRR). In this model, the analyst calculates the percentage return expected on the project investment. A ratio above the current cost of capital is considered positive, and a higher expected return is more favorable.

Payback Period (PP) The fourth financial model is the payback period (PP). In this analysis, a person calculates how many years would be required to pay back or recover the initial project investment. The organization would normally have a stated period that projects should be paid back within, and shorter payback periods are more desirable.

Exhibit 2.9

Financial Models for Project Selection

	Net Present Value (NPV)	Benefit-Cost Ratio (BCR)	Internal Rate Of Return (IRR)	Payback Period (PP)
Calculation	PV revenue – PV cost	Cash flow/Project investment	Percentage return on project investment	Project costs/Annual cash flows
Neutral Result	NPV = $0	Ratio = 1.0	IRR = Cost of capital	Payback period = Accepted length
If used to screen projects or to select projects outright	NPV > Acceptable amount	Ratio > Acceptable amount	IRR > Acceptable amount	Payback period < Acceptable length
If used to compare projects	Higher NPV better	Higher ratio better	Higher IRR better	Shorter payback period better

Disadvantages of Each Method Financial models are useful in ensuring that selected projects make sense from both cost and return-on-investment perspectives. Nonetheless, we must understand the weaknesses of these models before they are used. For example, payback period models do not consider the amount of profit that may be generated after the costs are paid. Thus, two projects with a similar payback period could look equal, but if one has substantially higher revenue after the payback period, it would clearly be superior. BCR would not be acceptable unless all costs and benefits were calculated in present dollars (in which case it is similar to NPV, except it is a ratio of benefits to cost instead of the difference between revenue and cost). However, there are benefits and costs that are intangible and cannot be determined in financial terms.

IRR and BCRs have problems choosing between mutually exclusive projects because they can favor smaller projects that create less total value for the firm but have high percentage returns. For example, a huge project with a medium rate of return would create a lot of value for a firm but might not be chosen over a smaller project with a higher return if only one can be chosen. Additionally, it is sometimes quite difficult to calculate an IRR if a project has nonconventional cash flows. For the most part, the finance discipline recommends using net present value. The other measures can be calculated to provide perspective on whether a project meets a minimum financial return threshold or to communicate with people who might not understand NPV.

However, none of the financial models ensure alignment with an organization's strategic goals. Therefore, financial analysis, while very useful, is normally not enough. Also, one must remember that some of the benefits or costs—such as brand image and perceived market value—are not tangible and cannot be quantified in financial terms. It is critical to understand these limitations of financial models.

2.3d Using a Scoring Model to Select Projects

In addition to ensuring that selected projects make sense financially, other criteria often need to be considered. A tool called a scoring model helps to select and prioritize among potential projects. It is useful whenever there are multiple projects for selection and several selection criteria to prioritize projects. A few organizations use more complex models

such as the analytical hierarchy process (AHP) to compare projects, but since many more organizations keep things simple with variations of scoring models, that is what we will cover in this chapter.

Identifying Potential Criteria The first step in using a scoring model is to identify potential criteria. These criteria should include how well each potential project fits with the organization's strategic plan and objectives. The criteria may also include items such as risk, timing, technical capability, and resources needed. It is a normal practice for the company's leadership team to jointly determine criteria for project selection. A list of questions executives may use to develop their list of criteria is shown in Exhibit 2.10.

Determining Mandatory Criteria Once the leadership team agrees on a list of important criteria, the next step is to determine whether any of the criteria are mandatory. That is, are there any situations that dictate a project must be chosen regardless of any other considerations? Examples of this include government mandates and clear safety or security situations. This list of "must-do" projects should be kept as small as possible since these projects automatically get selected and can crowd out other worthwhile projects.

Weighting Criteria Next, the leadership or project selection team determines the relative importance or weight of each decision criteria. While more complex methods of determining criteria weights and project evaluations have been used in the past, many firms now use the simple methods described here for determining criteria weights. See Exhibit 2.12 as an example of project evaluations.

First, the team determines which criterion is most important and gives that a weight of 10. Then they consider and determine, in comparison, how important each criterion is. For example, if the leadership in a consumer products company determines that the development of new products is most important, it will be assigned a weight of 10. If the customer relations factor is deemed almost as important as new product development, maybe it would be assigned 8. If the factors of supplier relations and probability of project success are each deemed to be half as important as new product development, each would

Exhibit 2.10

Examples of Project Selection Criteria
How well does this project fit with at least one organizational objective?
How many customers are there for the expected outcomes of the project?
How competitively can the company price the project outcomes?
What unique advantages will this project provide?
Does the company have the resources to plan and execute the project?
What is the probability of success?
Are the data needed to perform the project available or easily collected?
Do the key stakeholders agree that the project is needed?
How sustainable will the project outcomes be?
How does this project promote (or hinder) our corporate social responsibility?
What risks are there if we do not perform this project?

Exhibit 2.11

Project Selection and Prioritization Matrix

Project/Criteria & Weight	New Products 10	Customer Relations 8	Supplier Relations 5	Success Probability 5	Weighted Total Score
Project A					
Project B					
Project C					
Project D					

be assigned 5. Perhaps other criteria such as cost reduction, safety, and so forth would also be considered but determined to be not as important. The resulting criteria with weights are shown in Exhibit 2.11 in the top row of the selection and prioritization matrix. Most organizations use three to five criteria. Lesser-rated criteria can be used as tiebreakers if needed.

Evaluating Projects Based on Criteria Now the leadership team evaluates each project on each criterion. The most efficient and accurate method is to concentrate on one criterion at a time and rate each project on that specific criterion, with scores ranging from 1 (potential project has very little or even negative impact on this criterion) to 5 (project has excellent impact on this criterion). The upper-left portion of each cell in the matrix can display the rating, representing how well that project satisfies that criterion. This works best when each person first determines how they wish to rate, and then the group reaches a consensus after letting members who rated differently than the group describe their ideas.

Once a project has been rated on a specific criterion, that rating should be multiplied by the weight assigned to that criterion and displayed as the weighted score in the main body of each cell. The total for each project should be added across the row. The highest-scoring projects would ordinarily be selected. If several projects have close scores (virtual ties), other criteria or discussions can be used to break the tie. For example, in Exhibit 2.12, there is a virtual tie between Projects A and B.

Sensitivity Analysis Scoring models allow leadership or project selection teams to perform sensitivity analysis to examine what would happen to the decision if factors affecting it were to change. Selection criteria may be added or altered, and the team may decide that some criteria are more important than others and weigh them accordingly. Missing criteria or new alternatives can be added and the decision revisited. For example, if the team evaluating the projects in Exhibit 2.13 had a bad experience with an unsuccessful project and decided to reevaluate their decisions with success probability now weighted a 9 for very important, the new project selection and priority matrix would be calculated as shown in Exhibit 2.13.

Exhibit 2.12

Completed Project Selection and Prioritization Matrix

Project/Criteria & Weight	New Products 10	Customer Relations 8	Supplier Relations 5	Success Probability 5	Total
Project A	5 / 50	3 / 24	5 / 25	2 / 10	109
Project B	5 / 50	2 / 16	3 / 15	5 / 25	106
Project C	1 / 10	5 / 40	3 / 15	3 / 15	80
Project D	2 / 20	4 / 32	1 / 5	2 / 10	67

Exhibit 2.13

Revised Project Selection and Prioritization Matrix

Project/Criteria & Weight	New Products 10	Customer Relations 8	Supplier Relations 5	Success Probability 9	Total
Project B	5 / 50	2 / 16	3 / 15	5 / 45	126
Project A	5 / 50	3 / 24	5 / 25	2 / 18	117
Project C	1 / 10	5 / 40	3 / 15	3 / 27	92
Project D	2 / 20	4 / 32	1 / 5	2 / 18	75

Decision makers can ensure that they use solid ratings for each potential project. For example, if one criterion was the number of customers, the marketing department could interview some potential customers to gauge their level of interest.

A company might want to select several projects. If so, the scores from the selection matrix could serve as one method of prioritizing the projects.

Selection of projects based on certain criteria is a decision-making process that varies geographically as priorities and thinking styles tend to be different. Due to cultural differences, education, and background, people think and approach problems differently; therefore, they also adopt different decision-making styles. This aspect assumes importance due to increased diversity in the workplace. Due to these factors, someone might rely more on inductive, deductive, or a combination of these approaches in making decisions. This diversity would influence how people look at a scoring model or any other decision-making tool in selecting projects and making project portfolio management decisions. These issues are discussed further in Chapter 15.

2.3e Prioritizing Projects

Once projects have been selected, all of them will be prioritized—that is, the decision makers will determine which ones will get assigned resources and be scheduled to begin first. If a company selects several projects for a year (or even for a fiscal quarter), it cannot expect to start all of them at the same time due to resource constraints, and the scoring models are useful in determining the starting order of projects. Most leadership teams will consider the weighted scores of each project as a starting point in assigning resources to projects and determining their start dates. The leadership team members, however, also generally discuss other issues, such as:

- The urgency of each project
- The cost of delaying the expected benefits from various projects
- Practical details concerning the timing
- Opportunity costs associated with the project

For example, an important process improvement project may be far less disruptive to perform when the factory is shut down for routine maintenance. One more discussion frequently occurs in the prioritizing process—if there is a conflict between resource needs for two projects, which one gets the needed resources first? Often, this is left to the project sponsors to iron out; especially for important projects, it may be formally decided by the leadership team. In that way, the probability of the critical project being held up by a misunderstanding is greatly decreased.

Exhibit 2.14 shows how the Alternative Breaks (AB) planning committee at a university ranked spring break projects. This exhibit shows four of the twenty-six projects that were selected for trips. Each trip is a small or sub-project, while the combination of all twenty-six trips forms the overall project.

2.3f Resourcing Projects

Once all projects have been prioritized, it is time to assign resources to each project. Resources can include key personnel such as sponsors, project managers, core team members, and subject matter experts. Resources also include space, materials, tools, equipment that may be in short supply, and/or the funds necessary to acquire these resources. The easiest way is

Exhibit 2.14

Alternative Breaks Project Selection and Prioritization Matrix

Project/Selection Criteria	Active Service Opportunity		Issue Itself		Organization to Work With		Cost		
	9		10		6		5		Total
New York Vegan Farm	5	45	4	40	3	18	4	20	123
West Virginia Sustainability	4	36	3	30	4	24	5	25	115
Chicago Halfway House	2	18	4	40	4	24	4	20	102
El Salvador Cultural Immersion	1	9	5	50	5	30	1	5	94

Exhibit 2.15

Resource Assignment Matrix

Project/Resource	PM/DEJI	PM/BUD	PM/CORY	TEAM/ BRADLEY	TEAM/ RAJEEV	TEAM/ LARRY	MONEY
Maximum Availability	200	400	300	300	150	150	$30 million
Project List							
Project B: PM 240, Team 200, $5M		240		200			$5M
Project A: PM 200, Team 150, $10M	200				150		$10M
Project C: PM 300, Team 150, $14M			300			150	$14M
Project D: PM 150, Team 180, $4M							
Remaining Availability	0	160	0	100	0	0	$1M

to use a resource assignment matrix and begin by assigning resources to the highest-priority projects. Once an individual resource is no longer available, the organization is limited in the number of projects that it can take on during a particular time.

Assigning resources requires a prioritized project list such as the one shown in Exhibit 2.13, a list of resources and how much of each is available, and an estimate of how much of each key resource each project will need. For simplicity, organizations often plan for a fiscal quarter. Exhibit 2.15 shows the same four projects and choices of project managers, team members, and the budget for each. Note that while there is enough project manager time to start all four projects, there is neither enough team member time nor enough cash. Therefore, only three projects can be started.

2.4 Securing Projects

The discussion above pertains to projects that are internal to an organization. This section deals with a company (called the client) interested in completing a project, but for which it may hire external resources (called contractors) to execute a significant part or all of the work. External projects can be viewed either from the perspective of the client company that wants the project to be executed or from the perspective of the contractor company that wants to perform the work. Client companies may first put prospective external projects through a selection and prioritization process as described above and, if selected, then decide whether to perform the work internally (make) or hire the project to be performed by others (buy). If the decision is to buy, then the client company needs to plan and conduct the procurement.

Contractor companies need to identify potential project opportunities, determine which they will pursue, submit proposals, and be prepared to either bid or negotiate to secure the work. We consider the client company's perspective in Chapter 13, Acquisition, Partnering, and Collaboration. We consider the contractor's perspective next.

2.4a Identify Potential Project Opportunities

Contractors seeking external projects to perform should pursue them in a fashion similar to that of any company considering internal projects, as described earlier in this chapter in the portfolio alignment section on identifying potential projects. Additionally, since they need to look for projects externally, contractor companies should have representatives at trade shows, professional conferences, and anywhere else where information on the intentions of potential customers and competitors may surface. Contractor companies should also actively practice customer relationship management by establishing and nurturing personal contacts at various levels and functions.

2.4b Determine Which Opportunities to Pursue

Just as all companies should decide on internal projects selection, most contractor companies are best served by targeting the projects they wish to pursue. Some companies have a policy that they will bid on every potential project, knowing that if they do not bid, they will not be awarded the project. More companies, however, find that if they target their opportunities, their "hit rate," or probability of securing the work on any given proposal, increases. As it takes time and resources (costs money) to put together a good proposal, it makes sense to increase the acceptance rate by developing a bid/no-bid decision strategy.

Each company has strengths and weaknesses compared to its competitors. Hence, a quick SWOT analysis could be used to decide whether to pursue a potential project, just as a more involved version of SWOT analysis was described earlier and depicted in Exhibit 2.2. Decision makers can also ask how well a potential project will help achieve their objectives. If they determine a project will help achieve their objectives, the next considerations are the cost to pursue the work and the probability of successfully securing the project. A company frequently considers risks both of pursuing and not pursuing a potential project.[11] Finally, the question "does the company have the capability to perform the work if it is awarded?" must be addressed.

2.4c Prepare and Submit a Project Proposal

Preparing and submitting a proposal itself is a small project, with the primary deliverable of the project being a compelling and complete proposal. The contractor should understand

Aliakseu Matsiushkou/Alamy Stock Photo

Exhibit 2.16

Typical Source Selection Criteria

Technical	Management	Financial	Operational
Technical experience	Management experience	Financial capacity	Production capacity
Understanding needs	Project charter	Life cycle cost	Business size and type
Technical approach	Planning and scheduling	Cost basis and assumptions	Past performance
Risk mitigation	Project control	Warranties	References

the project's **source selection criteria**, the "basic minimum criteria the sellers have to be fulfilled to get shortlisted."[12] While criteria will vary extensively from one project to another, generally, a client would like to be convinced that the potential contractor is technically, managerially, financially, and operationally competent. Successful project managers try hard to convince potential clients that they are capable of all four dimensions. A short list of these factors is shown in Exhibit 2.16.

2.4d Negotiate to Secure the Project

Once all proposals have been delivered and evaluated, the client company may elect to either award the project or enter into negotiations with one or more potential contractors. On more routine projects, the contract may be awarded at this point. Further clarifications and negotiations may follow for complex projects.

Negotiation is an approach to redefine an old relationship that is not working effectively or to establish a new relationship. Negotiations should aim for a win-win solution, meaning the outcome must benefit both the parties involved in negotiations.

A client company and a contractor company may negotiate the amount of money to be paid for a project. They may also negotiate the contractual terms, schedule, specific personnel to be assigned to work on the contract, quality standards, reporting mechanisms, and various other items. A project manager may need to make arrangements with potential suppliers to secure the products and services needed to perform the project. All these considerations will be covered in subsequent chapters.

Successful project managers understand the need to prepare well for negotiations. This starts with a clear understanding of what is most important to their management. Often, it includes fact finding with the client company to understand its needs and abilities. Armed with an understanding of both perspectives, a project manager attempts to find a solution that allows the organization to secure the project work with enough profit potential and with the start of a good working relationship with the client. In the end, the client company will select the contractor(s) and award the contract(s).

2.5 *PMBOK Guide 7e*

Domains Impacting Project Selection

- Stakeholders
- Team
- Development Approach
- Planning
- Uncertainty

2.5a Stakeholders

The seventh edition of the *PMBOK* takes an explicitly wide-frame view of the value projects provide not just to the project team and customers but also the performing organization as a whole. This approach is useful in project selection and prioritization. It encourages us to see the role individual projects play as part of a larger organizational strategy of providing useful outcomes for both internal and external stakeholders. It reminds us that benefits and values derived from a project may outlive the project itself.

2.5b Team

Projects are often chosen at the executive level based on their perceived potential value as part of a business portfolio. As such, team members—including the project manager—may not be involved in the process of selecting projects. Nevertheless, *PMBOK 7e* is clear in its recommendation to get team members involved in project planning as early as possible. Team members will be far more invested in a project they help to plan, and a variety of opinions often leads to better outcomes. A project manager may do well to take on the role of servant leader by removing obstacles, providing encouragement and development opportunities, and empowering team members more than instructing them.

2.5c Development Approach

When choosing projects to add to a portfolio, executives often follow the same strategy they would if managing a financial portfolio: diversification. It makes sense to have a range of projects in terms of size, complexity, cost, etc. They may also look at the development approach when choosing which project(s) to undertake since predictive approaches require more planning upfront, whereas adaptive (*PMBOK 7e* uses the word *adaptive* far more than *Agile*) projects are planned and executed in sprints.

2.5d Planning

At both the project management and portfolio management levels, decision makers need to remember that "deliverables drive outcomes." In other words, we are not pursuing projects for the deliverables themselves but rather for the value and benefits they can bring to our organization. Planning needs to be holistic and ensure various components are in alignment with one another (formerly referred to as Integration).

2.5e Uncertainty

When selecting and then planning projects, we need to begin with an understanding of the larger environment in which the project is being conducted. This includes political, social, market, and environmental factors.

2.6 Agile Project Selection

The project selection process in Agile environments differs from traditional project selection methods discussed thus far in this chapter, as shown in Exhibit 2.17.

While strategic planning is conducted in both predictive or Agile environments, project selection is quite different in Agile projects. Potential projects are selected based upon a product vision of how a user will achieve a desired outcome, not just receive an output from a project team. This vision guides the project, but still leaves a substantial amount of detail to be determined. These details emerge gradually.

Exhibit 2.17

Comparison of Plan-Driven and Agile Approaches for Project Selection

Project Selection Questions	Plan-Driven	Agile
How is strategic planning conducted?	Outputs considered at the organizational level	Outcomes considered at the organizational level
How is alignment with organizational goals ensured?	Portfolios and programs	Portfolios and programs shown as roadmaps
What is the primary organization at a lower level?	Projects and subprojects	Products and sometimes projects
What is the primary way future work is organized?	Projects in portfolio	Products in backlog
How are projects selected?	Scoring model	Customer-driven value
How is work prioritized?	Scoring model	Backlog refining led by Product Owner
How are resources determined for selected and prioritized project work?	Resource Assignment matrix	Relative Priority Ranking
How is project work secured?	Proposal and negotiation	Partnering

2.6a Agile Terms Used in an Introduction to Project Selection and Prioritization

Product roadmap	Visual showing high-level plans of products expected to be created during each release
Release	Period when functionality is created and transitioned to users
Portfolio vision	Description of desired future state of value streams and solutions
Solutions	Deliverables that are usable, desirable, and functional in helping customers achieve desired outcomes
Product	The deliverables that are created in an Agile project
User story	Need to be described by who wants it, how they will use it, and why
Product backlog	A wish-list of things that may be created by the project team
Epic	Large functionality or product, not defined enough to produce
Eat your dessert first	Find and create the highest value capability for the customer first
Minimum viable product (MVP)	The simplest version of a product with just enough features to gain quick customer feedback
Customer-driven value	Define value from a customer's perspective

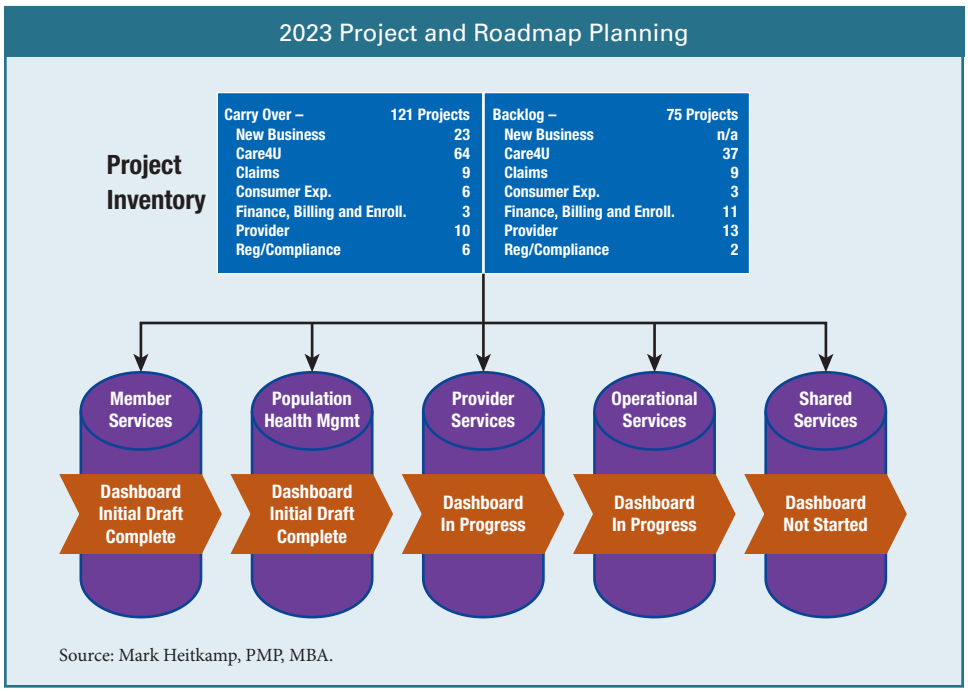
Refine requirements	Use feedback to progressively understand true needs
Customer prioritization	Decide importance or urgency of work based on customer input
Risk-adjusted backlog	To-do prioritized list of work to both create product and reduce risk
Prioritized backlog	Desired products prioritized by business value and risk

In this book, we use many Agile terms and definitions from Anantatmula, V., and T. Kloppenborg, *Be Agile Do Agile* (New York, NY: Business Expert Press: 2021).[13]

Organizations that exclusively use a predictive approach to projects ensure organizational alignment by organizing work into portfolios and programs. Organizations that use Agile methods instead often use **product roadmaps** showing the functionality that will be developed in each **release** to consider upcoming work. These roadmaps are based upon the **portfolio vision** that describes the future state of value and **solutions** to be delivered, not just the **products** that are to be created.

Roadmap Example We are a major national health insurance company. Our planning approach starts with creating an inventory of project initiatives, which has been identified by the key business areas. We separate the projects into foundational pillars (operation functions) and develop roadmaps of activities going out six quarters (eighteen months), as can be seen in Exhibit 2.18. Priority and timing of business need determine in which quarter(s) the project initiatives are developed and implemented. The roadmaps also

Exhibit 2.18



Source: Mark Heitkamp, PMP, MBA.

include smaller activities called capabilities that are integrated with the project activities. Each of these foundational pillars aligns with the supporting Agile sprint teams and the backlog of activities gets translated into **user stories** within the sprints. A key role is the Product Owner who represents the business area and determines which activities (stories) go into each sprint. There is one Product Owner for each pillar and they are at a Director level within the organization. The product owner must have a complete understanding of the organization's strategy and short-term goals of their respective business area.

Organizations using predictive approaches typically organize work at more detailed levels as projects and sometimes as sub-projects, all contained in an overall work portfolio. Organizations that use Agile methods often organize lower-level work as products contained in a **product backlog**. That means work for developing, maintaining, and improving systems is often performed by the same teams of workers and those teams stay together indefinitely. Often when a large new capability is desired, it is described as an **epic** without much detail. Then, two terms are used to guide early work. One is "**eat your dessert first**," meaning find the highest value capability the customer seeks and create that first. The other is "**minimum viable product (MVP)**" which is the simplest version of a product a customer may find useful.

Individual projects in a predictive environment may be selected using a scoring model, as shown in the previous section. In an Agile environment, individual projects are selected based on customer-driven value. That often entails significant conversations with both internal and external customers to understand what each considers most important, **customer driven-value**. Part of prioritizing work in Agile environments is to continually **refine requirements**, by looking more closely at the epics to continually evaluate each based on the most current understanding of the value (**customer prioritization**) and risk (**risk-adjusted backlog**) of each.

Once a set of projects are selected, prioritization and resource assignment take place. Predictive organizations often use scoring models and resource assignment matrices for this. Agile organizations often use other techniques such as relative priority ranking in which each project is placed in priority order (no ties allowed) by a senior person with authority to make prioritization decisions. Each time a new potential project or feature is proposed, it is slotted into the set and all work deemed less important slips down in priority. That way the total amount of work expected to be completed remains within the capacity of the workers available and is now the **prioritized backlog**.

When seeking work, organizations using predictive methods most often use proposals or negotiations to secure project work. While organizations using Agile methods may do the same, their primary focus is often on partnering with customer organizations both so they best understand the customer and so the customer thinks of them as part of their team and does not need to look elsewhere for an organization to perform their project work.

Summary

Project selection does not occur in isolation. Ideally, it begins with the organization's strategic planning. This planning begins with a strategic analysis of the organization's internal strengths and weaknesses, as well as the external threats and opportunities it faces. The organization should then develop its guiding principles such as mission and vision statements. Most companies will have an annual planning session in which strategic objectives and consequent action plans are developed. These action plans will lead to the identification of potential projects. Larger organizations will continue this effort with one or more levels of planning in which the overall objectives are flowed down to determine objectives that are appropriate for each organizational level.

Once the strategic planning is accomplished, the organization's leadership team engages in portfolio management. The first part is an open and honest assessment of the organization's ability to perform projects.

The decision makers consider how many resources are available, the organization's overall capabilities, and the capabilities of the individuals who will be assigned to projects. An ongoing portfolio management activity is for everyone in the firm to identify possible opportunities that they feel might help the organization achieve its goals. Each potential project should be described by stating a sentence or two about what work is involved and how it would help the organization achieve one or more of its goals.

Once potential projects are identified and briefly described with statements of work and business cases, they should be put through a process to determine which will be selected and what their relative priorities are. Both financial and scoring models are frequently used to evaluate potential projects. Net present value is the preferred financial method, although others are sometimes used. Financial analysis tells the leadership team how much each potential project is worth from a benefits-versus-cost comparison, but it does not tell how each potential project may help to achieve the organization's goals. Scoring models can incorporate various goals and should also be used. Once a project list is selected, the projects need to be prioritized so some can start right away and others can start later.

Contractor companies need to be constantly on the lookout for potential project opportunities. Once potential projects are identified, companies need to decide which ones they pursue. Just as for internal projects, some external projects will be better at helping an organization reach its goals because they are a better fit. The contractor needs to prepare and submit proposals for desired projects and be prepared to follow up and often negotiate to secure them.

Key Terms Consistent with PMI Standards and Guides

vision, 38
mission statement, 40
strategic objectives, 41
SMART, 41
portfolio management, 41
portfolio, 42
program, 42
program management, 42
subproject, 43
statement of work, 46
business case, 46
cost-benefit analysis, 48
source selection criteria, 56

Key Terms Consistent with Agile Practice

Product roadmaps, 59
Release, 59
Portfolio vision, 59
Solutions, 59
Products, 59
User stories, 60
Product backlog, 60
Epic, 60
Eat your dessert first, 60
Minimum viable product (MVP), 60
Customer driven-value, 60
Refine requirements, 60
Customer prioritization, 60
Risk-adjusted backlog, 60
Prioritized backlog, 60

Chapter Review Questions

1. List and describe each step in the strategic planning process.
2. Name at least four things that a mission statement should include.
3. What does the strategic analysis acronym SWOT stand for?
4. What is the most widely accepted financial model for selecting projects?
5. What are some advantages and disadvantages of using a financial model for selecting projects?
6. What are some advantages and disadvantages of using a scoring model for selecting projects?
7. What are some common reasons for project failure?
8. Who should be involved in identifying potential projects?
9. If there is a conflict between resource needs for two projects, who decides which one gets the needed resources first? Does this depend on whether the organization uses a traditional or Agile approach to project management?

10. In a project scoring model, why is each decision criteria given a weight?
11. What purpose do sensitivity analyses serve in using scoring models to choose projects?
12. If several projects have close scores as the result of a scoring model, what can be done to break the virtual tie?
13. Why might a contractor company perform a SWOT analysis before bidding on a potential project?
14. Why is it important for a contractor to understand the source selection criteria a client uses to decide to whom they will award a project?
15. Name five things that may be negotiated between a client company and a contractor company.

Discussion Questions

1. How might the internal and external parts of a SWOT analysis affect one another?
2. Describe the interaction between vision and mission statements.
3. How is a company's portfolio similar to and different from a financial portfolio?
4. What is the best way for an organization to prioritize selected projects? Does it vary if an organization adheres to Agile versus traditional project management methodology?
5. Why is aligning potential projects with the parent organization's goals the first step in avoiding project failure?
6. Why is it a good practice for organizations to identify twice as many potential projects as they plan to implement?
7. Suppose you are purchasing a new car, and you decide to use a scoring model to decide among four options. What would be your top three criteria, and what would be each criterion's relative weight?
8. Under what circumstances should a selected project take precedence over other selected projects?
9. If you are a contractor looking for project work, why might you decide not to pursue a particular project opportunity?
10. What are the four main areas of competency a client company is looking for in a project manager? How can you best demonstrate these competencies to a potential client?

PMP Exam Study Questions

1. A collection of projects, programs, and operations managed as a group to achieve strategic objectives is called a:
   a. process
   b. portfolio
   c. subprogram
   d. life cycle
2. Projects may be undertaken as a result of any of the following strategic reasons *except:*
   a. social need
   b. market demand
   c. need to keep workers busy during slow times
   d. environmental considerations
3. A narrative description of products, services, or results to be delivered by the project is a/an:
   a. request for information
   b. business case
   c. project statement of work
   d. elevator pitch
4. All of the following statements are true *except:*
   a. A portfolio may contain multiple programs and projects.
   b. A project manager has the discretion to make trade-offs regarding which programs to pursue.
   c. A program manager has the discretion to make trade-offs regarding which projects to pursue.
   d. Projects have a finite timeline, while programs may exist as long as the parent organization does.
5. Which of the following is a financial analysis tool that an organization may use to determine the cost-value of potential projects?
   a. Payback period (PP)
   b. Internal rate of return (IRR)
   c. Net present value (NPV)
   d. All of the above

6. All projects should be aligned with their organization's strategic plan, which includes the organization's vision, goals, and objectives. Which of these describes an organization's vision?
   a. Conveys a larger sense of organizational purpose and is both inspiring and guiding
   b. Describes short- and long-term results along with measures to determine if they have been achieved
   c. Includes the organization's core purpose, core values, beliefs, culture, primary business, and primary customers
   d. Is SMART: specific, measurable, achievable, results-based, and time-specific
7. The _____ best describe(s) *why* a project is being undertaken.
   a. statement of work
   b. business case
   c. subprojects
   d. source selection criteria
8. When selecting projects, it is important to understand the following types of environments and their potential effects on the project:
   a. political
   b. market
   c. social
   d. all of the above
9. An organization's vision often includes reference to its social, environmental, and economic health, collectively referred to as the:
   a. triple bottom line
   b. business case
   c. statement of work (SOW)
   d. net present value (NPV)
10. On an Agile or adaptive project, the goal is often to produce a:
    a. Cost-benefit Analysis
    b. Minimum Viable Product (MVP)
    c. Business Case
    d. Subproject

Exercises

1. Complete the following scoring model. Show all your work. Tell which project you would pick first, second, third, and last. How confident are you with each choice? If you lack confidence regarding any of your choices, what would you prefer to do about it?
2. Complete the following scoring model. Show all your work. Tell which project you would pick first, second, third, and last. How confident are you with each choice? If you lack confidence regarding any of your choices, what would you prefer to do about it?

Project/ Criteria & Weight	Criteria 1 10	Criteria 2 6	Criteria 3 4	Weighted Total Score
Project A	4	3	5	
Project B	3	2	3	
Project C	2	4	3	
Project D	1	3	4	

3. Pretend you are on the leadership team for a pharmaceutical company that is in a difficult financial situation due to patents that have expired on two of your most profitable drugs. Brainstorm a list of criteria by which you would select and prioritize projects. Weight the criteria.
4. Pretend you are on the leadership team of a manufacturing company that is currently challenged by low-cost competition. Brainstorm a list of criteria by which you would select and prioritize projects. Weight the criteria.

Project/ Criteria & Weight	Criteria 1 10	Criteria 2 7	Criteria 3 3	Weighted Total Score
Project A	1	3	4	
Project B	3	5	3	
Project C	5	4	3	
Project D	2	3	1	

Integrated Example Projects

Suburban Homes Construction Project

Suburban Homes, like any other real estate company, has many strategic directions to pursue to expand the company's operation and increase revenue and profits. To explore and pursue various investment opportunities that would eventually translate into projects, the company developed strategic directions to successfully invest in real estate. It identified six options for portfolio project management. They are investments in purchasing land for future development, communities for single-family homes, multifamily properties, small-scale apartment buildings, large-scale apartment complexes, and commercial investments.

1. Purchasing land in areas that have potential for future growth makes sense, as the cost of land tends to be substantially cheaper 10–20 years before it is turned into a developed suburban area. At an appropriate opportunity, the land can be improved to add value, or it can be leased or rented to create cash flow. Further, the land can be divided and parts of it can be sold for a profit. However, this option requires a vision for future growth and development and consequently, risks are also associated with this strategic direction.
2. Building single-family homes in suburban areas is one of the best and most popular strategic directions for growth for companies like Suburban Homes. Most of the clients who are interested in a quality life and view their home as an investment prefer buying single-family homes. Clients realize that it is easy to rent, sell, and finance.
3. Small multifamily properties usually consist of two to four units. They also present similar advantages that are associated with a single-family home such as easy financing and being a wise investment option for clients while providing a good residence for their family.
4. Small apartment buildings usually consist of five to fifty units for clients to reside in. They are more popular among those who prefer urban areas and a busy social life. Clients are usually unmarried or married with no children. These properties can be more difficult to finance because they rely on commercial lending standards. For this investment option, Suburban Homes must look for investment opportunities closer to densely populated areas, and the investor must provide parking areas.
5. Large apartment complexes require that you include pools, a gym, tennis courts, and parking facilities, in addition to other attractions that lure people to choose the complex as a residence. Such a complex requires full-time staff to manage the property, provide safety and security, and provide good customer service. These properties can be very expensive to purchase. However, this investment option provides steady revenue flow.
6. Commercial investment, in its truest sense, is an investment for growth and diversity in a portfolio. This investment's aim is to lease the property for business. Size, style, and purpose also vary. Clients could range from small business owners to large malls and mega office complexes. This investment option offers a consistent cash flow. However, occupancy would depend largely on the local economy and could prove to be risky. Further, investments are of higher magnitude and Suburban Homes is seriously considering this option after establishing steady growth in the residential market and improving their financial stability and growth.

Given these six options, Suburban Homes has approached you to develop a project selection model to maintain a balanced portfolio.

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https://www.biggerpockets.com/real-estate-investing/strategies-niches

Heritage Arboretum Development Project

The township staff person who is responsible for renting out the Heritage Center looked around and realized there are quite a few types of trees on the grounds. She asked the question, "could this be considered for an arboretum?" If the grounds were to be certified as an arboretum, the building and grounds could perhaps be advertised more widely and rented both more often and for a higher daily rate.

If a decision was made to pursue arboretum certification, there would be some challenges. For example, about half of the property is protected green space, so any work on that portion of the property is

subject to green space policy. Another challenge is that most of the work would need to be accomplished by volunteers. A related challenge is to create a budget for this. What department would the budget come from and how much could be allocated? Who would make the decision first to create the application and then to approve the application before submission? Finally, would the end goal be to merely qualify for arboretum certification, or would there be additional work to capitalize upon that certification and/or make additional improvements to make the land more appealing? Would brainstorming of possible future improvements dissuade decision makers from approving the basic application or motivate them further with the excitement of possibilities?

One of the questions was answered. The staff person brought the concept to the volunteer Tree Committee of the township. They considered the idea, several members walked the site with an eye toward identifying existing trees, and the committee decided to pursue certification. The Township Administrator and the Board of Trustees then agreed to assign a staff member to work with the Tree Committee to develop an application and, after reviewing the application, agreed to submit it.

Related Link:
https://www.andersontownship.org

Student Questions:

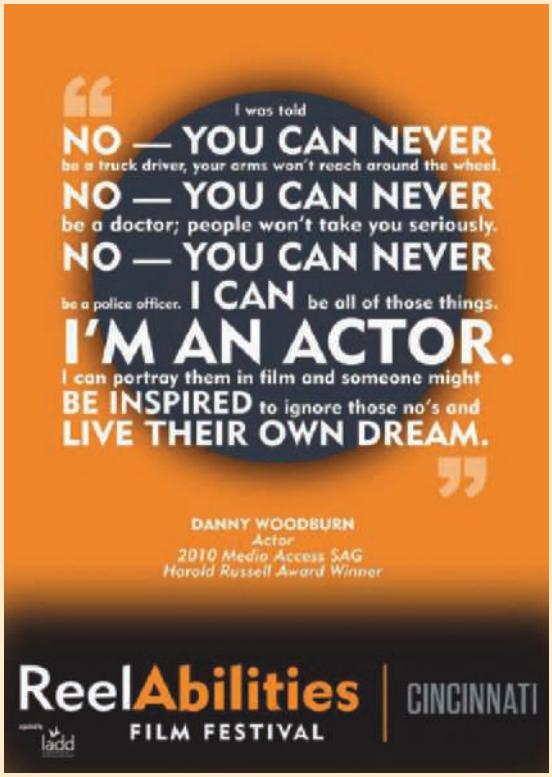
1. Why or why not should this project be selected? If you were a decision maker, what additional information would you like to have before deciding?
2. What is the minimum viable product (MVP) goal for this project?
3. What additional goals may emerge and when?

Semester Project Instructions

Your instructor may bring example projects to the class and facilitate the assignment of students to the various project teams. Alternatively, your instructor may ask you to identify potential projects. Therefore, you may or may not be involved in project selection. If your instructor has each student bring in a project idea, you will first need to create your elevator pitch to describe tersely what work is involved in your project and why it is important. Then you and a small team will likely need to select one of the potential projects using a scoring model. Unlike the criteria for selecting among projects in a typical organization, for your class, you may use criteria that will help you learn. You may want to include size and complexity criteria so the project is involved enough for you to benefit by using many of the techniques in this book, but small enough so you can do the work in a reasonable amount of time. Finally, you may need to identify resources to accomplish the project using a resource matrix.

Regardless of whether your project is student- or faculty-generated, one of the first things you should do when assigned to a project is to learn about the company or other organization that wants the project to be completed. Why did they select this project? Is it a "must-do" project or did it get chosen over other competing projects? By understanding what makes the project so important, you will make better decisions and will be more motivated through the term. If your project is a "must-do" project, explain why. If it is not a "must-do" project, explain how it was selected. Explain where it fits in priority with other work of the organization.

Project Management *in Action*



Source: ReelAbilities Film Festival/Cincinnati

Prioritizing Projects at LADD

LADD's project prioritization process introduced at the start of this chapter brought along a few surprises. It was not a clean and quick process. With a staff of seven directors in the room, all with varying levels of experience and understanding, many conversations transpired requesting clarification and explanation on why peers used criteria to rank projects higher or lower than the overall average. The wall of the board room was covered with paper that contained projects, numbers, and many markings that could be deciphered only by those involved in the process. Some directors provided unsolicited advice as to why their program's project deserved higher marks. Such requests were generally met with equal banter, advocacy for one's own project, and ultimately ended in a fruitful discussion that resolved any discord.

As projects were scored and then ranked, the outcomes were not always predictable. A project such as the film festival emerged as the top priority because it was so closely linked with the scored criteria of generating revenue and having a large community impact. Creating an infrastructure for IT needs was last because it would cost a significant amount of money and have no direct return for the individuals LADD supports. From the process, it was evident that a small handful of projects were nonnegotiable and would require completion to establish a base for other larger, more impactful projects.

Ultimately, the leadership team was able to create a plan of action that is scheduled to accomplish all of the objectives outlined in the strategic plan in a deliberate, organized manner within the five-year timeline. LADD's leadership team members assumed the title of project manager for the majority of projects. They will work across departments, employing the strengths of many, and be held accountable to their peers weekly when the prioritization plan is reviewed at the director's meeting.

Although in its infancy, LADD has taken the top-ranked twelve projects and broken down quarterly expected outcomes for each. The outcomes may be revenue based and focused on generating income for the organization or task based with a method of planning and implementation. Whatever the method, program managers are held responsible for the project being supervised, and project progress will be reported directly to LADD's board of directors. Such a framework allows for accountability all the way through the organizational structure and a conclusively better service provision for those who LADD supports. Exhibit 2.19 illustrates the prioritization process with the highest-ranked projects selected by LADD and shows the five criteria used to do so.

Exhibit 2.19

LADD Project Selection and Prioritization Matrix

Project	Mission (10)	Finance (9)	Workforce (8)	Relationships (8)	Community (7)	Total
Film Festival	40	36	32	32	35	175
Expand meaningful community-inclusion activities	50	27	32	40	21	170
Develop Victory Parkway site	50	36	16	40	28	170
Implement vacation/respite services	40	36	24	24	35	168
Health and Wellness Program	50	18	40	32	21	161

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Chapter 3

Chartering Projects

Chapter Objectives

Core Objectives:

3-1 Describe a project charter and its critical role to project success.

3-1 List the various elements of a charter and the purpose of each element.

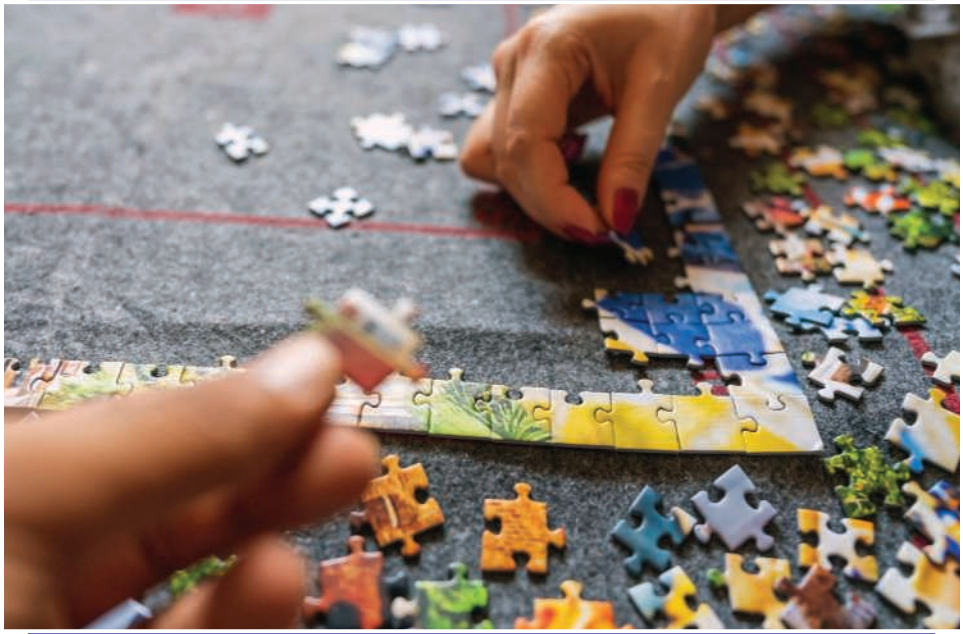
3-2 Discuss with the project sponsor and work with the team to develop a realistic and achievable project charter.

3-3 Initialize a project in Microsoft Project and set up a milestone schedule.

Agile Objectives:

3-5 Discuss differences between an Agile charter and a predictive project charter.

3-6 Create an Agile project charter with a vision statement and roadmap.



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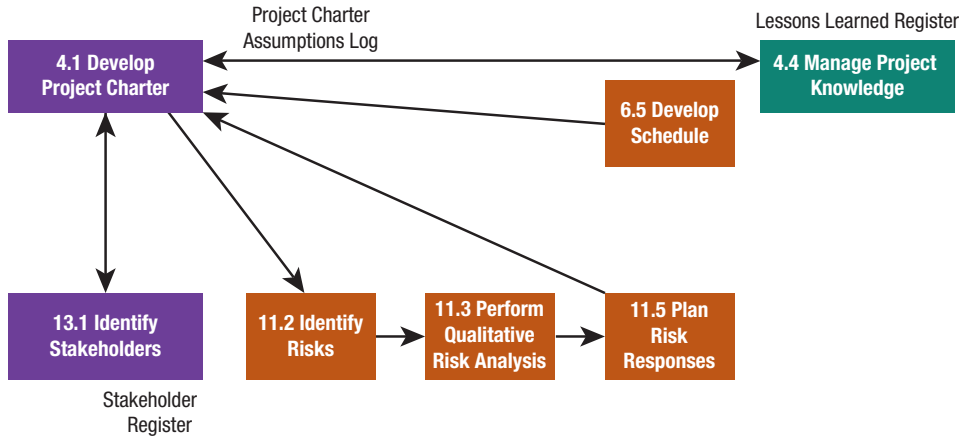
Planning a project is similar to putting together a large puzzle. If you were to dump a 1,000-piece puzzle on a table, you would probably not start the detailed "planning" right away by comparing two pieces randomly to see if they fit. You would likely take several preliminary steps. Some of these steps might include turning the pieces so the picture side was visible on each, sorting outside pieces so you could form the boundaries, studying the picture on the box, and sorting by color so you could match pieces more easily. These preliminary steps make the detailed planning of the puzzle much easier and more efficient. If completing projects is analogous to putting puzzles together, then project charters are the initial step of understanding the big picture. Initiating a project requires some preliminary actions, including understanding the needs and concerns of stakeholders, of whom the most critical stakeholder is the project sponsor.

Ball Aerospace & Technologies Corp., Systems Engineering Solutions provides a wide range of air, space, and counterspace engineering and professional analytic services. At Ball, we increase stakeholder buy-in by addressing and thinking about things up front. With an agreed-upon charter, the project team has preliminary

PMBOK Guide 6e Coverage



Note: Refer to Appendix A to view the entire *PMBOK Guide 6e* flowchart.

PMBOK Guide 7e

Domains:

- **Stakeholders**
- **Team**
- **Development approach**
- **Planning**
- **Measurement**
- **Uncertainty**

guidance to effectively plan and execute the effort. In addition, by going through the chartering process, stakeholders take ownership in the project.

At Ball, our project sponsors are typically U.S. government customers, and we provide work for them on a contractual basis. They provide funding and broad direction for our efforts, and we go through a formal proposal process for all our projects. Project sponsors provide initial statements of work or objectives defining their goals for the task and then select among several proposals from interested companies such as Ball to fulfill their requirements. The chosen company is then under an official formal contract to complete the project. This is, in effect, a pre-chartering process.

Typically, after an effort is under contract, a kickoff meeting is scheduled between the project sponsor and the chosen company to review the objectives of the project. This is part of the initiating stage of the project lifecycle, in which stakeholders review and approve the following as part of the project's charter:

- Overall project objectives
- Contrast between technical approach as written in the company's proposal for execution and sponsor expectations
- Milestones, checkpoints, and potential payment plans
- Success criteria and schedule
- Identification of key stakeholders and risks
- Processes for executing, monitoring, controlling, and overall management of the project

There are a number of things to consider when initiating a project and generating a project charter. These serve as pieces of the overall puzzle of managing and executing a project. A little pre-work in initiating the project goes a long way, with increased goodwill and understanding from the project sponsor, clear tasks and goals for the project team, and a single way forward toward achieving the products and services of the project.

– Lydia Lavigne, Ball Aerospace

In this chapter, we will first present a high level of understanding of what a project sponsor, manager, and team do to initiate a project. We define a charter, why it is used, and typical sections that are included within. Then, we will walk you through the process of creating a project charter yourself. Once the charter has been created and signed, the project proceeds into the more detailed planning phase. During this phase, the elements from the charter are expanded upon and planned in as much detail as required. Chapters 5, 6, 7, 8, 9, 10, and 11 describe this comprehensive project planning.

3.1 What Is a Project Charter?

For a project manager, team member, or project sponsor, one of the first and most important initial concerns is a project charter. This short document (usually about one to four pages) serves as an informal contract between the project team and the sponsor (who represents both senior management of the organization and the outside customer, if there is one).

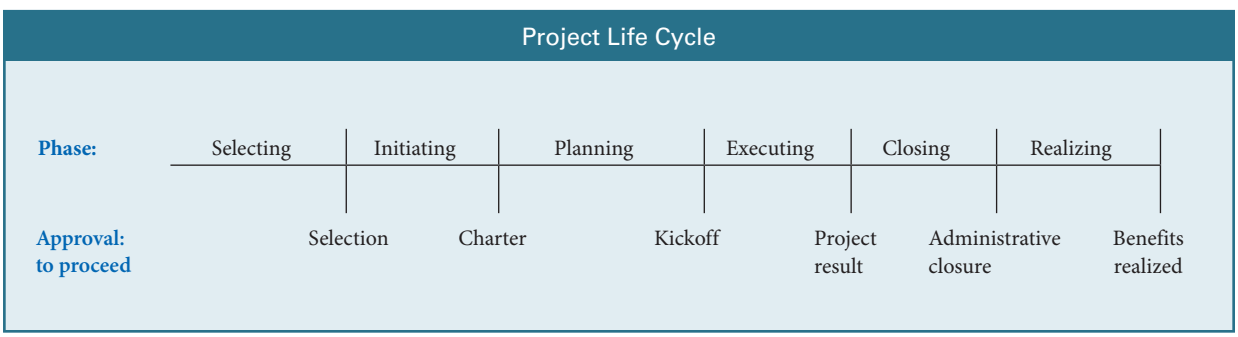
The project charter reflects a common understanding and collaboration between the project sponsor and project manager. Negotiation skills of the project manager play an important role in developing a viable project charter.

Since a charter is like an informal and a high-level contract, it is helpful to remember what a contract is. First, it is an agreement freely entered into by two or more parties. Second, one party cannot arbitrarily change it. Third, there is something of value in it for each party. Finally, it is a living document that can evolve with changing conditions if both parties agree and receive something of value for making the change. Signing the charter represents the transition from the high-level project initiation phase into the more detailed project planning phase. See Exhibit 3.1 for a review of the project life cycle.

The project charter is the deliverable that grants a project manager the right to continue working on the more detailed planning phase of a project. This may include *only* permission to plan the project, permission to make decisions that would slow the project if delayed (such as ordering long-lead materials or hiring special workers), or permission to plan and perform the entire project in the case of a small and simple project. Officially, a charter is drafted by either project manager or sponsor and then negotiated; however, as projects are often conducted in a more collaborative manner, some organizations assign core team members early enough to help draft the charter. Also, early input from key stakeholders may be considered.

While either party (the sponsor or the project manager) can write the rough draft, more often than not, the project manager writes the draft charter. Ideally, then, the project

Exhibit 3.1



manager and the sponsor candidly discuss each item of the charter. Like a contract, the people who sign a charter are wise to ensure that they understand and agree to all of it. Unlike a contract, however, both parties feel obligated to the spirit (as opposed to the letter) of the charter since the project details have not yet been worked out and as specifics will certainly change.

Thinking of a charter like a contract means that both the project manager and the sponsor sign the charter willingly and strive to make the project successful. When core team members have helped write the charter rough draft, they may also sign the charter. If the project manager feels bullied into making a change, it is not a free choice. However, the sponsor may legitimately insist on receiving the project results more quickly or make some other change to the project.

One party alone cannot change the charter. If a project has to change, both the project sponsor and the project team must work together to incorporate the change.

3.2 Why Is a Project Charter Used?

The four major purposes for a charter are to:

1. Authorize the project manager to proceed.
2. Help the project manager, sponsor, and team members (if any are already assigned) develop a common understanding of the project.
3. Help the project manager, sponsor, and team members commit to the spirit of the project.
4. Quickly screen out obviously poor projects.

First, a **project charter** is "a document that formally authorizes the existence of a project and provides the project manager with the authority to apply organizational resources to project activities."[1] Many project managers do not have the authority to commit resources without a charter. This gives the project and the project manager official status within the parent organization.

Second, a project charter helps everyone involved in the upcoming project to develop a common understanding of what the project entails. This includes at least the broad justification for the project, how it aligns with the goals of the parent organization, determination of what is included and excluded in the project scope, rough schedule, success measures, major risks, rough estimate of resource needs, and stakeholders. On larger and more complex projects, additional understanding may be required at this point. Small, simple projects may use a simplified single-page charter. Once everyone has a common understanding of clear project goals, several additional benefits occur:

- Advancement of teamwork.
- Development of agreement, trust, communication, collaboration, and commitment among the sponsor, project manager, and project team.
- The ability of the project team to focus on the project plan, as they do not need to worry about management approval for their decisions.
- Decreased likelihood that the sponsor will change the original agreement unilaterally.[2]

Third, it is a moral duty of all project team members to commit to the shared goals articulated in the charter. This results in each person personally and formally committing to doing their best to achieve the agreed-upon project results. This formal commitment often helps a person continue to work hard on a project even when things are not going well.

Fourth, a charter is used to quickly screen potential projects to determine which appear to be poor choices. Needless to say, a charter is much quicker to put together than a full, detailed project plan and schedule. If by constructing a charter it is determined that the project is likely to fail, much planning time (and, therefore, money and resources) will be saved.

Remember, the charter helps all project stakeholders. Charters are often publicly disclosed to many individuals beyond the project team and the sponsor for communication purposes. Company culture differs with regard to characteristics such as task or people orientation, competitiveness, work ethics, and attention to detail. Therefore, charters used in different industries and companies have somewhat different elements and formats.

3.3 When Is a Charter Needed?

Project methods can be scaled from very simple to very detailed. The *PMBOK 7e* makes clear that everything we do on a project should be tailored to the needs of both the organization we are working for and the project itself. Consequently, a project charter can vary in its length from one page to multiple pages. A project manager prefers using details that are enough to develop a common understanding and agreement between the project manager and the project sponsor.

TriHealth has developed both full and mini charters for large and small projects, respectively. They have also developed the decision matrix shown in Exhibit 3.2 to help people determine if a full charter, mini charter, or no charter is needed.

3.4 Typical Elements in a Project Charter

The following sections list some of the typical key elements in a project charter. While the intent of most of these sections is included in charters, some project teams combine sections or leave out a few of them. Furthermore, while the term *charter* is a widely used standard, some organizations use other names such as *project request, project submission form,* or *project preplanning form.* As long as the four purposes of a charter (authorization, understanding, commitment, and screening) are accomplished, the exact format and title are negotiable. Typical charter elements and the question each element answers are shown in Exhibit 3.3. In Section 3.5, we show you how to create each of these elements.

Exhibit 3.2

Project Charter Decision Matrix

Project Name

Date

When an improvement, change, or new program is going to be implemented, it is important to first determine whether or not it is a project. If it is a project, TriHealth has specific tools that should be used to guide the planning and implementation.

A project is a time-bound effort with interdependent tasks that creates a unique product, service, or result. If your project impacts more than one department, requires expertise or resources beyond your own department, or could affect the operations in another area, the standardized templates should be used. Answering the questions below with a check mark will help you determine what types of tools are needed for your project. Evaluate where the majority of your check marks lie and use the most appropriate tool.

Resources	☐	Little or no monies, supplies, or change in resources	☐	Requires moderate resources	☐	Requires significant and/or additional FTEs
Multidisciplinary	☐	1 discipline involved/ impacted	☐	2–3 disciplines involved/impacted or more than one site	☐	More than 3 disciplines involved/ impacted
Complexity	☐	Little complexity	☐	Moderate complexity; affects care delivery	☐	Very complex
Technology Involvement	☐	No technology changes	☐	IS consult needed	☐	IS resources assigned
Approvals	☐	None needed	☐	Approval by immediate supervisor	☐	Executive-level approval
Potential Risk Level	☐	Minimal impact on customer	☐	Moderate impact on customer	☐	Significant impact on customer
Staff Commitment	☐	Involvement of 2–3 people for solution	☐	Small team needed to generate solutions	☐	Requires large team of multiple departments for improvement
Communication and Education	☐	Simple communication plan or unit-based education only	☐	Moderate communication plan; requires education across departments	☐	Complex communication/education plan with various media
Metrics	☐	Requires at least a one-time follow-up check	☐	Improvement will be tracked	☐	Baseline and ongoing tracking of data
If the majority of your checks lie in this area:		⇩		⇩		⇩
	☐	**No charter needed**	☐	**Complete a mini charter**	☐	**Complete a full project charter**

Source: TriHealth.

Exhibit 3.3

Charter Elements and Questions Answered

Charter Element	Answers the Question
Scope overview	What?
Business case	Why?
Background	Why?
Milestone schedule	When?
Success criteria	What?
Risks, assumptions, and constraints	What?
Resources	How much?
Stakeholders	Who?
Team operating principles	How?
Lessons learned	How?
Signatures and commitment	Who?

The charter should be short enough so that the project team and sponsor (and any other interested stakeholder) can examine it carefully to ensure they understand and agree. One to four pages in total is generally about the right length.

3.4a Title

The existence of a unique and meaningful project title is critical. In an organization with a number of projects, the title can be used to quickly identify which project is being referenced. In general, the title reflects key characteristics of a project such as location, type, name of technology, and sometimes the year.

3.4b Scope Overview

The scope overview and business case sections are the high-level "what and why" of the project. They are sometimes considered to be brief like the "elevator pitch" that a person would use if given a very short amount of time to describe a project.

The scope overview is the project in a nutshell: a high-level description of *what needs to be accomplished and how it will be done.* The scope overview defines the project boundaries. It states what is included and what is not—at least at a fairly high level.

3.4c Business Case

The business case is the project purpose or justification statement. It answers the question "why?" and helps all parties understand the purpose of the project. It should clearly tie the project to the organization's strategy or the strategic goals it meets and explain the benefits the organization hopes to achieve by authorizing the project.

A well-written business case should persuade decision makers to support the project and inspire the project team members and key stakeholders to work hard toward successful completion of the project.

3.4d Background

Many people are quite busy and prefer short statements that can be quickly reviewed. Key project stakeholders should know enough about the project after reviewing the short scope overview and business case statements, as these statements will provide all of the information needed. Some other stakeholders may need more details to understand the rationale and purpose behind these statements, and that is the reason inclusion of the background information in the charter and a more detailed background statement may be helpful in these cases.

3.4e Milestone Schedule with Acceptance Criteria

The **milestone schedule** is a high-level plan that indicates a few significant achievements that are anticipated over the life of the project. It divides the project into a few (about three to eight) intermediate major achievements or milestones whose completion can be verified. The team estimates an expected completion date for each milestone.

Adding a column for acceptance criteria factors to the milestone schedule helps the project team understand the quality of the deliverable associated with each milestone, the criteria that will be used to assess it, and the responsible person who will judge the completeness and correctness of completing the milestone. **Acceptance criteria** stipulate conditions that must be met to approve the deliverables.

3.4f Risks, Assumptions, and Constraints

A **risk** is an uncertain situation that could negatively *or positively* affect the project if it occurs. **Assumptions** are suppositions made during project planning that are treated as correct or factual even though they have not been proven. Project teams frequently identify, document, and validate assumptions as part of their planning process. Assumptions generally involve a degree of risk. A **constraint** is anything that limits the implementation of a project activity or the project itself. Collectively, risks, assumptions, and constraints are referred to as project uncertainty in *PMBOK 7e*.

3.4g Resource Estimates

Remember that executives consider projects to be investments. The scope overview and business case sections of the charter describe the expected return on investment, while the resources section describes what will be invested. These sections collectively help decision makers and senior management determine if the project is worth approving. **Resources** include the workers, tools, equipment, materials, licenses, and anything else needed to execute the project.

3.4h Stakeholder List

Project success is partially dictated by identifying and prioritizing stakeholders (based on interest and influence), managing robust relationships with them, and making decisions that address stakeholder expectations. Therefore, it is good practice to identify key stakeholders early in a project.

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3.4i Team Operating Principles

Team operating rules or principles are sometimes established to enhance team performance. The goal is to increase team effectiveness and ensure that all parties are aware of what is expected of them. Team operating principles or norms that are especially useful are those that deal with conducting meetings, making decisions, accomplishing work, and treating each other with respect by following behavioral norms. This concept is further elaborated on as a Team Charter in Chapter 5 because some organizations will choose to create a separate team charter instead of including team operating principles in their project charter.

3.4j Lessons Learned

While every project is unique, a great deal can be learned from the successes and failures of previous projects. **Lessons learned** represent the knowledge acquired and captured by the project team throughout the project planning and execution, including things that should be replicated and things that should be avoided on future projects. In the project charter, the project manager may consider including relevant lessons learned from past projects that add value in developing a detailed project plan.

3.4k Signatures and Commitment

The commitment section of the charter lists who is involved and sometimes describes the extent to which each person can make decisions and/or the expected time commitment for each person. This is where the project sponsor, project manager, and perhaps core team members publicly and personally show their commitment to the project by signing the charter. By formally committing to the project, the key players are more likely to work harder during difficult periods and see the project through to a successful conclusion.

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3.5 Constructing a Project Charter

It is meaningful if the sponsor can work with the project manager and possibly core team members to construct the charter. The sponsor, however, as a busy executive, often does not have time to be present for the entire chartering process. In those cases, it is very helpful if the sponsor can create the first draft—however crude—of the scope overview and business case. A sponsor's ability to convey concisely to the project manager and core team what the project is and why it is important helps the project get off to a good start. If the sponsor wants the team to consider any important constraints, assumptions, risks, or other factors, they may outline them at this time.

Sometimes, usually for an important project, the organization's leadership team may draft other critical aspects of the project, beyond just the business case and scope overview. Likewise, if the sponsors knows they will only approve a charter with one of the elements written a particular way, they should tell the team that up front. Beyond those scenarios, it is most frequently the project manager—along with the core team—who writes much of the rough draft of the charter.

3.5a Scope Overview and Business Case Instructions

What needs to be accomplished can be described as the **product scope**, including all the characteristics that must be present to satisfy a contract, client, or other stakeholder. **How** it will be done is the **project scope**, the entirety of what will and will not be done to meet the specified requirements.

The scope overview quickly describes the project work and desired results. It makes a distinction between what the project will and will not do. The scope overview defines boundaries and helps to prevent **scope creep**, which is an incremental increase in the work of a project without corresponding adjustments to resources, budget, or schedule.

Quantifying the scope, such as "15 touch points will be included," helps everyone understand the project's size. If a project could be compared to an animal, the scope overview briefly describes both the size and features so one can tell if it is a rabbit or an elephant. By understanding what is included and what is not, the project team is more likely to estimate cost and resources, and schedule needs accurately. It also helps to understand and manage project risks.

Depending on the organization, a business case can either be just the rationale for the project, or it can also include high-level estimates of the costs and benefits of the project. A business case may also include emotional and ethical reasons for performing the project.

If feasible, the first draft of the scope overview and business case should be provided by the sponsor or the leadership team. Because these are the "what and why" of the project, it is easiest to work on them at the same time. If the sponsor provides a first draft of these sections, the project manager and core team can carefully dissect it to ensure they both understand and agree. The project manager and team frequently propose refinements to the original draft. Teams often brainstorm key ideas and then craft the parts on which they agree into smooth-flowing statements.

Scope overview and business case examples are depicted in Exhibit 3.4.

3.5b Background Instructions

Unlike the scope overview and business case—which should be limited to about two to four sentences each—the background statement can be of any length. The background statement is purely optional—develop one only when it is absolutely necessary.

Exhibit 3.4

Scope Overview and Business Case Examples

Phase II multicenter trial scope overview

This project will initiate a Phase II multicenter clinical trial at Cincinnati Children's Hospital Medical Center (CCHMC). The trial will be conducted at five medical centers in the United States to investigate the safety and efficacy of an investigational drug's ability to improve cognitive functioning and quality of life in pediatric patients with Tuberous Sclerosis Complex. The project is a follow-up study of a Phase I clinical trial conducted at CCHMC.

Online tuition reimbursement project scope overview

This project will design, develop, and implement an online tuition reimbursement system that will provide employees with a self-service tool to submit a request for tuition reimbursement payment. This project will incorporate a workflow process that will do the following:

- Move the request to the appropriate personnel for approval.
- Alert the employee of any additional items necessary for processing the request.
- Upon approval, send the request to payroll for final processing.
- Notify the employee of payment processing.

Development of a biological research specimen shipping center project business case

The purpose of this shipping center is to provide professional shipping services and supplies for CCHMC employees who are responsible for shipping biological specimens as part of research. This shipping center will improve compliance, streamline shipping processes, enhance research productivity, reduce time and money invested in employee training, and reduce potential liability for noncompliance.

Establishing a second pulmonary function testing (PTF) lab project business case

An additional PTF lab will *enhance patient access* by:

Decreasing wait times and
Providing a convenient location close to primary care appointments.

It will also *improve patient outcomes* by assisting in:

Diagnosis,
Accurate assessment, and
Chronic management of pediatric lung disease.

In addition, establishing a PTF lab will increase revenue by:

Increasing availability of PTF and
Increasing community referrals for PTF.

Source: Cincinnati Children's Hospital Medical Center.

The project manager and team decide whether this optional section is necessary for their project. If the scope overview and business case seem detailed enough for all important stakeholders, an extra background section may not be needed. If necessary, the team probably brainstorms ideas and then combines them into a single, simple statement.

3.5c Milestone Schedule with Acceptance Criteria Instructions

A milestone schedule should list major milestones and deliverables with anticipated completion dates. They are expected to be completed both on time and to the satisfaction of key decision makers. The milestone schedule is considered very useful for communicating with the key stakeholders who are not actively involved with the project.

A **deliverable** is a "unique and verifiable product, result, or capability to perform a service that is required to be produced to complete a process, phase, or project."[3]

Requirements of a deliverable are often translated into specifications so that the deliverable can be validated, qualified by measurable conditions, verified for completion, and bounded by constraints.

Sometimes, milestones occur right before the approval of a large expenditure. At other times, they occur at completion of a critical design, a key deliverable, or a major accomplishment of the scope. It is helpful to identify the relatively few milestones and key deliverables in the project that the team and sponsor wish to monitor closely.

Acceptance criteria are like the project's vital signs. A paramedic would check pulse, breathing, maybe skin color, and body temperature immediately when responding to a 911 call. Other tests are not as critical and may be performed, just not immediately. Likewise, it is important to identify the vital signs for the project. Project success is easy to measure after the project is complete. The equally important, but often more difficult, challenge is how to measure success while the project is progressing and there may still be time to make changes if necessary.

Another way to understand acceptance criteria is to understand how a key stakeholder such as the sponsor, customer, or end-user is going to determine if the deliverables created are of good enough quality to accept. Including advance understanding of criteria is similar to the old saying that a trial lawyer never asks a question without knowing how the witness will answer. An astute project manager never turns in a deliverable without knowing how it will be judged. An example of a milestone schedule is shown in Exhibit 3.5.

Six Steps in Constructing a Milestone Schedule The most effective way to construct the milestone schedule with acceptance criteria is to use the six-step procedure described below. A method of depicting all of this information for simple understanding is to set up a four-column table as shown in Exhibit 3.5 for a project of creating a centralized electronic record system for a major research hospital. Identifying the end points first (Steps 1 and 2) helps project teams avoid the problem of sinking into too much detail too quickly. Note that the timeline is the final item to be identified. It is unethical for a project manager to agree to unrealistic dates. Even though the milestone schedule is not very detailed, it represents the first time a team thinks through how the project will be performed and how long it will take. This allows a bit of realism in the schedule.

Step 1 The first task is to briefly describe (in three or four words) the current situation that requires the project and place this description in the first row of the milestone column. The current state may be a shortened version of the business case. The starting point for many projects is either that something exists but does not work as well as desired, or a desire exists for something completely new. However, the starting point for some projects is the ending point of a previous project. Keep the description very short, and it will form an effective starting place. In Exhibit 3.6, the problem was paper records that were not centralized.

Step 2 Once the current state is agreed upon by the project manager and team, skip down to the desired future state. Describe the project (or phase if there will be future phases) at its successful completion in three or four words. Put this description in the last row of the milestone column. It is hard for many core teams to distill this to the ideal three or four words, but keeping it concise helps the team develop a better understanding of what is most important. If the current project is a phase of a larger project, also write briefly what the final successful result of the last future stage will be. In Exhibit 3.6, the desired future state is to have records centralized and available in electronic form, and the ultimate goal is for seamless information flow throughout the organization. More work will need to be completed beyond this project to reach that ultimate goal. Since contemporary project management is often iterative, many projects are part of a larger goal.

Exhibit 3.5

Milestone Schedule with Acceptance Criteria Example

Completion Date	Milestone	Stakeholder Judge	Acceptance Criteria
Current state: Paper, noncentralized records			
Needs assessment	February 28	Ops management	List of needed features
Hardware selection	April 15	Ops management, CIO	Hardware choice with contract
Vendor selection	May 30	Ops management	Vendor choice with contract
Installation and configuration	July 15	Application specialist, IS department head	Functional software in test environment
Conversion	August 31	Application specialist, IS department head	All files converted
Testing	October 15	Application specialist, IS department head	Sign off on test
Training	November 30	Ops management, HR	Sign off on training
Future state: Electronic, centralized records	November 30	Sponsor	Ability to enter and retrieve information from all departments
↓ ⋮ ↓ **Ultimate goal** Seamless information flow throughout organization			

Step 3 Next, describe the acceptance criteria for the final project deliverables (at the future state). What stakeholder(s) will judge the deliverables, and on what basis? Exactly how will they become confident that the project results will work as desired? These stakeholders will almost always demand a demonstration of project results. The project team wants to understand what that demonstration will be at this early point so they can plan to achieve it. Note that there very well could be multiple stakeholders and multiple methods of ensuring the project results are satisfactory. At this point, strive to identify the most important stakeholders and acceptance criteria. Place these in the third and fourth columns of the future state row. In Exhibit 3.6, the sponsor wants a representative from each department to show they can enter and retrieve pertinent data.

Step 4 Now, go back to the milestone column. Determine the few key points where quality needs to be verified. On most small- to medium-sized projects, approximately three to six intermediate points are satisfactory. Start by identifying the three most important intermediate points, and add more if necessary. If you need to identify considerably more major deliverables at this point, you might consider splitting your project into phases and concentrating on the first phase for now. Satisfactory completion of each milestone will be determined by how the sponsor and other stakeholders will judge your performance. They

should be in enough detail so stakeholders are comfortable with your progress, yet not so detailed that you feel micromanaged. The project in Exhibit 3.6 has seven milestones.

Step 5 Now, for each milestone, determine who the primary stakeholder(s) is and how they will judge the resulting deliverable. Remember, these are intermediate deliverables, and often it is not as easy to determine desired performance. One idea to keep in mind: if practical, ask the person who will judge the overall project results at the end to judge the intermediate deliverables also to make sure you are on the right track. Quite a few different stakeholders will judge various milestones in the project in Exhibit 3.6.

Step 6 Finally, determine expected completion dates for each milestone. Do not be overly optimistic or pessimistic. You will be at approximately the right level of detail if you have a milestone somewhere between every one and six weeks on many projects. Obviously, there will be exceptions for especially large or small projects. Most of the milestones in the project in Exhibit 3.5 are about six weeks apart.

Some companies that perform many projects use templates to guide their project teams through chartering and other activities. An example of a template for the milestone schedule and acceptance criteria for a Six Sigma project is shown in Exhibit 3.6.

3.5d Uncertainty Instructions

Project managers and teams should look at risks for three reasons. First, any and all negative risks that may inhibit successful project completion needs to be identified. Also, if it is a major risk (it is likely to happen and/or it will have a catastrophic impact), a plan must be developed to overcome it. Second, a positive risk—an opportunity to complete the project better, faster, and/or at lower cost or to capitalize upon the project in additional ways—should be benefited from, whenever possible. Third, sometimes there is more risk to the organization if the project is *not* undertaken—and this provides additional rationale for doing the project.

In addition to risks, project teams should consider constraints, assumptions, and uncertainties. Constraints that limit choices and unproven assumptions can be identified. Assumptions are especially important when a cross-functional team is performing the

Exhibit 3.6

Six Sigma Milestone Schedule and Acceptance Criteria Template

Milestone	Completion Date	Stakeholder	Acceptance Criteria
Current Situation Define	_____	_____	Problem in operational terms Customers and metrics identified Project schedule and assignments
Measure	_____	_____	Causal relationships defined Data gathering procedures approved Sufficient data gathered
Analyze	_____	_____	Potential variables identified; Root causes statistically proven
Improve	_____	_____	Problem resolution ideas gathered Solution evaluated and confirmed Solution implemented
Control Future State	_____	_____	Standards, procedures, training in place

project because some team members may make vastly different assumptions based upon the manner in which work is normally accomplished in their respective departments. **Uncertainties** include unpredictability, ambiguity, and just plain not knowing what might happen. On large or complicated projects, the types of uncertainty—risks, assumptions, and constraints—may be presented in separate sections of a charter. An **assumptions log** may be created as a living document to record all assumptions and the findings of whether they proved to be true or false. However, in this book, we deal with all types of uncertainty together. From this point forward, all risks, assumptions, and constraints are simply referred to as uncertainty.

First, the project manager (possibly with core team members, sponsor, and/or key stakeholders if available) should brainstorm to identify all the things that could pose a risk to the project schedule, budget, usefulness of any project deliverables, or satisfaction of any project stakeholder. This is the process of risk identification. All of the risk processes will be covered in more detail in the risk planning chapter. Brainstorming often works very well when each team member writes at least one risk, constraint, or assumption per Post-it Note.

Either the project manager or one of the team members can then act as a facilitator and assess one risk at a time. Risks can be assessed based on probability of occurring and impact on project success criteria if realized. Both dimensions can be shown with a simple continuum of low to high using a flip chart or marker board. The team can agree to assess each risk at any point on the continuum. It works best if one dimension is considered at a time. For example, first ask how likely the risk event is to occur. Only after this is answered, ask how big the impact will be if it happens.

After all risks are assessed, the team needs to decide which of the risks should be considered major risks. That is, which are important enough to require a formal response plan with someone assigned responsibility? The other, more minor risks are not formally considered further in the charter, but they very well may get more attention in the planning and executing stages. This is the process of qualitative risk analysis.

The project team constructs a table depicting each major risk, with its contingency plan and "owner" who is responsible for making sure the risk response plan(s) is inacted if/when necessary. This is the process of planning risk responses.

Examples of risk assessment and major risk response planning for a hardware upgrade project in an Irish factory are shown in Exhibits 3.7 and 3.8, respectively.

3.5e Resources Needed Instructions

Since executives consider projects to be investments, a rough estimate of resources is required. On some internal projects, the pay for the associates who work on the project often comprises much of the project cost. On many projects, however, additional expenses for materials, tools, and equipment are incurred. It is helpful to identify which expenses the project manager can authorize and which the sponsor needs to control.

Armed with the milestone schedule, the project manager and team may be prepared to make crude estimates of the project budget and other resource needs—such as people, equipment, or space. It is imperative to briefly describe how the estimates were developed and the level of confidence the team has in them, such as "this is a rough order of magnitude estimate only based upon the milestones, and the true project cost could range from 25 percent below this to 75 percent above it." On many projects, especially those with customers internal to the organization, a budget is not established. However, a limit of spending authority for the project manager is often developed. An example of resources needed for a project is shown in Exhibit 3.9.

Exhibit 3.7

Risk Assessment Example

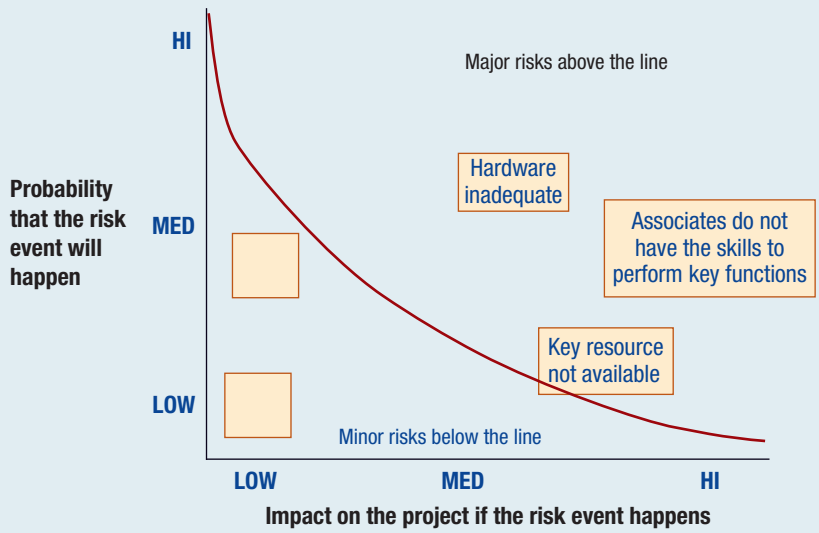


Exhibit 3.8

Risk Response Planning Example

Risk Event	Risk Owner	Risk Response Plan(S)
Hardware inadequate	Edie	1. Techs revise existing hardware 2. Replace hardware
Associates do not have skills to perform key functions	Padraig	3. Train existing associates 4. Hire additional people
Key resource not available	Ute	5. Identify external resources to fill need

Exhibit 3.9

Resources Needed Estimate

Money	People	Other
Marketing $10,000	Project Manager, 250 hours	1 Dedicated Conference Room
	Core Team Members, 500 hours	
AV and Communications $5,000	Internal Consultant, 100 hours	
Miscellaneous $5,000	Data Analyst, 100 hours	
	Focus Group Participants, 50 hours	
Total=$20,000	Total=1000 hours	**1 Room**

3.5f Stakeholder List Instructions

Stakeholders are all the people who impact or are impacted by the project. They can be internal or external to the organization, be for or against the project, and have an interest in the project process and/or the project results. Some of the stakeholders can also influence the project management execution and outcomes. The project manager and team begin by identifying all stakeholders and determining which are most important. They next ask what interest each stakeholder has in the project. A stakeholder list example for a clinical research project is shown in Exhibit 3.10. This is the process of identifying stakeholders, and the resulting list is the start of a stakeholder register. Both will be described in more detail in the stakeholder chapter.

3.5g Team Operating Principles Instructions

The project manager and team will decide project team operating principles. The operating principles establish how meetings will be conducted, how decisions will be made, how work will get done, and how everyone will treat each other with respect. Exhibit 3.11 is an example of team operating principles.

Exhibit 3.10

Stakeholder List Example

Stakeholder	Priority	Interest in Project
Institutional Review Board	Key	Unexpected problems, progress
Food and Drug Administration	Key	Serious adverse events, progress
Site Principal Investigators	Key	Protocol, safety reports, changes
Pharmaceutical Company (Customer)	Other	Serious adverse events, progress
Research Subjects (Patients)	Other	Purpose of study, risks and benefits, protocol

Exhibit 3.11

Team Operating Principles Example

ABC Project Team Operating Principles

1. Team members will be prepared with minutes from previous meeting, agenda, and project updates.
2. Meetings will normally last for up to 90 minutes.
3. Team members will rotate the role of recorder.
4. Each team member will be responsible for setting their own deadline.
5. In the event that a team member cannot have their assignment complete by the expected date, they must notify the team leader prior to the due date.
6. The team leader will be responsible for drafting the minutes from the previous meeting and the agenda for the next meeting within 48 hours.
7. Decisions will be made by:
   Team leader on ____ issues.
   Consensus on ____ issues.
   Delegation on ____ issues.

3.5h Lessons Learned Instructions

Each project by definition is at least somewhat different from any other project. That said, there are many commonalities in how projects can be planned and managed. When starting a new project, a project manager and team need to consider what has worked well and what has worked poorly on previous projects. A sponsor is wise not to sign a project charter authorizing work until the project manager and team demonstrate their knowledge about past lessons from recently completed projects. One easy way to accomplish this is to have each project report lessons learned at key reviews and at project completion and to have the lessons available to all in a lessons learned knowledge base. The project manager and team can then look at the lessons until they find at least a couple that can help them on their project. These lessons are included in the charter. The more specific the lessons, the more likely the team will find them useful. Exhibit 3.12 is an example of project lessons learned.

3.5i Signatures and Commitment Instructions

The project sponsor, manager, and team members sign the charter to publicly acknowledge their commitment. Sometimes other key stakeholders also sign, though trying for too many would add unnecessary bureaucracy. An example of a charter signature section is shown in Exhibit 3.13.

Exhibit 3.12

Project Lessons Learned Example

All parties are responsible for defining and following the project scope to avoid scope creep.
All parties should share good and bad previous experiences.
Aligning team roles to sponsor expectations is critical.
Keep sponsor informed so sponsor stays committed.
Identify any possible changes as soon as possible.
Use weekly updates on project progress to avoid unpleasant schedule surprises.
Review previous events for specific lessons.

Exhibit 3.13

Charter Signature Example

Anne E., Sponsor	_____	
	Signature	*Date*
Karen H., Project Leader	_____	
	Signature	*Date*
Jim B., Team Member	_____	
	Signature	*Date*
Charlie H., Team Member	_____	
	Signature	*Date*
Mitch N., Team Member	_____	
	Signature	*Date*
Katie S., Team Member	_____	
	Signature	*Date*

3.6 Ratifying the Project Charter

The project manager and team formally present the project charter to the sponsor for approval. In some organizations, the leadership team is also present for this meeting. The sponsor (and leadership team members, if present) ideally is supportive, but also ready to ask questions regarding any part of the charter. These questions are for both clarification and agreement. Once all questions are satisfactorily answered—including any agreements regarding changes—the sponsor, project manager, and core team all sign the project charter and are bound by it.

Project managers are generally held accountable for team members' performance, though they lack the authority to direct people to perform. Because of this, project managers must negotiate. Here, we discuss how they need to negotiate a project charter with their sponsor. Later in the book, we discuss how they are often compelled to negotiate with functional managers for specific resources they wish to have on the project to deal with challenges related to the triple constraints of scope, cost, and schedule, as well as stakeholder demands.

Nobody is more concerned and responsible for a project than the project manager. However, a project manager must remember that negotiations will be smoother if they realize that everyone with whom they negotiate has their own set of issues and goals.

Regardless of a negotiation's size or complexity, this six-step process can serve as a guide. The negotiation process is based on the project manager and the sponsor attempting in good faith to reach a solution that benefits both—useful deliverables for the sponsor and a manageable process and project deliverables for the project manager.

Step 1 is advance fact finding to determine desired outcome of the negotiation. It includes seeking to understand both what the sponsor is likely to want and how they may act during the negotiation.

Step 2 is for the project manager to understand what the minimum acceptable result is. Just as when buying a car, a project manager needs to understand when to walk away. This can vary a great deal depending on how much power each party has. Obviously, the sponsor is likely to have more power. However, in negotiations, if one party has more power and takes advantage of it, the other party may not work with them again. Therefore, the goal is not to always drive the hardest bargain, but to strive for a fair bargain.

Step 3 is for the project manager to understand the underlying requirements of the sponsor and to share their own needs. This is not a 10-second political sound bite that says "take it or leave it." This is developing a real understanding of each other's needs.

Step 4 is for both parties to use that understanding what the other really needs, to explore various creative solutions that might be acceptable to both.

Step 5 consists of the process and strategies of the negotiation itself. It is helpful to keep in mind the ultimate goal while focusing on the many details of information sharing, trading of concessions, and exploring possible solutions.

Step 6 is actually a reminder to reach an agreement and then to document that agreement.

One must remember that negotiations:

- are pervasive in project management,
- are one way in which conflicts are managed and resolved, and
- often determine the extent of success or failure of any project.

Finally, project managers must recognize that poor negotiations can potentially sabotage the project. It is unrealistic to believe that negotiations are automatically well-managed within a project. Rather, this is something the project manager must pay a great deal of attention to.

3.7 *PMBOK Guide 7e*

Domains:

- Stakeholders
- Team
- Development approach and life cycle
- Planning
- Measurement
- Uncertainty

Charters may be impacted by several portions of *PMBOK Guide 7e*. Depending on the format being used for charters, some of these points may be captured directly in a good project charter while others may at least influence the thinking and discussion as the charter is being developed.

3.7a Stakeholders

A primary purpose of creating a charter is to engage proactively and align with your customer by understanding what their vision for the project is and what outcomes they are trying to obtain. The chartering process ideally starts a two-way communication between the project team and key stakeholders. The project team and stakeholders begin to develop productive working relationships, reach agreement on objectives, and enhance stakeholder satisfaction.

3.7b Team

The charter is a good tool to begin team development by leaders sharing a project vision and objectives and beginning to create an environment that encourages team members to work collaboratively. Team roles and methods may be enumerated in a project charter or in an associated team charter. The conversations started in the act of chartering set the stage for transparency and trust.

3.7c Development Approach and Life Cycle

Charters are used to show an overall project plan at a high level and gain commitment and understanding from at least the sponsor, project manager and team, but maybe also key stakeholders. As such, the charter should indicate the development approach to be taken—whether it is predictive, hybrid in either iterative or incremental fashion, or adaptive (agile). The development approach will largely depend on the project type and uncertainty associated with requirements. Whatever the approach, each project phase should show exit criteria.

3.7d Planning

Project teams should plan enough to meet stakeholders' expectations, but no more. Predictive projects may have clearly stated acceptance criteria in the charter for the ending delivery of each phase. Often milestones are identified and included in the charter. Adaptive projects may have definition of done for the first iteration or early delivery and a roadmap or epics describing the ongoing project direction.

3.7e Measurement

Stakeholders want reliable understanding of project status and actionable data to keep project performance on track. As such, a charter may include both the high-level plan of what is expected to be done at various times and the indicators to judge progress. Charters may ideally include a few metrics that are SMART (specific, meaningful, achievable, relevant, and timely) to enable teams to understand what they need to develop, assure stakeholders that progress is satisfactory, and enable both to predict the future project results.

3.7f Uncertainty

Projects need to consider and manage uncertainty, ambiguity, complexity, volatility, and risk. Teams may consider alternative approaches to combat uncertainty and volatility. They may handle ambiguity by progressive elaboration and prototypes. Teams deal with threats (negative risk) by avoidance, escalation, transfer, mitigation, or acceptance and with opportunity (positive risk) by exploiting, escalating, sharing, enhancing, or accepting.

3.8 Agile Projects and Charters

The chartering process in agile environments is similar to and differs from traditional project selection methods discussed thus far in this chapter, as shown in Exhibit 3.14.

Exhibit 3.14

Comparison of Plan-Driven and Agile Approaches for Project Chartering

Project Chartering Questions	Plan-Driven	Agile
How do people initiate a project?	(Formal) Charter	(Informal) Charter
What are the purposes of a charter?	authorize, understand, commit, screen	authorize, understand, commit, screen
Why do the project?	business case	vision statement
What is included?	scope overview	product roadmap
When will it be done?	milestone schedule	releases and iterations
How will outputs be judged?	success criteria at milestones	definition of done
What might interfere?	risks, assumptions, constraints	impediments
Who cares?	stakeholders	stakeholders
How will work be accomplished?	team operating principles and lessons learned	team operating principles and retrospectives
Pledge	signatures and commitment by sponsor and team	signatures and commitment by product owner and team

3.8a Agile Terms Used in Chartering Projects

Share knowledge:	Deliberatively capture and share tacit knowledge
Product vision:	Description of customer satisfaction and alignment with business objectives at an initially high level
Timebox	A defined number of hours or days to complete an agreed-upon amount of work
Sprint (aka iteration)	Short time period when team commits to creating specific deliverables
Defer decisions:	By making decisions as late as possible, teams have better information

Sustainable pace:	Amount of work team can consistently produce well
Commit to work:	Team promises how much they will accomplish in timebox
Commitment:	Team follows through, only taking on tasks they can do
Definition of done:	Agreement on exactly how the Product Owner (PO) will judge the deliverables produced

In this book, we use many Agile terms and definitions from Anantatmula, V., and T. Kloppenborg, *Be Agile Do Agile* (New York, NY: Business Expert Press: 2021).[4]

3.8b Agile

On Agile projects, the first iteration is planned as a milestone with acceptance criteria (usually called definition of done) just as described in Section 3.5c. Also, on well-conducted, plan-driven and Agile projects, team members seek to learn from previous projects so they can be more effective and to **share knowledge** they gain from the current project.

Rather than have a defined set of milestones, an Agile charter after the first milestone is more of a general roadmap of the product. Subsequent milestones and definitions of done are determined on a just-in-time (JIT) basis.

Agile projects adopt an informal approach rather than a formal project charter, although many elements are similar. An Agile project charter serves the same purposes of understanding, committing, and authorizing the project, but in a less formal manner. While project charters are developed and justified based on a business case for traditional projects, Agile projects are initiated based on the **product vision**. Therefore, instead of clearly defining the scope overview, Agile projects define the product based on the client's vision.

For a traditional project, milestones or major achievement stages are articulated in the project charter. However, Agile projects describe product releases, and the entire project is executed in **time boxes** called **sprints**. The sequence of these product releases and sprints are determined based on the product owner's priority, which in turn depends on value and quality of the product. The product owner's perception of value and quality will determine if the project outcome is successful or not.

One key idea of Agile projects is to **defer decisions** to the latest responsible moment so that more complete information can be used in the decision. For that reason, after the first sprint, the product owner and team agree to work toward the vision but do not specifically agree on what will be accomplished and by when. Teams learn how much work they can accomplish at a **sustainable pace** in normal conditions, and that is what they **commit to work**. Teams will then do their level best to live up to that **commitment**.

In Agile projects, something of value will be delivered at each iteration. Something of value for IT projects means working software. For other projects, it still refers to something the user can put to use—not just documentation. An agreement is reached during iteration planning on the **definition of done**—meaning exactly how each feature and function must perform. This is comparable to deliverables with acceptance criteria for each milestone as just described.

Finally, an Agile project begins with approval by the product owner for the team to start the project. It is different than traditional projects in which the project sponsor and the project manager sign the project charter to authorize it.

Exhibit 3.16 represents thinking that goes into an Agile charter. Obviously, Agile was not around in 1850 when this project started. Nevertheless, it was conducted in what we

now know as an Agile manner and this small exhibit describes the thinking that went into the project to create the Chrystal Palace. Exhibit 3.15 shows a section of what an Agile charter for this project may have included.

3.9 Starting a Project Using Microsoft Project

Microsoft (MS) Project is a software application designed to aid project managers in the planning, execution, and assessment of projects. It allows the project manager to track project tasks, set milestones, create corresponding schedules, and administer resources and budgets. Throughout the text (Exhibit 3.16), various MS Project processes will be demonstrated in a series of tutorials using the textbook's running *Suburban Homes Construction Project* as a basis. A fully functioning demonstration version of MS Project 2016 is available for download from Microsoft.

Exhibit 3.15

Agile Project Charter

Queen Victoria of England invited the world to a grand industrial exhibition to open on May 1, 1851 in London to showcase the latest industrial technologies. She wanted a building of approximately 1 million square feet to hold this, the first world's fair, and it needed to be designed and completed much faster (nine months instead of three years) and cheaper than typical prevailing construction of the time. Furthermore, her vision was that the building had to be visually stunning and technologically innovative to showcase England's dominance during the Industrial Revolution. Queen Victoria appointed her husband Prince Alpert as project sponsor.

The first sprint was preliminary design approval based upon proven, small-scale, previously successful greenhouse buildings. Once the iron and glass design for the building that would come to be known as the Chrystal Palace was approved, a project roadmap was created so the project could proceed rapidly with a detail design and selection of engineering and construction companies. All other contracting and construction work followed. The Chrystal Palace is widely considered to have been a smashing success for its visual appeal, low cost, and ease of construction. The Queen's vision was fulfilled.

Create Building to House First World's Fair

Vision
Design and build a visually stunning and technologically innovative building of about one million square feet to showcase England's industrial dominance within nine months and at very low cost.

First Sprint
Develop and present a preliminary design to the selection committee with a simple sketch and convincing approach based upon previous experience with much smaller buildings.
Definition of done: Wow factor, simple and cheap design, ability to complete on time.

Roadmap

Detail Plans	Construction Award	Manufacture	Erect
Modular design	Proposals	Foundation	Foundation
Prefab elements	Selection	Skeleton	Skeleton
Ridge & Furrow		Glass walls and roof	Glass walls and roof
Detail decorations		Load-bearing transept	Load-bearing transept
		Decorations	Decorations

All remaining charter sections similar to plan-driven project charter. Exhibit 3.15 is adapted from Hashem, Sherif, *Greatness in Construction: Project Management Lessons from the World's Greatest Projects and Project Leaders* (New York, NY: Business Expert Press, 2022).

3.9a MS Project Introduction

MS Project is part of the Microsoft Office family; therefore, much of the basic interface and interaction with the software should seem familiar. You will find the unique aspects of the application in the project-specific tools and visuals the software provides the project manager. When you first open MS Project, you have the option to create a new (blank) plan, open a recently used or saved plan, or start a plan based on a template. The following overview showcases the visible features of the main MS Project interface once a "blank" project has been created (Exhibit 3.16).

1. Ribbon—As with other Microsoft Office applications, the "ribbon bar" along the top of the interface contains the controls (or access to controls) used to develop and manipulate your project data. Controls are logically grouped in the following tabs:
   - **FILE** includes familiar commands such as Open, Save, Print, and Options.
   - **TASK**, **RESOURCE**, and **PROJECT** tabs allow task, resource, and project data entry and adjustment.
   - **REPORT** offers a variety of customizable visual and print reports of project data.
   - **VIEW** offers multiple ways to visualize your project data, including Calendar, Gantt Chart, Network Diagram, Resources, and Teams. A "split" (or "combination") view is also available, providing two different types of data displays at once.
   - **FORMAT** displays formatting controls that apply to the current *active* view. The Format tab header (above the tab) identifies the currently active view (e.g., Gantt Chart).
2. Quick Access Toolbar—As with other Microsoft Office applications, this customizable area allows you to create shortcuts to regularly used commands.
3. Project Schedule Details View Pane(s)—Below the ribbon is the project data "view" pane that displays information about the project. MS Project offers several different views, but the default setting is a split, dual display of the project Timeline and Gantt Chart views in an upper and lower pane. Although both are visible, only one view is active (indicated by a colored view name label on the far-left end of the view pane). The active view can be changed in the View tab or with the View Shortcut buttons.

Exhibit 3.16

MS Project Coverage in This Book

Chapter	Chapter Title	MS Project Process
3	Chartering Projects	Introduce MS Project; Set up a project; Create a milestone schedule
7	Scope Planning	Set up a work breakdown structure (WBS)
8	Scheduling Projects	Set up schedule; Build logical network diagram; Understand the critical path; Display and print schedules
9	Resourcing Projects	Define resources with calendars; Assign resources, including modifications; Find and resolve over-allocations
10	Budgeting Projects	Develop project budget
12	Project Quality Planning and Project Kickoff	Baseline the project plan
14	Determining Project Progress and Results	Update and report on project schedule
15	Finishing Projects and Realizing Benefits	Close projects

- Timeline View: The Timeline View shows you the "big picture" of your project schedule. Milestones or other key activities can be marked and highlighted in the timeline to help better visualize the project.
- Gantt Chart View: The Gantt Chart is a commonly used tool to represent a project schedule. Once a list of project task details is inputted into the table on the left-hand side of the view, horizontal bars populate the right side to graphically represent each task against a calendar along the top of the view.

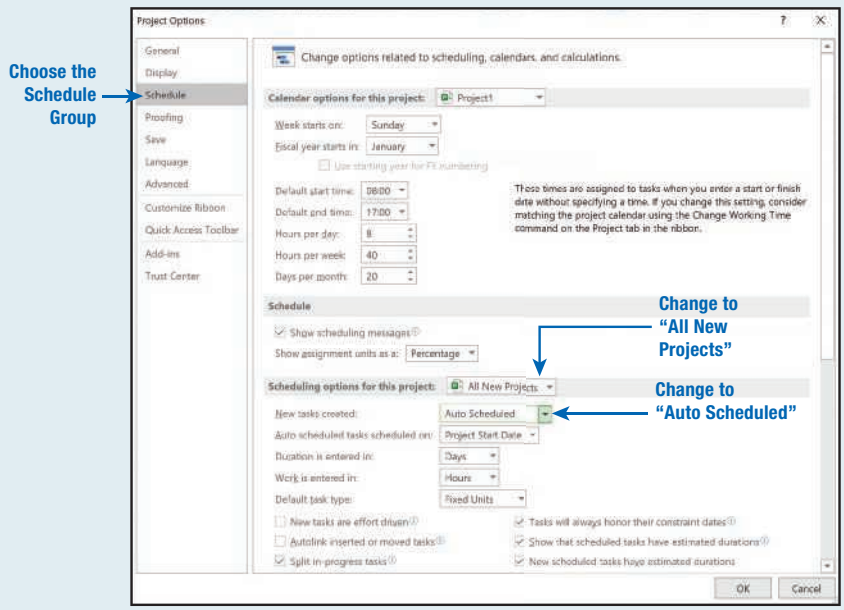
4. Zoom Slider—The zoom slider in the bottom right is useful in any view that contains calendar data. It quickly changes the timescale by sliding left or right.
5. View Shortcuts—View Shortcuts (also in the bottom right, just to the left of the Zoom Slider) provides a quick switch from the active view to five different views: Gantt Chart, Task Usage, Team Planner, Resource Sheet, and Blank Report.
6. Scheduling Mode selector—On the bottom left of your screen, Scheduling Mode reports the default scheduling mode (manual or automatic) for each new task. To change it, click Control and choose the desired setting from the list (a change only applies to the active schedule). See the next section for more on Scheduling Mode.

3.9b Setting up Your First Project

There are two scheduling modes in MS Project: Auto Scheduled and Manually Scheduled. Auto scheduling calculates the project's running schedule based on task start and finish dates, as well as other changes you might make in the future. Manually Scheduled is the default setting, but we will change that immediately to take advantage of the program's automatic scheduling powers. To change the scheduling mode, do the following (Exhibit 3.17):

Exhibit 3.17

Set Auto Scheduling



Source: Microsoft Corporation.

With a blank, new project open, click **File tab**>>**Options**>>**Schedule**.
In the "Scheduling options for this project" section:

- Change the dropdown to "**All New Projects**"
- Change the "New tasks created" option to "**Auto Scheduled**" Click **OK**.

Note: This action sets all future projects you may start in MS Project to Auto Scheduled. These options allow you to change this setting on a project-by-project basis, or you can simply click the "Scheduling Mode Selector" shortcut on the left-hand side of the bottom status bar and choose your desired scheduling method.

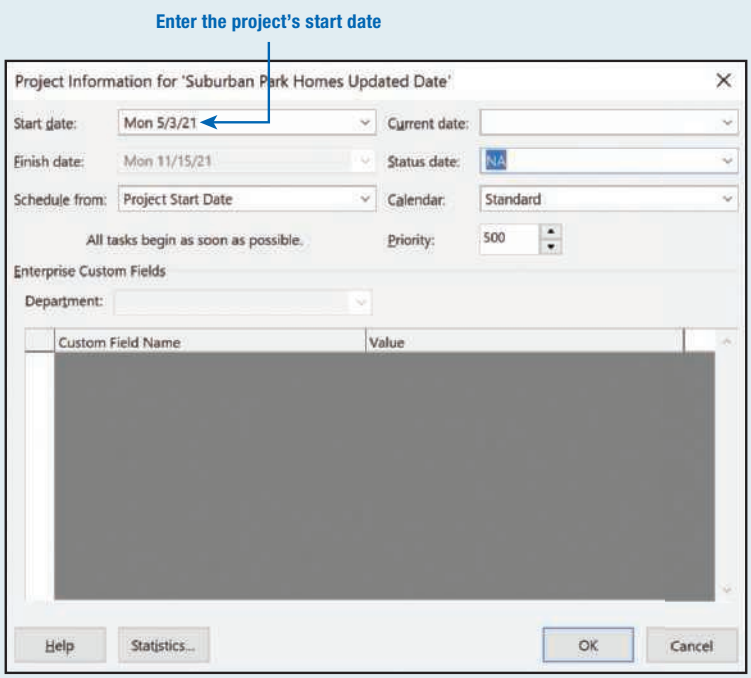
3.9c Define Your Project

Next, you need to define your project by entering the following information:

1. Set the project start date (Exhibit 3.18)
   - Click **Project tab**>>**Project Information**
   - In the dialog box, enter your project's start date (e.g., Mon 10/17/22)
   - Click **OK**; you'll notice Timeline View has updated with your start date!
2. Enter identifying information about the project (Exhibit 3.19).
   - Click **File tab**.
   - On the left-hand side of the screen, click Info>>**Project Information** (right side, click drop down arrow)>>**Advanced Properties**.

Exhibit 3.18

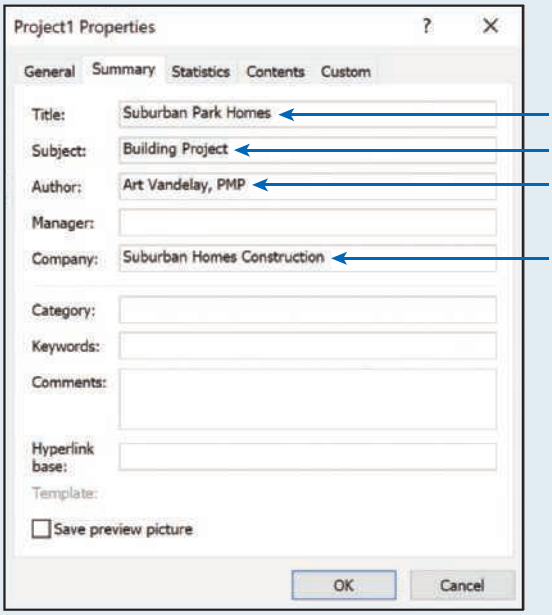
Set Project Start Date



Source: Microsoft Corporation.

Exhibit 3.19

Enter Identifying Information



Source: Microsoft Corporation.

- In the **Summary tab**, enter "Suburban Park Homes" in the Title box.
- Add other information as needed for future reports.
- Click **OK**.

3. Generate a "Project Summary" task row (Exhibit 3.20).
4. Creating a Project Summary task row gives you another overview of the entire project in the top row of the Gantt Chart view.
   - Click **File tab>>Options>>Advanced**.
   - On the Advanced page, scroll to the "Display options for this project" section.
   - Click the checkbox for "**Show project summary task**".
   - Click **OK**; you'll notice a new summary row at the top of the Gantt Chart table!

3.9d Create a Milestone Schedule

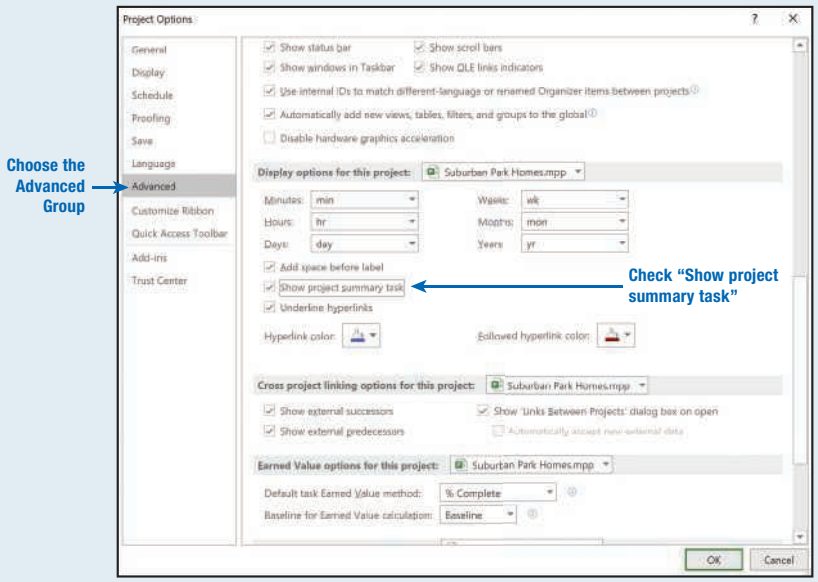
You will now create a milestone schedule that will capture significant deliverable completion dates and be viewable in your Gantt Chart view.

- Click the Gantt Chart view to make it active
- Enter the milestone names from the *Suburban Park Homes* project in the "Task Name" cells below the Project Summary row. (You can find milestone information from the project on page 91.)
- In the Duration cells, use the up/down arrows to set each milestone's value to zero.
- For each milestone row:

Double-click the milestone name to activate the "Task Information" dialog box (Exhibit 3.21).

Exhibit 3.20

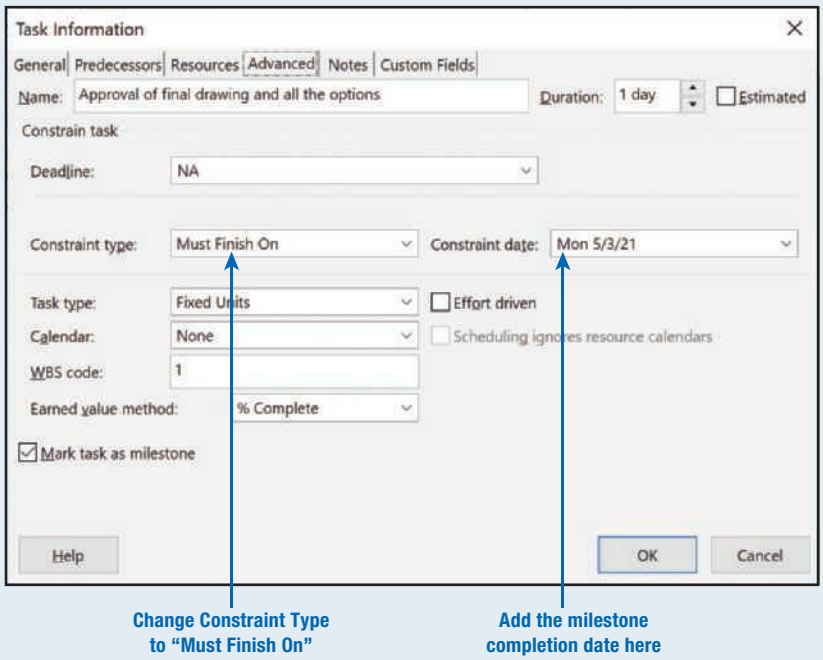
Create a Summary Row



Source: Microsoft Corporation.

Exhibit 3.21

Task Information Dialog



Source: Microsoft Corporation.

Click the **Advanced tab**; change the Constraint type to "**Must Finish On**."
In the Constraint date box, enter the milestone date.
Click **OK**.

Your milestone schedule in the Gantt Chart view should now look like the example in Exhibit 3.22.

Now, we will add milestone markers to the summary row so the key project dates will remain easily visible as the Gantt Chart task list expands.

- Right-click the **Suburban Park Homes summary task row>>Information**.
- On the **General tab**, check the "Hide Bar" and "Rollup" boxes.
- Click **OK** (Exhibit 3.23).
- Hold the **Shift** key and click your first task row>>click the last task row.
- Now all tasks should be selected.
- **Right-click** on the selected group**>>Information**.
- On the **General tab**, check the "Rollup" box until a checkmark appears.
- Click **OK** (Exhibit 3.24).

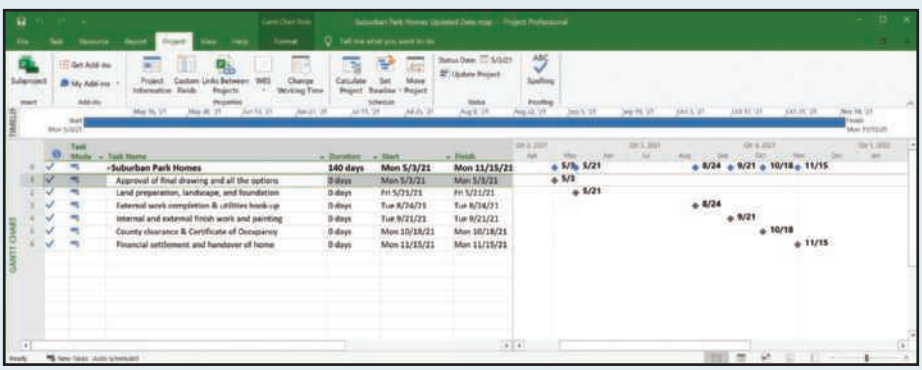
You will now see that the summary row "bar" has disappeared and been replaced with milestone markers. We need to make them stand out a bit more and have the date (Exhibit 3.25).

- Select the **Suburban Park Homes summary task row**.
- Click **Format Tab>>Format>>Bar Styles**.
- In the Bar Styles dialog box, click the "**Rolled Up Milestone**" style.
- In the **Bars** tab, change the "Type" to solid; change the color to blue (or your choice!).
- Click the **Text** tab, click "**Right**" (or Left if you prefer!), choose "**Finish**" from the drop-down.
- Click **OK**.

Your milestone schedule in the Gantt Chart view should now look like the example in Exhibit 3.26.

Exhibit 3.22

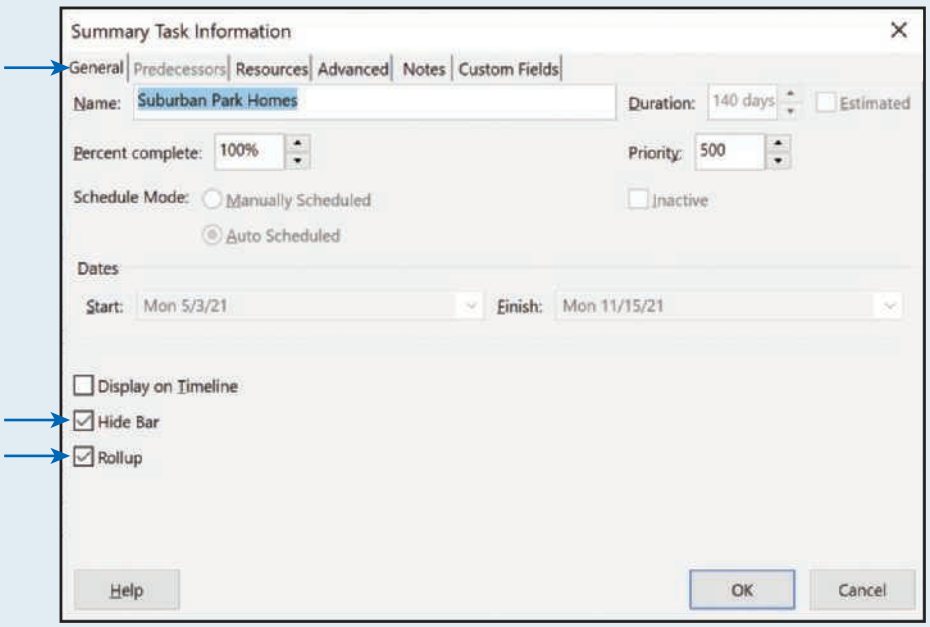
Suburban Park Homes Milestone Schedule



Source: Microsoft Corporation.

Exhibit 3.23

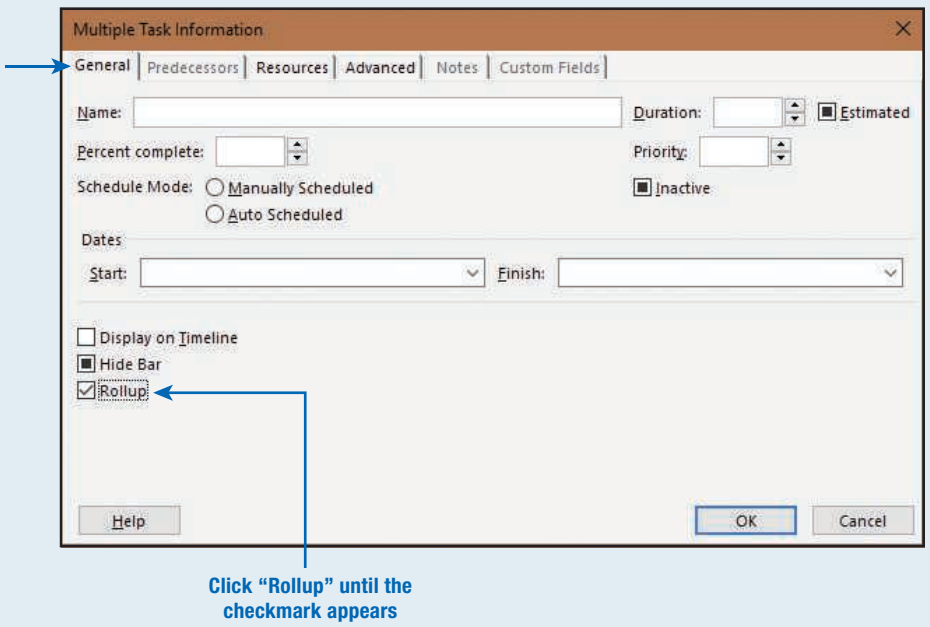
Summary Task Dialog



Source: Microsoft Corporation.

Exhibit 3.24

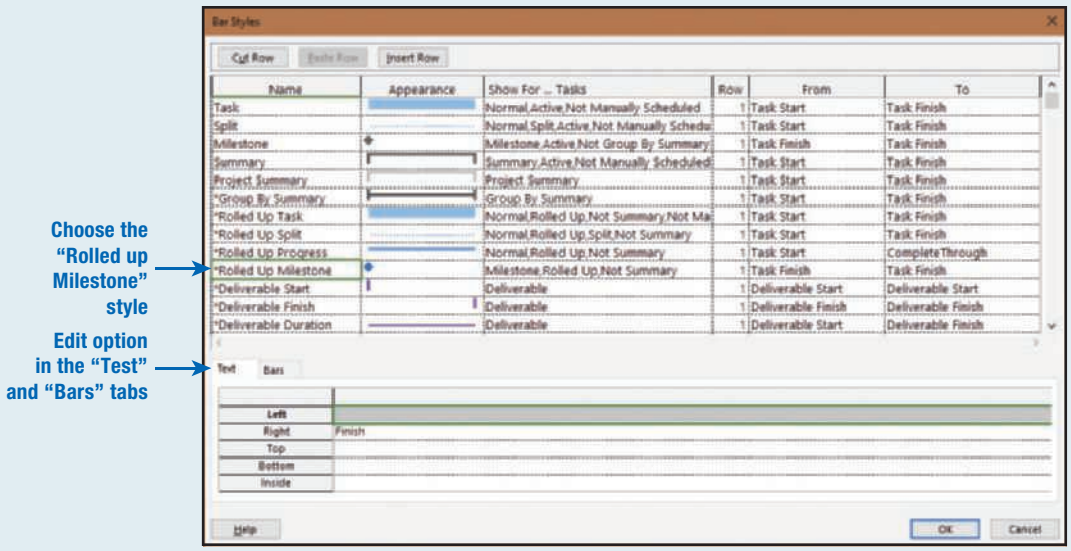
Multiple Task Information dialog



Source: Microsoft Corporation.

Exhibit 3.25

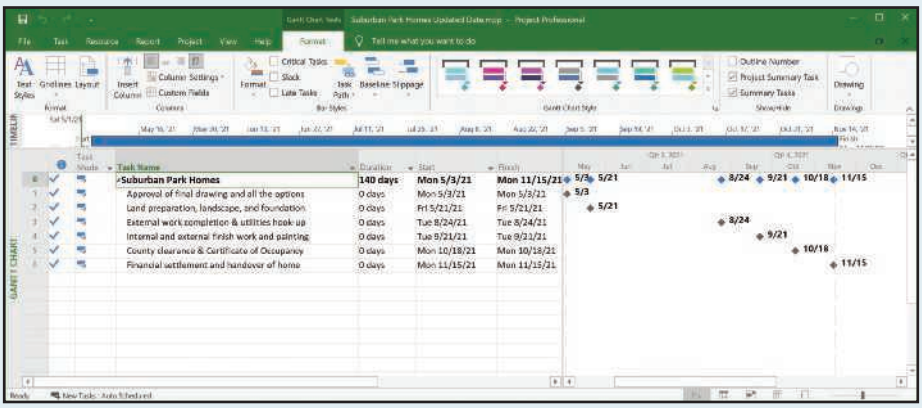
Bar Styles Dialog



Source: Microsoft Corporation.

Exhibit 3.26

Updated Suburban Park Homes Milestone Schedule



Source: Microsoft Corporation.

Summary

The project charter is a vital document since it enables the project sponsor and project manager to reach mutual understanding and agreement on the project at a high level. Often, core team members who have been preassigned and sometimes a key stakeholder or two also sign the charter. All parties commit to the intent of the charter with confidence. Charters typically include sections such as a scope overview, business case, milestone schedule, acceptance criteria, risks, and signatures. Some project charters include additional sections.

The sponsor or leadership team might write the rough draft of the business case and scope overview, but the project manager and core team typically write the rough draft of the majority of the charter. Once the draft is written, the sponsor meets with the project manager and core team to go over the charter in detail both to ensure understanding and to reach agreement.

Agile projects do not use a formal project charter, although many elements are similar. An Agile project charter serves the same purposes of understanding, committing, and authorizing the project, but in a less formal manner. Agile projects are based on a vision statement provided by the client and are planned in sprints, with each sprint delivering something of value. Only the most immediate sprint is planned in any detail.

The charter, by signaling commitment on the part of the team and authorization on the part of the sponsor, is the document that completes the project initiating stage. Once the charter is complete, the project team can usually turn their attention to planning the details of the project. In the following chapters, we will cover both the behavioral and technical components of this planning.

Key Terms Consistent with PMI Standards and Guides

project charter, 73
milestone schedule, 76
acceptance criteria, 76
risk, 77
assumptions, 77
constraint, 77
resources, 77
lessons learned, 78
product scope, 79
project scope, 79
scope creep, 79
deliverable, 80
uncertainties, 84
assumptions log, 84

Key Terms Consistent with Agile Practice

share knowledge, 91
product vision, 91
time boxes, 91
sprints (aka iteration), 91
defer decisions, 91
sustainable pace, 91
commit to work, 91
commitment, 91
definition of done, 91

Chapter Review Questions

1. What is a charter?
2. Describe what an effective charter should accomplish.
3. How is a charter like a contract? How is it different?
4. How long should a typical charter be?
5. Signing the charter marks the transition between which two phases of the project life cycle?
6. Who generally writes the rough draft of a charter?
7. Give three reasons for using a charter.
8. What are some typical elements of a charter?
9. What is scope creep and how can it be prevented?
10. When would a background section be helpful?
11. On most small to medium-sized projects, how many intermediate milestones should be identified in the charter?
12. What types of resources might be included in a resources-needed section of a charter?
13. Name three reasons project managers and teams should plan fort project uncertainty, including risks.
14. Why should each contingency plan have an "owner" who is responsible for it?
15. What are the four columns of the milestone schedule?
16. With whom might the project manager and project team need to negotiate when creating the charter?
17. What is the primary difference between "Auto" and "Manually" scheduled settings in Microsoft Project?

Discussion Questions

1. Identify the purpose of each element in a project charter.
2. Explain how a charter helps secure both formal and informal commitment.
3. How are the various types of uncertainty (risks, assumptions, and constraints) related?
4. If you are a project manager and have the choice of forming your core team before or after charter approval, which would you do and why?
5. List and describe at least four lessons you have learned from previous projects. Relate how each is valuable in planning a new project.
6. In your opinion, what are the three most important items in your project charter? How did each help you understand and explain your project better?
7. Give an example of how an incorrect assumption could become a risk.
8. Briefly summarize the process of creating a milestone schedule.
9. How are *project* scope and *product* scope similar and different? Which is generally the focus of an Agile project?
10. Upon seeing the rough draft of your charter, your project sponsor asks you to move the finish date up by two months. What do you do?
11. What are the greatest advantages to using a computerized scheduling program like Microsoft Project?
12. Compare reasons for and various elements a project charter on a traditional versus an Agile project.

PMP Exam Study Questions

1. Which of the following is *not* a purpose of an approved project charter?
   a. formally authorizes the existence of a project
   b. provides detailed information about financial resources
   c. helps the team and sponsor develop a foundational understanding of project requirements
   d. provides project manager with authority to apply organizational resources to the project
2. Adding to the project after it has already begun without making adjustments to time, cost, or resources is known as:
   a. scope creep
   b. risk
   c. milestones
   d. acceptance criteria
3. "It is inconvenient and time consuming for employees to walk across campus every day to eat lunch, which is why we need an employee lunchroom in our building" is an example of:
   a. project scope
   b. business case
   c. milestone schedule
   d. constraint
4. What information does the project charter contain that signifies how the customer or user of the final product, service, or result will judge the deliverables, in order to determine that they have been completed satisfactorily?
   a. high-level project risks
   b. measurable objectives and acceptance criteria
   c. high-level project boundaries
   d. project assumptions
5. The project charter should include "factors that are considered to be true, real, or certain without proof or demonstration." These are known as _____.
   a. risks
   b. assumptions
   c. high-level requirements
   d. objectives
6. Which of the following is both a domain and a delivery principle according to the *PMBOK 7e*?
   a. Value
   b. Stakeholders
   c. Measurement
   d. Holistic thinking
7. What project charter component documents significant points or events in the project and, per the author, may be developed most effectively when combined with other information such as acceptance criteria?
   a. Network diagram
   b. Gantt chart
   c. Stakeholder management strategy
   d. Milestone schedule

8. You are the project manager. Upon presenting your charter to your sponsor, they requests several changes. What do you do?
   a. Agree to all the changes in order to make your sponsor happy.
   b. Refuse to change the charter, since that would be unfair to your team.
   c. Have your team vote on whether or not to make the changes and go with the will of the majority.
   d. Negotiate with your sponsor to see how you can best accommodate their requests without agreeing to unreasonable expectations.
9. The charter is the primary deliverable of the _____ phase of a project's lifecycle.
   a. selecting
   b. initiating
   c. planning
   d. executing
10. According to the *PMBOK*, the rough order of magnitude for the summary budget within the project charter is _____.
    a. −100% to 200% accuracy
    b. −25% to +75% accuracy
    c. −5% to +10% accuracy
    d. none of the above
11. After identifying potential project risks, the project team should then _____.
    a. develop risk response plans for all identified risks.
    b. wait for the sponsor to conduct a risk assessment.
    c. move on to other components of the charter, since identifying risks is the only risk-related activity in the *initiating* phase.
    d. assess each risk based on probability and likely impact, and then create a risk response plan for each major risk.

Exercises

1. Consider a major team project for a class. Write the scope overview and business case sections of a charter.
2. Write the business case and scope overview sections of a project charter for a project in which your company is considering buying out another company.
3. You are part of a student team that is going to host a picnic-style party as a fundraiser event for a deserving local nonprofit. Develop a milestone schedule with acceptance criteria for this event. Include between four and eight milestones.
4. You are part of a student team that has volunteered to host an alumni event at a recently reopened museum in your city's downtown. The event has the twin purposes of establishing contacts with long-lost alumni and raising awareness of the newly reopened museum. Brainstorm the potential risks for this, quantify them both according to probability and impact, assign responsibility for each major risk, and create one or more contingency plans for each major risk.
5. You are part of a student team that is hosting a number of inner-city junior high and high school students from several nearby cities at your campus for a weekend. The primary purpose is to encourage them to attend college and, second, to attend *your* college. Identify as many stakeholders as possible for this project, prioritize them, and list the interests each has in your project.
6. You have started a project working with your peers at your rival college to create a "cross-town help-out." You want to encourage many people in the community to contribute a day's work on a Saturday for various community projects. You have a rather heated rivalry with this other college. Create a comprehensive set of team operating principles to use on this project. Which of these principles is most important and why? Do you expect any of them to be difficult to enforce and why? What do you plan to do if some of them do not work?

Integrated Example Projects

Suburban Homes Construction Project

Scope Overview

Building a single-family, partially custom-designed home as required by Mrs. and Mr. John Thomas on Strath Dr., Alpharetta, Georgia. The single-family home will have the following features:

- 3,200 square-feet home with 4 bedrooms and 2.5 bathrooms
- Flooring—hardwood on the first floor, tiles in the kitchen and bathrooms, carpet in bedrooms
- Granite kitchen countertops, GE appliances in the kitchen
- 3-car garage and external landscaping
- Ceiling—10′ in first floor and vaulted 9′ ceilings in bedrooms

Business Case

Suburban Homes is in the business of constructing high-quality homes at an affordable cost with luxury options to provide quality of life for families. The business strategy is to use the best construction technologies and practices to enhance productivity and increase profits, while offering cost-effective and best-value homes for all its customers simultaneously. The current project, "Suburban Park Homes- GA," is aimed to expand business operations in Georgia.

Milestone Schedule and Deliverables

CM – Construction Manager; PM – Project Manager

Milestone	Completion Date	Stakeholder Judge	Acceptance Criteria
Approval of final drawing and all the options	January 2nd	Client	PM and the client to approve
Land preparation, landscape, and foundation	January 15th	CM	PM and CM approval
External work completion and utilities hookup	April 3rd	CM	PM and CM approval
Internal and external finish work and painting	May 10th	CM	PM and CM approval
County clearance and Certificate of Occupancy	May 30th	CM	County Inspectors and PM ok
Financial settlement and handover of home	June 21st	PM, Client	Design Specifications – approval by PM and the client

Risks

Project Risks	Risk Owner	Contingency Plans
County approval and permissions	Suburban Homes, PM	None
County Property Taxes hike	Client, Suburban Homes	Document as contract clause
Traffic congestion	Client, County, DMV	None

Resources Required

- Funding: the client, underwriters, and Suburban Homes
- People: Suburban project management team, contractors, subcontractors, and skilled labor
- Equipment: construction equipment, tools, and machinery
- Material: building materials, appliances, landscaping, shrubs, and trees

Stakeholders

Stakeholders	Interest in Project
Primary: The client Suburban Homes County Officers	Overall project cost, time, quality Overall project cost, time, quality, success criteria Adherence to the county standards
Others: Contractors Suppliers Utility companies	Timely payment of invoices Business expansion, profits Adherence to laws, business expansion

Team Operating Principles

- Commitment to project schedule: Project team and contractors will complete their assigned work as per schedule.
- Progress Meetings: Construction team meetings scheduled on Mondays at 8 a.m. every week and as demanded by work progress. Members should prepare for these meetings with information required for review.
- Communication: Regular updates of status, reporting issues, and weekly progress reports.

Lessons Learned

- Team participation in developing project schedule is critical.
- Transparent communication is encouraged for resolving issues.
- Conflicts must be reported to the construction manager immediately.
- County laws and utility standards must not be compromised.

Commitment

Sponsor	Department/Organization	Signature
Project Manager	**Department/Organization**	**Signature**
Core Team Members	**Department/Organization**	**Signature**

Heritage Arboretum Development Project

The decision made was to apply for Level One Arboretum Status. This was tentatively approved subject to signs being created for, and placed in front of, each of the tree species identified. Forty-eight aluminum signs were placed. Each sign contains the Latin name and common name for each tree, an Anderson Township logo, a Heritage Center Arboretum logo, a QR code people can click on to read more information regarding that tree species, and a number so people can look up on the map where each tree is located.

One of the tree committee members also created a high-resolution map of the site showing exactly where each tree is, the buildings, drives, parking, and patio, and the elevation changes. This map will be available on-line, posted at the arboretum, and in a hallway of the government center.

Given the information in the first two chapters and here, it is time to create a charter for the project going forward.

Student Questions:

1. Create a vision statement for this project. Write it so the charter would be for one more year of work with an eye toward on-going maintenance of the arboretum after that. In addition, write the statement to consider potential (but not yet approved) future development work after the first year.
2. Create a product roadmap showing two releases for the first year and other potential work that might be performed in future releases.
3. If you were the scrum master, what expertise would you want in your sponsor, product owner (PO), and core team members to help create a definition of done for the first milestone?
4. Brainstorm risks. Prioritize them. Develop at least one avoidance or mitigation response for each big risk.
5. Who are the key stakeholders and what does each one want? Which ones have the most power?

Semester Project Instructions

Determine one member of your student project team to be the primary contact with the project sponsor (the manager or executive who came to class when projects were announced). The sponsor is also the product owner. This sponsor was encouraged by your professor to come with a draft of the business case and scope overview sections of the charter, but some sponsors probably did a better job than others. You need to ensure that you understand these statements and how they fit with the organization's goals.

Then, your student team needs to draft the remainder of the charter with as much help as you can get from the sponsor and/or other people at the organization. Once the charter is in rough-draft form, submit it for comments to your professor. Armed with the professor's suggestions, you can present it to your sponsor and any other people your sponsor chooses. Often, this may involve a leadership team, department heads (functional managers), and/or project team members. One difference on this project is that your student team will likely do most of the planning and only part of the execution, while members of the organization for whom you are planning the project will need to complete the execution. Therefore, you need to consider how you will transition responsibility over to the parent organization near the end of the class.

Project Management *in Action*

Information Systems Enhancement Project Charter

The following charter was used when a nonprofit agency formed a project team to upgrade its information systems. Comments on the left side give advice from a communications perspective regarding how to write a project charter, and comments on the right side offer suggestions regarding the content of each section.

Design Principles

Headings:

Headings facilitate scanning by identifying information covered in each section.

Heading descriptions should accurately indicate the information that follows.

Lists:

Listing techniques help readers remember key details of a message.

Numbers, bullets, and other ordering devices promote retention and improve visual design.

Lists are best limited to five points so they do not look overwhelming to readers.

Project Charter: Information Systems Enhancement Plan

Scope Overview

This team will implement a new information system based on a needs assessment of personnel of the agency. The project team will detail technological issues, as well as upward, downward, and lateral communications issues within each department and recommend software package options for each program area. The sponsor will select a vendor, and the project team will oversee implementation.

Business Case—Objective

The agency needs to overhaul its information systems to increase productivity for staff, and create additional learning opportunities for clients. It is estimated that 20 percent more clients will be served with the new system.

Content Principles

Scope Overview:

The scope overview defines the major deliverables. It sets project boundaries by clarifying what is included and, sometimes, what is not included.

Business Case:

The business case defines project objectives and why they are important to the parent organization.

Milestone Schedule:

The milestone schedule shows the project starting point, a few major milestones, and the ending point.

Lists are written in parallel structure, with the first word of each item having the same grammatical form, such as all nouns, all verbs, or all -ing words.

Milestone	Completion Date	Stakeholder Judge	Acceptance Criteria
Outdated facility, poor productivity	Start January 6th		
Staff survey	January 31st	Sponsor	Discussion with department heads
Software recommendations	March 14th	Operations Manager	All areas included, pilot results
Vendor selected	March 28th	Sponsor	Best meets qualifications
Technology in place	May 9th	Project Manager	System test demonstration
Updated facility, productivity improved	May 30th	Sponsor	Two-week data reports from department heads

Acceptance Criteria Factors:

These identify which stakeholder will judge the acceptability of each milestone and what criteria they will use.

Design Principles

Tables:

Use tables to organize complex information into an easy-to-follow column and row format.

Design tables so they make sense when read independently of the text.

Use table headings that reflect logical groupings of information.

Phrase column language so it is in parallel structure.

Character Formatting:

Use character formatting, including boldface, italics, underlines, and centering to highlight headings.

Use character formatting hierarchically. Boldface,

Major Risks

Risk	Risk Owner	Response Plans
System may not work properly	Technical Lead	Define top defect and focus on it exclusively until fixed.
Implementation may cost too much	Accountant	Identify areas of cost reduction and added funding.
Lack of sponsor buy-in	Project Manager	1. Conduct staff survey to identify most-needed capabilities. 2. Understand sponsor requirements.

Resources Needed

This project will require the project manager to spend 50% of their time and the lead user and 3 core team members 25% of their time for 5 months. The budget estimate is $45,000.

Content Principles

Project Risks and Assumptions:

This section identifies major risks and how the team will either reduce their probability of happening and/or their impact if they do occur. One person is assigned responsibility for each risk.

Resources Needed:

This is an estimate of the money, personnel, and other resources expected to be needed.

Stakeholder List:

Identifies those individuals and groups who have an interest in either the project process and/or results.

underlines, and all caps are best for major headings. Use fewer or less dramatic techniques for subheadings.

Type Size and Face:

Use 10-, 11-, or 12-point type for most documents. People who have poor vision often prefer larger type.

Use a conventional typeface, such as Arial, Times Roman, or Palatino.

White Space:

Use white space to separate document sections attractively and to improve readability.

Page Breaks:

When possible, complete entire sections on the same page. Redesign documents where one or two lines of text from a section run onto the next page.

Stakeholder List

Stakeholder	Interest in Project
Board Sponsor Department Heads	Overall cost and overall project success Overall project success, resource needs; Impact on their department, resource needs
Lead User	New work methods, productivity increases

Design Principles

Sentences:

To express complex ideas effectively and to make ideas easy for readers to understand, compose most sentences to be 15–25 words long.

Simple Language:

So all readers understand your language easily, substitute short, actionoriented, easily understood words for long, unfamiliar, and unpronounceable words.

Team Operating Principles

- **Commitment to timetable.** The project management team members will complete their assigned work on time.
- **Regularly scheduled project team and sponsorship meetings.** Project team meetings will be held every Saturday at 4:15 p.m. The team will also communicate via e-mail as required. Sponsorship meetings with the agency staff will be held bimonthly and as-needed.
- **Timely communication.** The project management team will communicate status, issues, and questions with agency via e-mail or conference call weekly. Project actions will be distributed to the team every Monday.

Content Principles

Operating Principles:

Operating principles indicate agreement on deadlines, meetings, decision making, and how participants will treat each other with respect.

Lessons Learned:

This section highlights specific learnings from previous similar projects that will help the team copy good practices and avoid problems.

- **Majority rule.** The project management team will negotiate and resolve issues on a majority-rule basis.

Lessons Learned

- **Agreeing on project scope** is a key preliminary project planning activity.
- **Maintaining project goals and timeline** requires open communication and quick issue resolution.
- **Understanding roles and responsibilities** facilitates smooth teamwork and timely project completion.

Commitment

Sponsor	Project Manager
Lead User	Core Team Member
Core Team Member	Core Team Member

Commitment:

Project principles signal agreement in principle to the project, recognizing that some of the specifics will probably change when the detailed planning is complete.

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Endnotes

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2. Kloppenborg, Timothy J., and Joseph A. Petrick, *Managing Project Quality* (Vienna, VA: Management Concepts, Inc., 2002): 39.
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Part 2

Leading Projects

Organize | Lead | Plan | Perform

Chapter 4
Organizational Capability: Structure, Culture, and Roles

Chapter 5
Leading and Managing Project Teams

Chapter 6
Stakeholder Analysis and Communication Planning

Leading for success in project management includes effectively guiding

- the parent organization that is conducting the project,
- the project team, and
- the various stakeholders who care about the project in one way or another.

Chapter 4 deals with the parent organization by giving ideas about how the organizational structure, organizational culture, project life cycle model, and roles of various players impact a project. Chapter 5 includes acquiring, developing, and leading the project team. Chapter 6 includes engaging stakeholders, managing communications, and running project meetings. When considering the impact of Agile on each of these chapters, we refer back to the original Agile Manifesto which was written in 2001 and still influences much Agile thinking today. While ideas spawned by the manifesto are included in all fifteen chapters of this book, specifically, each of these three chapters utilize ideas from some Manifesto principles, as shown here.

Chapter 4:

4. People representing business and the development team must work together constantly.

8. Sustainable development requires sponsors, developers, and users to work at the same pace.

Chapter 5:

5. The project team composed of motivated people who must be engaged in the project; support and trust must extend to the project team.

11. Self-managed teams develop the best requirements and designs.

Chapter 6:

1. Customer satisfaction is given the highest priority.

6. Face-to-face communication is best. In other words, teams should be co-located or at least use co-location communication tools.

Chapter 4

Organizational Capability: Structure, Culture, and Roles

Chapter Objectives

Core Objectives:

- **4.1** Compare and contrast the advantages and disadvantages of the functional, project, strong matrix, balanced matrix, and weak matrix structures of an organization.
- **4.2** Describe organizational culture elements that are helpful in planning and managing projects and demonstrate how to overcome organizational culture elements that hinder project success.
- **4.3** Compare different project life cycle models and distinguish when each is appropriate.
- **4.4** Describe how to tailor your development approach according to *PMBOK 7e*.
- **4.5** Describe the duties, motivations, and challenges of the executive, managerial, and team roles in projects.
- **4.6** Explain ethical behavior that is consistent with PMI's Code of Ethics and Professional Conduct in a project situation.

Agile Objectives:

- **4.7** Define Agile in your own words.
- **4.8** Describe situations in which the Agile approach may be better than the plan-driven approach.
- **4.9** Describe the iteration-based and continuous Agile project life cycle models.
- **4.10** Contrast plan-driven and Agile approaches in project management.
- **4.11** Describe typical primary and additional team roles and responsibilities on Agile projects.

Bloomberg/Getty Images

We implement project management best practices for the purpose of increasing the likelihood of project success. Formerly, as an executive, I was responsible for establishing, operating, and evolving a national project management office (PMO) for one of the nation's largest print/mail and electronic outsourcing firms. **Organizational structure**, **culture**, **roles**, and responsibilities of project participants and **project life cycle standard processes and tools** were critical influencers to achieving project success. As there is no single way to implement project management, how we chose to address each influencer shaped the way projects were managed. A snapshot of our approach follows.

From an operations perspective, there was a strategic need to implement a centralized approach to project management. Through several mergers and acquisitions, ten geographically dispersed operation centers were servicing a broad range of expanding customer needs. As a result, two key factors were at play. One: the customer base was growing from regionally based to nationally based customers. Two: the best-of-the-best operations technology needed to be leveraged across all centers.

PMBOK Guide 6e Coverage	
PMBOK Guide 6e	**Outputs**
1.2 Foundational Elements	Life Cycle and Development Approach
2.4 Organizational Systems	
3.3 The Project Manager's Sphere of Influence	
3.4 Project Manager Competencies	Leader Roles and Responsibilities
Note: Refer to Appendix A to view the entire *PMBOK Guide 6e* flowchart.	

PMBOK Guide 7e
Domains
- **Team**
- **Development approach and life cycle**
- **Project work**
- **Tailoring (additional section of *PMBOK 7e*)**

Structurally, the decision was made to consolidate operation centers to three, geographically in the East, Central, and West. This meant that internal and external projects that applied nationally could no longer be managed at a regional level using only regional resources. A new type of project manager was needed to manage national resources using a standardized set of practices. Creating a matrixed project organization to serve the functional organization was the first phase.

Ensuring the work culture would accept and support these changes was critical to success as change is not easy and resistance was anticipated. Senior management buy-in was essential and plans were implemented to dialogue, collaborate, and communicate the benefits of a PMO throughout the organization. The PMO's first mission was to establish national project management standards and manage a select few strategic national projects with a limited set of project managers. Proof of concept was key to continued buy-in. Clear roles and responsibilities for executive sponsors, project managers, and project team members were collaboratively established. Standard processes and tools used by the project teams were jointly developed. Training occurred from the executive suite to project managers and project team members. As time progressed, project success rates increased and the PMO responsibilities were expanded to include the project management of all strategic operational projects and new customer implementations. Career paths for regional project managers were established. Selected regional project managers were promoted and trained to be national project managers. The organizational structure changed with selected regional project managers reporting to the national PMO. The executive sponsorship roles continued to evolve along with standard processes and practices to facilitate new responsibilities. In *Improving Executive Sponsorship of Projects: A Holistic Approach*, additional insight on each influencer, considerations, pitfalls, and tips for project management implementation approaches can be found.[1]

—Dawne E. Chandler, PhD, PMP

Chapter 2 dealt with organizational issues of strategic planning, selecting, and resourcing projects. Chapter 3 detailed how to initiate a project—usually by composing and ratifying a project charter. This chapter introduces both project leadership and project planning. Leadership in this chapter includes organizational structure and culture along with roles of all key project participants. Planning is presented in the selection of the project life cycle approach and in introducing the concept of a project plan. Both project leadership and planning lead to project success, as shown in Exhibit 4.1. Effectively managing project team members and

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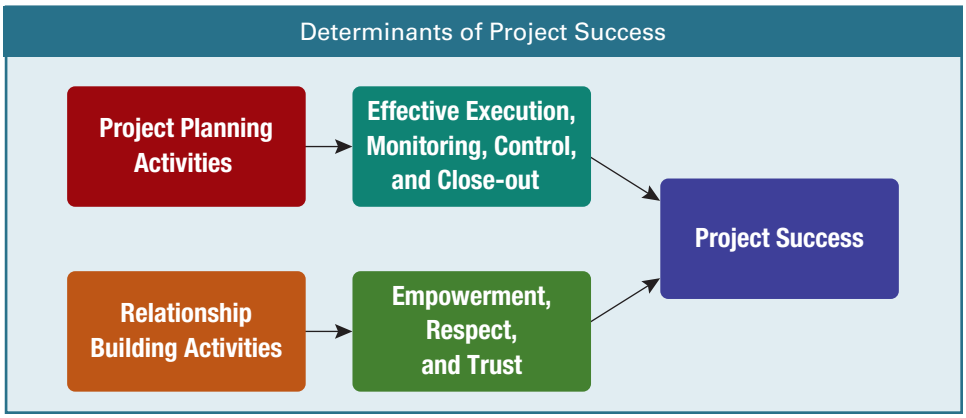
other stakeholders leads to a foundation of empowerment, respect, and trust, which, in turn lead to project success. Effective project planning lays the groundwork for effective project execution, monitoring, control, and closeout, which also lead to project success.

Exhibit 4.1



4.1 Types of Organizational Structures

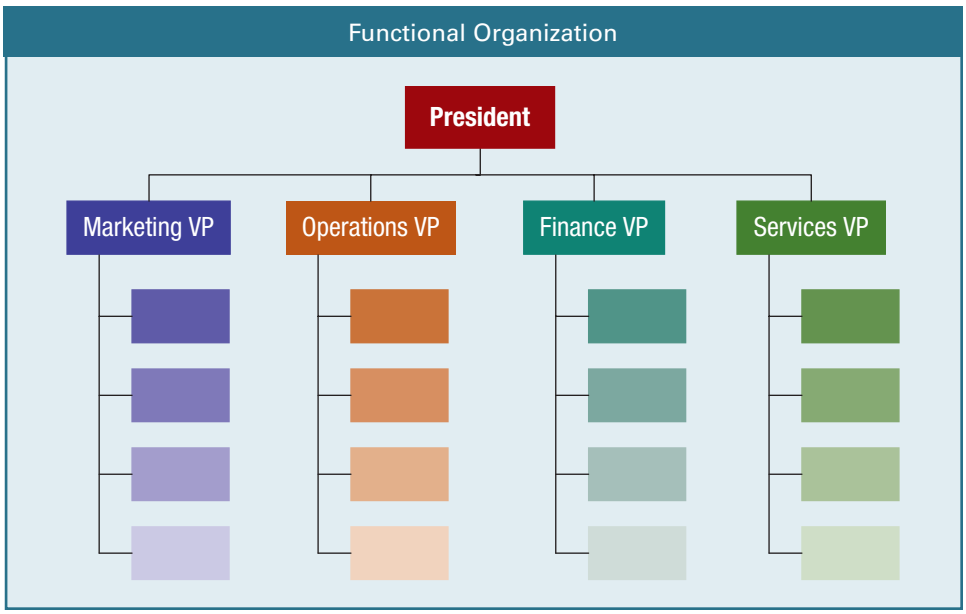
Contemporary organizations choose among various methods for establishing their organizational structure. Organization structure is often developed by grouping people together based on criteria such as functional or technical skills or long-term activities. The structure, size, and complexity increase along with the number of employees. The structure is the way in which an organization divides its people into distinct tasks to achieve coordination among all these groups. It also describes the easy and simple approach to managing people from different functions/disciplines. Organizational structure can include work assignments, reporting relationships, and decision-making responsibility. Each method of structuring organizations has strengths and weaknesses. In this section, we will investigate various organizational methods and the impact of each on managing projects. The advantages and disadvantages of each form of organizational structure are discussed in the following sections and then summarized in Exhibit 4.5.

4.1a Functional

A **functional organization** is an organizational structure in which people are grouped on the basis of specialization/function and the project manager has limited authority to assign work and apply resources.[2] This is the traditional approach in which clear lines of authority are drawn according to the type of work. For example, all accountants might report to a head of the accounting department, all marketing professionals report to the head of marketing division, and so on. An organizational chart for a functional organization is shown in Exhibit 4.2. Note that everyone in the organization reports up through one and only one supervisor. That supervisor is the head of a discipline or function (such as finance).

The functional manager generally controls the project budget, makes most project decisions, and is the primary person who coordinates project communications outside the functional areas by contacting their peer functional managers.

Exhibit 4.2



Advantages One advantage of the functional form of organization is called *unity of command*—all employees understand clearly what they need to do because only one "boss" is giving them instructions. Communication is vertical and clearly established. Another advantage is that since all workers in a discipline report to the same supervisor, they will have an opportunity to interact frequently and can learn readily from each other to keep and enhance their technical skills. Consequently, functional or discipline-specific expertise can be nurtured easily. Having the same supervisor also acts as a motivating factor for several employees to maintain and improve their technical expertise. A third advantage is that workers, after they finish work on a project, will still have a job and support from the functional manager. For small projects that require most of the work from one department, the functional organization often works well, both because of the advantages already stated and because the functional manager can share resources among various small projects and control the work centrally.

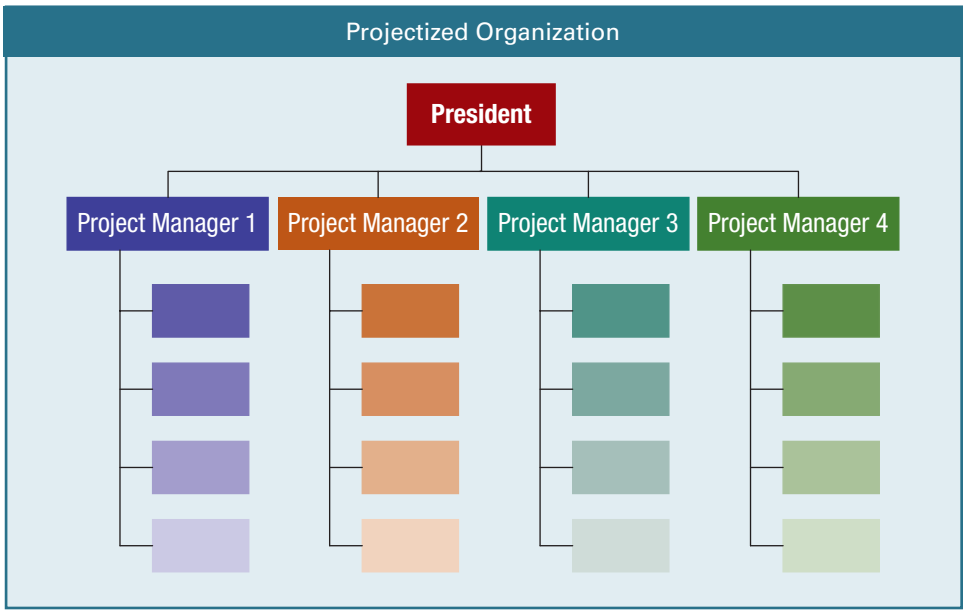
Disadvantages The functional form of organization can slow down communications when input is required from multiple functions. It can also be challenging from a technical standpoint if input is required from multiple disciplines. The functional manager is probably an expert within their domain but may have less understanding of other disciplines. However, in small organizations where most people have been forced to understand multiple functions, this may be less of an issue. Coordination among departments is frequently conducted at the manager level, as the functional managers have a great deal of decision-making authority. This often means communication needs to first travel up from an employee at a low level in the structure to the manager, then across from one functional manager to another manager, and then down from the manager to an employee at a low level who will be working on it. This can become more complex when organizations have multiple levels of hierarchy within functional divisions and a chain of command must be followed. In short, coordination in a functional organization is complex and time consuming. These long communication channels often result in slow decision making and slow response to change. Integration becomes difficult and it may lead to frustration and a decrease in motivation and innovation. Also, decisions will tend to favor the strongest functional group or division. For these reasons, some organizations choose other forms of organization.

4.1b Projectized

The exact opposite of the functional organization is the **projectized organization**, which is defined as a structure wherein employees, collocated or not, are grouped by activities on a project and the project manager may have complete, or very close to complete, power over the project team.[3] In this organizational form, the larger organization is broken down into self-contained divisions that support large projects, geographies, or customers. Most people in the organization are assigned to a project and report upward through the project manager, as can be seen in Exhibit 4.3. While the structure of the two organizational charts appears similar, the reporting manager is a project manager instead of a functional manager. The project manager has extensive authority over budgets, personnel, and other decision-making issues in this organizational structure. This provides adequate time and autonomy for the project manager to make decisions. Projectized organization structure provides an opportunity to maintain expertise on a given project.

Advantages The advantages of the projectized organizational structure are very different from the advantages of the functional structure. Because people from different functions now report to the same project manager, traditional department barriers are

Exhibit 4.3



reduced. Since the project manager is responsible for communications, response times and decision making tend to be swift. All employees understand clearly what they need to do because only one "boss"—the project manager—is giving them instructions.

Projectized organizational structures often utilize **co-location**, which is "an organizational technique in which the project team members are moved to alternate locations (either full time or only for parts of days) to allow them to better work with one another, and on the project in general."[4] This co-location often results in enhanced project team identity, and it improves trust, collaboration, coordination, productivity, customer focus, and integration of effort on the project.

Disadvantages However, this organizational form also has disadvantages. Team members are often assigned to just one project, even if the project sometimes only needs part of their time, which results in idle time and misuse of resources. This can be costly because project team members are retained during and even after completing the project. Since the project manager is in charge and the team may be physically located on-site rather than with the rest of the organization, some projects tend to develop their own work methods and disregard those of the parent organization. As a result, organizations may not have a common work culture. While some of the new methods may be quite useful, project teams that are not watched closely may fail to practice important organizational cultural norms, or accepted practices, and they sometimes fail to pass on the lessons they learn to other project teams. Team members who are co-located, while learning more about the broader project issues, often do not keep up their discipline-specific competence as well. Team members sometimes worry about what they will do when the project is completed, which leads to adverse motivational, morale, and security issues. In short, motivating people could become a challenge.

4.1c Matrix

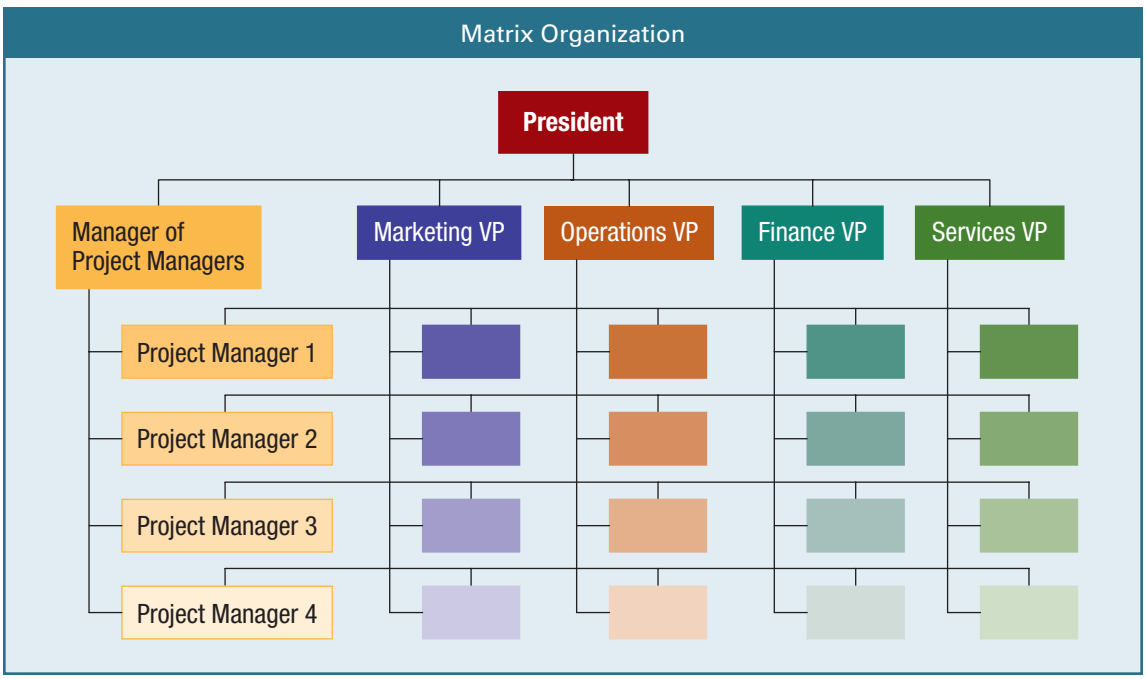
Each of the extreme strategies already described (extreme in the sense that either the functional manager or the project manager has a great deal of authority) has strong advantages,

but also significant weaknesses. In an attempt to capture many of the advantages of both, and to hopefully not have too many of the weaknesses of either, many organizations use an intermediate organizational strategy in which both the project manager and the functional manager each have some authority.

This intermediate strategy is the **matrix organization**, which is an organization in which the project manager or project lead shares responsibility and accountability for the project with functional managers.[5] A matrix organization is shown in Exhibit 4.4. Note that project team members report to both functional and project managers. This is a clear violation of the unity-of-command principle; however, it is necessary to enjoy the benefits of a matrix organization. In short, the hoped-for benefit of a matrix structure is a combination of the task focus of the projectized organizational structure with the technical capability of the functional structure.

Advantages Matrix organizations have many advantages, which is why an increasing number of organizations are using some variation of them today. One advantage is that because both project and functional managers are involved, there is good understanding and visibility into who is working where, and resources can be shared among departments and projects. This reduces possible duplication—a major advantage in this age of lean thinking in business. Since both types of managers are involved, cooperation between departments is likely to be better. With multiple perspectives and diverse input, decisions tend to be of higher quality and are better accepted. This is a major issue since enthusiastic support for controversial decisions often helps a project team work through challenges. Since people still report to their functional manager, they can develop and retain discipline-specific knowledge. As various disciplines report to the same project manager, effective integration is still possible. Because people report to both the project manager, who is responsible for capturing lessons learned, and to the functional manager, who is responsible for how the work in a function is performed, lessons learned can be shared effectively between projects. Furthermore,

Exhibit 4.4



policies and procedures for each project can be set separately. The project manager can commit resources and respond to changes, conflicts, and project needs quickly.

Yet another advantage of the matrix form is its flexibility. The amount of decision-making authority can be shared in whatever manner is desired. When the functional managers enjoy relatively more power, it is almost like a functional organization. This is the way many organizations start evolving—by giving project managers a bit more decision-making authority. This is called a weak matrix since the project managers have less authority than the functional managers. The next step in the progression is a balanced matrix in which project managers and functional managers have about equal power. Finally, a strong matrix is one in which the project managers have more power than functional managers. This is more like a projectized organizational form. The progression of forms is shown in Exhibit 4.5.

Disadvantages The matrix organizational form has drawbacks as well. Some people claim that having two bosses (both a functional manager and a project manager) is a disadvantage. This problem certainly needs to be managed because the two managers may each try to do what they think is best for their department or project respectively and may give conflicting advice. Dual responsibility and accountability can be demotivating for some people. However, this is a common experience for most people. Most students take multiple classes per term. Many people face conflicting and competing demands from personal and professional lives. Often, companies have multiple customers. Balancing competing demands can be difficult, but it is often the norm.

A related potential disadvantage is that more people are providing the necessary input, which means there may be more sources of conflict, more meetings, and more challenges to control. Decision making may not be quick. Also, priorities are likely to change routinely.

Firms need to consider which organizational structure is best for them so they can capitalize on its advantages and mitigate its disadvantages. These decisions can change over time. Exhibit 4.6 summarizes a comparison of organizational structures.

Note that in a matrix organization, a new role is inserted in the organizational chart—manager of project managers. Sometimes this person leads an office called the project management office (PMO). This does not mean that other organizations cannot have a PMO. In some organizations, an additional manager will be in the reporting chain between the project managers and the person in charge (shown as the president). In other matrix organizations, the project managers report directly to the person in charge. For simplicity, this chart shows each function with four workers and each project with four team members. In reality, some functions may have more workers than others, and some projects may have more team members than others. In fact, some people may only report to a functional manager since they are not currently assigned to a project, and others may report to more than one project manager since they are assigned on a part-time basis to multiple projects.

Exhibit 4.5

Progression of Organizational Form

Organizational Question	Functional	Weak Matrix	Balanced Matrix	Strong Matrix	Projectized
Who has power?	FM almost all	FM more	Equally shared	PM more	PM almost all

Exhibit 4.6

Organizational Structure Comparison

	Functional	Matrix	Projectized
Who makes most project decisions?	Functional manager	Shared	Project manager
Advantages	• Good discipline-specific knowledge • Easy for central control • Effective for shared resources • One "boss" • Clear career path for professionals	• Flexible • Easy-to-share resources • Good cooperation between departments • More input for decisions • Wide acceptance of decisions • Good discipline-specific knowledge • Effective integration on project • Increased knowledge transfer between projects	• Break down department barriers • Shorter response time • Quicker decisions • One "boss" • Enhanced project team identity • Customer focus • Effective integration on project
Disadvantages	• Slow communication between departments • Slow response to change • Slow decision making	• Two "bosses" • Many sources of conflict • More meetings • Slow reaction time • Hard to monitor and control	• Duplication of resources • Rules not always respected • Potential lessons learned can be lost • Discipline-specific knowledge can slip • Less career continuity for project team members

Source: Adapted from Richard L. Daft, *Management,* 9th ed. (Mason, OH: South-Western Cengage Learning, 2010): 250–255; and *PMBOK® Guide,* 21–26.

While both project managers and functional managers have certain authority in any matrix organization, the extent of this authority can vary substantially. Often, the project manager has authority to determine what work needs to be accomplished and by when. The functional manager often retains authority to determine how the work is accomplished (who will be assigned to the work). Sometimes, the two managers will negotiate to determine which workers will be assigned to the project. While both hopefully would like the optimum productivity and profitability for the overall organization, each has specific responsibilities. For example, the functional manager with several employees reporting to them wants each employee to have enough work but not be overloaded. They also want all workers to learn and grow in their expertise. The project manager, on the other hand, wants the most productive and skilled employees for the project so they can be more assured of delivering good results. In a case like this, when they negotiate, the project manager may want the best resource (who is already busy), but the functional manager may offer the least experienced resource (often, who is available).

One other source of potential conflict between the project and functional managers concerns performance review. Often, the functional manager is tasked with writing performance reviews, yet some employees may spend a great deal of their time on projects. If project managers are not allowed to provide input into the performance reviews, some project team members will work harder to please their functional managers and may neglect project work. Their projects can suffer as a result. One project manager offers ideas regarding performance reviews in Exhibit 4.7.

Exhibit 4.7

360-Degree Performance Reviews

In some organizations, the functional manager performs a 360-degree evaluation. This appraisal style requires that the functional manager seek feedback from a representative sample of the staff who have worked with that project team member to provide feedback on a 360-degree form. Being appraised by your peers or team members on a given project is considered best practice because they've observed the individual in action "in the trenches." Many large organizations use this appraisal technique, since in large and/or complex organizations some staff rarely see their direct supervisor or manager, depending upon their function in that organization.

Source: Naomi J. Kinney, CPLP, Principle Consultant, Multilingual Learning Services.

Closely related to the organizational structure is another organizational decision that needs to be made—that of organizational culture. Project managers are not often part of the executive team that decides on organizational structure or organizational culture, but they certainly need to understand how these decisions impact reporting relationships, decision-making methods, and commitment for their projects.

4.2 Organizational Culture and Its Impact on Projects

Both organization structure and organization culture will influence communication and performance of individuals within the organization. Just as project managers need to understand the structure of the parent organization, they must understand the culture of the parent organization in order to communicate effectively. Organizational culture consists of values, social rituals, symbols, work ethics, organizational behavior, beliefs, and practices that are shared among members of the organization.

The culture of an organization is not obvious and explicit, so one must make an effort to understand it. New members are ideally introduced to this work culture during their initial period of employment. "Values serve as a moral compass to guide us and provide a frame of reference to set priorities and determine right or wrong."[6] Values are implemented through social rituals such as meetings, training, and ceremonies, along with symbols such as work layout and dress code.[7] Collectively, these can informally:

- Motivate the ethical actions and communications of managers and subordinates;
- Determine how people are treated, controlled, and rewarded;
- Establish how cooperation, coordination, collaboration, competition, conflict, and decision making are handled; and
- Encourage personal commitment to the organization and justification for its behavior.[8]

Social rituals, symbols, work ethics, organizational behavior, beliefs, and practices are understood through observation and experience. Most importantly, organizational culture determines the quality of communication and, needless to say, open, frank, and transparent communication is critical for organizational success and project success. Once a project manager understands the culture of the parent organization, they can determine how best to foster the culture within his project team.

Projects are classified as internal projects or external projects. Internal projects are executed within an organization using organizational resources, and organizational culture only matters for such projects. However, some projects are executed cooperatively between

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two or more parent organizations, or one organization (a contractor) will perform the project for the other organization (a client). Whenever more than one parent organization is involved, the project manager needs to understand the culture of each organization well enough to facilitate effective project communications and decision making. Conflicts in work culture may result in poor performance.

4.2a Culture of the Parent Organization

When a project manager studies the culture of the parent organization, they need to ask the following questions:

- What is the corporate culture in general?
- What are the ascribed values?
- What are the work ethics?
- What are the undocumented beliefs?
- Are there standard project management practices and policies?
- How is the organization viewed by insiders and others in terms of being true to its values?
- How does the organization like to communicate internally and externally?
- How well does the organization support project management specifically?

Types of Power One framework that clarifies a corporate culture distinguishes the following four types of culture according to what is the most powerful motivator:

1. Power culture
2. Role culture
3. Task culture
4. Personal culture

Power culture exists when the supervisor exerts a great deal of economic and political power, and everyone tries to please the boss. In organizations with power culture, those in formal authority control competition, conflict resolution, and communication.

Role cultures motivate everyone to understand and confine themselves to their appointed roles. Reliable workers follow formal designations of responsibility with utmost respect for regulations, rules, processes, and laws.

In task cultures, it is more important to get the job done than to worry about who does the work or who gets credit. Hallmarks of task cultures are skill-based assignments, self-motivated workers, and more deference paid to knowledge than to formal authority.

In personal cultures, people show genuine interest in people's needs, consider employee development critical to the organization's success, and display an attitude that collaboration is satisfying and stimulating.[9]

Many organizations will have one dominant culture modified by at least one of the other types. An astute person will look not only for what people say when trying to understand the culture but also for actions, decisions, symbols, and stories that guide behavior of individuals within the organization.

A variety of organizational culture characteristics make project success more likely. These characteristics include appreciation for project management; formal recognition for project management; collaboration to meet organizational goals; engagement of stakeholders; desire to provide value to customers; teamwork across cultures; integrity; trust; transparency; insistence on continual learning; knowledge management practices that are tied to individual and organization learning; and provision of appropriate rewards and recognition. Recent research has added the following organizational culture themes as helpful in achieving project success: vision-led, egalitarian, goal-oriented, timely and effective communication, and flexible leadership with rapid decision making.[10]

Midland Insurance Company Midland Insurance Company espouses its values by giving every employee the "One Pager" that lists the organization's mission, strategic imperatives, and core values. The CEO will often pull his "One Pager" out at meetings and expects everyone else to do likewise. In talk and in action, Midland tries to live out the core values that comprise its organizational culture. Exhibit 4.8 shows Midland's culture.

4.2b Project Cultural Norms

While some of the project team's culture is dictated by that of the parent organization, effective sponsors and project managers can do many things to promote good working cultural norms within the project. Many times, participants on a project might not have worked together previously and may even come from parts of the organization (or outside organizations) that have historically been rivals. The sponsor and project manager need to understand organizational politics and work to develop cooperation both within the core

Exhibit 4.8

Midland Insurance Company Values

- Integrity Win/Win
- Team
- Humility
- Strong Work Ethic
- Creativity
- Propriety
- Sharing/Caring
- Personal Growth

Source: Martin J. Novakov, American Modern Insurance Group.

project team and among the various groups of project stakeholders. A project team charter helps to formalize this process and set expectations specifically for existing team members and inducting new team members. A team charter should be a formal document that outlines behavioral norms, work norms, responsibilities, communication protocols, and work ethics to name a few.

When the project sponsor and manager are determining how to create the project culture, ethics should be an important consideration. One aspect of an ethical project culture is to determine how people should act. Project sponsors and managers learn that they need to act in the best interests of three constituencies: (1) the project itself—attempting to deliver what is promised within performance targets; (2) the project team—encouraging, recognizing and rewarding, and developing all team members; and (3) the other project stakeholders—satisfying their needs and wants. Ethical project managers make decisions so that one of the three constituencies does not suffer unfairly when satisfying the other two. One list of behaviors adapted from the *PMI Code of Ethics and Professional Conduct* tells project managers to exhibit the following:

- Responsibility—take ownership for decisions.
- Respect—show high regard for ourselves, others, and resources.
- Fairness—make decisions and act impartially.
- Honesty—understand the truth and act in a truthful manner.[11]

The other aspect of an ethical culture is how people actually act. Every project has difficult periods, and the measure of project ethics is how people act during those times. The project manager needs to show courage both in making the right decisions personally and in creating an atmosphere in which others are encouraged to make the right decisions. An ethical project culture in which people know how to act and have the courage to do so yields better ideas; when a spirit of mutual trust prevails, everyone participates with their ideas and effective partnering relationships within and beyond the project team.

4.3 Project Life Cycle

All projects go through a predictable pattern of activity, which we refer to as project life cycle. *PMBOK 7e* describes these cycles in the domain titled Development Approach and Life Cycle. The development approach can range from very traditional, with all planning before implementation, to Agile with planning and implementing interspersed. Between the two extremes is a range of hybrid, iterative, and incremental models. Project planning teams use project life cycle models because various types of projects have differing demands. A research and development (R&D) project may require a certain test to be performed before management approves the expenditure of large amounts of cash, while the manager of a quality improvement project may need to document how the work is currently performed before it makes sense to experiment with a new method. The major types of project life cycle models, while differing in details, have some things in common:

- They all have definite starting and ending points.
- They involve a series of phases that need to be completed and approved before proceeding to the next phase.
- The phases generally include at least one initiating, one planning, one closing, and one or more executing phases.
- The various life cycle models are all frequently adapted based on how they align with the organizational culture and language.

We will now look at several models that represent those used in improvement, research, construction, and other plan-driven projects. Then we will introduce the Agile life cycle and approach to project management later in the chapter. In the remainder of the book, we will deal with the generic, plan-driven model that includes selecting and initiating, planning, executing, and closing and realizing benefits, as shown in Exhibit 4.9.

4.3a Define-Measure-Analyze-Improve-Control (DMAIC) Model

Many firms use projects to plan and manage quality and productivity improvement efforts. Various models are used for these improvement efforts. While these models appear to be somewhat different, they all strive to use facts to make logical decisions and to ensure desired results. The Six Sigma approach to quality improvement (a popular current approach explained in Chapter 12) uses the DMAIC model. A simple version of this model is shown in Exhibit 4.10.

4.3b Research and Development (R&D) Project Life Cycle Model

Many organizations use project management techniques to organize, plan, and manage their research and development efforts. These can vary in length from as long as a decade for taking a new pharmaceutical product from idea to successful market introduction to as little as a few weeks to re-format an existing food product and deliver it to a client. Some R&D project models are complex and have many phases due to huge risks that demand oversight; yet some are much simpler. One simple R&D model adapted from defense development projects is shown in Exhibit 4.11.

4.3c Construction Project Life Cycle Model

Just as in other project applications, since construction projects differ greatly in size and complexity, a variety of project life cycle models are in use. A generic construction

Exhibit 4.9

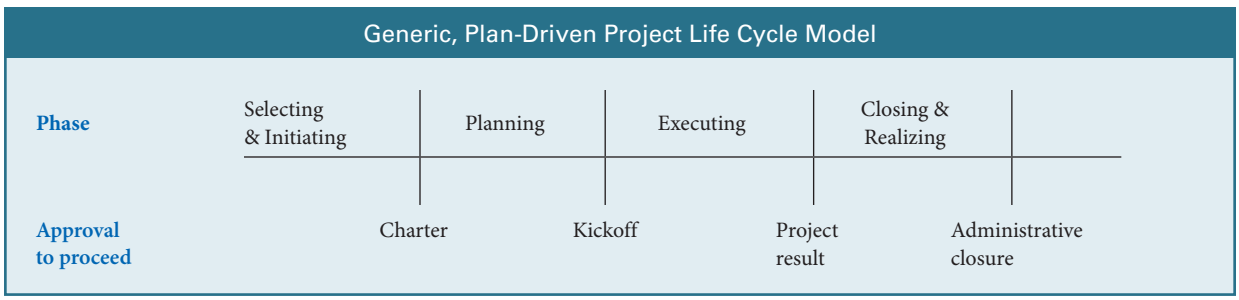


Exhibit 4.10

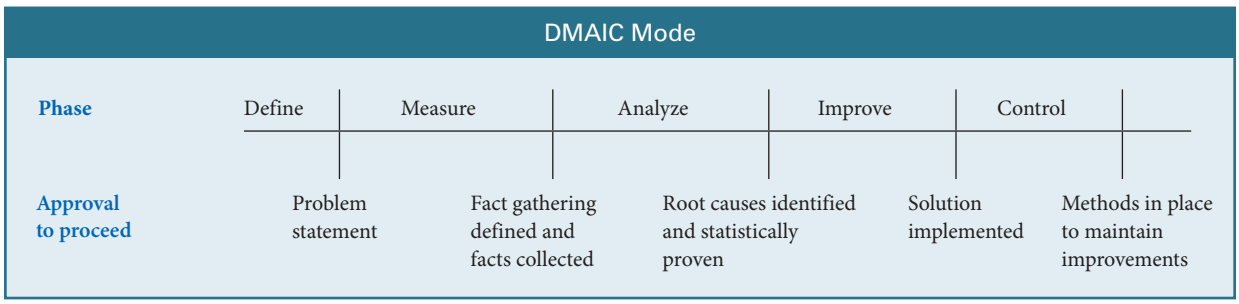


Exhibit 4.11

R&D Project Life Cycle Model

Phase	Idea Generation	Idea Screening	Concept Development	Validation	Transition	
Approval to proceed		Opportunity analysis	Business case	Proven concept	Prototype	First lot and hand off

Exhibit 4.12

Construction Project Life Cycle Model

Phase	Pre-Planning	Design	Procurement	Construction	Start Up	
Approval to proceed		Scope definition and execution strategy	Procurement and construction documents	Materials and services	Facilities and processes	Production attainment

Source: Adapted from Stevens, James D., Timothy J. Kloppenborg, and Charles R. Glagola, *Quality Performance Measurements of the EPC Process: The Blueprint* (Austin, TX: Construction Industry Institute, 1994): 16.

project life cycle model used for design build projects is shown in Exhibit 4.12. Increasingly, construction projects are using a design-build strategy in which once enough of the rough design is developed, early construction commences while the remaining design work is completed.

4.4 Traditional Project Executive Roles

Organizations employ projects to implement a strategic plan and to reach strategic goals. Projects do not exist in a vacuum but rather in organizations that require resources and executive attention. As such, a variety of players are involved at the executive, managerial, and associate levels, as shown in Exhibit 4.13. Especially in small organizations, one person may perform more than one role. For example, a sponsor may perform some or all the activities normally expected from the customer. The four project executive roles are the steering team (ST), the sponsor, the customer, and the chief projects officer (CPO), often known as the project management office (PMO).

4.4a Steering Team

In small- to medium-sized organizations, the steering team (may also be known as the executive team, management team, leadership team, operating team, or any similar other titles) often consists of the top person in the organization and their direct reports. They should collectively represent all the major functions of the organization. In larger organizations, there may be steering teams at more than one level. When that occurs, the steering teams at lower levels are directed and constrained by decisions from the top-level steering team. Some organizations divide the duties of the steering team by creating project review

Exhibit 4.13

Traditional Project Executive, Managerial, and Associate Roles

Executive Level	Managerial Level	Associate Level
Steering Team (ST)	Functional Manager (FM)	Core Team Member
Sponsor	Project Manager (PM)	Subject Matter Expert (SME)
Customer	Scrum master	
Chief Projects Officer (CPO)	Facilitator	

committees and delegating tasks to them. In any event, the duties of the steering team revolve around the following five activities:

1. Overall priority setting
2. Project selection and prioritization
3. Sponsor selection
4. General guidance
5. Encouragement

The steering team generally sets overall organizational priorities with the CEO. This is a normal part of strategic planning, as described in Chapter 2. Once the overall organizational goals have been set, the steering team agrees on the criteria for selecting projects and then selects the projects the organization plans to execute during the year. Once the overall project list is complete, they determine the relative priorities of the projects to decide which will start first.

Simultaneously, the steering team often helps the CEO decide who will sponsor potential upcoming projects. Further, the steering team may assist the sponsor with selecting the project manager. In some cases, the steering team even gets involved in deciding which critical team members will be on the project. This is especially true if very few people in the organization have skills in high demand. The steering team can decide which project these people will work on as part of the prioritizing effort.

Guidance from the steering team includes feedback during formal reviews as well as informal suggestions at other times that are either scheduled or unscheduled. Since steering teams understand the importance of project success in achieving organizational objectives, they normally demand formal project reviews. These can occur either at set calendar times or at a project **milestone**, which is a significant point or event when a major work or deliverable is complete in a project and is shown with a duration of zero time periods. At these formal reviews, the steering team can tell the project team to continue as planned, redirect their efforts in a specific manner, or to stop the project altogether.

In terms of informal suggestions, it is very empowering to project participants if the steering team members ask how the project is going and offer encouragement when they run into each other in the normal course of work. It shows project participants that their work is important and has high visibility within the organization.

4.4b Sponsor

We defined a sponsor in Chapter 1 as "a senior manager serving in a formal role given authority and responsibility for successful completion of a project deemed strategic to an

organization's success."[12] In this sense, the sponsor is normally an individual who has a major stake in the project outcome. Sponsors often perform a variety of different tasks that help a project, both in public and behind the scenes. Major sponsor responsibilities are shown by project stage in Exhibit 4.14. The sponsor for major projects is often a member of the steering team. On smaller projects, the sponsor may hold a lower position in the organization. The interaction—indeed, the partnership—of the sponsor and project manager is critical to project success.

As a member of the steering team, the sponsor should understand the corporate strategy and be prepared to help with project selection and prioritization to link each project explicitly with organizational strategy.[13] Sponsors usually pick the project manager and core team (sometimes with help from the project manager and/or others). Sponsors should mentor the project manager to ensure that they understand the role and has the skills, information, and desire to manage the project successfully.

In the previous chapter, we discussed the project charter. Sponsors ideally take an active role in chartering the project by creating a first draft of the business case and scope overview statements for the project. If a sponsor does not take time for this or does not pay close attention to it, the project manager must ask questions to elicit this business case and scope overview information. Then the sponsor should insist that a milestone schedule, preliminary budget, risk identification, assessment criteria, communication plan, and lessons learned be developed by the project manager and team. Thus, the sponsor sets performance goals and establishes priorities.[14] The sponsor then either approves the charter or presents the charter to the steering team for approval.

As the project progresses, the sponsor helps behind the scenes by obtaining resources, removing roadblocks, making high-level decisions, and interfacing between the project core team and the executive team. Sponsors often share their vision for the project with various stakeholders. When assigning staff, sponsors ensure they are adequate in number and skills. If necessary, a training plan may be included. A sponsor's hidden role may also include negotiating for staff. Sponsors often let their project managers arrange this training and negotiate for resources. However, the sponsor often ensures that both are satisfactorily completed.

Exhibit 4.14

Sponsor Responsibilities by Stage

Stage	Sponsor Responsibilities
Over-arching	Provide resources, manage stakeholder relationships, deliver results
Selecting	Identify, select, prioritize projects
Initiating	Select and mentor project manager, charter project
Planning	Meet key stakeholders, ensure planning
Executing	Nurture key stakeholders, ensure communications, ensure quality
Closing	Ensure stakeholder satisfaction, closure, and knowledge management
Realizing	Ensure benefits are achieved and capability is increased

Source: Adapted from Kloppenborg, Timothy J., and Laurend J. Laning, *Strategic Leadership of Portfolio and Project Management* (New York, NY: Business Expert Press, 2012): 47; Kloppenborg, Timothy J., Debbie Tesch, and Chris Manolis, "Project Success and Executive Sponsor Behaviors: Empirical Life Cycle Stage Investigations," *Project Management Journal* (February/March, 2014): 15–17; and Kloppenborg, Timothy J., and Debbie Tesch, "How Effective Sponsors Influence Project Success," *MIT Sloan Management Review* (Spring 2015): 28–30.

Once again, sponsors with experienced project managers may merely need to ensure their project managers have all the means to monitor and control their projects. Large projects with many stakeholders often have formal kickoff meetings. The sponsor's presence demonstrates corporate commitment. Sponsors represent the customer and the sponsor must ensure that several important customer-related tasks are performed as follows:

- All customers (stakeholders) have been identified.
- Their requirements have been identified and prioritized.
- The project delivers what the customers asked for.
- The customers accept the project deliverables.

Again, the project manager should do much of this, but the sponsor is also responsible for its completion. While sponsors represent their projects, they also represent the larger organization. As such, they often should be one of the first to determine the need to stop a project that is no longer needed or is not performing adequately. Finally, after the project deliverables have been used for a period of time, the sponsor should make sure the expected results have been achieved. It is desirable for a sponsor to understand uncertainty and risks associated with the project and must possess a creative mindset to manage them.

So, who makes a great sponsor? In addition to having a major stake in the project outcome and fulfilling the responsibilities described above, the following general behaviors and temperaments are desirable:

- Excellent communication and listening skills
- Ability to handle ambiguity
- Ability to self-manage
- Approachability
- Collaborative attitude
- Responsiveness[15]

Jupiterimages/Pixland/Getty Images

4.4c Customer

While the specific demands of the customer role are spelled out here, understand that some or all of this role may be carried out by the sponsor—particularly for projects internal to a company. When a busy customer buys something, it may be tempting to just place an order and have it delivered. That process is fine for an off-the-shelf item or for a transactional service. However, when it is a one-of-a-kind project, hands-off ordering does not work. The question then becomes: What must a customer do to ensure the desired results? Exhibit 4.15 shows a list of seven tasks a customer can do before and during a project to improve the probability of success.

Independent Tasks The first customer task is to prioritize each project. The knowledge that one particular project is the highest priority for a company should be communicated, and that project should be tackled by the "A team." A related prioritization question is: Do we need this project so badly right now that we are willing to start it even without the skilled personnel, resources, or technology on hand that would improve the probability of successful completion? If so, ensure this particular project gets top billing. If not, consider delaying it. Another prioritizing question that needs to be addressed repeatedly is what project requirements must be satisfied first so the project team is working on what matters most to the customer.

The second customer task is to carefully select a competent and honest contractor to perform the project, assuming that it is an external project. If the project is internal, it is important to select a competent project manager. All of the important joint tasks are much easier with the right contractor, as the probability of success goes up, and everyone's stress level goes down.

The third customer task is to determine whether and when to pull the plug on a troubled project. This could happen right at the start if the project appears to be impractical. It could happen during detailed planning when the requirements, schedule, budget, risks, or other aspects indicate trouble. More often, it occurs during project execution when the project progress does not live up to the plan. A customer needs to decide when to stop throwing money into a project that may not yield desired results.

Joint Tasks with Project Manager The first joint task for customers and project managers is to create and ratify the project charter. Here, the "contractor" refers to the project manager for internal projects and project executing organization for external projects (that are executed by outside agencies). The charter is a broad agreement concerning a higher level of understanding of the project goals, rationale, risks, timeline, budget, approach, and roles—even when details are yet to be determined. The charter should help to identify projects that appear risky or otherwise impractical from the outset. These projects should

Exhibit 4.15

Customer Tasks on Projects

Independent Tasks	Joint Tasks with Project Manager
1. Prioritize project	1. Write and sign charter
2. Select good contractor	2. Develop clear requirements
3. Kill project if needed	3. Use control system
	4. Conduct kickoff meeting

either be scrapped, or a different approach should be used. If a project looks promising, both the project executor (or contractor) and the customer normally sign the charter and feel morally bound to it in spirit.

Once the charter is signed, the contractor and customer will work together to develop detailed requirements. Many customer organizations face the challenge of differing project expectations among the members of the organization. Somehow, the conflicting desires of multiple people in the customer's organization must be combined into one set of requirements that will be provided to the people who will perform the project work. Senior customer representatives and project managers frequently work together to determine the requirements.

The customer and the contractor often collaborate on the setup and use of several project control systems. One of these is a communications plan (which is explained in Chapter 6). Since the customer is often the recipient of communications, he needs to tell the contractor what he needs to know, when he needs to know it, what mode of communication is preferred, and what format will be most convenient. This should include regular progress reports. Second is a change control system (explained in Chapter 7). Most projects will often have multiple changes. A method must be created to approve potential changes, document their impact, and ensure that they are carried out as agreed. Third is a risk management system (explained in Chapter 11). Customers should work with developers to brainstorm possible risks, consider how likely each risk is to occur, measure a risk's impact should it happen, and develop contingency plans. The customer must ensure that effective communications, change management, and risk management systems are used.

Customers must help plan and participate in a project kickoff meeting. This meeting should be widely attended, give everyone involved in the project a chance to ask questions, and be used to build excitement for the project.

Customers get what they pay for on projects, but only when they are actively involved in key activities. Customers have the sole responsibility of prioritizing their own needs, selecting a contractor to perform their project, and terminating a project that is not working. Customers and contractors share the responsibility for crafting and agreeing to a project charter, articulating requirements, developing and using project control systems, and conducting an informative and energetic project kickoff.

4.4d Chief Projects Officer/Project Management Office

Ideally, organizations should assign a person who "owns" their project management system and is responsible for all the people who work on projects. While different companies use different titles for this position (such as project director or manager of project managers), we will use the title chief projects officer (CPO). Just as organizations' size and complexity vary greatly, so does the role of CPO. Large organizations, that routinely execute projects, frequently have a project management office (PMO) and the PMO performs the CPO role. In small organizations, the CPO role may be performed informally by the CEO, who also juggles many other activities and demands. Organizations in the medium-size range may find it useful to appoint an executive, who already has other responsibilities, as the CPO. Ensuring projects are planned and managed well is so central to the success of most companies that a highly capable individual is normally assigned for this responsibility.

To be effective, the CPO must consider organizational enablers for project success: these include standardized supporting processes such as approvals and appointments; standardized execution guidance such as performance assessment criteria and templates; well-defined responsibility systems such as sponsor and project team roles; project management practices and procedures; and a mature organizational structure that fosters cooperation and joint problem solving.[16]

So, what are the responsibilities of the chief projects officer? They include ensuring that the organization's steering team does the following:

- Identifies potential projects during strategic planning
- Selects a manageable set of projects for implementation
- Prioritizes projects effectively
- Ensures enough resources (people, money, and other resources) are available to perform the projects
- Selects appropriate project sponsors and teams
- Charters the project teams
- Monitors and controls the implementation of the projects
- Rewards the deserving project managers, project teams, and individual team members
- Celebrates the results of successful projects!

The CPO also ensures that each individual serving on a project:

- Receives the training they need
- Captures lessons learned from completed projects
- Uses lessons learned from previous projects on new projects
- Uses templates and standards when appropriate

4.5 Traditional Project Management Roles

The manager-level roles in traditional projects include the functional manager, project manager, and facilitator.

4.5a Functional Manager

Functional managers are often department heads. Projects come and go, but departments generally remain. Functional managers have a large role in deciding how the project work pertaining to their functional area is done. Functional managers and project managers may negotiate who will be assigned to work on the project.

Generally, the top management of an organization decides how to divide the relative decision-making power between project managers and functional managers. Organizations that are new to formalized project management often start with functional managers having more power. Often, this changes over time due to organization's maturity in developing project management practices and the importance assigned to project management as a discipline. Regardless of organizational maturity, project managers for big projects generally have relatively more power.

4.5b Project Manager

The project manager is the focal point of the project. They spend a large amount of time communicating with everyone who is interested in the project and impacted by its outcomes. The project manager leads the planning, execution, and closing of the project. This person ideally should be a flexible, supportive, and facilitating leader. Since project managers are responsible for the project schedule, they have a major role in deciding when project activities need to be accomplished. Project managers are trusted and entrusted with delivering project results needed by their parent organizations. As such, project managers must be worthy of that trust by possessing integrity, competency, and requisite skills.

Desired Behaviors Exhibit 4.16 shows behaviors a project manager will exhibit to successfully plan and manage projects and how they relate to the ten knowledge areas of *PMBOK 6e*. This book describes some of the factual knowledge project managers must acquire to become proficient and successful. Project managers also need to acquire experiential knowledge by practicing these behaviors on projects. Not all project managers will become equally adept at each behavior, but an understanding of the behaviors exhibited by excellent project managers is a great way to start. The remaining chapters in this book elaborate on these behaviors. Collectively, all these skills and knowledge help as a person strives to become a great, well-rounded project manager.

Communication Channels Envision a bicycle wheel, as shown in Exhibit 4.17. The project manager is like the hub, and the spokes are like the many communication channels

Exhibit 4.16

Desired Project Manager Behaviors

Integrity: A PM demonstrates integrity by making honest decisions, protecting people, defending core values, leading major change, maintaining and honoring trust, showing respect, establishing a culture of honesty, and displaying total commitment to project and people.

Integration: A PM is an effective integrator by leading the chartering process, coordinating assembly of a detailed and unified project plan and its execution, balancing the needs of all stakeholders, making logical trade-off decisions, and keeping focus on primary objectives.

Scope: A PM deftly handles project scope by obtaining a deep understanding of stakeholder wants and needs, determining real requirements, learning if proposed changes are essential, disallowing unnecessary scope creep, and demonstrating needed flexibility.

Time: A PM is an effective scheduler by leading schedule development, understanding resource and logistic limitations, understanding the project life cycle, focusing on key milestones, and making schedule decisions while being aware of cost and scope issues.

Cost: A PM maintains cost control by developing an accurate understanding of project scope, calculating reliable and accurate cost estimates, controlling all project costs, and determining and honestly reporting all variances in a timely and transparent manner.

Quality: A PM achieves project quality by learning customer expectations and how they relate to organizational objectives, insisting project decisions be based upon facts, utilizing lessons learned, ensuring effective work processes are used, and leading quality assurance efforts for project quality and project management quality.

Human Resources: A PM effectively handles human resource issues by leading in a facilitating and supporting manner when possible and directing when needed, attracting and retaining good people, nurturing professional growth of project team members, developing a self-managed project team, and creating a sense of urgency.

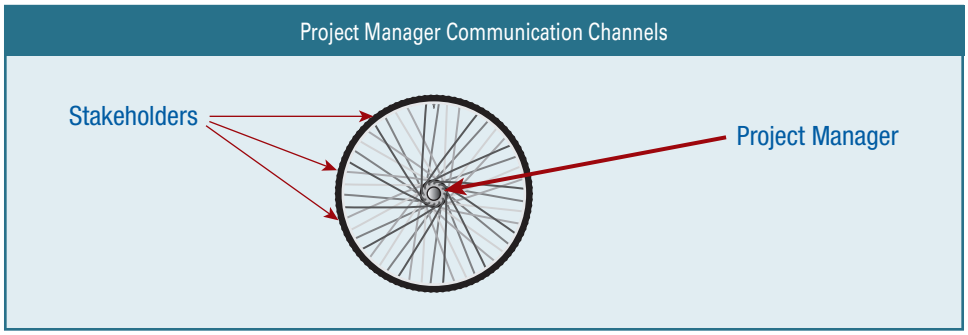
Communications: A PM displays good communications through writing, actively listening and speaking articulately, advocating the project vision, maintaining enthusiasm, focusing attention on key issues, establishing order, working through conflict, negotiating for resources and contracts, seeking support, and openly sharing necessary information.

Risk: A PM effectively deals with project risk by candidly identifying risks and opportunities, honestly evaluating each, developing avoidance strategies where practical and mitigation strategies when needed, and courageously recommending needed actions.

Procurement: A PM effectively procures needed goods and services by accurately documenting all requirements developing specifications, identifying and fairly considering all potential sellers, proactively managing contracts and relationships, and ensuring all deliveries.

Stakeholder: A PM deals effectively with stakeholders by robustly identifying all who are interested in the project and those who exert influence on project completion, asking probing questions to understand their needs and expectations, and ensuring someone on the project team maintains effective relationships with each.

Exhibit 4.17



the project manager needs to establish and use with project stakeholders. There are many project manager requirements, and while some of the technical needs can probably be delegated, every project manager needs integrity, leadership, and communications skills.

Challenges Project managers deal with several challenges. One is that they often have more responsibility than authority. This means they need to persuade people to accomplish some tasks rather than direct them to do so. However, project managers can create interesting and challenging work assignments for their team members, and many people find this stimulating. Project managers can more effectively attract followers when they display high integrity and the ability to get the job done. This includes technical, communication, and leadership abilities. Project managers primarily deal with formal and informal networks of people both within and outside their parent organization. An effective project manager knows how to get to the source of the networks. A challenge for project managers is determining how formal and informal networks function within certain organizational cultures. This is why organizational culture is so important. What are the networks within the organization? How do people work, communicate, and problem solve beneath the function of their job titles?

A rookie project sponsor and an inexperienced project manager should not be assigned to the same project. While the sponsor normally mentors the project manager, when a sponsor is new, some of the mentoring may go the other way—just as a master sergeant may help a new lieutenant learn about leading troops.

Judgment Calls Due to the very nature of projects—each one having a unique set of stakeholders, output, and project team—project managers cannot always follow a cookbook approach in how they manage. The *PMBOK 7e* emphasizes that project management tools, techniques, and decisions should be tailored both to the organization and the project itself. For this, project managers must develop judgment. Exhibit 4.18 lists some judgment calls that project managers need to be prepared to make on a frequent basis.

Competencies by Project Stage Just as sponsor demands vary by the stage of the project life cycle, so do those of project managers, as shown in Exhibit 4.19.

Project Leadership Project managers need to provide leadership in various ways. Knowing the tools and techniques of project management and even knowing the content of the professional standards such as *PMBOK Guide* is useful, but not enough. A dozen of the more common leadership challenges faced by project managers are shown in Exhibit 4.20. Another way to understand leadership demands of project managers is to consider the core competencies at a glance, as shown in Exhibit 4.21.

Exhibit 4.18

Project Manager Judgment Call

A few general questions project managers may ask themselves are when to:

- Act vs. analyze
- Lead vs. follow
- Manage vs. administer
- Repeat vs. change
- Change expectations vs. accept them
- Take over vs. let the team perform
- Focus on the big picture vs. focus on details
- Focus on technical vs. focus on behavioral
- Focus on short term vs. focus on long term
- Promote order (control) vs. promote innovation (freedom)
- Allow (constructive) conflict vs. discourage (destructive) conflict
- Focus communications inside the project vs. focus communications outside
- Demonstrate optimism vs. demonstrate pessimism
- Advocate for the project vs. accept termination
- Focus on project goals vs. organizational, personal, or team member goals
- Enhance, maintain, or accept changes in scope, quality, cost, and schedule vs. maintain baseline
- Direct vs. guide
- Manage vs. facilitate

Exhibit 4.19

Project Manager Competencies by Project Life Cycle Stage

Stage	Competency
Initiation	Effective questioning/generating feedback Persuasiveness/Marketing/Selling Listening skills Vision oriented/articulate the business problem Consensus building
Planning	Project management skills and knowledge Consensus building Technical skills/theoretical knowledge
Implementation	Ability to get along/team player Results oriented Truthful/honest
Close	Writing skills Share information and credit Pride in workmanship/quality truthful/honest

Source: Skulmoski, Gregory J., and Francis T. Hartman, "Information Systems Project Manager Soft Competencies: A Project-Phase Investigation," *Project Management Journal* (March 2010): 61–77.

4.5c Facilitator

Some project management situations require facilitation because the situation is so complex and/or because the opinions are so varied. Sometimes, the people on a project need to expand

Exhibit 4.20

A Dozen Project Leadership Challenge

General Project Leadership
- Provide situational and shared leadership
- Develop trust
- Manage and negotiate conflicts
- Manage political, social, cultural, and ethical issues

Team Leadership
- Develop high-performing project teams
- Participate in self-organizing project teams
- Overcome team-building obstacles
- Facilitate team decision making

Stakeholder Leadership
- Engage all stakeholders
- Influence stakeholder behavior
- Maintain effective multidirectional communications
- Deal with changes in the environment and within the project

Source: Adapted from unpublished discussion of Project Management Executive Forum meeting, October 10, 2016, Cincinnati, OH

their thinking by considering the many possibilities (possible projects, approaches, risks, personnel, and other issues). Other times, the people on the project need to focus on selecting from many options (a project, an approach, a contractor, or a mitigation strategy). Most project managers and sponsors can and do facilitate many meetings. However, the project manager may prefer to focus on the content of a meeting and enlist a facilitator to help focus on the process of the meeting. In these situations, an outside facilitator may be useful. Often, a disinterested sponsor or project manager (one who works on other projects, but not on this one) is used when a facilitator is needed. Sometimes, the chief projects officer or an outside consultant is used to facilitate.

4.6 Traditional Project Team Roles

The team- or associate-level roles in projects are core team members and subject matter experts (SMEs).

4.6a Core Team Members

Core team members are the small group of people who are on the project from start to finish and who jointly, with the project manager, make many decisions and carry out many project activities. If the project work expands for a period of time, the core team members may supervise the work of SMEs who are brought in on an as-needed basis. Ideally, the core team is as small as practical. It collectively represents and understands the entire range of project stakeholders and the technologies the project will use. It is generally neither necessary nor useful to have every single function represented on the core team, since that would make communication and scheduling meetings more difficult. Also, if every function is represented directly, team members tend to fight for their function.

The ideal type of core team member is one who is more concerned with completing the project (on time, with good quality, and on budget, if possible) than with either gaining

Exhibit 4.21

Today's Project Manager Core Competencies

Today's Project Manager
Core Competencies

AT A GLANCE
What Project Managers need today to be successful

Today's PM must be a LEADER	Today's PM must understand BUSINESS	Today's PM must be a CONTINUOUS LEARNER	Today's PM must be committed to the PROFESSION	Today's PM must have extensive EXPERIENCE	Today's PM is in the "PEOPLE BUSINESS"
Decision maker, lead by example, have integrity	Strategic thinker, company goals	Skills training, ongoing education	PMI Certification: PMP®, CAPM®	Different size projects & complexity	Stakeholders, project teams, communicator
Goal setting, results driven, be accountable	Finance, customer & internal needs	PM terminology, PM best practices	Program Mgmt, Agile, other PMI certifications	Virtual teams, global projects	Motivate, inspire, reward and recognize
Ask questions, active listener, follow-through	Industry, market	Sales skills, continuous improvement	Industry and technical certifications	Diversity in viewpoints, backgrounds, teams, cultures	Relationship builder, influencer, get buy-in
Project leader and business leader	Competition, trends	Project close-out: use Lessons Learned	Volunteer projects, contribute your expertise	Proven success on projects and teams	Maximize everyone's strengths

Developed by Connie Plowman, PMP, based on her experiences as a hiring manager, practitioner and instructor. *connie@plowman.us* *www.linkedin.com/in/connieplowman*

Source: Connie Plowman, PMP, Chief Operating Officer (retired), PMI Eric Jenett Project Management Excellence Award Recipient

personal glory or with only doing work in their own discipline/function. The core member does what it takes to get the project done.

4.6b Subject Matter Experts

While core team members are typically assigned to the project from start to finish, projects also have a specific and temporary need for additional help. The necessary help may be from an expert who can help make decisions. Or, it may be extra workers who are needed at a busy time during the project life. Some extra help may be needed for as little as one meeting; other extra help may be needed for weeks or months. These subject matter experts (SMEs) are usually needed for their specific expertise.

SMEs are brought in for meetings and for performing specific project activities when necessary. A project could have almost any number of SMEs, depending on its size and complexity. SMEs are not on the core team but still are essential to the project. SMEs could be on a project for a long duration and thus be almost indistinguishable from core team members.

However, SMEs may spend only a little time on a particular project and, therefore, may not invest their expertise and time into it fully. At times, it is also a struggle to schedule

SMEs and get their commitment for project work. Typically, a project manager would have a newly assigned SME review the project charter and the minutes from the last couple of meetings before discussing the project with him. It is a balancing act to ensure that the SME understands what she needs to do and how important it is, without spending a great deal of time in the process.

4.7 *PMBOK Guide 7e*

PMBOK 7e Domains Impacting Chapter 4

- Team
- Development Approach and Life Cycle
- Project Work
- Tailoring (additional section of *PMBOK 7e*)

4.7a Team

Many of *PMBOK 7e's* suggestions for team work and management come from adaptive (Agile) or hybrid practices. It recommends fostering a sense of shared ownership among team members and empowering them to be self-managing to the greatest extent possible. Irrespective of the organization structure, it encourages project managers and other leaders to take adopt a "servant leadership" mentality, in which their main roles are removing obstacles, shielding the team from diversion, and providing encouragement and development opportunities.

PMBOK 7e also emphasizes the need for project leaders—and, ideally, all project team members—to have a high degree of emotional intelligence. This is comprised of self-awareness, self-management, social awareness (i.e., empathy), and social skills. Despite its advocacy for empowering teams, *PMBOK 7e* also refers to situational leadership and recognizes that leadership style, like everything else in project management, needs to be tailored appropriately to the situation. Different approaches are likely to be successful in various cases. Project teams are expected to carve out a work culture that promotes leadership, empowerment, and collaborative effort.

4.7b Development Approach and Life Cycle

An organization's structure and culture will help determine which development approach is used and what a project's life cycle looks like. In turn, the development approach will largely determine what the team members' roles look like. While the terms *development approach* and *life cycle* are sometimes used interchangeably, *PMBOK 7e* emphasizes that they are distinct from one another. The development approach refers to which methodology is being used (predictive, iterative, adaptive, incremental, hybrid), while the life cycle depicts the series of phases through which the project will progress.

4.7c Project Work

The developmental approach and life cycle along with the organizational structure and culture will determine when and how project work is executed and delivered. Regardless of how and when work is delivered, the focus should not only be on the deliverables themselves but also on the benefits and value they can provide.

4.7d Tailoring

Perhaps one of the greatest changes in the new *PMBOK 7e* is its emphasis on tailoring. We are advised to choose a developmental approach (predictive, hybrid, or adaptive) and then tailor everything we do first for the organization and then for the project itself. Tailoring is not a one-time exercise but rather something to be considered throughout a project. As such, the organization's culture and structure will have a large influence on almost every project-related decision.

4.8 Agile Projects and Organizational Capability

4.8a What Is Agile?

Agile is a form of adaptive or change-driven project management that largely reacts to what has happened in the early or previous stages of a project rather than planning everything in detail from the start. From this perspective, it is quite different from plan-driven or traditional project management, as shown in Exhibit 4.22.

Exhibit 4.22

Comparison of Plan-Driven and Agile Approaches for Organizational Capability

Organizational Capability Questions	Plan-Driven	Agile
What project characteristics suggest using this approach?	Scope is definable early	Outcomes are definable early; needed deliverables to achieve those outcomes are harder to define at project outset
What advantages do you expect by using the appropriate approach depending on ability to define scope early?	Increased ability to firmly commit to details and increased adherence to plan	Increased visibility, adaptability, and business value while decreasing risk
What defines success?	Meeting scope, schedule, and cost agreements	Providing business value by helping client achieve desired outcomes
How do you start a project?	Charter, then detailed plan	Charter, then backlog, first release plan, and first iteration plan
How does the project life cycle proceed?	Plan then do	Iterative or continuous
How much time is spent planning?	Significant, mostly early in the project	Significant, throughout project
How is progress planned and communicated?	Plans, milestones, updates, and change orders	Backlog refinement, release planning, iteration planning, daily-scrum, demonstration, and retrospective meetings
How are customers and suppliers treated?	Fairly—as stakeholders	Fairly—as collaborators
What are key roles?	Sponsor, project manager, core team member, subject matter expert	Sponsor, product owner, scrum master, development team member

4.8b Agile Terms Used in Organizational Capability

Duration	The time-boxed length of sprints such as one or two weeks
Experimentation	Encourage individuals and teams to try, perhaps fail, and share lessons
Empiricism	Work in a fact-based, experienced-based manner
Small releases	Provide tested, working product often to deploy to users
Product increment	The deliverables created and accepted during a sprint
Stakeholder vision	Part of charter in which initial scope, technology, risk, and so on are agreed upon
Lean (aka Kanban) life cycle	Continuous workflow with highly visible information
Proven approach	Milestone early in planning and execution when approach is verified to reduce risk
Continued viability	Milestone(s) in planning and execution to ensure a team is making progress
Production-ready	Milestone at end of planning and executing when a product is tested and complete, and users are capable of accepting and effectively using it
Hybrid	Approach that combines Agile and plan-driven or two different Agile approaches such as lean and scrum

In this book, we use many Agile terms and definitions from Anantatmula, V., and T. Kloppenborg, *Be Agile Do Agile* (New York, NY: Business Expert Press, 2021).[17]

4.8c Agile Manifesto Principles to Cover

4. People representing business and the development team must work together constantly.
8. Sustainable development requires sponsors, developers, and users to work at the same pace.

4.8d Why Use Agile?

As briefly discussed in earlier chapters, a plan-driven approach is often desirable when the scope of the project can be defined early with reasonable accuracy. On the other hand, when the client is ambiguous about project deliverables or has a wish list of outcomes that are vague and cannot be defined early on, an adaptive method like Agile is adopted.

With the traditional approach, a firm plan can be developed with complete identification of resources required and a near-accurate estimation of costs and **duration** for completing the project. However, Agile projects offer visibility and adaptability with a goal of enhancing business value while decreasing risk.

Traditional plan-driven project management works well in many situations, but if the scope is hard to define early in the project and/or when much change is expected, Agile often works better. For these ill-defined and rapidly changing projects, an Agile approach can decrease time, cost, and risk while increasing visibility and innovation to enhance value and improve productivity.

4.8e What Is an Agile Mindset?

While much has been written about Agile, starting with the Agile Manifesto, a simplified version of the mindset to successfully plan and manage Agile projects boils down to five key ideas:

1. Satisfy the customer by placing emphasis on outputs that add business value.
2. Engage all participants through empowerment, cooperation, **experimentation**, and knowledge sharing.
3. Facilitate that engagement through leadership and visible, continual communication.
4. Keep things simple with a sustainable pace or cadence and emphasis on process improvement through **empiricism**—learning through facts and experiences.
5. People representing business and the development team must work together constantly.

Some projects have portions that are best planned and managed in an agile fashion and other portions that are best managed in a plan-driven fashion. These project life cycles are called hybrid as they use parts of more than one methodology."

4.8f What Is Needed for Agile to Be Successful?

Experienced and motivated team members are needed because one hallmark of Agile is self-managed teams. Without experience and willingness to be a cross-functional team member, the teams would likely flounder. A key stakeholder, often called the product owner, needs to commit to frequent and detailed meetings with the development team both for initial chartering and requirements gathering, but also for ongoing prioritization and evaluation. Trust between the client and contractor (or user and developer) is necessary because the details of the requirements and scope are initially unknown and everyone should work in the interest of the client to create value. Trust is also necessary, as the client needs to prioritize work to get maximum value, given time and resource constraints, and the project team needs to commit to creating output during each iteration or sprint.

4.8g What Is an Agile Project Life Cycle?

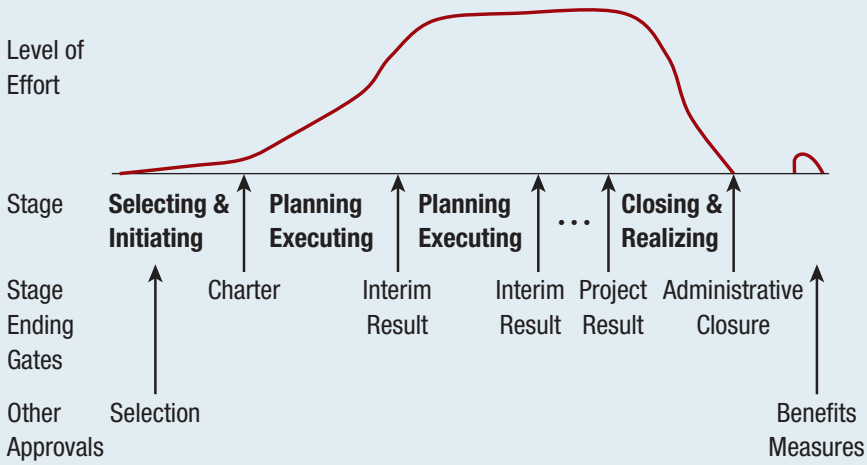
An Agile project should start with a charter, as any other project should. This high-level agreement between the product owner, scrum master, and empowered team will help to define and share the compelling project vision, create commitment, uncover risks, identify stakeholders, ensure common understanding of success criteria, and establish working agreements and ground rules.

Once the charter is approved Agile teams identify a prioritized wish list of potential deliverables called a product backlog, then release a first iteration plan and consider backlog items after the first iteration is complete. In other words, an iterative plan is used as compared to the plan-driven approach of developing a comprehensive project plan at the beginning. Often, the first iteration is used to determine the viability of the approach or of the product to be built and prioritize the most valuable work for the next iteration.

Deliverables created on Agile projects are called products. Agile projects create products in **small releases**, verifying that they are acceptable to their customers. Each small amount of functionality that is released to the customer is called a **product increment**-and all of the increments that are released during the entire project add up to the total product the project team produce.

Exhibit 4.23

Agile Project Life Cycle with Measurement Points



Source: Anantatmula, Vittal, *Project Teams: A Structured Development Approach* (New York, NY: Business Expert Press, 2016): 136–139.

Documentation is minimal early in the project but becomes progressively more complete. Project teams plan in short bursts (generally of one to four weeks), often called sprints or iterations. The details are planned for the upcoming iteration and very little change is allowed during the iteration or sprint. Products are defined and delivered one iteration at a time with an output that has business value successfully delivered at the end of each iteration. Then the next iteration is planned.

An Agile life cycle model is shown in Exhibit 4.23. Just as any other project, Agile projects need to be selected and initiated. Charters are frequently used with Agile projects, as described in Chapter 3. Understanding of and agreement with the **stakeholder vision** is key in Agile charter acceptance. Note that planning and executing project work continue together. On **lean** Agile projects, planning and executing are continuous. On other Agile projects, they occur repetitively. These increments are time-boxed, often every one to four weeks so all participants can work at a sustainable and predictable pace. Often, the first work performed after chartering is to ensure a **proven approach** is understood and accepted by everyone. At the end of each subsequent iteration, the primary goal is to show the project has **continued viability**. This is accomplished by delivering something of value to the customer at each point. Near the end of each iteration and the project, the team ensures the products are **production-ready** with testing complete and clients ready to accept and use the deliverables. Just as in any well-managed project, benefits should be measured after clients have used the deliverables. One other thing to note regarding agile life cycles is that often the project does not end as the product owner simply selects more items from the backlog for the team to create and they keep working to improve and support the product indefinitely.

4.8h What Are the Key Roles in Agile Projects?

Agile project roles are shown in Exhibit 4.24. Most of the same work still needs to be accomplished in organizations using Agile methods. Some of the work is performed

Exhibit 4.24

Agile Project Roles

Executive Roles	Managerial Roles	Associate Roles
Product owner	**Product owner**	**Team Member**
Sponsor (product manager)	Scrum Master	
Portfolio Team	Functional Manager	
Project Management/Scrum Office	Coach	

by different people, as there is an emphasis on empowering teams. Collaborative effort and communication—specifically with the client—are common features of Agile project teams. The three most essential and continuous roles are product owner, scrum master, and team member.

The product owner is responsible for the return on investment earned by the project and accepting or rejecting the deliverables at the end of each iteration. She ensures that the needs and wants of the various constituents in the customer's organization are identified and prioritized and that project progress and decisions continually support the customer's prioritized needs. The product owner does much of what a sponsor might in traditional projects. The product owner works with the team on a continuous basis, often performing some of the work a project manager might on a traditional project. The product owner role is so continuous and active that we show it as both an executive- and managerial-level role.

The scrum master serves and leads in a facilitating and collaborative manner, emphasizing the need to add value and remove obstacles. The scrum master is a more limited, yet more empowering role than that of a traditional project manager. This is wholly consistent with contemporary project management, since many individuals do much better work when they actively plan rather than have work assigned to them. The scrum master guides team members as they prioritize tasks and removes obstacles to their progress. In this book, we consider the scrum master to be the project manager.

The team members in Agile projects are assigned full-time and co-located as much as possible. The teams are self-governing and accomplish many of the planning and coordinating activities a project manager would typically perform. Since the team members in Agile projects are assigned full-time as much as possible, there are very few subject matter experts. Small and co-located teams often characterize Agile projects, and they work closely together. They organize themselves and exhibit significant maturity. They create their own estimates and report to each other daily. The same members should be on the team for the entire project or at least for an entire iteration, although the team can change from one iteration to the next.

Several other roles are included on some Agile projects. There also may be a designated sponsor (sometimes known as a product manager) who controls the budget. A portfolio team often performs much of the work of a traditional steering team and a similar office that may be titled differently, such as scrum office, performs much of the work of a project office. The functional manager (sometimes called a resource manager) has a similar, but sometimes more limited, role than the traditional department head. Many organizations using Agile also have a coach—acting as a facilitator and trainer.

Exhibit 4.25 describes how one company defines the three key agile roles of product owner, scrum master, and team member.

Exhibit 4.25

Key Agile Roles at TQL

Total Quality Logistics, LLC (TQL), along with its subsidiary TQL Global, LLC ("TQL"), is one of the largest freight brokerage and third-party logistics firms in North America. The company arranges the global movement of freight using a variety of modes and services, like truckload, rail, and warehousing. TQL uses propriety technology and 24/7/365 customer service to keep customers informed about the location and status of their freight.

At TQL, Product Owners and Application Development teams are aligned by focus area/product line, allowing them to specialize in one area of the business to create efficiencies and maximize value. Key roles include:

Product Owner

- Partners with business units such as such as Marketing, Sales, Operations, Customer Service, and Accounting to understand their needs and develop solutions that will benefit internal and external customers
- Prioritizes backlog of work and sets the roadmap for their Product Line
- Signs off on business requirements and definition of "done," which are translated into features and user stories by a Business Analyst

Scrum Master

- Assigned to two or more Scrum teams consisting of four to eight members
- Facilitates Scrum ceremonies including daily standups, sprint planning, refinement, and retrospectives on a two- or four-week sprint cycle
- Communicates sprint goals, progress, and accomplishments to stakeholders via mid-sprint and end-of-sprint summary emails
- Tracks and report Key Performance Indices (KPIs), removing impediments to velocity

Team Member

- Asks questions and provides input during backlog refinement sessions in order to shape and better define requirements
- Estimates the size of user stories to assist with sprint planning
- Writes code in accordance with business requirements to complete features for release
- Provides updates on progress in daily standup meetings

Source: Rebekah Wilks, PMO Director Total Quality Logistics

Summary

Projects are accomplished either within an organization or between multiple organizations when different firms work together. Project managers are more effective if they understand the impact the organization and surrounding environment has on the project. In contemporary society, different organizations choose different organizational structures to realize advantages depending on their unique circumstances. While many organizations still officially use a traditional functional organizational structure, an increasing number of organizations have at least informal matrix relationships. The days of having only one boss are gone for many employees—and especially for many project managers. Each form of organization has strengths and challenges with respect to projects and project performance.

Organizations also have a culture—the formal and informal manner in which people relate to each other and make decisions. The hierarchical approach with the boss having supreme authority has long vanished in many places. Many organizations today use a more collaborative approach—some much more than others. Whatever the approach, project managers need to understand it and the impact it creates on their project. Project managers and sponsors need to create a culture in their project that is consistent with, or at least can work effectively with, that of the parent organization. Both organizational structure and culture can become more complicated if more than one organization is involved in the project and if they differ in these respects.

Projects follow a predictable pattern or project life cycle. Many industries have typical project life cycles, but they vary greatly. A project manager needs to at least understand what development approach and project life cycle model is used at her organization and often needs to select or modify the project life cycle to the specific demands of the project.

Multiple executive-, managerial-, and associate-level roles need to be performed in projects. The project manager is a central role and the subject of this book. Project managers need to understand the other roles and relate effectively to them, regardless of whether their project is being conducted using a traditional, Agile, or **hybrid** approach.

Key Terms Consistent with PMI Standards and Guides

functional organization, 115
projectized organization, 116
co-location, 117
matrix organization, 118
milestone, 127
agile, 139
product owner, 141
scrum master, 143
team members, 143

Key Terms Consistent with Agile Practice

Duration, 140
Empiricism, 141
Experimentation, 141
Product increment, 141
Small releases, 141
Stakeholder vision, 142
Lean (aka Kanban) life cycle, 142
Proven approach, 142
Continued viability, 142
Production-ready, 142
Hybrid, 145

Chapter Review Questions

1. Describe how a strong (project) matrix is different from a weak (functional) matrix.
2. Which organizational structure is often used for small projects that require most of their work from a single department?
3. List advantages and disadvantages of functional, projectized, and matrix forms of organization.
4. What is co-location, and why is it used?
5. What are organizational values, and why should a project manager be aware of them?
6. List and describe four different types of corporate culture.
7. If more than one parent company is involved in a project, why is it important for the project manager to understand the culture of each?
8. The project manager and sponsor need to act in the best interest of which three constituencies?
9. According to the *PMI Code of Ethics and Professional Conduct,* project managers need to exhibit which four behaviors?
10. In your own words, describe an ethical project culture.
11. What are some characteristics of almost all project life cycles?
12. What does the DMAIC model acronym stand for? When is this type of model used?
13. What distinguishes an Agile project life cycle model from other types of life cycle models?
14. For what five activities is the project steering team responsible?
15. Who should select the project manager and the core team?
16. Who is responsible for ensuring that the steering team completes its tasks?
17. What types of control systems should a customer and contractor work together to set up and utilize?
18. What is meant by the term "servant leadership," and how does it apply to project management?
19. What does it mean to have team members with high "emotional intelligence?"
20. What is the difference between development approach and life cycle and how are the two related?

Discussion Questions

1. Marissa Mayer, former CEO of Yahoo!, sparked a national debate when she insisted that all her employees be physically present for work. Debate the merits of co-location, including its advantages and disadvantages.
2. Identify each of the four organizational culture types with respect to power, and the strongest motivator for each type. In which organizational cultures do you feel most and least comfortable working? Why?
3. List and describe at least four organizational culture characteristics that increase the likelihood of project success. Why is each characteristic helpful?
4. Explain multiple methods through which project managers can lead by example and/or demonstrate servant leadership.
5. Define your personal project code of ethics.
6. Brainstorm techniques that effective project leaders can use to resolve ethical conflicts on projects. How could a self-regulating Agile team resolve similar conflicts?
7. You work for a software company. What benefits do you achieve by utilizing an Information Systems project life cycle model as opposed to other project life cycle models?
8. If a project will be divided into many phases, which development approach and life cycle model would you recommend using to plan it? Why?
9. Describe a possible imbalance between a project manager's authority and responsibility. What impact might it have on a project?
10. Is it important to choose a member from every impacted function of a project for the core team? Explain why or why not.

PMP Exam Study Questions

1. All of the following are characteristics of a projectized organization *except:*
   a. Decision making is streamlined.
   b. Coordination is the responsibility of project managers.
   c. Functional managers have the majority of authority.
   d. Focus is on the customer.
2. Characteristics of an organizational culture can have a major impact on a project's success. All of these are attributes of an organizational culture *except:*
   a. motivation and reward systems
   b. risk tolerance
   c. code of conduct
   d. financial control procedures
3. _____ organization structures can be classified as weak, balanced, or strong, depending on the relative level of influence between the functional manager and the project manager.
   a. Silo
   b. Matrix
   c. Composite
   d. Projectized
4. How should we tailor project work?
   a. to the organization only
   b. to both the organization and the project itself
   c. to the project only
   d. project work is prescribed and should not be tailored
5. In an Agile life cycle model, _____.
   a. the scrum master controls the team
   b. detailed planning precedes execution
   c. customer requirements are gathered early in the project
   d. the team is self-directed
6. The project sponsor's responsibilities during the executing stage include:
   a. reviewing and signing the project charter
   b. signing off on the detailed project plan
   c. ensuring communications with key stakeholders
   d. producing project status reports
7. Group phenomena that evolve over time and include established approaches to initiating and planning projects, the acceptable means for getting the work done, and recognized decision-making authorities are referred to as:
   a. organization structures
   b. roles and responsibilities
   c. project culture (norms)
   d. vision and mission
8. Customer responsibilities on a predictive (or plan-driven) project might include all of the following *except:*
   a. perform the work of the project to achieve its objectives
   b. advise on project requirements
   c. review and accept project deliverables
   d. participate in status or kickoff meetings

9. The Chief Projects Officer's or PMO's responsibilities might include:
   a. signing the project charter
   b. ensuring enough resources are available to perform the project
   c. working with the team to create a project schedule and budget
   d. promoting the project at the executive level of the organization

10. PMI's *Code of Ethics and Professional Conduct* is a guide for project management practitioners that describes the expectations that they should hold for themselves and others. Which of these is *not* one of the desired behaviors and basic obligations referenced by the code of conduct?
    a. fairness
    b. honesty
    c. authority
    d. respect

Exercises

1. Given a scenario, select a preferred organizational structure and justify your selection.
2. Describe examples of ethical (or nonethical) behavior as outlined in PMI's Code of Ethics and Professional Conduct exhibited on a project in the news.
3. Describe, with examples, how a project manager on a project you have observed did or did not exhibit desirable project manager behaviors as described in Exhibit 4.16.
4. Briefly describe how the sponsor of your project is or is not displaying appropriate life cycle–specific behaviors as described in Exhibit 4.19.

Integrated Example Projects

Suburban Homes Construction Project

Suburban Homes, once a medium-sized company, is rapidly expanding its business to southern states and is focused on maintaining its status as the fastest-growing construction company in the Midwest region of the United States. Its significant growth and good reputation for building quality single-family homes and townhomes presents both challenges and opportunities.

Suburban Homes is considering various options to expand its operations while retaining its focus on managing resources effectively and efficiently to increase profits:

- Given the nature of its projects, Suburban Homes is considering either a projectized or matrix organization structure. However, a functional organization structure has not been ruled out.
- With its focus on maintaining high quality in its construction tasks and end-product (home for the customer) as well as quality assurance in implementing project management processes, the company is actively considering a combination of the DMAIC model with a traditional project life cycle approach.
- Organization culture plays an important role in sustaining and promoting efficiency. The culture, in turn, is influenced by the organization structure. Suburban Homes is highly committed to employee development and functional expertise through training, mentoring, and collaborative learning.

Which type of organization structure is more suitable as Suburban Homes opens new offices in other states? What is your advice to the company to address all these issues comprehensively and coherently?

Heritage Arboretum Development Project

When this project was envisioned, it was possible to state a vision for the outcomes, but way too premature to try to describe specific outputs. Therefore, it made sense to use an agile approach. Success from this project is defined as helping the customer achieve their desired outcomes. These outcomes include securing arboreta status so the center

could be rented more frequently and for a higher rate along with educating citizens, especially on native plants.

An Agile approach allowed for increased visibility for stakeholders to see the plan implemented a bit at a time and to make adjustments. When certain early plans did not materialize, it allowed for adaptations. An example of this was when the garden tour date was announced for the first year of the arboretum, that date had already been rented out, so the arboretum could not be on the garden tour. Since an educational event is an essential component of arboreta status, plans shifted quickly to hosting local science teachers to encourage them to engage their students and with the state forester to bring in tree commissioners from other jurisdictions to show them how to create an arboretum.

Anderson Township's organizational structure has three elected Trustees with various departments and volunteer advisory committees. The departments impacted by this project include:

- planning and zoning (for the overall planning and how this fits in the community),
- operations (for maintenance),
- events (for site rental), and
- public works (for protecting greenspace).

The committees offer advice. Each has one Trustee and at least one staff member who works with them. The citizen volunteers on each committee are appointed one year at a time, expected to attend bi-monthly meetings, encouraged to help further, and may reapply for future years. The committees impacted include:

- Tree (to promote appropriate tree planting and maintenance),
- Greenspace (to perpetually retain designated greenspace in its natural state), and
- WeTHRIVE! Anderson (to promote beauty, clean-up, and health).

The Agile life cycle of this project started with the equivalent of a charter by the Trustees giving permission to apply for arboretum status. Arboretum status was granted based upon agreement to develop plans, maintain the facility, and use it for educational purposes. While the master plan was being developed, enthusiastic volunteers opportunistically planted some trees. It was determined that future plantings would only be accepted if they fit with the master plan. The master plan includes a vision statement, site conditions, design concept, both current and planned site maps, and recommendations specifically identified for the first year and generally identified for some time in the next four years. This master plan was iteratively developed by a few members of the Tree Committee with as much input as was possible to acquire from staff and other committees. It was presented to the Tree Committee, then the Trustees, then at the Trustees annual planning meeting with all managers from Township staff. This development and presenting of the master plan effectively shared the vision, helping to transition from initiation to planning and implantation. This master plan serves as a general roadmap for the next four or five years and specific plans for short-term development will be developed from it.

Other Agile concepts are being used on this project. One is to demonstrate a proven approach. The site map and concept included a "buffer zone" to transition from lawn into woods. Even though all stakeholders saw that, it was not until flags were placed to show exact planting spots for trees and shrubs that some stakeholders envisioned exactly what was planned and then objected. The sites for the plantings were moved and the number of plantings were reduced in response. Further, some stakeholders have said to possibly wait a year for more planting to see how this looks and how maintenance is impacted. This is an example of operating in an experiment-based manner. Progress and plans are reported every two months to the Tree Committee and every year to the Trustees.

One key question is how roles should be defined and who should fill each role. As the project started, the Greenspace Inspector took the active role from the Township side, acting as product owner. This person, however, did not have the full authority to also act as sponsor. Some of the other impacted staff functions provided active input and others did not. One Tree Committee member acted as scrum master. However, due to the pandemic and cold winter weather, meeting in person was very difficult. Since many people involved are volunteers, scheduling virtual meetings and even securing timely feedback was sometimes difficult. All projects meet challenges, and rather than use them as excuses, methods needed to be developed to overcome them. On this project, there were more informal meetings and calls and texts between two or three people rather than larger teams.

Questions for Students:

1. How can planning and implementation of this project be simplified?
2. Define roles and expectations for each role.
3. How would you get all stakeholders to work together if you were the scrum master?
4. What do you feel is a sustainable pace for this project and why?
5. How can team members effectively utilize the following Agile principles to advance these projects?

- Accept simplicity
- Embrace change
- Maximize value
- Provide and respond to rapid feedback

Semester Project Instructions

For your example project, describe the organizational structure of the agency or company for which you are planning the project. Describe as many of the organizational culture attributes as you can. List, by name, as many of the project executive, management, and team roles as you can identify. Be sure to assign roles to yourself and your classmates if you are doing the project as a team. How do you anticipate that the organizational structure, culture, and role assignments help or hurt your ability to successfully plan this project? Describe the project life cycle model that is used in the organization—and if one is not currently used, describe the life cycle model you plan to use and tell why it is appropriate.

Project Management *in Action*

Project Leadership Roles at TriHealth

TriHealth is a company that manages several large hospitals and a variety of other health organizations, such as physical fitness facilities and nursing services. Due to the company's increasing size and complexity, TriHealth leadership decided they needed to formally define roles of project executive sponsor, project leader, performance improvement consultant, core team member, and subject matter expert. These roles are shown as follows.

Project Executive Sponsor Initiating Stage

- Empower Project Leader with well-defined charter, which is the overarching guide.
- Clearly define expected outcomes.
- Demonstrate commitment to and prioritization of project.
- Define decision-making methods and responsibility—sponsor/project leader/team.
- Partner with Project Leader to identify obstacles, barriers, and silos to overcome.

Planning Stage

- Ensure Project Leader understands business context for organization.
- Ensure Project Leader develops overall project plan.
- Assist Project Leader in developing vertical and horizontal communication plan.
- Demonstrate personal interest in project by investing time and energy needed.
- Secure necessary resources and organizational support.

Executing Stage

- Communicate and manage organizational politics.
- Visibly empower and support Project Leader vertically and horizontally.

- Build relationships with key stakeholders.
- Actively listen to and promote team and project to stakeholders.
- Remove obstacles and ensure progress of project.
- Ensure goals are met and stakeholders are satisfied.

Closing Stage

- Ensure closure, planned completion, or termination.
- Ensure results and lessons learned are captured and shared.
- Ensure assessment of related applications or opportunities.
- Ensure any necessary next steps are assigned and resourced.
- Recognize contributions and celebrate completion.
- Negotiate follow-up date(s) to assess project status.

Project Leader

All of the roles listed are the ultimate responsibility of the Project Leader. However, in the development of the charter, the Sponsor and the Project Leader will have a discussion about the Project Leader role. At that time, the individuals will determine if the Project Leader needs additional assistance or skills to facilitate the project success and which of these responsibilities need to be delegated to others with expertise in those areas.

- Leads negotiation with Sponsor for charter definition.
- Collaborates with Sponsor to clarify expectations.
- Provides direction to the team with integrity, leadership, and communication skills.
- Facilitates productive meetings and supports the team's decisions.
- Prepares the high-level work plan and timeline.
- Champions the project on the management level and with the staff.
- Leads the implementation of the project.
- Manages project flow, including agenda setting, meeting documentation, and coordination of team assignments.
- Develops implementation, education, and communication plans for the project.
- Responsible for the team and project progress and proactively intervenes to promote team and project success.
- Identifies, communicates, and facilitates the removal of barriers to enable successful project completion.
- Supports the team with tools and methodologies to accomplish goals.
- Facilitates collection and analysis of data.
- Leads the team in developing a plan to sustain the change and monitor effectiveness.
- Leads the team in developing recommended next steps.
- Closes project with Sponsor and ensures lessons learned are captured.
- Establishes with Sponsor the dates for post-project checkup and overall measurable effectiveness of project.

Performance Improvement Consultant

If the Sponsor and the Project Leader determine additional support/expertise is needed, a Performance Improvement Consultant can provide the following expertise:

- Provides direction to the Project Leader in establishing targets and a measurement and monitoring system.
- Mentors the Project Leader on leading the team through the project management process.
- Collaborates with the Project Leader to prepare a work plan and timeline for the project.
- Proactively intervenes to promote team and project success based on teamwork and interactions.
- Assists the Project Leader in identifying, communicating, and removing barriers to enable successful project completion.
- Assists in the researching, best practices, and benchmarking.
- Coaches the Project Leader on the development and implementation of a comprehensive communication, education, and change management plan.
- Provides the Project Leader support in ensuring regular communication with the Sponsor and Stakeholders.
- Offers expertise to the team with tools and methodologies to accomplish goals.
- Collaborates with the Project Leader on the collection and analysis of data.
- Ensures a system-wide perspective is considered and downstream effects analyzed.

- Provides change management education and assists the Project Leader in developing key strategies for successful change management.
- Provides coaching to the Project Leader on key strategies for successful planning, implementation, and sustainability of the project.

Core Team Member

- Takes responsibility for the success of the team.
- Attends meetings for duration of the project.
- Actively participates in team meetings.
- Understands the entire range of the project.
- Actively participates in the decision-making process.
- Supports the team's decisions.
- Completes outside assignments.
- Carries out many of the project activities; produces deliverables on time.
- Provides testing or validation of decisions being made by the team.
- Provides data collection and reporting.
- Participates in the communication, education, implementation, and evaluation of the project.
- Gathers input from the areas they represent, if appropriate.
- Shares team decisions and plans throughout the project.
- May work directly with Stakeholders or Subject Matter Experts.

Subject Matter Expert

- Not a core team member of the team.
- Participates in demonstrations/presentations and/or team meetings, as needed.
- Carries out project activities as assigned; produces deliverables.
- Responsible for supplying requirements.
- Provides input to the team or complete activities based on a specific expertise they possess that is essential to the project.

Source: TriHealth.

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Chapter 5

Leading and Managing Project Teams

Chapter Objectives

Core Objectives:

- **5-1** Discuss stages of team development and strategies to move teams through the project life cycle.
- **5-2** Describe characteristics of a high-performing project team.
- **5-3** Compare project team decision-making methods and the circumstances in which each is likely to be most effective.
- **5-4** Describe collaborative leadership, empathy, and relationship building in teams.
- **5-5** Explore ways to utilize the project team relationships and ground rules to improve them.
- **5-6** Discuss types of power and determine when each type is appropriate for the project manager.
- **5-7** Describe typical sources of project conflicts and the steps in a conflict-resolution process, strategies for managing conflict, and steps in a negotiation process.
- **5-8** Summarize ways to develop high-performance traditional and virtual teams.

Agile Objectives:

- **5-9** Describe characteristics, composition, and governing principles of Agile teams.
- **5-10** Identify key tenets of Agile leadership.
- **5-11** Discuss pros and cons of transformational, servant, and developmental leadership for Agile projects and decide the one that is best suited to your Agile project.

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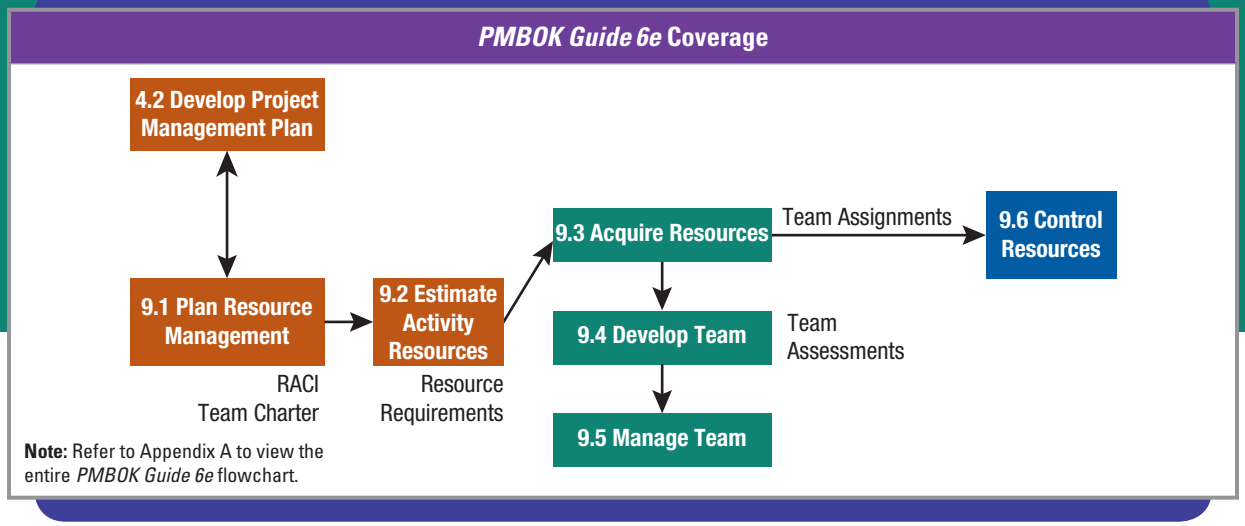
Gallup Consulting is a global research-based consultancy, specializing in employee and customer management. Our goal is to take discoveries in behavioral economics and apply them to management and business problems. Every organization has an enormous, but largely untapped, potential for breakthrough improvements in productivity through leveraging how human nature drives business performance. This unrealized potential can be measured and managed to improve performance.

Our consulting work is managed as a series of projects. At the start of each client engagement, project leaders gather the high-level information required to identify the client's problems and possible remedies, while understanding any constraints that will affect project success over the long term. The resulting project charter is a business case for the project and a description of how Gallup will add value to the client's organization. Codifying these commitments also helps in enumerating the roles and responsibilities of the project team members.



PMBOK Guide 7e
Domains:
- Team
- Stakeholders
- Development Approach
- Planning
- Delivery
- Measurement
- Uncertainty

Staffing a team is critical to project success. Our research shows that there are three keys to being an effective project leader:

1. Knowing and investing in your own strengths and the strengths of your project team.
2. Getting people with the right talents on your team.
3. Satisfying the four basic needs of those who follow your leadership: trust, compassion, stability, and hope.

By "strength," I mean an ability to provide consistent, near-perfect performance in a specific activity. The first step to building strength is to identify your greatest talents—the ways in which you most naturally think, feel, or behave. Strengths are created when your naturally powerful talents are combined with learnable skills, such as how to put together a project budget. Gallup has studied more than six million people, and we have found that individuals have much more potential for growth and productivity in areas of great talent than areas of weakness.

A strengths-based approach improves team cohesion and generates better results. We have found that high-performing teams are more likely to match individuals' talents to assigned tasks and emphasize individual strengths versus seniority in making personnel decisions. High-performing teams also have leaders who meet the needs of trust, compassion, hope, and stability.

We have found that while each team member has his or her own unique strengths, the most successful and cohesive teams possess a broader array of strengths. A tool like the Clifton StrengthsFinder® is useful for helping team members identify the ways they can best contribute to the team's goals. Our research shows that the thirty-four StrengthsFinder themes naturally cluster into these four groups:

1. Executing—making things happen
2. Influencing—reaching a broader audience
3. Relationship building—holding the team together
4. Strategic thinking—focusing on all the possibilities

The student website describes these strengths from a project management perspective and tells you how to discover your own unique strengths.

—Jim Asplund, Gallup Consulting

An experienced project manager envisions project performance as two related activities. First, people must perform their roles in completing work activities according to the plan. Performance by people is the topic of this chapter. Second, data must be collected and used to determine the project progress and results. Data collection and determining project progress as measured in schedule, cost, quality, and risk are the subjects of Chapter 14. While determining progress and results is conducted largely in parallel with people performing the project, the two are covered in separate chapters to emphasize exactly what needs to be done in each.

"**Management** is the attainment of organizational goals in an effective and efficient manner through planning, organizing, leading, and controlling organizational resources."[1] Chapters 7 through 15 of this book deal primarily with planning, organizing, and executing the project. This chapter deals mostly with managing and leading project teams. While certain aspects of both management and leadership are necessary in dealing with project teams, in the contemporary approach to projects, the project manager works collaboratively with the project team to the extent possible while continually pushing to reach project goals. Management is generally focused on traditional functions such as planning, organizing, and controlling. In this chapter, management refers to making decisions and working in teams to improve operational efficiency and effectiveness.

"**Leadership** is the influencing process of leaders and followers to achieve organizational objectives through change."[2] Leadership, in the context of projects, is about providing direction, motivating, and guiding people and teams to realize their potential and achieve challenging project and organizational goals.

This chapter starts with acquiring the project team up to the point that team members have been successfully brought on board to the project. The second section deals with various activities needed to develop the project team's capability—many of which require leadership from the project manager. The third section presents several considerations for the project manager when managing the performance of the project team. The fourth section covers how to develop effective relationships within the core project team. The fifth section presents issues about conflict and resolution that occur when dealing with both team members and stakeholders. The sixth section details actions to develop virtual teams. The seventh section highlights the impact *PMBOK 7e* has on project teams. Finally, we conclude the chapter with a discussion about Agile project teams and their approach to delivering value to the product owner.

5.1 Acquire Project Team

Acquire project team is a process of identifying skill requirements for a project and acquiring human resources that possess those skills based on their availability to work on project assignments. Chances are the core team has already been assembled, as it is very helpful to have the core team together for planning—or even earlier, for chartering a project. However, on some projects, a few core team members may be added later. Also, on many large projects, subject matter experts (SMEs) may be added during the early stages. This section deals with the timing of assigning a project team member (pre-assignment), securing the needed and desired team members (negotiation), and successfully adding them to the project team (on-boarding).

It is not necessary for the project manager to always have an opportunity to select the project team members. However, they are still responsible for their performance. Likewise, in certain organizational settings, the project manager may not have total authority over the team member, but they still are accountable for all individuals and the team's performances.

5.1a Pre-assignment of Project Team Members

Generally, it is helpful to have both core team members and SMEs assigned to the project as early as possible for various reasons. One reason is that people often do not like to be told what they must do, but they are usually enthusiastic if they get a chance to help in creating a project plan. Therefore, it is good for motivational purposes to include those who execute the plan, in the project planning process. A second reason is that when the people who will perform the work participate in planning it, many more details may be considered and the resulting plans are often more realistic. Yet another reason to assign project team members early is to be sure they will be committed, dedicated, and available when needed. For external projects, it is a common practice to list specific employees who will be assigned to a project team in the proposal, and occasionally they must be approved by the client. If the project is secured, it is helpful to bring the employees onto the project as quickly as possible.

The downside to bringing SMEs on board before they need to complete project activities is that it could be expensive. For a highly paid expert, this decision can be costly and impractical. Another problem with bringing people on board early is that they may still be committed to finishing work on a previous project and may not devote the necessary attention to the new project. Regardless of how early you bring a person on a project, it is helpful to keep communications open with the prospective team member and their supervisor so they understand when the person is needed. This is especially critical if the project has a tight deadline and/or if the organization is using critical chain project management.

5.1b Negotiation for Project Team Members

Depending on the norms of the organization, a project manager may need to negotiate with the functional manager and/or a prospective team member directly to secure their services for a project. The functional manager (perhaps called a department head or line manager) has the responsibility of running their department. For example, the head of accounting is responsible for how the accounting function is performed. They want to keep all of their employees busy, but not too busy, as they would like all of their employees to learn and progress in their ability and capability.

The functional manager may see this project as a good opportunity for some on-the-job training to help a newer employee gain experience. The project manager, on the other hand, prefers the "best" resource for their project. The best resource may already be engaged in another project or busy with functional work. Wise project managers often develop good relationships with functional managers to have leverage in negotiating for a capable employee. Functional and project managers may look at the situation from the perspective of the department or project, respectively, and have different ideas of who is the appropriate person to work on the project.

A project manager cannot expect to have the best resource from every department (unless the project perhaps is the highest priority for the organization). The functional manager may sometimes need to agree to a different person from what they prefer. In short, most projects have a combination of experienced and inexperienced people. If a project manager finds that all functional managers are only considering inexperienced people, they should probably ask their sponsor for support.

In many organizations, project managers also need to persuade employees to work on their project. For experienced project managers, reputation goes a long way. A project manager can earn a reputation of being a good boss by caring for team members, helping people develop professionally, and assisting them in securing interesting work and

Exhibit 5.1

Tatro, Inc., Strategy for Recruiting Project Team Members

Tatro, Inc., is a designer and builder of high-end landscape projects. Its strategy is to retain its core strengths of securing contracts, designing exceptional landscapes, and managing projects for demanding clients. It subcontracts most other work but wants to be very careful that the work done is high quality. Tatro understands it needs to have self-motivated workers who are very presentable to clients. Tatro primarily relies on recommendations to identify potential workers. To screen potential workers, Tatro performs extensive background checks. It examines previous work performed by the worker, talks to previous clients, and attempts to ensure the worker's finances will allow him or her to be stable and stay with the company.

At that point, it attempts to recruit these proven workers. Chris Tetrault, president of Tatro, Inc., states that he uses a combination of four strategies to recruit, as follows:

1. Pay well.
2. Pay quickly.
3. Provide signature projects for the workers to showcase their skills.
4. Try to get them to like me.

Source: Chris Tetrault, President, Tatro, Inc. Reprinted with permission.

promotions at the end of a project. It is important to align individual aspirations and goals with project goals to get the best results from everyone on the project team.

Many employees campaign hard to work for a great project manager and avoid a poor project manager. When negotiating with a potential team member, a project manager wants to sell the project to the person. Of course, strong technical skills are important for SMEs and are helpful for core team members. However, especially for core team members, it may be more critical to be an excellent generalist and skilled at communicating and making decisions. It is also critical that one should be able to work with others and in teams productively. Many core team members need to deal with a variety of issues beyond their discipline and focus on making trade-offs that key stakeholders demand.

Sometimes, it is necessary to recruit project team members from outside of the parent organization. Tatro, Inc., uses this strategy, as described in Exhibit 5.1.

5.1c On-Boarding Project Team Members

The ideal time to bring team members and even a few SMEs on board is when the project charter is being written. When that is not possible, the first thing a project manager might do is share the charter and the meeting minutes with the new member and then have a one-on-one discussion with that person. There are several purposes for this discussion. The first is to ensure that the new person understands the project at a high level and is enthusiastic about being part of it. The second is to learn about the person's personal and professional aspirations. The happiest, most effective workers are those who understand how their personal goals and project goals are aligned. Do they want to experience the joy of working on something new, travel, acquire training, have new coworkers, etc.? What unique strengths do they already bring to the project, and what strengths do they want to further develop? At this point, the project manager can accomplish the third purpose of the discussion, which is to assign specific activities to the new team member and develop a plan for personal improvement. Exhibit 5.2 illustrates how one consulting company that has many projects acquires and on-boards resources.

Exhibit 5.2

Acquiring and On-Boarding Resources at Atos-Origin

Resources are the most important assets of a consulting company. It becomes very important to nurture them, utilize them effectively, and at the same time make money for the company. At Atos-Origin (a leading IT consulting company), a structured process is followed to manage resources. Resource skills, credentials, and travel preferences; the business unit to which the resource belongs; a summary of projects worked on; and so forth are maintained in a searchable database. Utilization (amount of time a resource is used on projects) is tracked on at least a weekly basis. Resource availability (amount of time each resource is idle or is available for client projects) is also tracked and published to a large group of managers to keep in mind for upcoming assignments.

A central resource manager is responsible for tracking and managing resource utilization. If any member of the management team has an open requirement, the resource manager is first notified of the requirement, so that work can begin on tracking the right person for the role. Resource managers from each business unit meet regularly to discuss staff availability and open positions.

Weekly meetings are held with senior management teams to understand the open staffing requirements. As a first fit, internal available resources are aligned (based on the skills required, time frame of the project, and whether the role aligns with a person's career preferences) with open positions. Since Atos-Origin is a global organization, this helps the company to increase utilization of the individual resource and of the group as a whole. If existing resources are not available or do not fit into the assignment, a requisition to hire new resources is completed, and the job is posted for recruitment.

Atos-Origin considers three different types of external hires: full-time employees (the preferred option), hourly employees (work on an hourly basis; the option used when the project is for a short period of time or when the right resource does not want to accept a full-time offer), and subcontractors (contracting with other companies; the option used sometimes to mitigate resource risks).

The new resource who is hired is on-boarded to the company in a structured fashion, and the same process for managing the person's utilization and availability is followed. This structured process has helped reduce attrition, increased internal transfer of resources, helped individual resource growth, and increased the company's profitability.

Source: Rachana Thariani, PMP, Atos-Origin.

5.2 Develop Project Team

Develop project team is the process of defining roles and responsibilities, improving competencies, working productively at individual and team levels, and improving the work environment to improve the team and project performance. Developing a highly effective project team requires the following six activities from the project manager. Note these six activities build upon each other and are overlapping.

5-2a Understand stages of project team development.

5-2b Understand characteristics of high-performing project teams.

5-2c Assess individual member capability.

5-2d Assess project team capability.

5-2e Build both individual and team capability.

5-2f Establish team ground rules (team charter).

5.2a Stages of Project Team Development

Project teams typically go through a predictable set of stages as they work together. By effectively using project tools and developing trust and understanding within the team, the

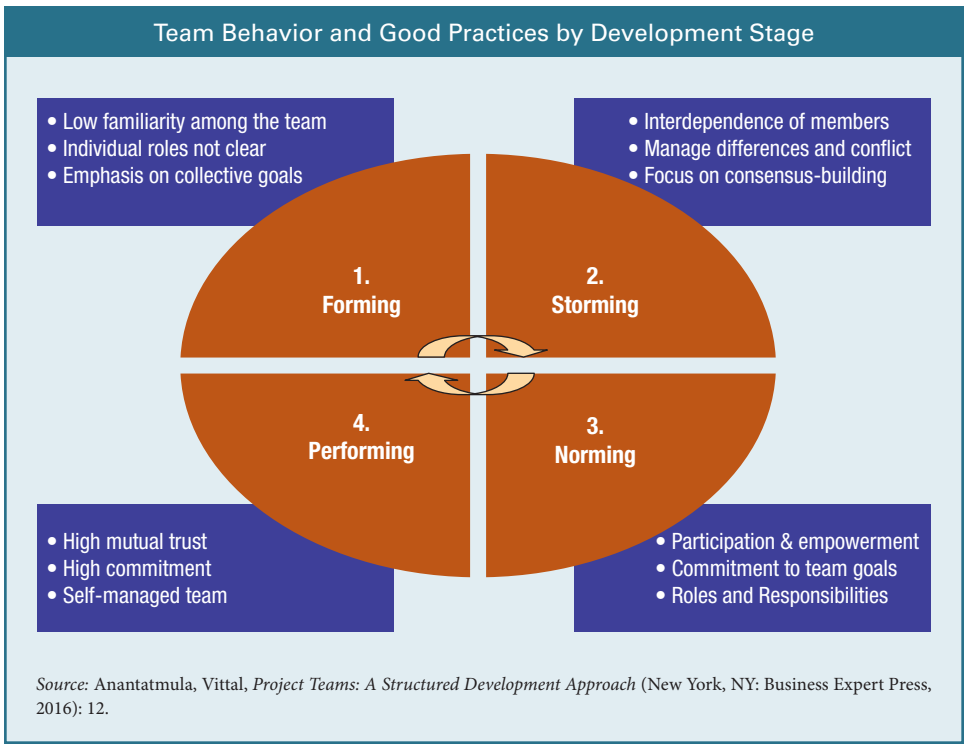
project manager can greatly diminish some of the negative aspects of project team development stages. While almost all teams go through these stages, the duration of each stage varies for each team, based on various factors such as familiarity among the team members, team size, project complexity, corporate culture, uncertainties and unknowns associated with the project, and the urgency of the project. Consequently, some teams get "stalled" in an early stage and do not progress. Some get further along and then have a setback.

Setbacks for project teams can also come from losing or gaining core team members or SMEs, changes in project requirements, changes in project conditions and circumstances, quality problems with project deliverables, or other reasons. The good news for a team that suffers a setback is that because they worked through the team development stages once, they can probably work through the stages more quickly the second time. The bad news is that they do need to work their way through again.

Each stage of team development has its own challenges. For a project manager to successfully help a team develop, they should be aware of how team members feel and what behaviors they frequently attempt at each stage. People tend to be friendly or comfortable with people who have similar values, while differences are often seen as a threat that may affect collaboration and lead to undesirable attitudes, behaviors, and conflicts. These behavioral issues present challenges in managing teams, specifically global and virtual project teams, in which diversity and cultural differences are the norm.

Exhibit 5.3 presents information about behavioral characteristics of the team during each stage of team development and suggestions for managing them.

Exhibit 5.3



Source: Anantatmula, Vittal, *Project Teams: A Structured Development Approach* (New York, NY: Business Expert Press, 2016): 12.

In learning about and using some of the project management tools that are described throughout this book, one can implement quite a few strategies for team development. For example, when a team works together to create a good charter, they rapidly work through the project-forming stage and often begin to develop the open and transparent communication, understanding, and trust that help make their storming stage shorter and easier. Information regarding the issues, behaviors, and strategies associated with each stage is displayed in Exhibit 5.4.

Understanding the stages of development that project teams typically progress through is a basis for project goal attainment and project team development. For example,

Exhibit 5.4

Project Team Progression through Development Stages

	Forming	Storming	Norming	Performing	Adjourning
Team member relationship issues	Feel excitement, yet skepticism	Feel resistance, yet longing to commit to project	Feel part of team and believe project will succeed	Feel close to teammates and understand teammates	Feel strong attachment to team and feel loss when team disbands
Team members attempt to	Understand expectations, activities needed, and power structures	Jockey for power, ask many questions, and establish dubious goals	Accept team members, hold open discussions, and establish team norms	Improve self, prevent and solve problems, and expand beyond official role	Complete project on high note, maintain relationships with teammates, and seek next challenge
PM strategies to promote organization needs	Develop business case and acceptance criteria in charter	Develop stakeholder analysis, communication plan, budget, and quality plan	Manage trade-offs per stakeholder desires, include sponsor in talks, and conduct audit	Share applied learnings with organization and report progress to stakeholders	Secure customer acceptance of deliverables, honestly appraise team members, and provide ongoing support to users
PM strategies to promote project needs	Develop scope overview, milestone schedule, risks, and learnings in charter	Develop scope statement, Work Breakdown Structure (WBS), schedule, and risk register	Add SMEs as needed, authorize work, and improve work processes	Monitor and control project according to plan and update plans as needed	Test project deliverables and secure team member endorsement of them
PM strategies to promote team member needs	Develop team operating methods and commitment in charter, and help members build relationships	Clarify each member's role, encourage all to participate, and determine team ground rules expanding upon operating methods in charter	Personalize each member's role, collaborate when possible, and assess and build members' and team's capability	Capture applied learnings and improve meeting and time management	Celebrate success, reward team members, and help team members secure follow-on work

Source: Adapted from Streibel, Barbara J., Peter R. Sholtes, and Brian L. Joiner, *The Team Handbook*, 3rd ed. (Madison, WI: Oriel Incorporated, 2005): 6–8.

if a project manager of a new team wants to help their team progress through the stages without too much trouble, they can look at the top and bottom rows of Exhibit 5.4. New members often feel a combination of excitement about being picked for the new team and concern that the work may be difficult or that they may not work with the new team effectively and collaboratively. The project manager can help the new team develop team-operating methods early—when they construct the project charter. Having the team decide how they will work together helps establish workable methods that are readily acceptable and simultaneously helps the team members start to know and trust each other.

When the initial forming is over, it is common for teams to "storm"—that is, to feel more stress as they begin to understand how big and difficult the project appears upon closer scrutiny. Some of the team members may want to participate in the project performance yet may resist committing fully. The project manager may work with the team to help ensure that everyone understands and accepts their respective roles. Further, when each team member understands the other members' roles, they can see how the project will be accomplished. The project manager can continue to encourage all team members to actively participate and to refine the team operating methods into ground rules if necessary.

Once a project team weathers the storming period, the members often are relieved because they start to believe they can work together and be successful. Continued team building can help a team to refine its ability to perform. As team members are encouraged to collaborate and build capability, the team moves to a higher level, which is often called the performing stage. Not every team reaches this level. However, it is very satisfying for the teams that do because the team members realize and increase their potential. Also, this level is a valuable milestone at which lessons learned can be realized and used to help improve other project teams. Finally, project teams disband when the project is over. If the project has been successful, team members often feel both excited about facing new challenges and sad about leaving a satisfying experience and good friends. Project managers should use celebration, recognition, rewards, and appropriate follow-on work to guide the team through this last stretch.

5.2b Characteristics of High-Performing Project Teams

Once a project manager understands the typical stages of team development, it is time to understand the characteristics of high-performing project teams. These characteristics, which are an elaborate expansion of the performing column in Exhibit 5.4, reflect the ideals toward which a project manager tries to guide their team.

Teams eager to become high performing often create and use a team charter to enhance their effectiveness. A team charter presents information about how members are expected to collaborate in the activities of the project and participate in making decisions. Specifically, team members work in concert with one another. The team charter also specifies professional performance and the personal behavior of the team members to achieve harmony, teamwork, team spirit, and dedication.

Developing a team charter promotes collaboration and synergy among the team members and leads to better team performance. The team charter describes group norms, which may clarify either previously written or unwritten rules that dictate behaviors and expectations of the team members. The charter guides team members regarding work ethics, honesty, integrity, respect, conflict management, decision making, and communication protocols. It is preferred for a project team to develop a team charter to improve its performance by defining norms for common understanding and agreement, as shown in Exhibit 5.5.

Exhibit 5.5

Project Team Charter

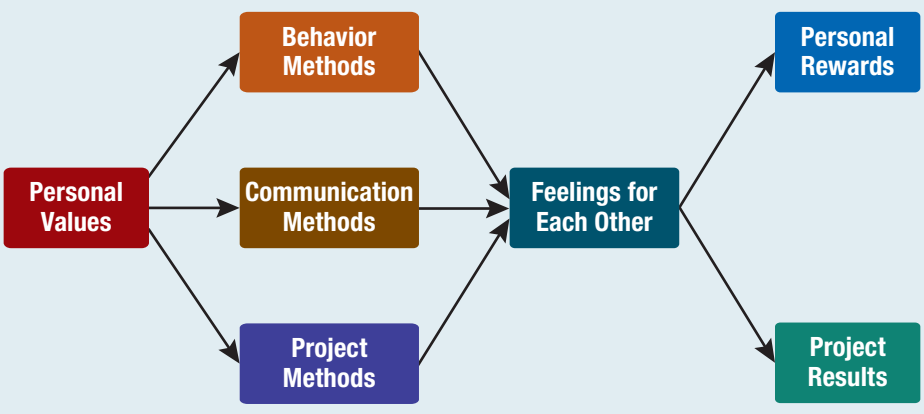
Basic Performance • Reporting/Processes • Elemental Data Reporting • Responsibilities and Assignments • Set Consequences of Nonconformance • Timeliness (Attendance as Well as Delivery) • Work Hours	**Specify** • Time Spent • Obligations • Reporting • Deliverables • Knowledge Sharing • Tracking (Plan vs. Actual)
Personal Behavior Expectations • Civility • Meeting Protocols • Social Graces • Decision Protocol • Receiving/Offering Assistance	**Attitudinal Expectations** • Cooperative Stance • Honest Communication • Conflict Resolution • Negotiations • Teamwork
Desirable Norms • Demeanor • Communication • Conflict Management • Negotiation	**Expected Outcomes** • Trust • Team Spirit • Harmony • Cohesiveness • Rare Major Conflicts • Commitment

Source: Anantatmula, Vittal, *Project Teams: A Structured Development Approach* (New York, NY: Business Expert Press, 2016): 136–139.

This chain of high-performing project team characteristics is shown in Exhibit 5.6. Remember, this is the ideal. Many project teams perform well and exhibit some, but not all, of these characteristics. Nevertheless, a conscientious project manager keeps these characteristics in mind and strives to help their team develop each one.

Exhibit 5.6

Characteristics of High-Performing Project Teams



The characteristics of high-performing project teams start with the *personal values* of individual team members. While a project manager can and should strive to improve upon these values, it is far easier if team members are recruited with a good start on the following values:

- High need for achievement
- Appreciation and acceptance of personal responsibility
- Commitment to self-development and self-directed behavior
- Ability to put project needs before their own needs
- Willingness to consider and accept alternative views
- Commitment to the project

The personal values can be enhanced by using the following effective team behavior methods:

- Team members are selected to represent the right skill mix.
- Team members help each other.
- Team members can work with each other productively (team players).
- Team members have mutual respect among team members.
- Team members demonstrate a constant focus on improvement.
- Team members use time effectively.
- Team members strive for innovation with few formal procedures.
- Team members capture, share, and use lessons learned.
- Team members manage and resolve conflicts.

The personal values can be further improved by practicing the following beneficial communications methods:

- Information is freely and widely shared within and beyond the team.
- Important topics are discussed openly.
- Conflict over approaches is valued, but personal conflict is discouraged.
- Potential problems are proactively reported.
- Teams conduct frequent debriefings and reflect to learn collectively.
- Barriers to communication are resolved.

Project managers can certainly use some of the following project management methods to further the team development:

- Agree on common goals and objectives for the project.
- Jointly plan the project.
- Use the charter to guide joint decision making.
- Work together to accomplish activities.
- Proactively identify and solve problems.
- Hold each other mutually accountable with individualized feedback.
- Provide guidance if methods are not clear or ambiguous.

Using effective team, communications, and project management methods leads to development of the following appropriate feelings that team members can begin to hold toward one another:

- Recognizing how interdependent they are
- Being flexible as to how each contributes to the project
- Being willing to share risks with teammates
- Demonstrating tolerance for minor mistakes
- Understanding, appreciating, liking, and trusting each other
- Sharing in project leadership

This chain leads to two favorable outcomes. The first set of outcomes is personal rewards that each team member is likely to receive such as the following:

- Enjoyment of their work
- High spirit and team morale
- Pride in being part of the team
- Satisfaction in project accomplishments
- Recognition and reward for good work

The other set of favorable outcomes includes the following strong project results:

- Persevering despite challenges
- Producing high-quality results
- Consistently meeting or exceeding stakeholder expectations.[3]

5.2c Assessing Individual Member Capability

Synergy results in a team having a collective capability that exceeds the sum of individual capabilities. Conversely, if team synergy is absent, the collective capability would fall short of individual capabilities put together. More often than not, individual team members of high capabilities can effectively be developed into a strong and productive team. So, what capabilities should project team members possess? Five types of useful project team member capabilities are as follows:

1. Activity-specific knowledge and skills
2. Personal planning and control
3. Personal learning
4. Organizational understanding
5. Interpersonal skills and sensitivity

The first three capabilities are necessary for a person to be a strong individual performer, and the last two capabilities help a person become a valuable team player. While all five are useful, if a project manager wants to develop a strong project team, the last two capabilities may be more important. Too many teams have not achieved the expected success because team members were content with their individual performance.

The first type is activity-specific capability. If a team member is responsible for a specific function such as managing the construction of a stone wall, they should understand in detail what needs to be accomplished to create a desirable stone wall. If they are required to personally build the wall, they also need the skills to do so. A second desirable capability is personal planning and control, such as setting personal goals, accomplishing work as planned, and managing time wisely. Regarding the third capability of personal learning, project team members should have the desire to continually improve and invest effort in their personal improvement. Learning should never stop.

The fourth useful capability is understanding the organizational structure, work culture, and roles and using that knowledge to support the project manager in accomplishing project activities. This involves knowing the informal methods and networks within the parent organization. If the project is being performed for a client, it can also include knowing how things work within the client's organization and what their focus areas are. The last useful team member capability is interpersonal skills and sensitivity. This includes skills such as active listening, effective speaking, and managing conflicts. It also includes possessing emotional intelligence and sensitivity toward others who have different personalities or backgrounds.

5.2d Assessing Project Team Capability

When assessing project team capability, the project manager should remember that their responsibilities are to simultaneously support the parent organization, the project, and the project team. These three are intertwined in many ways. While much has been written concerning teams, Exhibit 5.7 summarizes the success factors of project teams. Note the related chapter number and specific topic where this book gives guidance to help achieve each success factor. Many good project management practices (and good organizational management) help a project team to excel, just as many team success factors help a project team deliver desired project and organizational results.

For example, the project charter covered in Chapter 3 is helpful in achieving many of the project team success factors. The entire project charter is a basis for more detailed project planning and for understanding project objectives. Working together to develop, sign, and distribute the charter greatly aids in communications and commitment. Specific sections of the charter also help teams develop successfully as they realize shared goals and challenges. The team operating methods section helps guide team member behaviors as they resolve conflicts, the applied learnings help create a stimulating work environment, and the acceptance criteria help team members understand how and when they satisfy project stakeholders.

Following is a brief description of why each project team success factor listed in Exhibit 5.7 is useful:

1. Project teams with strong leadership are more likely to be successful. Leadership can occur at every level within a project team. Each member performs better by understanding both their own role and those of all the other executives, managers, and associates that are part of the team. Part of project team leadership is the project culture nurtured by the sponsor and project manager.
2. Effective team leadership can lead to mutual trust, respect, and credibility among all parties.
3. This, in turn, can lead to the cross-functional cooperation and support that help the team guide a project through turbulent situations.

4–5. Project managers have many project tools to guide a team—charters, stakeholder analysis, communications plans, scope statements, WBSs, schedules, and kickoff meetings which collectively help to create clarity and active support for the project. It is difficult to overestimate the impact that effective communication has on project teams. When people are not given information, they must guess and may be right or wrong (risk). Proactive project managers realize that developing and implementing an effective two-way communication plan is a major key to their teams' success.

6–8. The next three project team success factors—skills, objectives, and behaviors—apply specifically to the team. Assembling the right blend of skills and experience for the project team can be quite challenging. This is especially true in the current work environment of cost-control measures. One option for project managers is to staff the project with a combination of experienced and inexperienced members because it often costs less to include an inexperienced person in the project team. An expectation can be set for the more experienced person to mentor the junior person. This promotes organizational learning as well as achieving the project's goals at a lower cost. Many project teams include a section in their charter on team operating methods. This section often spells out methods of decision making, meeting management, and demonstrating professionalism. Teams exercise their skills and experience to make these decisions to achieve project objectives. While working through staffing decisions, an astute project manager may recognize people in two categories: task-oriented or people-oriented (relations). Both types are necessary, and the project manager will have to manage a balance by developing or recruiting team members.

Exhibit 5.7

Project Team Success Factors

	Project Team Success Factors	CPM Chapter	Topic
1	Team leadership in setting direction and project culture	4	Project management roles, organization, and project cultures
2	Mutual trust, respect, and credibility among team members and leaders	4	Project management roles
		6	Build relationships
		5	Develop project team
3	Cross-functional cooperation, communication, and support	3	Project charter
		6	Communications planning
4	Clear project plans created by team and supported by organization	3	Project charter
		6	Stakeholder analysis
		7	Scope and WBS
		8	Activity schedule
		12	Kick-off project
5	Effective communications including feedback on performance	6	Communications planning
		6	Information distribution
		14	Report progress
		15	Secure customer acceptance
6	Team skills and experience appropriate and adequate	9	Resource projects
		5	Acquire and develop project team
		14	Manage overloads and resolve resource conflicts
7	Clearly defined and pursued project and team objectives	3	Project charter
		14	Direct and manage project execution
8	Use of task and relationship behaviors to resolve conflicts and problems	3	Team operating methods
		6	Build relationships, meeting management
		11	Risk planning
9	Stimulating work environment with opportunities for improvement and learning	3	Applied learnings
		14	Process improvement
		15	Capture and share applied learnings
10	Opportunity for team and personal recognition when project satisfies stakeholders	3	Acceptance criteria
		15	Celebrate success

Source: Adapted from Thamhain, Hans J., "Team Leadership Effectiveness in Technology-Based Project Environments," *Project Management Journal* 35 (4) (December 2004): 38–39; and Herrenkohl, Roy C., *Becoming a Team: Achieving a Goal* (Mason, OH: Thomson South-Western, 2004): 9, 25.

9–10. When the first eight project team success factors are adequately accomplished, the last two are often realized. People work hard and enthusiastically if they find their work stimulating and believe they will be rewarded for it. Appropriate and sincere recognition can often be at least as powerful a motivation as monetary rewards. Project managers can use their creativity to reward all who merit it.

All ten of these project team success factors can be influenced by a project manager. Many of the success factors require some early work, such as the project charter, and some require continuing work as the project progresses. A new project manager can determine to what extent their project team currently displays each of these success factors. Using this information, the project manager determines the team's ability and will be ready to build the team's capability upon this base.

5.2e Building Individual and Project Team Capability

Project managers have many tools and methods at their disposal for developing individuals and teams. Many of them can be used together and reinforce each other. Seven methods that many project managers find useful are as follows:

1. Demonstrate personal leadership.
2. Utilize project management tools.
3. Demand situational leadership.
4. Create a desirable team identity.
5. Teach personal responsibility.
6. Develop understanding and respect.
7. Use a learning cycle.

Personal Leadership A good way for project managers to build the capability of their team is to become an effective leader. An effective leader creates and shares a strong vision for the project. Leading by example gives team members a model to follow. A project manager leads by balancing the demands of the parent organization, the project, and needs of the team members. In this context, the project manager is a team member—but one who treats themself and all the other team members in a respectful manner. In fact, many successful project managers take on the role of a servant leader who helps remove obstacles for their team members while encouraging them to be self-directed as much as possible.

No matter what, the project manager must model the highest levels of honesty and ethics. This includes never stating anything that is false, but also not giving any false impressions. This can cause a bit of extra work or conflict in the short term, but it is the only appropriate behavior and pays great dividends in the long run by encouraging (and even demanding) everyone else to do what is right. Aligning communication and action transparently is critical as it will set an example for the rest of the team and instill trust among all team members.

Project Management Tools Project managers can use project management tools to develop focus and cohesion among team members. For example, the charter helps a team to start quickly and collectively. The WBS, schedule, and other project management tools each help to focus the team in explicit ways. Specifically, the WBS is the best tool for project integration and assimilation of the project team to work toward specific goals and shared outcomes. The WBS provides a big picture of the project and its objectives. Individuals realize their role in achieving these objectives and the importance of working collaboratively with other project team members with the WBS as a template.

Situational Leadership Depending on the team's initial capability, a project manager may need to start as a strong individual leader, but the goal is to develop multiple leaders on the project team. In fact, in a great project team, leadership is situational and changes from one setting to another; that is, each member may have a leadership role in certain circumstances and follower roles in other situations. Areas in which a junior team member

has specific knowledge, they should ensure that everyone understands the situation. Thus, even a junior team member is expected to lead in certain situations. Furthermore, during the initial stages of team development, the project manager assumes the roles of directing and monitoring team activities, and then changes to supporting and facilitating roles once the team moves to the performing stage.

Desirable Team Identity Another way to build team capacity is to create a team identity that is valued. Frequently, the project manager and sponsor start thinking about this even before they recruit the first team members. People want to be associated with a winner. If people believe that a project is vital to the organization and that the work is professionally stimulating, they want to be part of the team. Depending on the organization, some teams give detailed thought to the project name and "brand." Military organizations and sports teams often do well in developing and maintaining team identity and associate themselves with pride and prestige. Uniforms demonstrate this identity externally.

Responsibility Project team members need to understand they all have three responsibilities. The first is to complete their individual work on time, on budget, and as specified in the WBS dictionary. Second, they must complete their joint work responsibilities with teammates on time, on budget, and according to the plan. Third, each team member is responsible for improving work methods. Everyone needs to improve their personal work and work with the team to jointly improve the project team's capabilities.

Understanding and Respect Project team members need to develop understanding and trust among other team members to develop team capability. Understanding other team members starts with understanding oneself. Thus, a self-aware individual is more effective in establishing relationships by appreciating and valuing the contributions of others and being willing to learn from them. One method of understanding both oneself and others better is to use StrengthsFinder and to realize how each individual strength can be productively applied on projects, as shown on the student website. As team members understand one another and develop interdependence, they are naturally able to understand and develop interdependence beyond the project team. Since most projects have multiple stakeholders, this ability to connect at many levels is vital to team development.

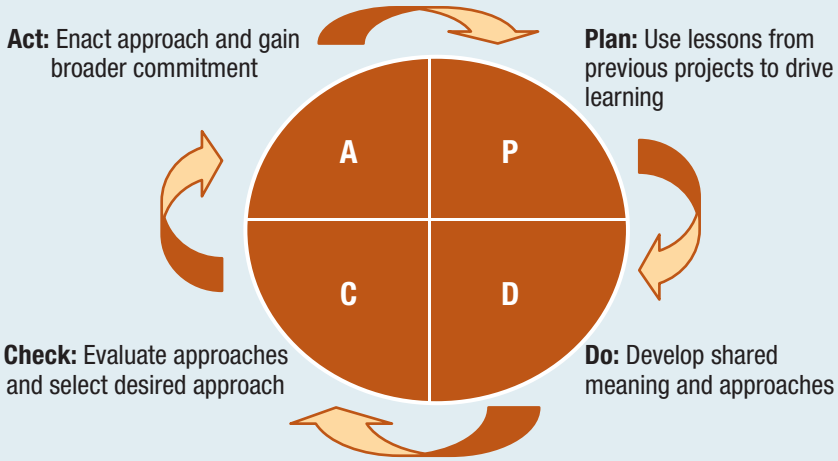
Learning Cycle Building project team capability can be envisioned as a learning cycle in which the team uses creativity to jointly develop and consider alternative approaches while striving to learn at each point in the process. This learning cycle can be easily understood using the plan-do-check-act (PDCA) model. The project team capability-building cycle is shown in Exhibit 5.8.

Project team capacity building is performed in the context of planning and executing project work. Project teams can pass through this capability-building cycle repeatedly as they progressively learn how to work better together to reach their project goals. Free and open communications along with a willingness to challenge each other are important because the project team may need to unlearn or give up past behaviors in favor of new approaches that might be more effective.

In the "plan" step, project teams are challenged with using lessons learned from previous projects to drive their improvement efforts. These lessons need to be compared to the emerging requirements for the project that the team learns from methods such as gathering requirements, meeting with customers, brainstorming risks, and holding design reviews. This comparison can lead to improved and more productive project management processes. Further, historical data from Earned Value Management (EVM) of previously

Exhibit 5.8

Project Team Capability Building Cycle



Source: Adapted from Senge, Peter, Richard Ross, Bryan Smith, Charlotte Roberts, and Art Kleiner, *The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization* (New York, NY: Doubleday, 1994): 59–63.

executed projects, which provide actual and realistic data, can improve accuracy of cost and time estimates of the current project, specifically for similar or identical WBS elements.

In the "do" step, the project team then uses this knowledge to develop shared meaning and potential approaches that they may use. The team uncovers assumptions and brainstorms alternative approaches to develop a robust and realistic project plan. Often, the team develops rolling wave plans for certain projects so the results of early work will give the information needed to create good plans for later work.

In the "check" step, the project team evaluates the potential approaches to select one that suits the project at hand. They can use techniques such as piloting new technology, creating a subject matter expert panel for recommendations, conducting feasibility studies, and reviewing the problem with key stakeholders to obtain a clear decision.

In the "act" step, the project team finishes the planning, executes, and gathers data regarding project work. This data can be verified with the planned data for continual improvement of the plan, including the planning processes of scope, cost, and time. Simultaneously, the team seeks acceptance beyond their team through articulating the project's business case involving key stakeholders, proactively communicating according to plans, and not acting until enough support is in place.

The cycle then repeats. Project teams that are serious about improving their capability repeat this cycle quickly within project stages, at key milestones, and from project to project. The improved capacity of one project team can be shared with other projects through lessons learned and with engagement of core team members and SMEs with other projects.

Select team members with a variety of strengths to ensure balanced participation.

5.2f Establishing Project Team Ground Rules

Project teams often create a brief set of operating principles in their charter as described in Chapter 3. For small teams performing simple projects, these principles are enough to

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guide their behavior. This is especially true if the organization has a track record of success with teams. However, many managers understand that more specific ground rules can help prevent many potential problems that project teams may encounter. Ground rules are acceptable behaviors adopted by a project team to improve working relationships, team effectiveness, communication, and project performance. Therefore, many times, the simple set of operating principles is expanded into a broader set of ground rules.

Exhibit 5.9 lists a dozen of the most frequent topics that project teams choose to create ground rules to address. Note the topics are classified as either dealing primarily with process issues or primarily with relationship issues. Note also that there is more than one way to implement each ground rule. Also listed in Exhibit 5.9 are two strengths from the student website that might be used in very different ways to accomplish each ground rule—and other strengths could be applied as well—each in its own unique manner.

Relationship Topics The relationship topics both help the team make better decisions and help project team members feel valued. People who feel valued often work with much more enthusiasm and commitment.

Encourage Participation The first relationship topic is to encourage balanced participation. This balance can include drawing out an introverted person to share and asking a talkative person to let another individual speak; this must be practiced consistently throughout the project life cycle. Balance can also mean ensuring that all functions are given the opportunity to provide input. Finally, balanced participation can mean sharing leadership roles. The project manager certainly needs to be a leader, but each project team member can provide leadership in certain situations.

Discuss Openly and Protect Confidentiality The second relationship topic is to encourage open discussion. When certain topics are off-limits for discussion, sometimes important issues

Exhibit 5.9

A Dozen Ground Rule Topics for Project Teams

Relationship Topics	Process Topics
1. Encourage participation. Consistency Includer	**1. Manage meetings.** Achiever Discipline
2. Discuss openly. Communication Intellection	**2. Establish roles.** Arranger Individualization
3. Protect confidentiality. Deliberative Relator	**3. Maintain focus.** Command Focus
4. Avoid misunderstandings. Connectedness Harmony	**4. Consider alternatives.** Analytical Strategic
5. Develop trust. Belief Responsibility	**5. Use data.** Context Input
6. Handle conflict. Adaptability Empathy	**6. Make decisions.** Activator Restorative

are not raised, and poor decisions are made. Closely related to open discussion is the issue of protecting confidentiality, the third relationship topic. People should have trust that a sensitive issue will not be repeated outside the project team. It is hard to work effectively together if team members are concerned that important issues could be shared inappropriately.

Avoid Misunderstandings Since projects are often staffed by people from different functions and even different organizations, there is a strong potential for misunderstandings. Both the person stating something and the person listening have a responsibility to avoid potential misunderstandings. Many active listening techniques are useful for this purpose, such as summarizing what was said, asking the listener to restate what was conveyed, or asking for an example.

Develop Trust The fifth relationship topic is to develop trust, which takes time. Each project team member has two responsibilities to establish trust. First, one should always be worthy of the trust of their teammates. This means accomplishing work as promised, communicating transparently, and being completely truthful always. Part of being truthful may be expressing in advance a concern about the ability to do certain work due to reasons such as skills, knowledge, or time constraints. The second responsibility is to trust their teammates unless and until one proves unworthy of trust. Many people live up to the expectations of others. By practicing the highest ethical standards and expecting the same from other team members, a project manager can expect most team members to demonstrate their trustworthiness. That does not mean that you trust an inexperienced person naively to figure out how to perform a complex task independently. Common sense must be exercised in assigning work and determining the level of support required for everyone in the team.

Handle Conflict The final relationship ground rule topic is how to handle conflict. Conflict can bring out creative discussion and lead to better methods and solutions if the conflict is confined to a technical or task issue. However, conflict that becomes personal can be destructive and demotivating. Therefore, conflict over ideas is often encouraged (up to a point), while personal conflict is often settled by the concerned individuals off the project. The project manager may get involved and/or may bring in a neutral third party if necessary to resolve people-related conflicts. Conflict management is covered later in this chapter.

Process Topics Process topics include how a project team works together as they gather data, meet, and make important project decisions.

Manage Meetings The process topic regarding meeting management is introduced in Chapter 6 in the context of improving and documenting meetings. Special applications of meeting management are covered in Chapter 12 for kickoff meetings and Chapter 14 for progress reporting meetings.

Establish Roles The second process topic is to establish roles. People are usually assigned to a project team in the role of project manager, core team member, or SME. Within the team, however, it is often helpful to assign roles such as who plans a meeting, who manages time, and who records the minutes. One important principle with these role assignments is to try to ensure that everyone feels valued. A person who is constantly assigned to perform unpleasant tasks may not feel as important or as motivated to contribute. Another part of assigning roles is to assign tasks to project team members between meetings. Each employee is then responsible for completing their assignments and reporting on their progress. However, it is good practice to follow up with the members between meetings to ensure that project tasks are being completed as planned. Ideally, follow-up is not required if we select appropriate people who are committed to their work.

Maintain Focus Project managers and the team are often under pressure to complete the project below the budget and ahead of schedule. Therefore, project managers need to ensure that the team stays focused. A periodic review of actual progress using the project plan and project documents to resolve disagreements regarding decisions can help greatly. The project charter and the plan remind the team what they are trying to accomplish and why. Another means of maintaining focus is referring to the stakeholder analysis and the trade-off decisions that the key stakeholders have indicated. The key aspect of focus is to spend the most time and energy on important issues and to delegate, postpone, or ignore less important issues.

Consider Alternatives The fourth process-oriented ground-rule topic is to always consider at least two alternative approaches before proceeding. It is amazing how many project teams simply agree with the first suggestion that someone makes. A team that invests as little as a couple of minutes of time can ensure that they have considered alternative approaches. Quite often, a much better idea emerges from a second or third suggestion than from the first one. Also, many times a project team decides to combine the better parts of two alternatives. This consideration of alternatives not only often yields a better approach, but it also can result in better commitment because more people's ideas are considered.

For example, in a project to install a suite of equipment at a customer's site, a final site investigation revealed that a major piece of equipment was not functional. One answer was to expedite the shipment of a similar piece of equipment, while a competing alternative was to use overtime labor and consultants to refurbish the onsite equipment. Both alternatives

were expensive, and neither looked very promising. However, upon further discussion, it was determined that one section of the equipment was the primary concern, so a new section could be airfreighted in, and the workers onsite could install it. This hybrid alternative proved to be far less expensive and more practical than either alternative that the panicked team first considered.

Use Data The fifth process-oriented ground-rule topic is to always use data when possible. The purpose is to be objective in making decisions. Gather the facts instead of arguing over opinions. In meetings, make the data visible to everyone on the team so that all can use it to help make informed decisions. It is possible that a team will generate more alternatives if the data is presented in meetings because it promotes constructive discussions and synergy. Many of the quality tools listed in Exhibit 14.9 help the project team to gather, organize, prioritize, and analyze data for making informed, objective decisions.

Make Decisions The final process-related topic is decision making. Project decisions can be made in several different ways. Adherence to the other ground rule topics will help regardless of which decision-making method is chosen. Methods that project teams often use to make decisions include the following:

- The project manager or sponsor makes the decision.
- One or two team members recommend or make the decision.
- The project team uses consensus to make the decision.
- The project team votes to make the decision.

On some issues, the project sponsor or project manager retains the right to make a decision because the decision needs to be made quickly or requires higher authority. A sponsor or project manager may also ask for input from the team and then make the decision. While this is often a good idea, one should exercise caution to tell the team upfront that they still intend to make the final decision. Otherwise, the team members who provided input may feel that their ideas were not considered.

Project managers may choose to delegate a decision to one or two team members—either members of the core team or SMEs. This strategy works well when sufficient information or time is not available and the decision needs to be made before the next meeting.

Decisions that primarily impact one or two members rather than the entire project team are ripe for delegation. Delegating to two team members has the secondary benefit of their getting to know each other better and working well together for the rest of the project duration. A variation on this delegation strategy is to ask one or two team members to investigate and recommend a solution on which the team can decide at the next meeting. Over the course of a project, most team members will probably get the chance to make certain decisions.

Consensus is wonderful, but it is a time-consuming approach. True consensus means each person actively supports the decision—even if it is not their first choice. The team informs stakeholders that the decision is the best one for the project, which was made after a detailed discussion. To reach this true consensus, each person must articulate what they believe is important in the decision and why. Creative approaches may need to be developed when none of the original ideas pleases everyone. Consensus is helpful when significant commitment is necessary to implement the decision. Consensus also might involve cultural issues, so it is important to include everyone in making decisions.

One final method that project teams might use to make decisions is to vote. This is often a poor choice since the losers of the vote may not be very enthusiastic and may not support implementation of the choice wholeheartedly. A slightly better approach to standard

voting is a straw vote—that is, a test for agreement—by which a team may take a nonbinding vote. If the majority agrees, then it may not take long to drive toward consensus. If many members do not agree, then delaying the decision, gathering more data, or agreeing to let one person make the decision may be in order.

5.3 Manage Project Team

Manage project team is the process of assigning tasks, roles, and responsibilities to all the team members, tracking team member performance, providing feedback, resolving issues, and coordinating changes to optimize project performance.[4] When managing the project team, a project manager uses various forms of power to get team members to prioritize and commit to project work. Project managers are often called upon to either assess members' performance or provide input for the performance assessments.

5.3a Project Manager Power and Leadership

Since project managers often rely on people who do not report directly to them to perform some of the project work, they need to use various forms of power to encourage people to perform. Types of power available to project managers are shown in Exhibit 5.10.

Legitimate Power Project managers often may not have authority over the project team members, although they are responsible and accountable for their performance. Consequently, project managers often have less legitimate power than other managers. However, to the extent that project managers can ask team members to perform certain activities, they should do so. In contemporary project management, a project manager

Exhibit 5.10

Types of Project Manager Power

Type of Power	Brief Description	When Used
Legitimate	Using formal authority based upon position	Asking people to perform within their job description
Reward	Persuading others based upon giving them something	If team members perform well and if negotiating for resources
Coercive	Punishing others for not performing	Only when needed to maintain discipline or enforce rules
Referent	Influencing others based upon personal relationship	Frequently, since project managers often lack legitimate power based upon position
Expert	Convincing others based upon your own knowledge and skills	When others respect your opinions
Information	Controlling information	Frequently, as a large part of a project manager's role is to convey information
Connection	Using informal connections based upon user's relationships with influential people	When working with project sponsors and when negotiating for resources

Source: Adapted from Lussier, Robert N., and Christopher F. Achua, *Leadership: Theory, Application, Skill Development*, 4th ed. (Mason, OH: South-Western Cengage Learning, 2010): 110–117.

often has a core team to help plan and manage major parts of the project. These core team members are the people the project manager can instruct to perform certain activities, but they would be better served by asking them to plan these activities, when possible. The old axiom is true: *people tend to support the things they helped to create*.

Reward and Coercive Power Reward and coercive power are opposites of each other. Not all rewards cost money. In fact, stimulating work is one of the most powerful rewards. Enticing people to perform well so they can be assigned to something more interesting, challenging, or that furthers their career helps the team member, the immediate project, and the organization. While reward power is the preferred method, a threat, or coercion, may be necessary when a person is not performing well. This is especially true if most members of the project team are performing and one or two members are not. People who work hard value teammates who also work hard and are often upset when some members do not contribute their share.

Referent Power Referent power is when a project team member works for the project manager out of respect and personal desire. Project managers sow the seeds for referent power when interviewing candidates for their project team. If the project manager takes the time to understand the personal motives of each team member, they can create desirable opportunities for each. Individual project managers who remember the adage "no one loves your project as much as you do" use their referent power by continuing to describe their project's purpose in ways that appeal to each individual worker's desires. Many successful project managers work hard to develop friendship and respect with their team members. Loyalty must go both ways. If a team member believes a project manager has their best interests at heart and will advocate for them, then that team member is more likely to demonstrate loyalty to the project manager by working hard and performing at a high level.

Expert Power Generally, people want to succeed in whatever they do. Project managers can tap into this desire by using expert power. If a project manager has a reputation for success or possess requisite expertise, they can convince others that they understand enough of the project management technology and politics to successfully guide the project. Then people will be more inclined to work hard on the project and follow the project manager's guidance. They will be convinced that their efforts will pay off and that they will have a chance to learn and grow professionally.

Information Power Information power is something that project managers want to use, but not in a coercive manner. While information is power, withholding or distorting information is unethical. A project manager's responsibility is to ensure that whoever needs certain information receives it in a timely manner, in a form they can understand, and with complete honesty and accuracy. That does not mean sharing confidential information inappropriately. It does mean empowering the core team to distribute information promptly and accurately according to the communication plan. This gives the core team power of knowledge.

Connection Power The very reason for having executives to sponsor projects is that the sponsor has more legitimate power than the project manager. Project managers can use the power of the sponsor when necessary. A project manager who frequently asks the sponsor to intervene looks weak. On the other hand, a project manager who does not ask for the sponsor's help when it is really needed lacks judgment. Project managers can create

more champions for their project by continuing to expand their contacts with important people in position power and by convincing them of the importance of their project.

5.3b Assessing Performance of Individuals and Project Teams

Another aspect of managing project teams is assessing the performance of both individuals and the project team. Goals of performance are primarily meant for project success. However, individual performance assessments are also factored into administrative uses such as rewards, promotions, and professional development such as determining areas for improvement and training. In many organizations, a large percentage of people dread performance assessments. Many people do not enjoy giving honest feedback—particularly about shortcomings. Also, many people do not receive constructive feedback well. However, for both reward purposes and to improve performance, honest assessments are needed. Performance assessment can be both informal and formal. Project managers often perform informal assessments by observing, asking questions, and providing suggestions. This improves performance if it is done regularly, as timely and specific feedback is very effective.

Formal performance assessments are often the primary responsibility of the manager toward people who directly report to him. In many organizations, this is the responsibility of a functional manager. However, because many project team members spend significant time on a project, the project manager is often asked to provide input for the formal performance assessment. The ideal situation for this input is when the team member participates in the project planning and is judged by how their actual work performance corresponds to the planned work. Many project team members may work on multiple projects during the formal assessment period. When that is the case, the projects where they spent the greatest time would ideally count the most toward their performance rating. On some large projects, a project manager may seek input from other team members regarding the team member's performance.

5.3c Project Team Management Outcomes

A variety of outcomes may result from managing the project team, such as the following:

- Morale changes
- "Quarter-mile stones" to "inch stones"
- Staff changes
- Training needs
- Discipline
- Role clarification
- Issues
- Lessons learned

Morale Changes Many projects have periods that are difficult when work demands are high and milestones to celebrate are few. During these times, the project manager must remember that the manner in which they wield power, communicate, appraise progress, and generally manage can enhance or detract from the morale of all involved. Continuing to reinforce the project's purpose, encouraging and supporting the project team, and making an effort to understand their concerns can go a long way toward boosting morale.

"Quarter-Mile Stones" to "Inch Stones" When constructing the project charter, the team develops a list of milestones that could be used to measure progress. On some projects, that is enough detail against which performance can be measured. On other projects, however, more details may be required. Perhaps these greater details could be considered

"quarter-mile stones"—giving the ability to check progress more frequently. When assessing the performance of individual employees, if one individual employee consistently does not perform well, the project manager may decide that more detailed oversight is necessary. This could result in "yard, foot, or inch stones," depending on the level of oversight deemed necessary. Hopefully, for most projects and most workers, this additional oversight will not be necessary. It takes time and effort that could be spent on other productive activities. However, a wise project manager is not going to let a project get derailed because of one worker who is not performing well. At the same time, the project manager must be cognizant of ill effects of micro-management and must strike a balance between close monitoring of work, which may be necessary, and micro-management.

Staff Changes Poor appraisals, insufficient progress, conflict, necessary reassignments, absence of required skills, or other causes may warrant staff changes on a project. When this occurs, wise project managers treat everyone with respect and inform the team that changes are happening and why. When new people are added, they are given a formal introduction to the team and are provided with necessary information about the project.

Training Needs In the course of performance appraisals, training needs are sometimes identified. Project managers should keep in mind the immediate project needs when they approve training programs.

Discipline Performance on some projects is so poor that employees need to be disciplined. While coercive power is often considered a last resort, it should be used at times. Project managers must ensure that prior warnings of poor performance are issued to a struggling team member, documented, and sometimes communicated formally so that person has an opportunity to make amends. Specific behaviors or lack of progress are documented, the need for the discipline is explained clearly, and specific improvement strategies are developed to reduce the chance that further disciplinary action will be needed.

Role Clarification Sometimes, progress may be lacking because of misunderstandings about responsibilities or miscommunication. In those cases, the project manager can clarify roles of all impacted employees by detailing their roles in completing WBS tasks, responsibilities toward other team members and the project, and what is expected of them in terms of project tasks and professional behavior.

Issues and Lessons Learned Many project managers keep issue logs. These serve as living documents of issues that arise while managing the project and the project team. As issues are raised, they are added to the log, and once they are resolved, they are deleted. The resolved issues sometimes make good lessons learned if they could help future project teams avoid similar problems. These lessons can be documented and stored for easy retrieval in a lessons-learned knowledge base.

5.4 Relationship Building Within the Core Team

Project sponsors and managers who wish to create highly productive workplace ensure that core team members understand what is expected of them, are given a chance to do work they are well-suited to perform, receive appropriate recognition, are provided with good coworkers, have their opinions considered, and are provided with opportunities to grow and develop.[9] The sponsor and the project manager ideally begin by asking one another about personal

Exhibit 5.11

Project Decision-Making Guide

Person/Method	When
Sponsor decides	Critical decision, large monetary stake, "big picture" needed
Project manager decides	Time is critical, no need for other input
Functional manager decides	"How" functional work is done
Core team discusses and project manager decides	Team input is useful
Core team consensus	Buy-in is critical
Delegated to one or two team members to recommend	Needs to be investigated, team input useful
Delegated to one or two team members to decide	Needs to be investigated, team input not needed

expectations regarding the project and project goals such as specific capabilities of the project deliverables. Both the project manager and sponsor may have *individual motives* also. It is helpful to disclose and acknowledge these personal aspirations to each other.

The project manager, in turn, asks each core team member what they personally expect from their involvement in the project. These conversations not only help the project manager understand priorities but also understand motivations. For example, core team members may want to participate in a stimulating experience, gain new skills, or earn a promotion. Understanding these motivations will make it easier for the project manager to address them. Aligning individual aspirations with project goals in determining individual roles and responsibilities is desirable and productive.

The project manager can encourage *open and transparent communication* such as keeping people informed, demonstrating that everyone's input is valued, personally sharing feelings, and respecting confidentiality. She should set the expectation that all team members practice these habits.

Joint establishment of project meeting agendas helps in building relationships because all team members feel their concerns are addressed (or included), and they develop a greater sense of ownership in meetings. When members get to *share in meaningful project learning,* they feel their insight is valued. *Frequent celebration of small successes* helps project team members *share the enjoyment* of working on a project, which in turn helps them stay committed to successful project completion.

One other key relationship-building activity that needs to start early and continue throughout the project is concerned with *appropriate decision making and problem solving.* The project manager and core team need to understand who makes each type of project decision and how those decisions are made. One consideration is that people involved in making decisions tend to support them. Decisions made by groups tend to take longer, and projects are often pushed for time. Some decisions are best made by a single expert, while others are best made by a group that represents various points of view. Each project team will need to determine who will make which types of decisions. Exhibit 5.11 gives general advice that can be applied in making this determination.

5.5 Managing Project Conflicts

Projects create unique outputs, deal with diverse stakeholders, are represented by team members representing various functions and even different organizations, and frequently operate in a matrix environment. These factors, along with scope, time, and cost

constraints, contribute to potential conflicts. Many project management initiating and planning tools exist to reduce destructive aspects of conflict, at least partly. This section discusses different ways to view conflict, along with various styles and approaches for dealing with it. This section also introduces a project conflict-resolution process model.

In dealing with task-related conflicts, project charters are meant to help the project core team, project manager, and sponsor understand many aspects of the project at a high level and head off potential conflict between individuals. Several components included in charters, such as assumptions, risks, roles, responsibilities, and acceptance criteria are examples of potential sources of conflict. Stakeholder analysis and communications planning can identify needs and desires of many others who will be impacted by either the process of performing the project or a deliverable of the project. These tools help to identify and deal with potential sources of conflict among the broader stakeholders. The more-detailed planning tools such as the WBS, schedule, and budget help to identify other sources of task-related conflicts.

People-related conflicts can be effectively addressed by developing a team charter, as discussed in Section 5-2b of this chapter. Everyone comes with unique experience, knowledge, IQ, and personality type, and these differences can be a source of conflict. In some cases, specifically in global projects and virtual project teams, diversity of culture and work ethics contribute to people-related conflicts. A team charter helps to define norms, attitudinal preferences, work ethics, and responsibilities for all team members. Adherence to team charter elements promotes mutual understanding and conflict resolution.

5.5a Sources of Project Conflict

Some conflicts on projects are useful; other conflicts can be destructive. Conflict over ideas on how to proceed with a project can lead to more creative approaches. Conflict over how to complete a project with a tight schedule can also be positive. Competition for ideas on how best to handle a project activity has the potential for generating more innovative and successful approaches and can be highly stimulating. However, when conflict becomes personal, it can often become negative and needs to be handled with care. A few typical sources of project conflict are shown in Exhibit 5.12. Generally, it is better to deal with

Exhibit 5.12

Typical Sources of Project Conflict

Relationship Sources	Task Sources
Roles and responsibilities	Stakeholder expectations
Lack of commitment	Unique project demands
Communications failure	Money and other resources
Different personalities	Technical approach
Stakeholder relationships	Priorities
Personal motives of participants	Differing goals of stakeholders
Energy and motivation	Task interdependencies
Next project assignment	Schedule
Individual rewards	Risks
Culture and ethics	Change in scope

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conflict on projects promptly—or even proactively. Conflicts do not get better with time! This is especially true for projects with significant pressure to stay on schedule or on budget (in other words, many projects).

Virtually all studies have determined that relationship conflict can be detrimental to project team success. When people spend time and emotional energy arguing, they have less energy to work on the project. Also, when people have personal conflicts to the point where they really do not like each other, they often feel less committed to the project and to their team.

Task conflict is a bit more complicated. A certain amount of task conflict can encourage people to consider alternative approaches and to better justify decisions. Up to that point, task conflict can be useful. However, beyond a certain point, when people spend a great deal of time arguing over task-related issues, conflict takes away from the project team's progress and camaraderie. The timing of task conflict can also make a difference on whether it helps or hurts the project. The best times to discuss different options are during the initiating stage, when high-level approaches are being decided, and during the planning stage, when more detailed decisions are being made. However, once the plans are made, a project team needs to be a bit more careful because prolonged discussions during the executing periods of the project can lead to schedule slippage and cost overruns.

In general, conflict occurs due to incompatible goals and differences in thoughts or emotions among the team members. It is a common experience with any team or a group of highly skilled and exceptionally creative individuals to interpret facts and events differently. The project manager must capitalize on this intellectual diversity using effective communication techniques and debates to identify the most appropriate resolution.

5.5b Conflict-Resolution Process and Styles

Once a project manager recognizes that a conflict exists, if it is a task conflict, they try to utilize it to develop a better solution. If it is a relationship conflict, they try to resolve it before it escalates. A project manager can use the six-step project conflict-resolution process, making sure to pay attention both to the tasks and relationships needed at each step.

Six-Step Project Conflict-Resolution Process

1. Understand the conflict.
2. Agree on conflict-resolution goals.
3. Identify causes of the conflict.
4. Identify potential solutions for the conflict.
5. Pick the desired conflict solution.
6. Implement the chosen solution.

First, the project manager and the team investigate the situation: What are the signs of the conflict? Is it specific to a certain stage in the project? Does each party in the conflict understand it the same way? If not, they need to ask clarifying questions, summarize how the other person has stated the problem, and confirm that they have a common understanding.

Next, ensure that all parties agree on what a successful conflict resolution would be. While there are often conflicting goals on projects, all stakeholders typically want useful deliverables on time and within budget. Use the project goals as a basis for what the solution must address.

Many conflicts have multiple causes, such as those shown in Exhibit 5.12. Identify potential causes and then verify which cause(s) are contributing to the conflict.

The next step is to identify potential solutions to the conflict. This is clearly a time where creativity and mutual trust are helpful. It is important to focus on the conflict issue and not the person. Also, potential solutions should be considered based on their value and should not be evaluated based on the person who suggests a solution.

The fifth step is deciding how to resolve the conflict. There are five general styles for resolving project conflict, as depicted in Exhibit 5.13.

The collaborative style is preferred for important decisions that require both parties to actively support the final decision. However, collaboration requires both parties to develop trust in each other and, therefore, often takes longer than the other styles. Therefore, each style in Exhibit 5.13 has its value in dealing with project conflicts.

The final step is to implement the chosen solution. For a major conflict, this could be almost like a mini-project plan with activities identified and responsibility assigned. It is vital to include communication of the solution to all concerned parties.

5.5c Negotiation

Negotiation is about redefining an old relationship that is not working effectively or establishing a new relationship.[5] Negotiation is also necessary when a proposal is not acceptable to both the parties; one reason for non-acceptance could be that it favors one party over the other in reality or in perception. Negotiation is the most commonly used process and the first step to resolve a dispute, a difference, or a conflict.

Project managers are generally held accountable for more performance issues than they have responsibility to direct people to perform. Because of this, project managers must negotiate. As stated earlier in this chapter, they often need to negotiate with functional managers for the people they wish to have on the project team. Project managers often need to

Exhibit 5.13

Styles of Handling Project Conflict

Style	Concern for Self	Concern for Others	When Appropriate for Projects
Forcing/Competing	High	Low	Only when a quick decision is necessary, we are sure we are right, and buy-in from others is not needed
Withdrawing/Avoiding	Low	Low	Only when conflict is minor, there is no chance to win, or it is helpful to secure needed information or let tempers cool
Smoothing/Accommodating	Low	High	Only when we know we are wrong, it is more important to the other party, or we are after something bigger later
Compromising	Medium	Medium	Only when an agreement is unlikely, both sides have equal power, and each is willing to get part of what they want without taking more time
Collaborating/Problem Solving	High	High	Whenever there is enough time, trust can be established, the issue is important to both sides, and buy-in is needed

Source: Adapted from Daft, Richard L., *Management*, 9th ed. (Mason, OH: Southwestern Cengage Learning, 2010): 519–520; Aldag, Ramon J. and Loren W. Kuzuhara, *Mastering Management Skills: A Manager's Toolkit* (Mason, OH: Thomson South-Western, 2005): 416–419; and *PMBOK Guide* 240.

negotiate with customers and other key stakeholders concerning schedule, budget, scope, and a myriad of other details. They also often need to negotiate with sponsors, suppliers, SMEs, and core team members.

Nobody is more committed to or involved with a project than the project manager. However, a project manager must remember that negotiations will be smoother if they realize that everyone they negotiate with has their own set of issues and goals.

Many of the project management tools discussed in this book, such as charters, stakeholder analysis, communication plans, schedules, budgets, and change control, help in eliminating conflicts and make negotiations easier. Several of the soft skills discussed in this book, such as involving your team in planning, treating everyone with respect, keeping communications open, and establishing trust, also simplify negotiations. The issues project managers need to negotiate can greatly vary in size and complexity. For example, many small negotiation issues can involve day-to-day scheduling of resources. On the other extreme, the entire set of project deliverables with accompanying schedule and budget are often negotiated.

Regardless of the negotiation size or complexity, the six-step process shown in Exhibit 5.14 can serve as a guide.

The negotiation process is based on the project manager and the other party attempting in good faith to reach a solution that benefits both—in other words, a win-win solution. Project managers need to be vigilant, however, because not everyone they must negotiate with takes that same attitude. Smart project managers recognize that their reputation is based on how they act in all situations. Therefore, even when negotiating against someone who plays hardball, it is still wise to stay ethical and keep emotions in check.

Step 1 involves advance fact-finding to determine what is needed from the negotiation. This may include checking with the sponsor and/or other stakeholders and determining the impact that various settlements may have on the project. It also includes seeking to understand both what the other party is likely to want and how they may act during the negotiations.

Step 2 is for the project manager to understand the bottom line. What is the minimum acceptable result? Just as when buying a car, a project manager needs to understand when to walk away. This can vary a great deal depending on how much power each party has. Project managers need to understand that if they have the power and take advantage of their negotiation partner, that partner may not work with them on a future project. Therefore, the goal is not to always drive the hardest bargain, but to drive a fair bargain. It is worth mentioning that if one party has more power than the other party, even if it is only a perception, negotiation may not be the right option until the inequality issue is addressed.

Step 3 is for the project manager to understand the underlying needs of the other party and to share their own needs. This is not a ten-second political sound bite that says, "Take it or leave it." This is about developing a real understanding of each other's needs.

Step 4 is to create multiple options. This is easy once both parties understand what the other party really needs because various creative solutions can then be developed that help to satisfy those underlying needs of both parties.

Step 5 consists of the process and strategies of the negotiation itself. It is helpful to keep in mind the ultimate goal while focusing on the many details of information sharing, trading of concessions, and exploring possible solutions.

Exhibit 5.14

Negotiation Process

Step	Explanation
1. Prepare for negotiation	Know what you want and who you will negotiate with.
2. Know your walk-away point	Determine in advance the minimum you need from the negotiation.
3. Clarify both parties' interests	Learn what the other party really wants and share your true interests to determine a common goal.
4. Consider multiple options	Brainstorm multiple approaches—even approaches that only solve part of the issue.
5. Work toward a common goal	Keep the common goal in mind: seek and share information, make concessions, and search for possible settlements.
6. Clarify and confirm agreements	Agree on key points, summarize, and record all agreements.

Source: Adapted from Aldag, Ramon J., and Loren W. Kuzuhara, *Mastering Management Skills: A Manager's Toolkit* (Mason, OH: Thomson South-Western, 2005): 129–132; and Baldwin, Timothy T., William H. Bommer, and Robert S. Rubin, *Developing Management Skills: What Great Managers Know and Do* (Boston, MA: McGraw-Hill, 2008): 307–318.

Step 6 is actually a reminder to reach an agreement and then to document that agreement. A consultant friend often says: "we have reached a violent agreement" when people essentially have agreed, but they keep talking. Clarify and document your agreement.

5.6 Communication Needs of Global and Virtual Teams

As organizations change more rapidly, projects are often conducted with members from various parts of the larger organization, various organizations, and even various parts of the world. These teams draw from a wider pool of talent but can pose added challenges. Furthermore, the global economy and competition are compelling organizations to acquire resources globally to complete projects efficiently and effectively while developing products and services faster, better, and cheaper. Together, all these factors coerce organizations to create and engage virtual teams for project planning and execution.

5.6a Virtual Teams

In contemporary project management, project managers use less-onerous command and control than they might have a few years ago. This trend is even more pronounced with global and virtual teams. A **virtual team** is also sometimes known as a distributed team. They rarely meet in person and rely on information and communication technology (ICT). An example of how one global consulting company develops their virtual teams is shown in Exhibit 5.15. When project teams operate in a virtual mode, many of the following characteristics are present:

- Team members are physically dispersed.
- Time boundaries are crossed.
- Communication technologies are used.
- Cultural, organizational, age, gender, and functional diversity are present.[6]

5.6b Cultural Differences

Cultural patterns differ in various parts of the world, so project team members need to be more sensitive as to how their actions are interpreted. For example, in some cultures, making

Exhibit 5.15

Virtual Team Building at Atos to Develop Team Cohesiveness

Covid has changed the future of work. Remote working is now an accepted way of working for almost all IT professionals across the globe. While the benefits of remote working are many, the lack of human interaction causes team productivity to be impacted. Several teams across Atos addressed this by holding virtual team-building meets with their teams. Virtual coffee and virtual happy hours are very popular. Other team-building events included use of tools like Kahoot for trivia contests, virtual bingo, virtual yoga, and meditation led by qualified instructors. This has really helped to address to an extent mental well-being that has taken center stage during the pandemic

Provided by Rachana Sampat, MBA, PMP

eye contact signifies that you are paying close attention. In other parts of the world, however, eye contact is considered rude; in these cultures, people may look slightly downward in deference to authority. When people do not have face-to-face contact, they do not have the opportunity to see and learn from a person's body language. Project managers working with global and virtual project teams must be especially mindful of the increased need for communications using methods other than face to face. Reading comprehension and listening skills are valuable for virtual teams.

Cultural differences present more communication. The various methods regarding charter development described in Chapter 4, along with stakeholder analysis and communications planning in this chapter, are even more critical on virtual and global teams partially due to cultural differences. The more unusual a team is, the more critical charters and communications vehicles become. Exhibit 5.16 lists some of the extra communications challenges posed by virtual and global project teams. Note that each project management need has a specific and increased challenge—for example, the third need, relationship building, needs more time since people do not have the advantage of full face-to-face communication. Project managers and teams can enhance stakeholder satisfaction by learning the cultural ethics and values of all their stakeholders, working hard to establish trust, and ensuring that they use fast and reliable information systems.

5.6c Countries and Project Communication Preferences

It is helpful if the project team members can meet each other face to face, even one time. While this can be expensive, it may be much less expensive than poor performance on the project. Sometimes, the core project team is assembled to write and approve the project charter. The core team members then get to know each other and are inclined to give each other the benefit of doubt in case of any misunderstandings. Another method that is frequently used is to confirm meetings and calls with quick meeting minutes or e-mail follow-ups. By documenting any decisions, it is easier to remember what happened and to uncover lessons learned when the project is complete.

While abundant differences exist among people from various countries, the method and timing of project communications are of interest here. Studies examine how cultural differences impact preferred modes of project management communication.[7] Factors such as collectivism versus individualism, along with the extent to which individuals in various cultures accept unequal power and ambiguity, impact project communications preferences.

Exhibit 5.16

Increased Challenges for Virtual and Global Project Teams

Project Management Need	Increased Challenges
1. Initiate project	1. More unique project needs
2. Understand stakeholders	2. More difficult to understand
3. Build relationships	3. Needs more time
4. Determine communications needs and methods	4. More unique needs, more reliance on electronic means
5. Establish change control	5. More facilitating than directing
6. Manage the meeting process	6. Fewer nonverbal clues, interest may wander
7. Control issues	7. With less group interaction, harder to identify

5.7 *PMBOK Guide 7e*

Domains:

- Team
- Stakeholders
- Development Approach
- Planning
- Delivery
- Measurement
- Uncertainty

5.7a Team

The new edition of *PMBOK 7e* considers the team performance domain a critical one, as it interacts with all other performance domains. Leadership function focuses on motivating, listening, enabling, and influencing; everyone in the project team should practice all these functions. However, management activities can be either centralized or distributed (in self-managed teams). Tailoring leadership style would depend on the maturity of the project team members, organization structure, distributed teams (virtual or geographically disbursed), and experience with the type of project at hand. A project manager may often consider the servant leadership style.

5.7b Stakeholders

Stakeholders change during the project in their interest and influence toward the project. The project team should seek to understand stakeholders' feelings, emotions, beliefs, and values throughout the project, as they may present opportunities and threats. Analyzing stakeholders must consider several aspects such as power, impact, attitude, beliefs, expectations, degree of influence, proximity to the project, and interest in the project. This information helps in developing project team interactions with stakeholders.

5.7c Development Approach

Depending on the project cadence and development approach—predictive, adaptive, or hybrid—project teams will have to modify their approach to collaboration style and aim to enhance their performance and to optimize project outcomes. Further, the cadence and development approach influence the project team's interactions with the stakeholders.

5.7d Planning

Project team composition and requisite skill sets are based on the project work which is assessed in the planning performance domain. Delivery of project work influences the planning process, which in turn, determines the team's level of involvement and participation in developing the project plan. In a predictive planning approach, the project team gets involved in planning from a very early stage. Incremental or iterative approaches defer a decision to allow project teams to consider multiple options until the cost of further delay exceeds the benefit.

5.7e Delivery

Project delivery activities concentrate on meeting requirements, specifications, and quality expectations to produce deliverables that will drive intended outcomes. The project team

plays a major role in eliciting requirements, defining scope, expanding the scope into various project activities, detailing effort and resources required for these activities, executing the work, and finally producing deliverables that meet stakeholders' expectations. Obviously, the project team is responsible for meeting quality expectations.

5.7f Measurement

The project team is responsible for development, execution, and measurement of project performance. The project team establishes effective measures of performance and evaluates the degree to which the work performed meets the specifications and quality expectations outlined in the plan. In doing so, the team tracks performance and resource use and assesses the performance of the deliverable. Further, the team may have to make trade-off decisions, provide progress information to stakeholders, and make effective use of opportunities for improving performance.

5.7g Uncertainty

Uncertainties arise out of political, social, market, and environmental factors. The project team is responsible for considering the effects of uncertainty while developing the project plan. These uncertainties present threats and opportunities and will have to be assessed, explored, and managed. When selecting and then planning projects, the project team must develop an understanding of the larger environment in which the project is developed and executed.

5.8 Agile Project Teams

Agile teams are often described as being self-managed, focused on project goals, strong communicators, able to decide quickly, responsible, and willing to trust their instincts once they understand their sponsor. The result is that these team members are more satisfied, flexible, and accommodating.

Traditional projects use distributed work teams and more specialists and adopt a process-oriented approach. On the other hand, teams on Agile projects typically employ co-located teams to manage rapid changes and increments. However, Agile teams can be in multiple locations. Further, Agile teams require motivated members with a higher level of commitment. Key differences between plan-driven and Agile project teams are shown in Exhibit 5.17.

Exhibit 5.17

Comparison of Plan-Driven and Agile Approaches for Project Teams

Leading and Managing Project Teams Questions	Plan-Driven	Agile
What is considered when team members are acquired?	Specialists with project-length membership	Generalized specialists with more emphasis on long-term team membership
What are the characteristics of project teams?	High-performing team attitudes and behaviors	High-performing team attitudes and behaviors with emphasis on collaboration and innovation

How is the project team involved in planning?	Provide input on their portion of plan	Collaboratively and continually plan and commit
What key thoughts drive work?	Meeting scope, schedule, and cost agreements	Agile principles of simplicity, willingness to change, value, and rapid feedback
How is the project team developed?	Assess and build individual and team capabilities, establish and use team ground rules	Assess and build individual and team capabilities, establish and use team ground rules. Team members know product.
What are team member responsibilities?	Actively participate and perform individual work	Actively help make decisions, perform individual work, offer and accept help and feedback, continually ask questions
What is the management/leadership focus?	Manage according to the plan	Trust teams by having them self-govern while using transformational, servant, and developmental leadership. Continue to refine vision and direction as feedback is received.
How are communications handled?	Periodic updates, meetings, reports	Visible and constant communication, face to face when possible
How is conflict handled?	Project manager understands conflict sources, uses resolution process and appropriate style	Scrum master facilitates, but team resolves when possible by understanding conflict sources, using resolution process and appropriate style

5.8a Agile Terms Used in Leading and Managing Project Teams

Generalized specialists	Very good at one thing, but also competent at a wide variety of work
Improve collaboratively	When one worker has problems, others help and learn together
Collective ownership	All qualified team members are responsible for product and all can change it
Pair programming	Practice of one programmer writing while another reviews, two minds are better than one
Openness	Seek new ideas, ask for help when needed
Transformational leadership	Leader aims to develop trust and align personal values of individuals (followers) to accomplish vision and mission of the organization
Servant leadership	Leader focuses on needs of the followers first through integrating followers' needs with project goals, honesty, delegation, and empowerment.

Developmental leadership	Safe environment in which different team members informally take on leadership roles at different times and are supported by team members and other stakeholders
Courage	Tell the truth, work together, adapt to changes, question status quo, have difficult conversations
Respect	Everyone gives and feels respect, everyone contributes, team strength is collaboration, give each other permission

In this book, we use many Agile terms and definitions from Anantatmula, V., and T. Kloppenborg, *Be Agile Do Agile* (New York, NY: Business Expert Press, 2021).[8]

Agile Manifesto Principles to Cover:

5. The project team composed of motivated people who must be engaged in the project; support and trust must extend to the project team.
11. Self-managed teams develop the best requirements and designs.

In a plan-driven project, the general preference is to engage specialists for the length of the project. Agile projects tend to recruit **generalized specialists** who are very good at one thing and also able to help on a variety of other things. These team members tend to learn more about the product there are creating, not just their specific area. Agile team members actively help plan their project and generally stay together for a longer period.

Another prominent difference is that Agile project teams require higher levels of collaboration because scope is ambiguous, and innovation may become necessary. Team members **improve collaboratively**: when one worker has problems, he is expected to ask others for help all team members are expected to proactively offer help when they think it may be needed. Thus, team members learn together.

A primary measure of success on Agile projects is solving a problem for a client. That solution to a problem or creation of a new capability is what clients value. Agile project teams recognize that to create that value in the end, they need to continually show the client that their project remains viable, it provides early and frequent value, their work is predictable, and they are generating quality outputs. They accomplish this by simple, transparent approaches, seeking feedback early and often, and using that feedback to quickly make needed changes.

Agile teams build individual and team capabilities and establish and use team ground rules as the team members learn what is to be delivered. Thus, Agile teams are more self-governed, and the leadership role focuses on facilitating and supporting the team. To meet all these challenges, face-to-face communication is preferred. An example of an Agile team in a global consulting company is shown in Exhibit 5.18.

There are several key principles of Agile team responsibilities that go beyond performing individual work and help drive improvement and innovation.

- **Collective ownership** states that all team members are responsible for the product being produced and any one of them can change it when it appears necessary.

Exhibit 5.18

Building "Squads" for Agile Delivery

At Atos, a model that is getting momentum is that of teams in "squads". A squad typically has no more than eight team members, typically with different backgrounds (technical, functional, etc.). The squad is put together to deliver on a particular product or a service. For example, developing a new solution for a cloud platform. Once the solution is developed, the squad moves on to another solution or to deliver the solution proposed, if the right kind of skill set exists. The squad has a "squad leader" who is a senior and experienced leader in the company. The accountability of the project or product lies with the squad leader.

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- **Pair programming**, while developed in an information systems environment, is useful in many situations. This suggests when practical have two people working together with one developing product and the other testing, and then switch.
- **Openness** states that workers help each other. If one needs help, they should ask. If another sees that a person needs help, they should offer. They learn together.

Three approaches to leadership are common and effective on Agile projects: transformational, servant, and developmental.

1. **Transformational leadership** is when a leader guides their team by sharing their vision (solving the client's problem) and helping each team member understand and believe that their work is essential to that overall goal.
2. **Servant leadership** is when a leader sees their primary responsibility is removing obstacles so team members can do their job more effectively and with less interruption.
3. **Developmental leadership** is when a leader creates a safe and nurturing environment so team members feel comfortable leading within their expertise, and further, draws those members out by encouraging them to lead.

In Agile projects, it is the team that manages risk and resolves conflicts with support from the scrum master on an as-needed basis. Two additional Agile principles help teams to solve their own conflicts. Team members must display **courage** by telling the truth and having difficult conversations. Team members also show **respect** to everyone by recognizing each person contributes, giving each person permission to state what they really feel, and believing that the team is strongest together.

Summary

While the project core team is ideally assembled early in the project to participate in chartering and planning the project, SMEs are commonly assigned as needed. Project managers try to secure the services of these important people as early in the project as possible. This often involves negotiating with the functional managers to whom the SMEs report. When new project team members arrive, they need to be on-boarded; that is, they need to understand the project and start to develop working relationships with their new team members. Experienced project managers ensure that the new members understand project goals but also learn about their personal goals so that both can simultaneously be achieved.

Teams progress through typical stages of development. High-performing project teams share several characteristics. Project managers can use understanding of these stages and characteristics to guide their team to better performance. They do this by assessing individual and team capabilities and developing strategies to improve both. The project team often develops team operating principles in the charter. Many teams expand upon these with more specific team ground rules. The ground rules are tailored to the unique needs of the project situation but generally include both rules for improving relationships among team members as well as improving the process of how the team works.

The project manager must manage the human side of their project. This involves utilizing appropriate forms of power in managing the project team to obtain desired results. Project teams also need to manage and control stakeholder engagements through understanding their expectations, delivering on those expectations, and communicating effectively. Projects are ripe for many kinds of conflict. Constructive conflict over ideas often yields better approaches, but destructive conflict of a personal nature needs to be headed off when possible and dealt with when it occurs. Many good project management practices and techniques are helpful in channeling conflict in constructive directions. Project managers also need to utilize many general conflict reduction techniques not only within the project team but also with and between various stakeholders. Furthermore, negotiation techniques can be used for resolving conflicts and for bargaining for project resources. Finally, project managers must understand unique challenges associated with virtual teams.

Key Terms Consistent with PMI Standards and Guides

management, 156
leadership, 156
acquire project team, 156
develop project team, 159
manage project team, 175
negotiation, 182
virtual team, 185

Key Terms Consistent with Agile Practice

Generalized specialists, 190
Improve collaboratively, 190
Collective ownership, 190
Openness, 191
Pair programming, 191
Developmental leadership, 191
Servant leadership, 191
Transformational leadership, 191
Courage, 191
Respect, 191

Chapter Review Questions

1. What is the potential downside to bringing in project workers too early in the project?
2. Why is it often necessary for project managers to persuade workers to be part of the project team?
3. When is the best time to on-board core team members?
4. What are the five stages of team development?
5. During which stage do team members often feel close to one another and have a good understanding of how to work together?
6. List two *personal values of individual team members* that contribute to a high-performing team. List two *team behaviors* that can enhance these personal values.
7. What are the two favorable outcomes of fostering a high-performing project team?
8. During all five stages of team development, is it important that the project manager keep in mind the needs of which three groups?
9. Why might it be helpful to bring out the charter when people are arguing over a decision?

10. What is meant by the term *ground rules?* Give examples.
11. Under which circumstances might a project manager or sponsor retain the right to make a project decision?
12. What are the benefits of delegating a decision to one or two team members?
13. When might consensus be the best decision-making strategy?
14. _____ power is the ability to persuade others based upon the project manager's personal knowledge and skills.
15. _____ power should be used by a project manager when they are asking their team members to perform a task within their job description.
16. _____ power should only be used in instances in which it is necessary to maintain discipline.
17. In order to manage stakeholders' expectations, a project manager needs to understand the stakeholders' assumptions. Which document(s) can help with this?
18. The collaborative style for handling conflict has a _____ concern for self and a _____ concern for others.
19. Why is it important for project managers to have one-on-one discussions with their core team members?
20. Name three increased challenges for a global and/or virtual team.
21. Why is it helpful for a virtual team to meet in person at least once?

Discussion Questions

1. You are a project manager leading an IT development project. Halfway through your project, you realize you need to hire an additional worker in order to complete the project on time. How will you convince your project sponsors to authorize the hire? How will you on-board your new worker?
2. Describe how to use project documents to help a team progress through the stages of development.
3. How can a project manager promote the needs of the organization during the norming phase?
4. How can a project manager promote the team members' needs during the forming stage?
5. Describe in your own words how a high-performing project team operates.
6. Describe, in your own words, what you believe are the four most important characteristics of high-performing project teams. Explain why you believe each is so critical, describe how they are related to each other, and give at least two specific suggestions for each.
7. Assess your individual capability for project teamwork. Tell why you feel you are strong in certain capabilities and give strategies for improving in areas you feel you need to develop.
8. What is meant by the term *situational leadership?* How can you apply this as a project manager? How could you apply this as a project team member?
9. Describe the three responsibilities of project team members.
10. Pick the four ground rule topics for project teams that you believe are the most important. Tell why you believe each is so critical and give at least two specific suggestions for each.
11. Using examples, describe how a project manager can use active listening. Why is this useful?
12. Describe each method of decision making a project team may use. Using examples, tell when each is most appropriate.
13. In your opinion, why is it necessary for the project manager to assess the performance of both individual team members and the project team as a whole?
14. List several characteristics of a project that can often result in creating conflict.
15. Give an example of when a conflict would be beneficial to a project and an example of when conflict would be harmful to a project.
16. You are working for a multinational organization and need to relay information to co-workers in Japan. Which communication method would you choose to use and why?

17. Give as many examples of cultural differences as you can, using information from this text and your own experiences.
18. Discuss how choosing an Agile development approach versus a predictive development approach could affect your interactions with stakeholders.
19. Brainstorm at least one example of how each of the following environmental factors could affect your project: political, social, market, and environmental.

PMP Exam Study Questions

1. Which of the following can contribute to project uncertainty?
   a. Environmental factors
   b. Market factors
   c. Political factors
   d. All of the above
2. All of these are stages of team development *except:*
   a. adjourning
   b. storming
   c. learning
   d. performing
3. _____ establish(es) clear expectations regarding acceptable behavior by project team members, and may cover topics such as protecting confidentiality, establishing trust, and handling conflict.
   a. The employee handbook
   b. Ground rules
   c. Management by objectives
   d. Personnel directives
4. The objective of the _____ process is to improve competencies, team member interaction, and overall team environment to enhance project performance.
   a. Plan Human Resource Management
   b. Acquire Project Team
   c. Develop Project Team
   d. Manage Project Team
5. All of these are techniques for managing project conflicts *except:*
   a. smooth/accommodate
   b. withdraw/avoid
   c. collaborate/problem solve
   d. none of the above
6. A document used to manage points of discussion or dispute that arise during projects, in order to monitor them and ensure that they are eventually resolved and added to lessons learned, is called a(n) _____.
   a. risk register
   b. stakeholder register
   c. SWOT analysis
   d. issue log
7. Which of these is *not* a challenge of working on global and virtual teams?
   a. competencies
   b. language
   c. time zones
   d. culture
8. Which of the following is *not* typical of an Agile team?
   a. co-located
   b. comprised of SMEs
   c. can make decisions quickly
   d. largely self-managed
9. Which of the following steps is *not* part of the six-step project conflict-resolution process?
   a. Identify causes of conflict
   b. Identify potential solutions
   c. Determine which teammate was in the wrong
   d. Understand the conflict
10. The sources of most project conflicts can be grouped into those related to _____ and those related to _____.
    a. relationships; tasks
    b. technical skills; budget
    c. personalities; deadlines
    d. schedule; risks

Integrated Example Projects

Suburban Homes Construction Project

Suburban Homes, a medium-sized, fast-growing construction company, has an ambitious plan to expand its business to several southern states in the United States because of its significant growth and good reputation for building quality single-family homes and townhomes.

As a project manager, Adam Smith worked for several years in the construction industry and supplemented his experience with project management education. From his initial realization that managing projects successfully requires implementation of various project management processes, tools, and techniques, Adam recognized the importance of building project teams composed of well-trained staff. From his experience managing a few projects in the Midwest and based on the lessons learned from these projects, it was evident to Adam that Suburban Homes did not place a strong emphasis on people-related factors and team development. Adam recognized the scope for improvement in managing and developing high-performance teams and decided to act on this knowledge immediately.

Adam's primary task was to improve the performance of project management and increase the project success rate, so he wanted to address project team selection and the team development processes. Further, he realized that employee turnover and the expansion of the business in southern states led Suburban Homes to recruit more employees. Many of these new recruits have prior experience in the construction industry. In addition, the workforce now represents different work cultures, attitudes, commitment, and work ethics.

Adam recognized the immediate need to manage human resources effectively and efficiently. He decided to formalize project team selection, development, and management so that all the locations in the Midwest and South will have similar team management philosophy and practices. To achieve these purposes, Adam has considered the following:

1. Train project managers as leaders. Also, project managers must be trained to identify talent, select project team members, and nurture their growth.
2. Develop a team charter so that all the team members are aware of performance expectations, professional behavior, and other team norms. The charter should also help in training newly recruited employees to improve productivity, collaboration, coordination, communications, and conflict resolution.
3. Develop a conflict management plan and prepare guidelines for all employees to identify and manage conflicts.
4. Design and implement a decision-making protocol for all the projects and in all locations.
5. Develop norms for high-performing teams.

You are hired as a consultant to develop the above deliverables in steps 2-5.

Heritage Arboretum Development Project

Leading and Managing a Project Teams While Creating an Arboretum During a Pandemic

Our team is a sub-committee of our township's Tree Committee. We started with anyone who volunteered during a Tree Committee meeting and discovered some individuals were more willing to work hard and promptly. We also discovered that trying to get a large team to even meet during the pandemic when we were not allowed to meet indoors and the weather was cold and rainy was difficult. So as we regrouped and formalized our team, it became a small team. Ease of meeting and making decisions are advantages of this small team as is team member knowledge of our product. Each team member can speak knowledgably about many aspects of our project.

We sought generalized specialists. Each member had experience with plants and an expertise such as being an arborist, landscape designer, self-taught native plant expert, or planner. Members also graduated from Tree Commission Academy, which is a two-year program taught by the state urban forester. This program includes not only general knowledge of plants and their care but also workings of local governments, budgets, planning, and related knowledge to help run a tree program.

Team members were involved in planning all along. This started with walking the site and assessing current plants.

It continued with providing input and review of the arboretum application. Once our arboretum status was granted, team members and other stakeholders engaged in rounds of input and discussion as we created our master plan that will provide general guidance for several years. As we looked at shorter time periods, team members met and recommended species to plant.

The team utilized several Agile principles. Simplicity was employed in keeping the design as clean and easy to maintain as possible while still adding to the number of species. The team changed in response to feedback, although this was a work in progress as some feedback was negative about team members' favorite design elements. We continued to consider our vision of native plants, beauty, and education as we selected plants so that we could add as much value as possible, and we strived to plant quickly in the more visible places to create quick value. We found that despite our early efforts for feedback, some feedback did not come quickly and was disruptive when it did come. Therefore, we had our product owner work intensively with key stakeholders to secure early and detailed feedback that was actionable.

Team member responsibilities include attending both our sub-committee meetings and those of our parent committee; collectively and actively participating in making decisions; performing between meeting work individually and in partnership with other team members and with other volunteers; and actively sharing ownership of the project.

Questions:

1. How can leaders use the following types of leadership effectively on this project?
   A. Transformational
   B. Servant
   C. Developmental
2. Explain how team members can implement characteristics of high-performing teams on this project.
3. What suggestions can you make for team development when in-person meetings are difficult such as when the pandemic limited inside meetings and weather limited outside meetings?
4. List types of decisions that will need to be made and suggest which ones should be made by the Product Owner, individual Team Member, Team collectively, or Scrum Master and tell why that person or group should make the decision.
5. How can the Product Owner, Scrum Master, and Team Members be more effective using the Agile concepts of simplicity, value, feedback, and change on this project?

Semester Project Instructions

Assess your project team's capability. Develop a strategy to improve your team's capability. Develop ground rules to use on your project.

As a team, audit one of the other project teams in your class and have them audit your team. Develop an improvement strategy for that team based on the audit results.

Brainstorm situations for your project for which each source of power makes sense.

Identify what you have done to manage and control stakeholder engagement and how you know the current level of satisfaction that your stakeholders feel. Identify issues you may need to negotiate and determine the style you will use to handle the conflict and your expectations at each step of the negotiation process.

Project Management *in Action*

On-boarding Your Project Team by Gerald Leonard, author of *Workplace Jazz*

Over the past 25+ years I have used the following project team on-boarding process for Federal and State Government agencies as well as small to multi-national corporations. The details of each application of this process may have changed due to the nature of the project but the key components of this process have not changed.

The purpose of the on-boarding process is to provide critical logistical information to your project team members related to their current project assignment and to provide a smooth start up experience for all stakeholders.

The on-boarding logistic guide checklist should contain the following components:

1. **About the client or project.** This section should provide a paragraph about the client, customer, or project and historical information so that everyone knows why the client needs this project to be successful.

   For example: Regional Medical Center is a 100-year-old tertiary care facility that features the widest array of specialty and sub-specialty services on the Delaware. Nearly 200 physicians and 2,400 other health care professionals with links to highly specialized clinical research provide daily technical and compassionate care that nearly 600,000 patients rely on each year for inpatient, outpatient, diagnostic, sub-acute, and emergency-trauma care.
2. **Our Role.** What job has the client or customer hired the project team to achieve and the benefit the project must deliver to meet the customers' expectations.

   For example: Regional Medical Center desires to have the consulting firm assist them by leveraging technology to increase overall productivity. This will be accomplished by replacing the current Windows 8 with a Windows 11 Active Directory Infrastructure. The Information Technology group is spearheading this initiative. This group will ensure the success and integration of the technology project by leveraging outside consulting expertise, hereby helping them achieve their overall business goals of providing an efficient, productive, stable, and secure computing environment.
3. **Project Goals:** Provide a description of the specific scope of work to be accomplished and include a list of goals to be accomplished.

   For example: Regional Medical Center has identified a need to migrate to an environment built on Windows 10 Server/Active Directory and Exchange 10. With this new environment, Regional Medical Center seeks to capitalize on the features built into Windows 11 Server/Active Directory and Exchange 11 to achieve the following goals:
   - Granular security and delegation of permissions.
   - Identify opportunities to optimize existing Citrix environment.
   - Maximize control over the existing workstation environment.
   - Improve account creation process.
   - Increase system reliability and performance.
   - Resource scheduling within Microsoft Exchange.
   - Utilize Outlook Web Access.
4. **Project Customer Contacts:** Create a table that displays the customer's contact name, contact phone number, and the contact's email.

Example: Client Key Contacts

Contact Name	Contact Phone	Contacts email
B Taylor	444- 555-7777	Taylor@clientemail.com

5. **Project Team Contacts.** Create a table that displays the project team's contact name, contact phone number, and the contact's email.

Example: Team Key Contacts

Contact Name	Contact Phone	Contacts email
Leonard	555-555-5555	Leonard@email.com
Udbinac	554-555-5555	Udbinac@email.com
Kotche	553-555-5555	Kotche@email.com

6. **Customer Address:** Description of the customer address the project team will be visiting during the project.

   Example:
   Regional Medical Center
   100 Example Street
   Sample, MD 21000-5493
   444.555.6666

7. **Work Week:** Provide the work week details so that the project team knows when and where work will be completed.

   Work week will consist of four 10-hour days.

8. **Hotel, Travel, and Virtual Web Call Details (Zoom or MS Teams).** Provide hotel and travel details so that everyone knows where to stay and what transportation services the customer has approved.

   Please plan to arrive the day before because we will start early.

   Example Inn
   3333 Merrittmill Road
   Sample, Maryland 21218

9. **Project Schedule:** Provide a table of the initial project start and kick off meeting details. The table should include dates, locations, and activities for each meeting.

Dates	Location	Activity
08/05/22	100 Example Street Sample, MD 21801	Kick off meeting
08/05/22	100 Example Street Sample, MD 21801	Understanding the current design
08/05/22	100 Example Street Sample, MD 21801	Project Discovery(PD) Current IT Process
08/06/22	100 Example Street Sample, MD 21801	PD Server and Desktops
08/07/22	100 Example Street Sample, MD 21801	PD Review and analysis client provided information; Began documentation
08/07/22	100 Example Street Sample, MD 21801	PD Security and Virus protection
08/08/22	100 Example Street Sample, MD 21801	PD Deployment; Terminal Services
08/08/22	100 Example Street Sample, MD 21801	PD Messaging; and Active Directory

10. **Finally, provide the location of project documentation or artifacts.** This section should provide details on where everyone can find project documentation as well as where project documents created during the project shall be stored.

    Example:
    On this project we will be using the public folders as the "cradle to grave" system for project related documents that are internal to our consulting firm. Documents shared with the customer will be hosted on the Extranet. Data should be created in Public folders and reside there from draft stages until final approval by the client. Achieving this goal will require each of us to select areas of the public folder tree we work with and replicate them to your local drive. The public folders are to be used for **draft documents!!!!** This will allow the entire team to know the current status of any document. Public folders should be replicated to the c: drive of each project team member for off-line access.

Folders this team will use:

- Our Clients\Regional Medical Center

Bonus derived from my book, *Workplace Jazz*. How to Build and Engage Your Team Exercise.

"Develop Rules of Engagement at the Beginning of Projects and Important Meetings

1. Use a whiteboard or flipchart to capture the rules of engagement and write the words Rules of Engagement at the top of the page.
2. Inquire of everyone in the group to provide the actions or behaviors that will produce the best outcomes for the meeting. If meetings are normally dominated by one or two people in the group, have everyone write down their ideas on a Post-it note, and once they are done writing down their ideas, each person gets up and sticks their notes on the flip chart.
3. Then, group the words that are similar and create an affinity diagram of the terms that have been provided by the team. When the team uses terms like love or respect, then ask them to explain what they mean by using those terms. This will help everyone get on the same page as far as what each term means for the group.
4. Finally, capture from the group how feedback will be handled when someone violates the rules of engagement that everyone has agreed. to. Also, clarify the process to resolve conflicts and escalation procedures when team members cannot agree on a principle that has been violated."

Source: Mr. Gerald J. Leonard who is a PMP, PfMP, and a C-IQ Coach and also the author of *Culture Is the Bass* and *Workplace Jazz*, published by Business Expert Press.

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Chapter 6

Stakeholder Analysis and Communication Planning

Chapter Objectives

Core Objectives:

- **6-1** Enumerate, describe, and prioritize stakeholders for a project.
- **6-2** List each section of a project communications plan and describe the necessity of each.
- **6-3** Build a communications matrix for a real project.
- **6-4** Develop strategies for stakeholder management.
- **6-5** Discuss the process of building project relationships and their importance in terms of communication.
- **6-6** Develop a project communications management plan for a real project.
- **6-7** Plan, conduct, and improve project meetings.

Agile Objectives:

- **6-8** Describe collaboration and communication needs and methods on Agile projects.
- **6-9** Develop a customer-driven vision and customer-driven value for a project, while balancing business needs.
- **6-10** Identify key Agile communication challenges and the most effective communication methods/techniques for your project.
- **6-11** Justify the importance of transparency on Agile projects.

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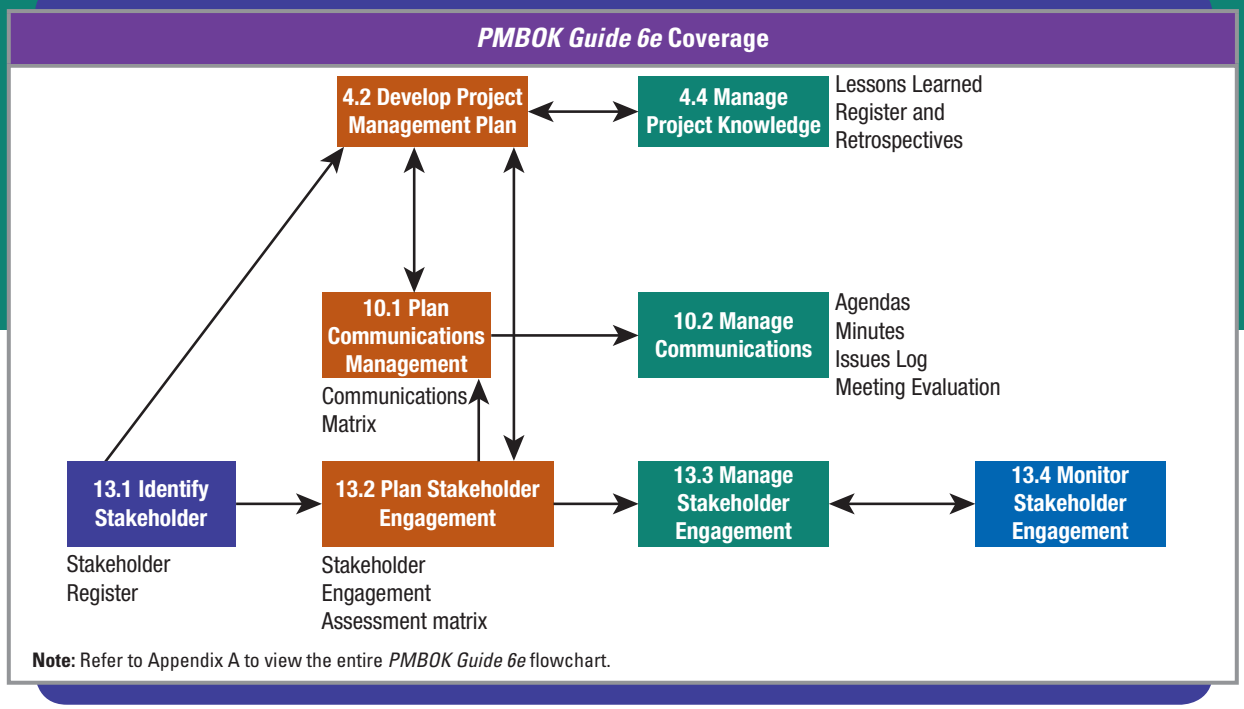
Humans are social animals who engage with each other in complex ways, especially in man-made environments such as organizations and projects. Inexperienced project managers can become buried in the control of the project plan's tactical aspects and miss the more strategic components like stakeholder engagement and effective communication. Ultimately, successful delivery of a project is about *both* managing the tangible outputs which are generally easily and objectively measured (time, cost, and project deliverables) *and* leading others through the more strategic and intangible outcomes (such as relationships, power, influence, motivation, interests, and commitment). Traditionally, measures of success focus on scope, time, cost, and quality to determine the success of the project as an entity. However, a more accurate measure of success also considers the longer-term outcomes and values delivered by your project, including well after its completion.



PMBOK Guide 7e

Domains:

- **Stakeholders**
- **Team**
- **Planning**
- **Delivery**
- **Measurement**

For example, the Sydney Opera House was a disaster as a project in terms of meeting its project management-related objectives, but it made significant contributions to the culture, national identity, meaning, and pride of the Australian nation, well beyond being a "failed" project. And, there are many other examples like this in human history. Equally, there are project "successes" that make negative contributions to society. This is because different stakeholders have varying perceptions of the worth of the project.

Stakeholders and communications with them are highly subjective aspects of projects and project management, and can be more difficult to manage than some of the hard skills discussed in earlier chapters. As such, these aspects are often not managed with anywhere near the time and thought investment of the tangible aspects of a project. And while not every project manager (PM) needs to be a skilled wordsmith or a psychologist (though these would, in fact, be very useful skills for a PM to have), the *PMBOK 7e* includes more content than any previous *PMBOK* edition around these aspects of leading and managing projects. As such, there is a vast amount of research and literature acknowledging the importance of the "soft skills" required to be a successful project manager.

Capable project managers invest time and effort in creating and maintaining informed stakeholder engagement matrices and insightful communications plans. They know whom to engage at what stage of the project (including critical stakeholders *before* the project starts, in some cases), at what frequency, and through what medium to secure optimal and favorable results. They then implement a communication plan and adjust it as circumstances change. In essence, this is the art of project management.

One effective and fun way a PM can accelerate the development of their stakeholder engagement and communication skills is to use a metaphor developed by Arthur Shelley. This approach uses animals to represent behaviors and stimulate constructive conversations about interactions among people. The Organizational Zoo describes a set of 27 characters that collectively represent the most common

Courtesy of Arthur Shelley

behaviors in the Zoo (i.e., your team, project, organization, or community). They are easy to remember (one for each letter of the alphabet, plus one "double"), and the cartoon characters help to make the conversation fun. Team members profile themselves and their stakeholders in order to understand what they are like and how they should engage with one another. Because we all have considerable prior knowledge of animals, understanding is intuitive, and the tool makes it easy to quickly assess our behavioral environments. It is clear a mouse does not approach a lion in the same way it would approach a dog, and the leadership style of a lion is different from that of an eagle.

In projects, the use of creative tools such as metaphors and reflective conversations is becoming more common and makes a significant contribution to the success and learning experiences of those involved. The free online profiler can be used for project team activities and to discover more about your own inner animals.

—www.organizationalzoo.com/profiler Copyright Arthur Shelley, 2013
Image artist John Szabo

6.1 Identify Stakeholders

Projects are undertaken to meet the needs of an organization or other stakeholders such as internal or external customers and end-users. To be successful, a project must satisfy its clients and their needs. Several things can complicate this goal. First, there may be multiple users, and each may have different wants and needs. Second, end-users often do not fully understand what they want because they do not know what alternatives may be available. Third, the customer who pays for the project may not be the actual person or group who uses the project deliverable or outcome, and the customer may not fully understand the end-users' expectations and needs. Fourth, when someone else is paying for the project, some users will ask for many project outcomes that are expensive or time consuming to deliver. Finally, many stakeholders, in addition to the users of a project's outcomes, have an interest in the project. Consequently, it is of paramount importance that project managers understand their stakeholders, build relationships with them, and then develop a communications management plan for managing them.

6.1a Find Stakeholders

One way to understand who stakeholders are is to ask, "Who will use, will be affected by, or could impact this project?" The answer includes users of the project results and others who may have some changes forced upon them by the project outcomes. It also includes people and groups who might choose to influence the project in some way. We use the **identify stakeholders** process to determine the people, groups, or organizations who are or might be impacted by some aspect of our project. Stakeholders include people who:

- work on the project
- provide people or resources for the project
- have their routines disrupted by the project
- monitor regulations, laws, and standards of practice at local, county, state, and federal levels
- are direct users of the project outcomes (products or services)
- are directly or indirectly affected (positively or negatively) by the project outcomes.

Another way to identify stakeholders is to determine whether they are internal to the organization performing the project or external to it. Examples of project stakeholders based on these categories are shown in Exhibit 6.1. Note that there are potentially more types of stakeholders affected by the process of performing the project than by the project results and more external than internal stakeholders.

Project managers and project core teams (often in consultation with the project sponsor) can use the examples in Exhibit 6.1 to find possible project stakeholders as part of a brainstorming technique. Classic rules of brainstorming apply—initially, the emphasis is on generating a long list of potential stakeholders in the first column of a chart without evaluating and analyzing them. It may be easy to construct this chart on a large work surface such as a whiteboard or flip chart. Another suggestion is to be specific; identify stakeholders by name when possible.

For each potential stakeholder, list the various project processes and results in which they might have an interest. Consider financial, legal, and emotional interests of potential stakeholders. The project charter can be useful here. Many stakeholders have an interest in multiple aspects of a project. Once the stakeholders and their interests have been listed, they may be combined into groups with the same interests.

Exhibit 6.1

Examples of Project Stakeholders

	Internal	External
Affected by Project Process	Owner Sponsor Project Manager Functional Managers Competing Projects Financing Source Project Core Team Subject Matter Experts Employees Stockholders	Suppliers Partners Creditors Government Agencies Special Interest Groups Neighbors Client Professional Groups Media Taxpayers Union Competitors
Affected by Project Result	Internal Customer Sponsor Users	Client Public Special Interest Groups Competitors People who receive benefit indirectly

6.1b Analyze Stakeholders

Stakeholder analysis is a technique composed of gathering and evaluating information to determine whose interests should be emphasized throughout the project. The first part of stakeholder analysis is to prioritize the stakeholders. Prioritization is important because, on many projects, there are too many stakeholders to spend a great deal of time with each. While it is important not to ignore any stakeholder, it also makes sense to concentrate on those who can impact or influence project outcomes. Stakeholders are frequently prioritized based upon level of:

1. Power—ability to get others to do something
2. Legitimacy—perception that their actions are appropriate
3. Urgency—time sensitivity and legitimacy of claim[1]

Some organizations use additional criteria such as interest, influence, and impact. Some organizations only use two or three criteria; others may use up to six. Each chosen aspect can be rated on a simple scale of 1 to 3, with 3 representing the highest priority. For the first aspect, *power*, a stakeholder who could order the project shut down or changed in a major way would be a 3, and a stakeholder who could not change the project much would be a 1. The other aspects can be analyzed in a similar fashion. The scores from the criteria are added to determine a total prioritization score.

We will use an example of a university based in London, UK that changed its entire curriculum to a modular approach—a major change project. This large university was in danger of closure because of failed quality ratings and public criticism of its performance.

Major improvements were required. The newly appointed vice chancellor decided to modularize all the courses offered by the university, which allowed the students to "pick and mix" topics and create courses that better suited their needs. This change impacted every part of the university, and it was not a popular decision. The appropriate engagement of stakeholders was crucial. One of the major challenges to the modularization program was the shift in power base from academic management (the deans of faculty) to the academic registry. In Exhibit 6.2, you can see that the academic registrar scores highly in every line. This shift in power was always going to meet resistance, and the project manager would need to carefully consider the positions of the three key stakeholder groups to find an appropriate strategy.

By determining who the stakeholders are and what each group (key, secondary, other) wants, project managers effectively:

- Set clear direction for further project planning, negotiating, and execution
- Prioritize among competing objectives
- Learn to recognize complex trade-offs and the consequences of each
- Make and facilitate necessary decisions
- Develop a shared sense of risk
- Build strong relationships with their customers
- Lead associates, customers, and suppliers with empowering style and principles
- Serve as good stewards of the resources of both the parent and customer organizations
- Develop a communication plan for stakeholders that is specific for stakeholder groups

Exhibit 6.2

Modular Courses: Stakeholder Identification and Prioritization Matrix

	Vice Chancellor	Deans of Faculty (*)	Academic Registrar:	Lecturers: (*)	Student Support	Students
What Is Important to This Stakeholder						
Power	3	3	3	2	1	1
Interest	3	1	2	1	2	2
Influence	1	3	2	2	1	1
Impact	3	2	3	1	1	1
Urgency	2	1	2	1	1	1
Legitimacy	2	1	3	3	1	3
Total:	14	11	15	9	7	6
Priority (Key or Other):	Key	Key	Key	Secondary	Other	Other

(*) Lecturers and deans are unlikely to be homogenous in their views—more information is needed to identify groupings and interest areas. For this case, we kept it simple.

Source: Louise Worsley.

The project team should next select the top 10 to 15 stakeholders for emphasis in the remainder of their planning. The stakeholders with the highest total scores are often considered to be key influencers for the project. The project manager and the core team should also plan to periodically review this prioritized list of stakeholders, as the relative importance may change as the project progresses, especially if the project goals are not clear at the outset. While from a practical standpoint, project managers need to be especially attentive to the top stakeholders, the enlightened "management for stakeholders" approach also encourages project managers to ensure that interests of all the stakeholders, including less powerful ones, are considered.[2] This approach of giving preference to the most important stakeholders while recognizing needs of all stakeholders requires judgment, and the advice of the sponsor is often helpful.

One additional consideration is that various stakeholders often have competing or contrasting interests. For example, the client may want the work done quickly, while the accountant is worried about cash flow. It can be true with external stakeholders too: for example, the client and end users may have different opinions about quality and release time of the deliverable. Exhibit 6.3 itemizes how different types of stakeholders frequently define project success. Another consideration is that each project was selected to support a specific business purpose, and that purpose should help determine the relative importance of various stakeholders.

It is not necessary that all stakeholders favor the project. Competitors in the business, public interest groups, voluntary organizations that promote environmental sustainability, and, occasionally, a segment of end-users may oppose the project and its execution. The project manager must identify them and monitor their actions closely.

If the project team developed the stakeholder identification and prioritization matrix without their sponsor, now would be a good time to share it with the sponsor to seek feedback. Chances are good the sponsor may suggest changes before the team firms up the stakeholder management plan. Sponsors are especially useful in sorting out conflicting priorities. Typically, when a conflict exists, external (paying) customers and top management are considered to be highly important stakeholders. The project team primarily considers these top stakeholders while they:

- Develop a communications plan (later in this chapter)
- Define the scope of the project (see Chapter 7)
- Identify threats and opportunities (see Chapter 11)
- Determine quality standards (see Chapter 12)
- Prioritize among cost, schedule, scope, and quality objectives (see Chapter 12)

6.1c Document Stakeholders

The primary output of the "identify stakeholders" process is a **stakeholder register**. The stakeholder register is a repository of information regarding all project stakeholders. Teams use it to develop strategies to either capitalize upon stakeholder support or to mitigate the impact of their resistance. The stakeholder register provides input to relationship building with various stakeholders and helps determine their requirements. In turn, these requirements serve as the basis of developing the project scope. The stakeholder register is a living document that changes as needed. A stakeholder register often is in the format of a matrix. Exhibit 6.4 shows the stakeholder register wherein we begin to evaluate the interests of the different stakeholder groups. Sometimes referred to as the WIIFT (what's-in-it-for-them), this analysis can be used to help identify common areas of interest between the groups, and what made this particular program complex was the *absence* of common ground. Strategies would be sought to change positions or reduce the impact of the behaviors of some of the groups.

Exhibit 6.3

Success Criteria for Various Stakeholders

Stakeholder/ Success Criteria	On Time	On Budget	Meet Requirements	Partner Ship	Profit Realized	Follow-On Work	Minimal Overtime	Recognition	Challenge	Well-Paid	Quality
Customer	X	X	X	X							X
End-user	X		X	X			X				X
Customer management	X	X	X	X			X	X			X
Project manager	X	X	X	X	X	X	X	X		X	X
Contractor management	X	X	X	X	X	X	X				X
Project team member	X		X	X		X	X	X	X	X	X
Subcontractor	X	X		X	X	X	X			X	X

Source: Adapted from Young, Ralph R., Steven M. Brady, and Dennis C. Nagle, Jr., *How to Save a Failing Project: Chaos to Control* (Vienna, VA: Management Concepts, 2009): 14. © 2009 by Management Concepts, Inc. All rights reserved, www.managementconcepts.com/pubs.

Exhibit 6.4

Modular Courses: Project Stakeholder Matrix

Stakeholder	Interest In Project	Priority	Support/Mitigation Strategies
Vice Chancellor	Make major improvements in university services and avoid government intervention.	Key	Consult on target improvement areas—use his power to support key and difficult changes.
Deans of Faculty	Protect against changes that could influence their power base. Reduce detrimental impact on faculty activities.	Key	Work with nominated representatives to identify and seek out solutions to barriers to change. Establish and communicate wins for faculties.
Academic Registrar (AR)	Develop the power base of AR—demand and obtain quality improvements on courses across the university.	Key	Increase visibility and power of AR. Increased visible support for AR regarding resources and political support from senior management.
Lecturers	Be kept informed of impacts upon them. Reduce or resist changes that are considered negative to them.	Secondary	Identify supportive champions. Create, test, and deliver carefully considered communication strategy.
Student support	Be able to prepare and train staff on how to roll out new schemes to current and prospective students.	Other	Help student support guide staff through process—develop training programs and online web support.
Students	University shows signs of improvement and ensures students' needs are considered.	Other	Set up consultation and communication groups. Keep informed.

Source: Louise Worsley.

Firma V/Shutterstock.com

6.2 Plan Stakeholder Engagement

Project teams plan **stakeholder engagement** both by creating a tool called a stakeholder engagement assessment matrix and by planning to build relationships with the stakeholders.

6.2a Creating a Stakeholder Engagement Assessment Matrix

Project teams create a **stakeholder engagement plan** to define how they will effectively engage stakeholders in planning and performing the project based on the analysis of the stakeholders' needs, wants, and influences. A primary tool used in this plan is the **stakeholder engagement assessment matrix**. This matrix typically includes the stakeholders in the first column. For each stakeholder, additional columns may represent how much they are currently supporting or opposing the project, where you would like them to be, barriers to change (from current position to target position), and strategies you may employ to move them. Strategies for powerful and supporting stakeholders may include accepting their ideas, compromising, or offering them trade-offs, while strategies for opponents might entail doing the minimum possible or fighting against their demands.[3] It is not uncommon to think that the best one can do with opposing stakeholders is to help move them to a neutral position. Those who are unaware of or neutral toward the project may be turned into supporters.

Exhibit 6.5 identifies both the current and target positions of the stakeholder groups. The greater the change in position, the greater the risk and the greater the engagement

Exhibit 6.5

Modular Courses: Stakeholder Engagement Assessment Matrix

Stakeholder	Current Position	Target Position	Barriers to Change	Strategy
Vice Chancellor	Leading	Leading	Competing day-to-day priorities	Ensure engagement is efficient and effective. Consider extending role of deputy Chancellor to cover for some day-to-day activities.
Deans of Faculty	Resistant	Neutral, Supportive, or Leading	Some Deans more powerful than others (relates to student numbers and academic ratings). "Power owners" are very influential.	Consider each Dean's WIIFT individually. Consider strategies for individuals as well as the group.
Academic Registrar (AR)	Supportive	Leading	Competing day-to-day priorities—lack of leadership skills.	Engage deputy, provide skills and mentorship.
Lecturers	Unaware to neutral	Neutral or supportive	Very large group with veto power through unionized actions.	Involve HR and legal department to evaluate all changes that may impact lecturers. Identify supportive champions and stakeholder groupings for engagement.
Student support	Neutral	Leading	Not considered important by academic staff—services currently limited and not highly rated.	Provide consultancy support to team to re-design and promote new services (including student website).
Students	Unaware	Neutral	Very large group. Student representative council not well resourced or highly valued by students.	Set up consultation and communication groups. Keep informed. Consider use of social media.

effort required. For example, the *Student support services* had a relatively unimportant position in the old system but would be critical to the new modularized operation. Significant expenditure of time and money was anticipated in this area. It is of interest to note that the initial analysis (see Exhibit 6.4) had identified this group as "other stakeholder." As the nature and impact of changes become clearer, they can alter the relative importance of different groups. Stakeholder positions and stakeholder strategies must be reevaluated throughout the project.

6.2b Planning to Build Relationships with Stakeholders

Project managers and teams seek to develop strong working relationships with important stakeholders. This is an ongoing process throughout the life of the project. In fact, the project manager normally continues to nurture the relationship even after the project is completed to increase the chances of securing future project work and to maintain good will with the external stakeholders. In building relationships both within the project core team and with other stakeholders, project managers need to remember that mutual respect and trust greatly enhance the prospect of project success. Therefore, relationship-building activities that lead to respect and trust should be planned and carried out carefully.

Typically, relationship-building activities are most effective when they are used in the process of planning a project. Project relationship-building activities (described more fully below) that are especially useful include the following:

- Share individual motives.
- Encourage open communication.
- Jointly establish agenda.
- Use shared learning.
- Regularly celebrate success.
- Share enjoyment of project.
- Use appropriate decision-making and problem-solving.[4]

Establishing a positive relationship early with all key stakeholders is vital for two reasons. First, it helps create a desire on the part of stakeholders to give positive support to the project—or at least refrain from disrupting the project. This early building of a coalition of supporters and engagement of opposition can help to positively shape the social and political context of the project and lead to success.[5] Second, it serves as the communications foundation for the project. The remainder of the project planning and execution are greatly enhanced by effective communication channels with key project stakeholders.

The sponsor, project manager, and core team can establish powerful and meaningful relationships with key stakeholders by delivering on all promises, always providing fair treatment, creating a sense of pride by association, and even helping the stakeholder develop a passion for the project.[6] This starts by learning what motivates each stakeholder. The old saying "What is in it for me?" describes what each stakeholder wants, and that is what the project team needs to understand. Stakeholders who feel threatened can disrupt a project during its process and are less likely to perceive that they receive project benefits in the end. Unhappy stakeholders are a sign of project failure. On the other hand, stakeholders can be treated as partners right from the start of planning by speaking their language and providing them opportunities to participate. Here are some things that customers (one of the primary stakeholders) value most from a contractor who is performing the project:

- A sincere invitation to early and continued involvement
- Responsiveness
- Transparency
- Reliability[7]

Exhibit 6.6

Building Commitment Through Stakeholder Relations

An example of building commitment to a project through stakeholder relations is provided by the Indian infrastructure developer GMR Group. During the COVID-19 pandemic, GMR accelerated its digital transformation, adopting new technologies like 3D modeling and transitioning to a digital project management platform to monitor its projects around the world. This was a big change from the organization's previous reliance on time-consuming spreadsheets, and it would only be possible by building trust through clear communications around the shift. "If we can't explain the benefits to everyone who will be impacted, it will fail," says Nirbhik Sengupta, PMP, vice president, operations, GMR Group, Singapore.[8]

These stakeholders are more likely to take ownership in the project by educating the project team about their needs and making timely project decisions. Consequently, stakeholders are more likely to feel that their expectations are in line with the project team's plans. They are more likely to go beyond merely inspecting results and writing checks. Further, they may participate early and often when their input is meaningful and they feel that the project is successful. The important thing for project managers to remember is that developing respect and trust among all project stakeholders is a goal that must be started early and continued throughout the project. Stakeholder relations and engagement are just as critical to project success as the more technical planning and should demand equal attention from project managers.

Exhibit 6.6 is an example of how an Indian developer recognizes the need to build relationships with stakeholders.

6.3 Manage Stakeholder Engagement

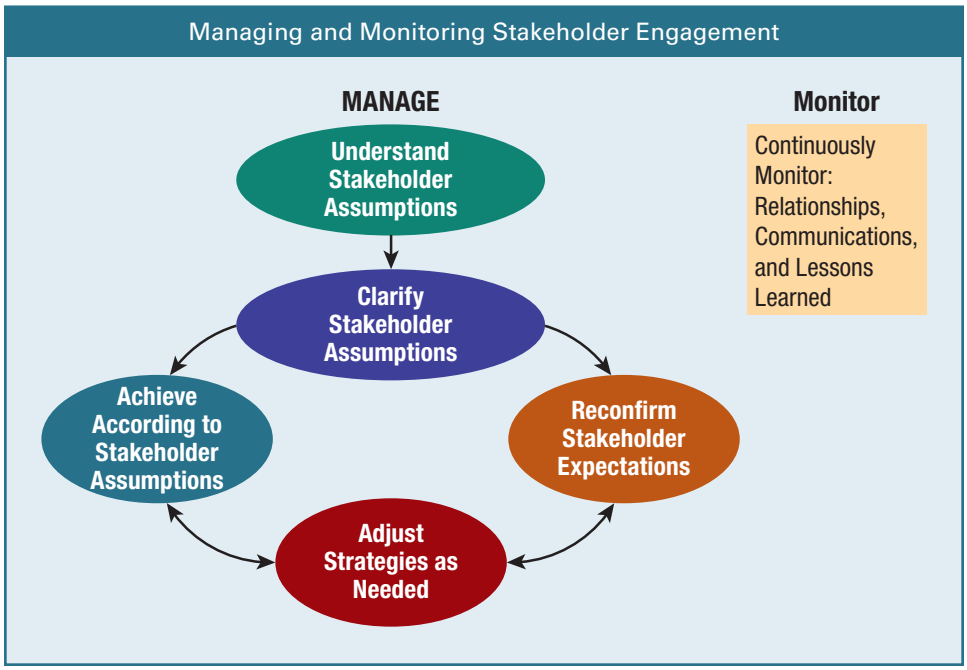
Manage stakeholder engagement is the process of the project team communicating and working with stakeholders to satisfy their needs (and additional desires if applicable and possible), manage issues quickly, and encourage active stakeholder participation throughout the life of the project. This process can be visualized as shown in Exhibit 6.7, with managing on the left and monitoring on the right.

The first part of managing stakeholder engagement—understanding stakeholder assumptions—is performed while creating the charter (Chapter 3), along with the stakeholder register and stakeholder engagement assessment matrix discussed earlier in this chapter. The requirements matrix, which will be developed in the next chapter, is also helpful in understanding stakeholder assumptions. Different stakeholders may hold very different assumptions concerning the project at the outset, and these assumptions form the basis of their expectations. Therefore, it is necessary that the project manager clarifies the assumptions with the stakeholders, challenges and negotiates some of them, and then uses them in project planning.

These clarified assumptions are then stated as expectations concerning project deliverables, features of the product, timeline, costs, quality measures, and generally how the project manager and team will act. Next, the stakeholders have a chance to agree or challenge the expectations before committing. The expectations are then documented and planned for implementation.

During project execution, the team works toward satisfying these expectations. This involves work between project meetings to complete assigned activities and to quickly resolve problems that have surfaced. Concurrent with the achievement of expectations is the continual recommitment to the expectations. One method that project teams can use to reconfirm expectations

Exhibit 6.7



is to share planning documents with stakeholders. The team informs the stakeholders that all the planning documents reflect the team's understanding of what it has been asked to do. This is what the team is expected to achieve and be judged against.

Some stakeholders may identify further expectations when they see everything spelled out. Project managers often hold informal conversations with various stakeholders to ensure that they fully understand and agree with all of the planning details. Finally, as project teams report progress to stakeholders, additional expectations emerge. When additional expectations emerge, they need to be considered in terms of the project's formal change control process and, if accepted, the project plan will be revised and these additional expectations will become additional project activities to be performed. All of the activities related to managing engagement with stakeholders increase support from those stakeholders who favor the project and decrease resistance from other stakeholders.

6.4 Monitor Stakeholder Engagement

Monitor stakeholder engagement is the process of engaging stakeholders and managing relations with them effectively. The vertical box on the right in Exhibit 6.6 shows three things a project manager must monitor throughout the process of managing stakeholder expectations: relationships, communications, and lessons learned. Through honest and ethical conduct, the project manager and project team must build trust with all project stakeholders. They need to continually manage effective two-way communications with all stakeholders as described in the communications plan. This includes a true willingness to encourage stakeholders to ask probing questions, which helps to develop confidence with some stakeholders. Finally, they should use lessons learned from previous projects and previous phases of the current project. Armed with trusting relationships, effective and transparent communications, and methods to

overcome some problems from previous projects, the team is prepared to adjust strategies and plans as needed to manage stakeholder engagement.

6.5 Plan Communications Management

The project team should next create the **communications management plan**. This plan considers stakeholders' information needs and steers the project communications. It is a living document that adapts to changing project needs. Exhibit 6.8 shows how one Dubai-based project executive feels about the criticality of planning project communications management.

6.5a Purposes of a Project Communications Plan

Projects face many challenges, including those of technical, cost, and schedule. Failure to manage any of them can derail a project. Perhaps the most common challenge to project success is communication. Many projects require a group of people to work together for the first time. Projects may involve people from various functional disciplines that present their own unique challenges. Sometimes, people from multiple organizations may end up working together on projects. All projects are unique and therefore they have a different set of stakeholders. "Communication leads to cooperation, which leads to coordination, which leads to project harmony, which leads to project success."[10]

6.5b Communications Plan Considerations

A myriad of considerations must be kept in mind when creating a communications plan. A project team can develop a workable communications plan, use it, and improve it as the project progresses. Some challenges that Fiesta® San Antonio organizers considered when creating a project communication plan are shown in Exhibit 6.9. Exhibit 6.9 shows considerations that apply to all project communication plans. The way to work through this is to read one column at a time. For example, for each communication, first determine why you need it (the purpose column), then proceed through the other columns.

Purpose Column The first column in Exhibit 6.10 instructs a project team to consider the *purpose* for each communication. A project manager must use effective communication to set and manage expectations of all stakeholders as well as to ensure that project work is completed properly and on time. Communications *from* stakeholders help in authorizing work, determining requirements, uncovering and resolving issues and assumptions, and receiving feedback on project progress and results. Different stakeholders often have conflicting desires; effective communication processes are necessary to understand and resolve these differences. Communications *to* stakeholders are necessary to help them make good decisions

Exhibit 6.8

Communication Planning at Dubai Municipality

A project management professional who understands the criticality of planning communication with stakeholders is Heba Al Shehhi, PMIACP, PMP, head of the PMO, Dubai Municipality, Dubai, UAE. Al Shehhi observes that "the role of leadership and managers has to be shifted to become supporters and catalysts of change for all the stakeholders in the organization." Thus, the most successful project managers are those who can combine their technical skills with strong communication skills to meet increasingly complex and ambiguous challenges.[9]

Exhibit 6.9

Fiesta San Antonio Communication Challenges

The Institute of Texan Cultures, a museum specializing in Texas culture and diversity, forged a partnership with the Fiesta® San Antonio Commission to produce a series of exhibitions showcasing the traditions of Fiesta, San Antonio's premiere festival. Fiesta is an annual 10-day festival of over 100 events and 5 large parades. The festival draws 3.5 million visitors. It is tradition for Fiesta events to commission new medals each year for event-goers to wear and trade throughout the festival.

The museum's leadership team convened with the Fiesta San Antonio Commission's executive director at the end of August to assemble a project management plan. The parties identified stakeholders who would be impacted by the project. They prioritized stakeholders by influence, and divided responsibilities for developing and maintaining relationships with each of those stakeholders. The following challenges were anticipated:

- It would take time for the 120 Participating Member Organizations (PMOs) to reach their members and assemble a full collection of medals to loan to the museum.
- Some PMOs might be offended if their medals were not displayed more prominently than other PMOs.
- The museum would be engaging the same PMOs to support future exhibitions, so it was critical to maintain positive relationships.

It was clear that a comprehensive communications plan must be implemented to establish lines of communication, nurture relationships, and manage the flow of information between stakeholders.

Source: Aaron Parks, Institute of Texan Cultures

(understanding options and risks), assure adequate understanding and project progress, enable commitment to the project, and prepare to accept project deliverables. Yet another communication purpose is to plan and manage escalation of issues that cannot be handled in a timely manner by the project manager. Informed and wise project managers determine

Joshua Rainey Photography/Shutterstock.com

Exhibit 6.10

Project Communications Plan Considerations

Purposes	Structures	Methods	Timing
Authorization	Existing organizational forms (reuse)	Push methods:	Project life cycle
Direction setting	Project specific:	Instant messaging	Charter
Information seeking	Templates (adapt)	E-mail	Project plan
Status reporting:	Unique (create)	Voicemail	Milestones
Schedule		Text	Output acceptance
Cost		Pull methods:	Project close-out
People		Shared document repositories	Routine time
Risk		Intranet	Daily—member
Issues		Blog (repository)	Weekly—core team
Quality		Bulletin boards	Monthly—sponsor
Change control		Interactive methods:	As needed—others
Approval of project outputs		Telephone—teleconferencing	
Escalation		Wikis	
Lessons learned		VOIP/videoconferencing	
		Groupware	

in advance how soon an issue will be escalated to the sponsor and/or other decision makers. Finally, communications plans ensure that meaningful lessons can be documented during the project execution and at project conclusion for the benefit of future projects.

A project manager, using open and transparent communications, develops trust with her core team and other stakeholders. However, they needs to respect all promises of confidentiality and to use good judgment on what is or is not appropriate to share.

Structures Column The second column suggests that when an organization has adequate existing communication *structures,* it should use them! There is no need to reinvent every document and, indeed, it would be confusing and costly to do so. Many stakeholders in organizations are accustomed to a particular method of communications, and making use of it is easier and better for understanding. When no precise organizational model is available for a specific communication, one can use a template, which is still easier than creating an entirely new type of document.

Using any of the listed choices, project teams need to maintain version control on all of their communications. One easy method is to end the file name of every document with six numbers representing year, year, month, month, and day, day. For example, an early version of this chapter was saved on February 1, 2021, and the file name given was *Chapter 6 Stakeholder Analysis and Communication Planning 210201*. The advantage of a simple system is that the files can still be easily found by their descriptive named titles, but they can also be sorted easily by the last date they were updated.

Methods Column The third column in Exhibit 6.8 deals with *methods* of communicating. Projects rely on "push" methods in which communications are sent or pushed to the receiver. In "pull" methods communications are posted either on paper or in electronic form, and interested stakeholders need to take the initiative to receive or retrieve the communication. Finally, in "interactive methods" communications flow in multiple directions. A typical project communication plan will use all or a combination of these methods.

Timing Column The fourth column is a reminder that a project team needs to consider *timing* issues when developing a project communications plan. Communications typically

are delivered according to one of three types of timing schedules. First is the project life cycle, with communications typically needed at the end of every major stage in the project and upon completion of each major project deliverable. The second timing schedule follows a more formal organizational structure, and in this case, project progress is often reported at regularly scheduled meetings. Meetings at the frontline level are usually more frequent than reports to higher levels within the organization. The third schedule is on an as-needed basis. Many times, a stakeholder wants to know a certain fact about a project and cannot wait until the next formal meeting, report, or communication schedule. Project teams need to keep themselves up to date so they can handle the as-needed requests.

6.5c Communications Matrix

At this point, project teams will normally assemble a project **communications matrix**. This matrix lists the following information:

Who	does the project team need to learn from?
What	does the team need to learn from this stakeholder?
Who	does the project team need to share with?
What	does this stakeholder need to know?
When	do they need to know it?
What	is the most effective communications method for this stakeholder to understand?
Who	on the project team is responsible for this communication? (the owner)

The communications needs of each project are unique and, therefore, the assignment of communications responsibilities will vary widely from project to project. A partially completed project communications matrix for the Modular courses program is shown in Exhibit 6.11. This identifies the information needs of the project team and the stakeholders.

Exhibit 6.11

Modular Courses: Project Communications Matrix

Stakeholder	Project Info. Needs	Stakeholder Info. Needs	Methods	Timing
Program Board (Vice Chancellor)	Direction, strategy, budget, authorizations	Status—progress and SH positions	Scheduled board meetings, circulated minutes, one-on-ones with Vice Chancellor	Weekly and as needed Daily 15-minute stand-up with Vice Chancellor
Deans of Faculty	Concerns, WIIFT	Plans, changes to practices affecting their staff	Program newsletter, across-faculty workshops, informal one-on-ones consultation	Every 2–3 weeks depending upon concerns.
Academic Registrar (AR)	Requirements	Resource commitments, status	Workshops with team, E-mails	Frequent in early stages then timed to delivery points.
Lecturers	Concerns	Plans, changes to practices affecting them	Program newsletter, presentations, E-mails	Monthly
Student support	Requirements	Resource commitments, status	Workshops with team, E-mails	Frequent in early stages then timed to delivery points
Students	Concerns	Changes to enrollment procedures	Social media, E-mails, presentations	E-mail and meetings

Various methods of communication are proposed, depending on the purpose of the communication and the constraints within which the stakeholder engagement must take place. It won't be possible to meet with the program board every day, so weekly meetings, supplemented by short one-on-one stand-ups with the Vice Chancellor, are planned. It was decided to create a program board made up of key decision makers—to serve as an important communication and decision-making conduit for the program. The actual communication plans impact the scope of the project. For example, having a program newsletter adds to the scope—the effort and costs of the project. In complex projects, the communications plan can form a major part of the project scope.

Stakeholders want to know how much work has been successfully delivered (acceptance tests passed) and how much work remains. The information serves to motivate and improve the performance of project team members. Sponsors use the information to strategically understand if the project team will complete all work on time and within budget. Some stakeholders are primarily interested in the details that concern their specific functions.

6.5d Manage Project Knowledge

If an organization is extensively involved in project work and uses project management capability as an organizational strength, it is important to keep developing expertise in managing projects. One way to develop and expand expertise is to capture and reuse the knowledge developed. **Knowledge** can be defined as insights derived from information and experience. Knowledge also is "a conclusion drawn from information after it is linked to other information and compared to what is already known."[11] Ironically, knowledge will remain dormant, and not very useful, until it is reflected in future actions. **Manage project knowledge** is the process of using and developing knowledge to help improve both the current project performance and the capability of the organization.

To increase knowledge and the successful use and reapplication of it, organizations often create a lessons-learned knowledge base. For this database to be useful, it is important to communicate project successes and failures from all aspects of a project. Captured throughout the life of the project, recommendations to improve future performance can be based on technical, managerial, and process aspects of the project. In addition, part of the project closeout process should include facilitating a lessons-learned session for the entire project, especially on *unsuccessful projects*. Remember, "people learn, not organizations. … Knowledge is created and exchanged through trusted relationships and social interaction."[12]

6.6 Manage Communications

Manage communications includes all the work associated with the project communications plan, starting with planning, generating, organizing and sharing, and, eventually, storing and disposing of it. In order to successfully communicate the right project information, in the right format, at the right time, and to the right stakeholders, several things must happen. First, all the information required to develop the project communications management plan should be assessed and obtained. Then, while the project is underway, the project manager and team need to determine any additional information needs not already uncovered, establish an information retrieval and distribution system, collect information on executed work and work in progress, and then report progress to all stakeholders.

6.6a Determine Project Information Needs

Many stakeholder information needs are identified during communications planning, such as authorization to proceed, direction setting, status reporting, and approval of outputs. Often, other information needs arise during project execution. All needs must be handled accurately, promptly, and in a manner that balances effectiveness with cost and effort.

- Communicate accurately—Accurate communication means not only being factually true and honest but also presenting information in a manner that people are likely to interpret correctly.
- Communicate promptly—"Promptly" means providing the information soon enough so that it is useful to the recipient to facilitate timely decisions.
- Communicate effectively—Effectiveness is the extent to which the receiver opens, understands, and acts appropriately upon the communication.

It is very easy to just copy everyone on an e-mail, but that is neither convenient nor effective for some people. Face-to-face communication tends to be the most effective, the telephone less so, and e-mail and formal reports even less. However, e-mail and formal reports document the communication and can be retrieved for future reference. All these communication methods are integral to both formal and informal communications in personal and corporate lives, and it is important to make best use of these methods in a project context. It is in the project manager's best interest to communicate effectively since the information provided allows stakeholders to make decisions, understand real challenges, remain motivated, and believe that the project is in control.

6.6b Establish Information Retrieval and Distribution System

Project information can be retrieved from many different sources. It can also be distributed via many systems. Project management software such as MS Project is frequently used for schedule information, resource allocation, and sometimes for cost and human resource information. Project managers use many methods of communicating. In this information age, project managers need to keep three things in mind with communications:

1. Target the communications. More is not better when people are already experiencing information overload.
2. Many methods are available, and the choices change rapidly. Use new methods if useful, but do not discard proven methods just for the sake of change.
3. Projects often have many stakeholders who need specific information. Use your communications plan and always keep asking if there is any other stakeholder in need of upward, downward, or sideways communications.

Tatro, Inc., uses a hosted project management page on its website that clients can have secured access to with a password to learn about project progress from anywhere in the world on a 24/7 basis. It displays photos that show actual progress for the client to view.

One specific and important skill that project managers can use to retrieve information is active listening. Active listening requires focus on what the person is saying. The active listener can ask clarifying questions and paraphrase to ensure that they understand exactly the intent and essence of what is communicated. As a listener, making eye contact and using body language that shows eagerness, encourage the speaker to continue.

An effort to simultaneously understand both the meaning of the message and the hidden emotions helps the receiver to understand the full message. Recognize that many speakers are not especially skilled in communications, so paying more attention to their message than their style of delivery also helps. Often, a project manager can successfully end the conversation by orally paraphrasing what they just heard and by following up with an e-mail for confirmation and reference.

6.6c Project Meeting Management

Planning and conducting projects require a variety of meetings in order to:

- Establish project plans
- Conduct the project activities
- Verify progress
- Make decisions
- Accept deliverables
- Close out projects

Meetings are an important process on projects since many important decisions are made at meetings and much time of expensive project personnel is invested in meetings. A former CEO of Deloitte discusses how he improved communication in his meetings in Exhibit 6.12.

PDCA Model The idea behind process improvement with the PDCA is that any process practiced repeatedly by people focused on reusing and adapting things that worked well and avoiding things that did not work well, improves over time. Exhibit 6.13 depicts the PDCA model as it is applied to project meetings. Each of the four sections will be explained in more detail in the following sections, but, in short, this model gives advice on how to do the following for meetings:

P **Plan:** prepare an advanced agenda to guide the meeting

D **Do:** conduct the meeting and write meeting minutes

C **Check:** evaluate the meeting and

A **Act:** perform in-between meeting tasks.

Project Meeting Agenda Template When applying the PDCA improvement model specifically to improving project meetings, the first step is planning the project meeting in advance. The project manager assures that the agenda is prepared and distributed ahead of time. If a project team is meeting often, this advance agenda preparation may be done at the end of the meeting for the next meeting. That way, everyone understands beforehand

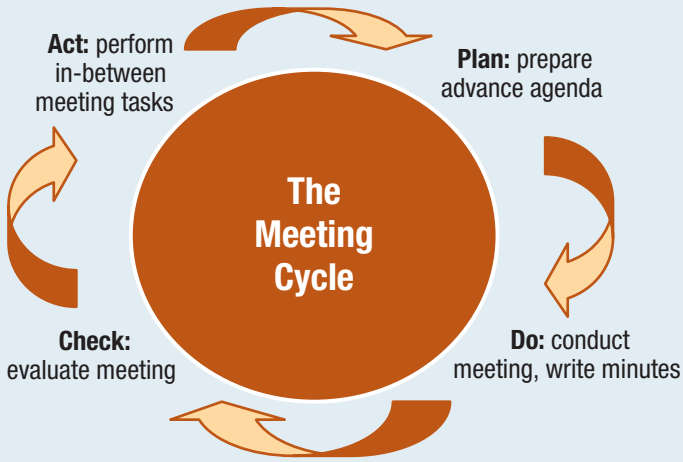
Exhibit 6.12

Improving Communications in Meetings

Jim Quigley, a former CEO at Deloitte, improved his communication style by setting a goal in meetings to talk no more than 20 percent of the time. "One of my objectives is listening. Many times you can have bigger impact if you know what to ask, rather than knowing what to say," Quigley explained. As he increased his questions, Quigley found himself gaining a deeper understanding of other people's needs.[13]

Exhibit 6.13

PDCA Model Applied to Project Meetings



Source: Adapted from Kloppenborg, Timothy J., and Joseph A. Petrick, "Meeting Management and Group Character Development," *Journal of Managerial Issues* (Summer 1999): 168–172.

what will be covered in the upcoming meeting and will have the opportunity to prepare for the meeting. The agenda can also be helpful in deciding whether to invite a particular subject matter expert (SME) or other guest to the meeting. A project meeting agenda for a Mexican archeology project is shown in Exhibit 6.14.

Tetra Images, LLC/Alamy Stock Photo

Exhibit 6.14

Project Meeting Agenda

Project: Mezquital Valley Project: Socio-Political Dynamics in Northern Mesoamérica. 2022

Date 07/01/22	Time 11.00 am	Place: MVP laboratory, in campus, National School of Anthropology and History (ENAH), Mexico.

Meeting Purpose: Reviewing next field season (2019-1) details and logistics.

Topic	Person Responsible	Time
Review agenda	Evgueni Santamaria.	2 min
Schedule for field season	Silvia Bn.	10 min
Logistics overview	Silvia Bn.	10 min
Authorization procedures, funding	Fernando Lopez (Ph.D) / Victor A.	5 min
Academic documentation/requirements	Evgueni S. / Fernando Lopez	5 min
Summary	Silvia Bn.	5 min
Meeting Evaluation	Fernando Lopez	2 min

Source: Rodrigo Villanova, PhD, author of *Project Management for Archeology*.

The top part of the agenda contains meeting logistics. The second item on the template is the meeting purpose. If a project manager cannot state the reason to conduct a meeting in a sentence, perhaps the meeting is not necessary. The main body of the agenda has three columns. First is a list of the topics. This starts with a quick review of the agenda because projects often move quickly, and this provides an opportunity to add or delete an item from the agenda. This also serves as an ice-breaker and gives a little extra time for people who join late. The major topics of the meeting are listed next, in the order in which they will be covered. Often, remaining items from previous meetings or other urgent matters top the list. However, a project manager wants to be sure to cover the most important matters, even if they may not have the same sense of urgency. The second-to-last item on the standard agenda is the meeting summary. The project manager summarizes major decisions that were made as well as work assignments that were distributed. This helps people remember what they agreed to do. The final item on the agenda is an evaluation of the meeting. This is explained in the check step of the PDCA model.

The second column lists the person responsible for each topic on the agenda. Typically, the project manager takes care of the meeting's start and close, but specific action items may be assigned to individual project team members. When people know in advance that they are responsible for an action item, they are more likely to be prepared. Additionally, if the advance agenda is available for key stakeholders to review, some of the stakeholders may contact the responsible person in advance to provide input. This is a good way to engage stakeholders.

The third column is a time estimate for each item. While the project manager does not need to be a slave to the clock, recognition of how long team members are in meetings and how many items are accomplished goes a long way. People are more likely to attend a meeting if they are sure it will end on time.

Project Meeting Minutes Template The second step in the PDCA process—"do"—means to conduct the meeting and to capture minutes as the meeting is conducted. Many project teams rotate the role of taking notes on meeting minutes. A template for taking project minutes is shown in Exhibit 6.15.

6.6d Issues Management

The project minutes mirror the agenda to the extent that both refer to the same meeting. The top part of the minutes form is logistics, just like in the agenda. The four primary types of information captured in a project meeting are:

1. Decisions made
2. New issues surfaced and old issues resolved
3. Action items agreed to
4. An evaluation of the meeting

Decisions and Issues First, any decisions that were made should be documented. Second, any new issues that surfaced or existing issues that were resolved should be recorded. An **issue** is a situation that requires a decision to be made by the team, but one that the team cannot make now, usually either due to needing information or more time. An **issues log** is a dynamic repository of information regarding both open issues and those that have been resolved. An *issues log* benefits a project in at least two ways. First, when an important issue—not something that can be solved in the immediate meeting—is introduced, the project manager can add it to the open issues and not spend time on it in the current meeting when more pressing matters need to be settled. Second, the issues log ensures that important issues are not forgotten. An issues log template is shown in Exhibit 6.16.

Exhibit 6.15

Project Meeting Minutes Template

Project Team _____ Date _____ Time _____

Members present:

_____

_____

Decisions Made:

Issues Log:

Resolved Issues _____

New Issues _____

Action Item	Person Responsible	Completion Date

Meeting Evaluation

Exhibit 6.16

Project Issues Log

Open Issues

Name	Date Opened	Originator	Potential Impact	Progress

Closed Issues

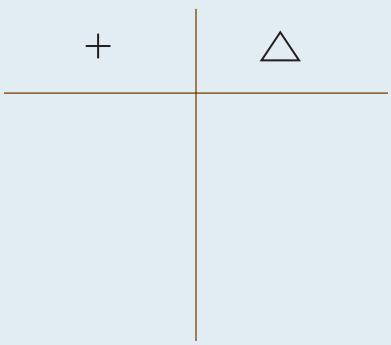
Name	Date Opened	Originator	How Resolved	Date Closed

Action Items The third type of project information is action items. Each of these is a task that one or more members of the project team agree to perform by a specific date. These are recorded, and the project manager reminds the team at the end of each meeting what each member agreed to do.

Evaluation The final item to be recorded on the project meeting minutes is an evaluation of both good points from the project meeting that the team would like to repeat or at least adapt and poor points from the meeting that the team would like to avoid or perform in a different manner in the future. An experienced team can collect these points in a minute or two; the time they save in future meetings often pays great dividends. An easy way to capture these evaluations is a Plus-Delta template, as shown in Exhibit 6.17.

Exhibit 6.17

Project Meeting Plus-Delta Evaluation Template



6.7 *PMBOK Guide 7e*

- Stakeholders
- Team
- Planning
- Delivery
- Measurement

6.7a Stakeholders

Much of what *PMBOK 7e* has to say about stakeholders remains unchanged from the sixth edition. Stakeholders should be identified, understood, analyzed, prioritized, engaged with, and monitored. Stakeholder engagement should be appropriately planned and will occur throughout the life of the project and perhaps beyond. According to the *PMBOK 7e*, frequent ad-hoc requests for information from stakeholders is probably a sign that current stakeholder communication planning was insufficient.

6.7b Team

The project team develops the communication plan with the stakeholders, and has and contains specific and unique communication requirements for each stakeholder. Communication and engagement with stakeholders assumes importance during the project planning and execution phases. When using an adaptive approach, communication and collaboration with the product owner is continuous throughout the project.

The most basic requirements of team members are commitment to the project and competence. Depending on the experience and motivation of team members, a wise project manager will try to progress along the continuum from directing to coaching to supporting to delegating to their team members. This allows them to grow and become more skillful through their work on the project and ultimately leads to the desired outcome of value and benefits for the organization.

6.7c Planning

Planning how to communicate as a team and with other stakeholders should begin with an analysis of *who* needs to know *what, when*. Modes of communication (push, pull, interpersonal, or some combination) need to be decided on, and a team member needs to be responsible for ensuring each required communication actually happens.

6.7d Delivery

The timing and method(s) for delivering a product, service, or result to stakeholders should be agreed upon well in advance. This requires reaching a consensus on the "definition of done." In other words, how will we know when something is acceptable to the stakeholder?

6.7e Measurement

This is closely related to the delivery principle. The team and stakeholders need to know as early as possible what metrics the stakeholders are looking for to ensure what they are producing will be deemed a success. In addition to more technical metrics, stakeholder satisfaction should be captured regularly, with corrective actions taken if crucial stakeholders are not happy. This satisfaction may be measured via a net promoter score (NPS), mood chart, turnover, or general morale.

6.8 Agile Projects

Exhibit 6.18

Comparison of Plan-Driven and Agile Approaches for Stakeholder Analysis and Communication Planning

Stakeholder and Communication Questions	Plan-Driven	Agile
How do you identify stakeholders?	Ask who may use, be affected by, or influence the project.	Ask who may use, be affected by, or influence the project.
How do you determine what each stakeholder wants?	Ask	Provide early and continuous design ideas, prototypes, and product and solicit feedback
How do you analyze the relative priority of stakeholders?	Formally using matrices with items such as power, legitimacy, and urgency	Less formally with focus on outcomes, remaining available, and asking questions
How do you document stakeholders?	Formally using stakeholder register showing interest, priority, and support or mitigation strategies	Less formal, may use stakeholder register showing interest, priority, and support or mitigation strategies
How do you build relationships with stakeholders?	Plan by creating stakeholder engagement matrix, learn what motivates each stakeholder, deliver on promises	Establish shared vision, embrace change that helps customer, only do work customer values, seek early and continuous feedback, establish working relationships with key stakeholder groups.
How do you manage and monitor stakeholder engagement?	Clarify and satisfy expectations, quickly resolve problems, share planning documents, put new expectations into change control process.	Clarify and satisfy expectations, resolve problems quickly, plan jointly with PO, maintain transparency, agree to changes PO desires, educate stakeholders on their role.
How do you plan communication with stakeholders?	Formally with communication matrix showing for each stakeholder information needs, communication methods and timing. Also informally as situations permit.	Less formally, emphasizing transparency, continuous communication with collaborative tools, facilitating conflict, and encouraging attendance to Agile events
What types of meetings do you use?	Planning, information gathering, and progress updates	Backlog refinement, sprint planning, daily scrum, sprint review (demo), and sprint retrospectives

6.8a Agile Terms Used in Stakeholder Analysis and Communication Planning

Feedback	Demonstrate results early, listen carefully, make adjustments
Communication	Confer on everything, every day, create best solution together
Embrace change	Acceptance and eagerness to serve updated customer needs

Information radiator	Highly visual device that conveys project information publicly in the workplace
Transparency	All people openly present the facts as they are to create necessary trust
Events	Five types of meetings: backlog refinement, sprint planning, daily scrum, sprint review, and sprint retrospective
Product backlog refining	A planning meeting to understand, slice, and estimate the time to create each user story to ensure each meets the definition of ready.
Sprint planning	A planning meeting to plan the work outputs and methods for the upcoming sprint.
Daily scrum (aka standup)	A 15-minute meeting for each team member to share what they did yesterday, what they plan today, and what may get in the way
Sprint review (aka demo)	A demonstration meeting when the team shows product created and PO determines if it meets definition of done
Sprint retrospective	Review meeting in which the team and scrum master reflect on what worked well, what did not, and plan to improve people, process, and product.

In this book, we use many Agile terms and definitions from Anantatmula, V., and T. Kloppenborg, *Be Agile Do Agile* (New York, NY: Business Expert Press: 2021).[14]

Agile Manifesto Principles to Cover:

1. Customer satisfaction is given the highest priority.
6. Face-to-face communication is best. In other words, teams should be co-located or at least use co-location communication tools.

6.8b Agile

Agile project teams interact frequently and effectively with their customers. While part of this is accomplished via the product owner meeting pretty much daily with the team, there are other effective actions. Teams present rough ideas as early as they conceive them. They create prototypes and mock-ups to help clients envision potential products. Throughout all of this, the team keeps asking the client for **feedback** of all types and the team uses the feedback transparently so the client knows they are heard and understood.

Teams try hard to understand the problem the client is attempting to solve or the capability they wish to acquire and why. Armed with this understanding of the desired outcomes, teams can better satisfy their clients.

A principal idea in Agile is that relationships with stakeholders are based upon collaboration, **communication**, and trust. This starts with the client sharing their vision and the team acknowledging it. Since the goal of the project is to provide value for the client, when the client changes their mind, the team **embraces change** because they know that will better satisfy the client. The team members share back with the client what it will take for them to respond to changes the client requests. The client (often through the product owner) and the team confer on just about everything every day, creating the best solutions together. Teams create and display **information radiators** which are visible means of communicating project progress and also problems. These methods of **transparency** in communications helps to establish trust. Teams and their clients strive to establish and nurture effective working groups.

Perhaps the easiest way to understand the process of running an Agile project is to visualize the five types of meetings (often called **events** or ceremonies) used:

1. **Product backlog refining** meetings are used to better understand client needs and to break down large functionality into smaller chunks that can be more easily planned and implemented.
2. **Sprint planning** meetings have the product owner share the highest value-added output they would like the team to work on next, along with a definition of what "done" or quality completion is. The project team then commits to how much output it can deliver in the iteration. This meeting may include backlog refining, or the needed backlog refining may be conducted in a separate meeting.
3. **Daily stand-up** meetings are often held for 15 minutes early in the morning, during which each team member shares the previous day's accomplishments, the plans for the current day, and any issues. Problem solving is not done in these team meetings, but if one teammate can help another, the two talk off-line afterward.
4. Demonstration meetings (aka demos or **sprint review**) are held at least once per sprint, in which the team demonstrates usable product. Only a completed, usable product is shown. The product owner and often other stakeholders are there to judge whether the product meets their predetermined definition of done.
5. **Sprint Retrospective** meetings are held at the end of each sprint and involve the project team, scrum master, product owner, and possibly other key stakeholders openly share what worked well and what could work better by making a change of some sort. The goal is to improve the work processes.

Summary

Projects frequently have many diverse stakeholders. Some stakeholders may not know their exact needs, and different stakeholders may want different things. The project manager and sponsor need to build effective working relationships with the project team and stakeholders. When good relationships are built and maintained, the project team can enjoy the trust that is so helpful in successfully completing the project.

Armed with the stakeholder analysis and the project charter, a project team is ready to create a communications management plan. One important component of this plan is the communications matrix. This is the document that answers these questions:

- Who needs to know something about the project?
- What does each need to know?

- When do they need to know it?
- What format is easiest for them to receive and understand the information?
- Who is responsible for sending it?

Other important aspects of a project communications management plan include managing and improving meetings; managing and escalating issues; and capturing and using lessons learned.

Once stakeholders have been analyzed and communications are planned, the project team can get into more detailed planning of scope, schedule, resources, budget, risks, and quality—the topics of the next six chapters.

Key Terms Consistent with PMI Standards and Guides

identify stakeholders, 205
stakeholder analysis, 206
stakeholder register, 208
stakeholder engagement, 211
stakeholder engagement plan, 211
stakeholder engagement assessment matrix, 211
manage stakeholder engagement, 213
monitor stakeholder engagement, 214
communications management plan, 215
communications matrix, 218
knowledge, 219
manage project knowledge, 219
manage communications, 219
issue, 224
issues log, 224

Key Terms Consistent with Agile Practice

Feedback, 228
Embraces change, 229
Communication, 229
Information radiators, 229
Transparency, 229
Events, 229
Product backlog refining, 229
Sprint planning, 229
Daily stand-up, 229
Sprint Review (aka demo), 229
Sprint retrospective, 229

Chapter Review Questions

1. List three reasons why understanding stakeholders is important to successful project management.
2. What is the difference between an internal and external stakeholder?
3. Name three criteria you should consider when prioritizing stakeholders.
4. When should relationship building between the project manager/other core team members and important stakeholders occur?
5. What are some ways to build relationships within the core team?
6. What are some ways to build relationships with key stakeholders?
7. What are some important functions of communication *from* stakeholders?
8. What are some important functions of communication *to* stakeholders?
9. In order to manage stakeholders' expectations, a project manager needs to understand the stakeholders' assumptions. Which document(s) can help with this?
10. What is the difference between "push" and "pull" methods of communication? Give examples of each.
11. What are three types of project communications timing schedules?
12. What six columns should a communications matrix contain?
13. Why is it so important to capture lessons learned in a knowledge database?
14. List the items that go into a project team meeting agenda and tell the purpose of each.
15. Describe an Agile "stand-up" meeting.
16. What is a possible sign that your communication planning was/is insufficient?

Discussion Questions

1. A new grocery store is being erected that will demolish a neighborhood basketball court. Who would be some internal stakeholders? Who would be some external stakeholders?
2. With a few of your classmates, conduct an Agile retrospective meeting about a project or class you recently finished.
3. Think of a recent project you completed and choose three stakeholders. Prioritize them, using the six-criteria model.
4. In your opinion, what is the single most important component of building relationships within a project team? Why?
5. In your opinion, what is the greatest benefit of having good communication between the project team and project stakeholders? Why?
6. Imagine you are the project manager of a team tasked with building a new hotel. When brainstorming project communication plan considerations, what would you list under "purposes"?
7. Using the same scenario as question 6, which timing schedule would you choose to use for each communication? Why?
8. Create a project meeting agenda for an upcoming project (or class) meeting you have.
9. Give an example of a time you have used push, pull, and interactive communication methods. Why did you choose the method you did based on the circumstances?
10. Betty, a project manager, sent out agendas before an upcoming meeting to everyone involved. During the meeting, she got a team member to take minutes. After the meeting, Betty followed up with team members to check on their progress. Evaluate Betty's actions using the PDCA model. What, if anything, could she have done better?
11. As a project manager, how will you try to progress along the continuum from directing to coaching to supporting to delegating to your team members? What are some signs your team members are ready for more autonomy?

PMP Exam Study Questions

1. The "component of the project management plan that describes how project communications will be planned, structured, and monitored" is the:
   a. communication model
   b. communications management plan
   c. stakeholder register
   d. organizational breakdown structure
2. In order for a new grocery store to be erected, a neighborhood basketball court located on the building site will have to be demolished. The neighborhood children who liked to play basketball there could be considered _____.
   a. subject matter experts
   b. internal stakeholders
   c. external stakeholders
   d. customers
3. A common method of prioritizing stakeholders is based on the stakeholders':
   a. legitimacy
   b. power
   c. urgency
   d. all of the above
4. The components of a project communications management plan should typically include the purpose of the communication, structure (format, content, etc.), methods or technologies to be used, and _____.
   a. work performance data
   b. time frame and frequency
   c. stakeholder priorities
   d. lessons learned
5. Which of the following is *not* a type of Agile meeting?
   a. iteration planning
   b. demonstration
   c. innovation
   d. retrospective
6. The "project document that includes the identification, assessment, and classification of project stakeholders" is called the _____.
   a. stakeholder engagement matrix
   b. organizational breakdown structure
   c. stakeholder register
   d. weighted scoring model

7. A document used to manage points of discussion or dispute that arise during projects, in order to monitor them and ensure that they are eventually resolved and added to lessons learned, is called a(n) _____.
   a. risk register
   b. stakeholder register
   c. SWOT analysis
   d. issue log
8. One of the key responsibilities of a project manager is to manage stakeholder expectations. It is important for the project manager to have interpersonal or "soft" skills that include: overcoming resistance to change, resolving conflict, active listening, and _____.
   a. displaying confidence
   b. subject matter expertise
   c. ability to command and control
   d. building trust
9. The process of communicating with stakeholders and working with them to meet their expectations, address issues as they occur, and obtain their continued commitment to the success of the project is called _____.
   a. Manage Stakeholder Engagement
   b. Monitor Stakeholder Engagement
   c. Monitor Communications
   d. Manage Project Team
10. The communication method that is used for large audiences or large volumes of information and requires recipients to access the content at their own discretion, is called _____ communication.
    a. push
    b. pull
    c. synchronous
    d. interactive

Integrated Example Projects

Suburban Homes Construction Project

Suburban Homes realizes the importance of maintaining excellent relations with all its key stakeholders. Among the stakeholders are clients who purchase homes, local law enforcement agencies, potential buyers, county and state agencies for real estate development, environmental regulatory agencies, both local and federal, community leaders, contractors, subcontractors, local construction material suppliers, and the list goes on.

Suburban Homes decided to build a new community of 120 homes in a suburb of Atlanta. It has acquired 15 acres of land for this purpose. It also has submitted a preliminary plan to the local county government for approval.

Suburban Homes is thinking of hiring a consultant for developing a stakeholder management plan and communication plan. For its stakeholder management plan, they would like to identify all the stakeholders and develop a stakeholder register. Further, it is considering selection of at least six key stakeholders for a detailed analysis of a prioritization matrix, as shown Exhibit 6.2, and to develop a stakeholder matrix, as shown in Exhibit 6.4.

As a consultant to Suburban Homes, you are asked to develop a stakeholder engagement plan (Exhibit 6.5) and a comprehensive stakeholder management plan after developing the stakeholder prioritization matrix and stakeholder matrix, as shown in Exhibits 6.2 and 6.4, respectively.

Using the stakeholder management plan, the company has also requested you to develop a communication plan that makes use of Exhibits 6.10 and 6.11.

Heritage Arboretum Development Project

Stakeholder Analysis and Communication Planning While Creating an Arboretum During a Pandemic

We identified stakeholders by first reviewing our vision statement and then asking who might be interested in or have some influence over the arboretum. Our vision states that we want to showcase native plants, educate citizens, and increase value. With that in mind, we identified citizens, teachers, greenspace inspector, events coordinator, and maintenance supervisor as stakeholders.

In an effort to understand their perspectives and offer value, we started by providing design ideas that became

more refined with feedback. To build relationships, we continue to share the vision and seek to understand their concerns. We prioritize work that adds the most value from their perspectives and include interested stakeholders in our planning.

We work closely with our product owner, maintain transparency, and educate stakeholders on their roles.

As with any project, we need to tailor our approach to the organization, the project, and the participants. Meetings have been a challenge. We have had just one large meeting with multiple stakeholders in attendance, outside at the arboretum with all participants wearing masks and viewing copies of a high-resolution map of the arboretum.

More often the best we could do is to have some small meetings of two or three team members and then follow that up with electronic communication and phone calls with members who could not attend. Backlog refining meetings are first between the product owner and scrum master, and then the scrum master works with the rest of the team, meeting together when possible and in smaller groups or individually when needed. Some of those meetings (which could also can be considered sprint planning as backlog refinement) have led directly into the choice of what to do in each sprint. Both backlog refinement and sprint planning are conducted on-site when possible. Our demonstration meetings are every two months at the end of sprints as we report progress to the Tree Committee who we report to. We are still challenged to have daily scrums (even weekly as all team members have other work and this is an outside service project). We also need to perform retrospectives as we meet a bit more often.

Questions:

1. Who are stakeholders (list several groups) and what are the concerns for each?
2. What communication challenges is this virtual, volunteer team experiencing and how do you suggest overcoming them?
3. How do you propose the team can fully represent the needs of the full range of stakeholders?
4. How do you suggest the team establish effective working relationships with each key stakeholder?
5. What suggestions do you have for conducting meetings?

Semester Project Instructions

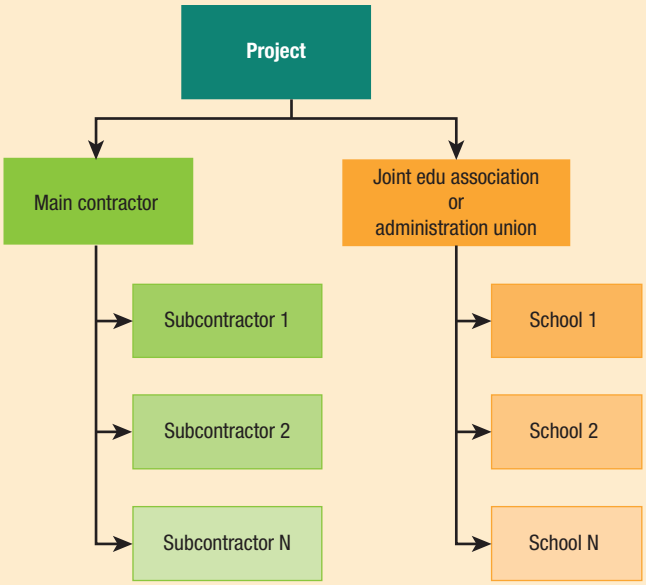
Do each of the following for your project:

- Develop a stakeholder analysis. Identify as many stakeholders as you can using Exhibit 6.1. List stakeholders by name and title where possible.
- Prioritize the listed stakeholders, as shown in Exhibit 6.2.
- Specifically identify each stakeholder's interests, as shown in Exhibit 6.4. Recognize that some stakeholders may have an interest in multiple aspects of the project process or results.
- Describe the activities you are using to build relationships with your stakeholders.
- Create a stakeholder engagement matrix like Exhibit 6.5.
- Develop a communications matrix like Exhibit 6.9. Be sure to use considerations in Exhibit 6.8 for ideas regarding purpose, structures, methods, and timing for each communications need.
- Document a project meeting with an advance agenda, meeting minutes, issues log, and Plus-Delta form of evaluation like Exhibits 6.11, 6.12, 6.13, and 6.14.

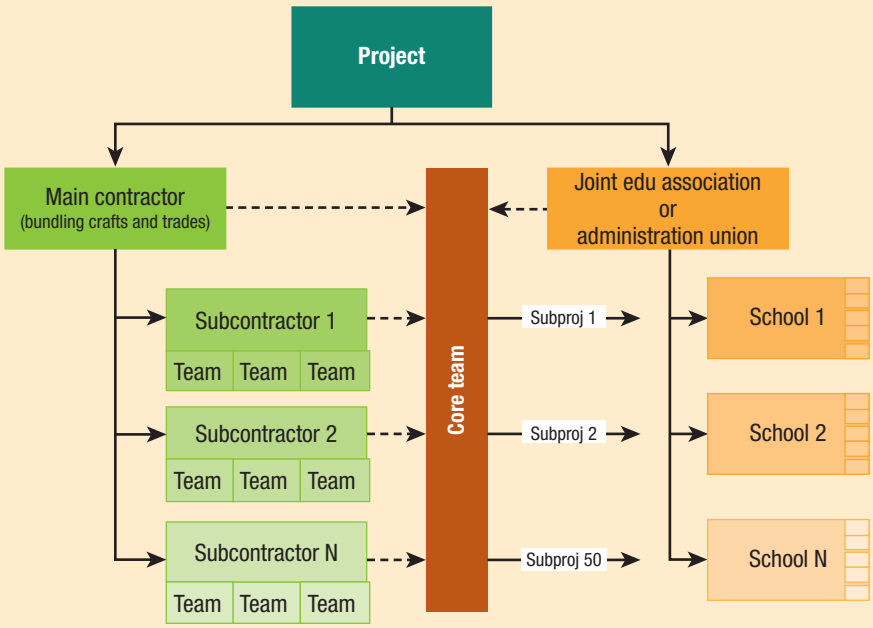
Project Management *in Action*

Project Communication Planning for a Distributed Project

During an IT rollout of servers, clients, networking equipment, and a central data center involving a range of subcontractors at each of the roughly 50 regional schools, **the original communication plan** showed:



After being appointed PM for rollout and implementation, I noticed that this was far from enough and needed to be amended.



First of all, **two on-site visits at each location** were introduced in order to

1. **get to know** the location and the people involved and
2. **make sure** all environmental preconditions agreed upon had been properly set up.

For each location, there were between 5 and 20 people involved who all needed special information (depending on their role), thus multiplying the planned effort of communication considerably. However, the still early discovery of the complex stakeholder situation also facilitated a degree of fast-tracking and intensifying the cooperation, which was essential to finalize the project in quality, time, and budget, despite several unexpected events, with very favorable media coverage and proper project close, which otherwise would have been impossible.

Apart from the headmaster and IT teacher, **what other roles** did we "discover"?

- All teachers whose classrooms were involved (receiving equipment, have to move/exchange furniture, rearrange the room).
- Caretaker (usually the one who knew about walls, wires, changes to the building, and the construction history where there were no drawings available).
- Owner of the building (community, private owner, society).
- Sponsor for each individual school (who had to agree to a detailed plan and a float sum of money. This was quite a topic since originally it was thought that a float lump sum of money could be spent on the whole project moving money between sites according to need. The need differed greatly since a newly built school (concrete/steel) poses a whole different range of tasks as compared to 150-year-old converted castle schools with thick walls (think of wireless LAN, think of "protection of historical monuments" = no drilling of holes anywhere and a long analysis and certificates for every little change to the building, think of moist or even wet intended server locations).
- The schools all had preferred local partners for electricity (dedicated electrical phases for 19" server, power supply and network equipment, ideally dry and ventilated and cool, usually a small moist place with no airflow at all like a broom closet of the Harry Potter type in Privet Drive).
- Structural fire protection authority (they had serious words for the people who suggested drilling through a bulkhead firewall).
- Regional politicians who support the improvement of learning environments.
- Media who supported the project in terms of regional development and marketing the initiative to improve education and bring up-to-date learning facilities also to the more rural areas.
- And not to forget the neighborhood and especially the parents (in particular, the ones less IT enthusiastic) who needed a good portion of convincing that this was something big and essential to their kids' development and future chances.

What Finally Saved the Project?

1. Initial core team brainstorming and **proper stakeholder analysis** (no matter whether according to PMI, IPMA, or PRINCE2, list them all, check their expectation, interests, influence, power, degree of potential support, and involvement).
2. Two alternative Meetings **informing all interested parties** (obligatory to certain stakeholders and open to the public and invited media), so everyone KNEW, everyone received a roughly 50-page handout with detailed plans and intentions, involvement of all relevant parties, order of steps, phases of progress, ways of communication, etc.
3. A short **pilot** consisting of eight schools, two schools **of every one of the four different types** (primary/small, secondary/middle, gymnasium/large, special needs) helped us group the remaining location in mixed regional groups for each rollout team. Scheduling the whole procedure was a challenge because due to different sizes and varying numbers of equipment, totally different buildings, etc., there was no chance to cut everything into weekly time boxes à la "sprints" in Agile scrum. Instead, every team had their own

stream of tasks, consisting of nearly the same steps, however, with independent underlying amounts of effort.

4. At virtually every first on-site visit, **someone unexpected played a vital role** (relevant for interdependency of activities, e.g., schedule, cost, resources, communication, risks, basically the whole range of PM topics), we (the project core team on "whistle-stop tour," usually four to five people) explained everything we said at the two kickoff meetings again, answered more questions, and made clear that local support according to schedule was vital, and deliberately failing to meet deadlines meant moving down the list and along the timeline.
5. During the second on-site meeting, we checked the **"preconditions ready"** and **if so** delivery and setup of IT equipment were approved, **if not** another school from further down the list was invited to move up if they met the criteria.
6. Every piece of equipment had a checklist, all functions were tested and ticked off by a technician and a school representative reporting status "green," which automatically approved the final steps including training of staff on-site by the same technicians who worked on-site the 1–2 weeks beforehand.

Bear in Mind

1. Have a **plan**. You need to follow a systematic approach throughout the project.
2. Employ **structured information**.
3. **Pilot** what you do.
4. Communicate **face to face** on site.
5. Have **clear rules**.
6. Have a **realistic time line, including buffers** for all sorts of risks and additional stakeholder involvement wherever necessary.

Source: Martin Kontressowitz.

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Part 3

Planning Projects

Organize | Lead | Plan | Perform

Planning is a large and critical part of project management. Planning may be largely completed before much executing work begins in traditional (plan-driven) project management, whereas it is performed in an iterative fashion in Agile. A middle path, or something in between traditional and Agile project planning, is adopted in a hybrid environment. Project planning tends to be a collaborative effort with many people involved. It is also integrative, as many factors need to be considered. That said, we cover the various aspects of planning in distinct chapters to clarify what needs to be done in each. Chapter Seven shows how to plan the scope by collecting requirements and creating work breakdown structures or backlogs. Chapter Eight shows how to create and communicate project schedules. Chapter Nine follows Chapter Eight closely by resourcing projects and resolving issues related to overloaded workers and the frequent need to compress schedules. Chapter Ten shows how to create a time-phased project budget that will be used for control. Chapter Eleven covers details of identifying, assessing, and dealing with myriad of project risks. Finally, Chapter Twelve deals with quality planning and with integrating all parts of the schedule into a single coherent plan.

Chapter 7

Holistic Scope Planning

Chapter Objectives

Core Objectives:

7-1 Describe the planning of scope management and collecting requirements.
7-2 Define scope processes.
7-3 Create a requirements traceability matrix, project scope statement, and change request form.
7-4 Describe a work breakdown structure (WBS) and its importance to planning and control.
7-5 Compare different methods of developing a WBS.
7-6 Create a WBS, including work packages and a numbering system both by hand and using MS Project.

Agile Objectives:

7-7 Use simplicity and emergent design in developing scope.
7-8 Capture user requirements as stories.
7-9 Create backlogs for a sprint and a release.

Pressmaster/Shutterstock.com

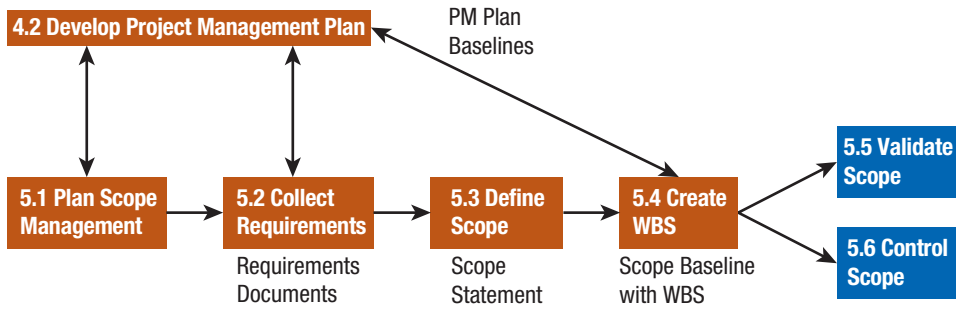
You're browsing a favorite retailer's website and you notice the onscreen recommendations are just right for you. The site seems to know what you've bought before. This great customer service is enabled by the retailer's web intelligence solution from Teradata.

Teradata is the world's largest company focused solely on enterprise data warehousing and analytic solutions. The simple web-shopping scenario is just one example of how our customers use information to improve their relationship with you.

So what does this have to do with project scope management? In this example, the retailer purchased a Teradata solution that included hardware, software, and a consulting project for the implementation. Teradata implemented this project based on experience and a methodology built upon a foundation of scope management.

We can manage scope in various ways—ranging from plan-driven to Agile approaches—to deliver the right solution effectively.

***PMBOK Guide 6e* Coverage**



Note: Refer to Appendix A to view the entire *PMBOK Guide 6e* flowchart.

PMBOK Guide 7e

Performance Domains:

- **Team**
- **Development Approach**
- **Planning**
- **Delivery**
- **Measurement**
- **Uncertainty**

The first step in project scope management is to mutually agree on what the project will deliver, or in the case of Agile, what value/benefit the project team will focus on. In our example, the retailer needed to integrate data from their web analytics software, an in-house customer relationship system, and other sources. They also had requirements for reports and technical integration with their IT infrastructure. The Teradata team elicited requirements in a way that uncovered what the customer really needed.

Projects often use a statement of work (SOW) or similar document to outline the high-level scope. In a Teradata project, this is part of our customer contract. We then elaborate on more detailed requirements in a traceability matrix. This ensures all requirements tie "end to end" from the contract through project testing and customer acceptance. The time spent up front in requirements management pays dividends during project testing and customer acceptance, specifically when discovering unknown requirements is much more time-consuming and expensive.

Teradata follows traditional project management practice to develop a work breakdown structure (WBS) as the basis for a detailed project schedule and resource plan. We typically use Microsoft Project as a scheduling tool; a plan based on the WBS makes it easy to track and communicate the status of each deliverable.

Finally, the entire set of requirements is managed under change control. This is an important process because the team must balance control and flexibility. We also must meet (or agree to change) the project cost and schedule parameters. Our project manager facilitates an analysis of the technical issues, schedule, and cost impact, and then all parties reach an agreement on how to proceed.

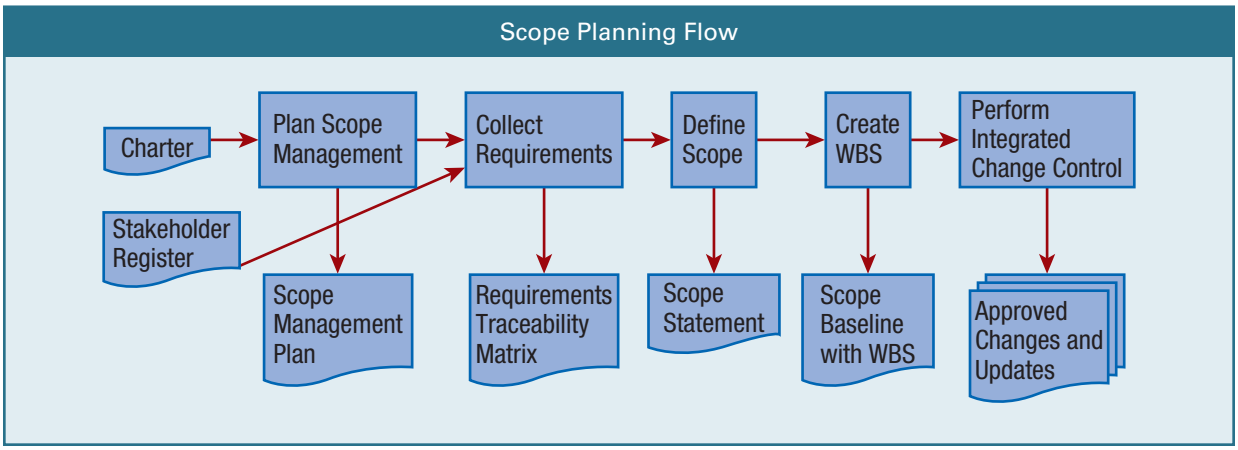
This simple example illustrates how the Teradata project methodology builds upon a foundation of scope management to deliver exactly what the customer needs most efficiently. An effective scope management approach fosters open communications and sound decision-making to ensure all parties get the business value expected from the project.

—Mike Van Horn, Teradata

7.1 Plan Scope Management

Once all the key stakeholders for a project have been identified, the project team members develop a scope management plan and assess project requirements. Next, they will develop the project's scope and create a WBS for plan-driven projects. On Agile projects, they will

Exhibit 7.1



create backlogs of work to be done. Both of these planning processes will be covered in this chapter. When planning scope, it is also wise to plan for changes. While this is not technically part of scope planning, it will also be covered in this chapter because accurate assessment of the client's requirements can minimize scope changes, so scope planning is an effective means to control changes to the project.

The flow of scope planning is illustrated in Exhibit 7.1. The boxes represent the project work processes involved, and the documents shown before and after the boxes represent major inputs needed to perform the processes as well as major outputs created by the work processes. Documents covered in previous chapters (Charter in Chapter 3 and Stakeholder Register in Chapter 6) are necessary inputs for the first two processes.

The first scope process, **plan scope management**, is the process of developing a plan that includes the total scope of what needs to be done and what is excluded from the project, implementation, and validation of the scope, and control deviations from the scope statement. The *product scope* describes features and functions of a project outcome such as product, and, in some cases, service or result. The project team also needs to determine the *project scope*, which is the work required to be performed for delivering a product, service, or result with the required features and functions. Together, the *product scope* (the outputs the team will deliver to its customers) and the *project scope* (the work they need to perform to create the project's outputs) form the total scope of a project. In other words, the project team members determine what they will do to ensure they have identified and organized all the project work, which is the basis of all other planning activities and also the basis for executing and controlling the project work. It is important to remember that for many projects, the client or the end-user may not be concerned about the *project scope* and may be interested only in the *product scope*.

7.2 Collect Requirements

A **requirement** is a condition or capability needed by the client or a user to solve a problem or achieve an objective that satisfies a standard, a specification, or any other formally documented need. **Collect requirements** is a systematic effort to understand and analyze stakeholder needs to define and document these requirements. This will help in refining and meeting project objectives.

7.2a Ensure Clarity of Objectives

The first step in collecting requirements is to ensure that the project team is clear on the project objectives. This could be accomplished by reviewing the project charter—particularly the "why" section that justifies the project. Then the project team members may describe in more depth what the expected project benefits are and/or what problems the project is attempting to overcome.

On simple projects, this may not take much time. On complex projects, a project manager may choose to use idea generation, grouping, and/or cause-and-effect techniques to make sure that everyone on the project team understands the necessity of the project. Understanding broad project objectives will help in making more-detailed decisions later. This also reinforces the project's importance and may help motivate and direct team members and other stakeholders during challenging periods in project execution. It is especially useful with multifunctional, virtual, and global project teams during the project execution. Finally, a clear understanding of the project's objectives helps in revising the project plan later, if necessary.

7.2b Gather Stakeholder Input and Needs

The second step is to gather input from the various key project stakeholders. Needs assessment begins with a high level of understanding of the client's needs during the project's inception and is occasionally documented in the project charter. A project manager is assigned, and eliciting more detailed requirements is done after a project's core team is selected. The size of this core team would depend on the nature of the project and the number of disciplines required to plan and execute the project.

When a project manager and the core team listen closely to both internal and external customers, their needs and associated risks emerge clearly. Good project managers know that for a project to be successful, its outcomes must be useful to the project's clients and their customers (end-users). In other words, the needs of the customers/clients and end-users of the project deliverables must be integral to the list of requirements.

The methods of developing a deep understanding of customers and their needs vary extensively from one industry to another. The traditional methods of obtaining and documenting requirements from key stakeholders and research are many, such as:

- Meetings
- Interviews
- Focus groups
- Questionnaires
- Surveys
- Observations
- Prototypes
- Industry standards
- Reference documents
- Market analysis
- Competitive analysis
- Requests from the client
- Standard specifications

In general, identifying most requirements are straightforward, and applying industry standards and standard specifications can help finalize them. However, the intricacies of certain requirements require extra effort. For example, in new product development projects, teams often use voice of the customer (VOC) techniques to elicit the benefits and features the customers want from the project outcomes, expressed in the customer's language.

Teams using VOC try to understand the customer by not only asking questions but also by placing themselves in the customer's situation. If a project team is designing a new system that is to be used in the field, the team member should get down in the mud with the mechanic to see from the mechanic's point of view how the new system will be used.

7.2c Define Needs as Requirements

Requirements can be classified as functional/technical and nonfunctional. The first category is usually the focus of needs assessment exercises and is centered on the performance of the deliverable—such as the mechanic's needs just described. The second category includes characteristics of requirements such as scalability, reliability, maintainability, and testability.

Once captured, these customer expectations and requirements are then stated in operational terms that the project team can use to plan that work. If the customer wants a blue color for an item, the project team developing the item needs to know the precise shade of blue, the quality grade, the tolerance for color variation, and how the blue color may interact with other components of the item.

The project manager needs to understand how a project's success will be determined from the customer's perspective. The best way to gain this understanding (and to begin building a strong relationship with customers) is to directly ask customers for clarification. The project leaders can ask the customer(s) to specify how they will judge the quality of the product or service based on both functional and non-functional requirements.

On an information systems project, the team may use a joint application design (JAD) session to elicit customer requirements. This is often a facilitated session in which users of the software should articulate their preferences regarding how the software should work. The project manager and the team often send their understanding of the project objectives and deliverables in advance to all the users so that they are better prepared to discuss their needs and provide clarifications. Only one group of users is normally in this meeting at a time, while the project manager and the technical people are in the session for its entire duration. Each possible feature of the system should be discussed. If the system is large and complex, the amount of time that can be spent per item may be scheduled. Users often wish to discuss in depth how they want to use the system, while developers often want a detailed discussion about how they plan to create the feature or the function. To avoid going into too much detail, the project manager can ask the users to start with only a high-level description of their reasons for the requested feature and then guide the discussion with the following five questions.

1. What do we not understand about the feature?
2. What is the business reason for the feature?
3. What is the impact of not providing this feature?
4. What action items need to be accomplished if we do this?
5. What impact will this have on other features of the project or elsewhere?

Exhibit 7.2 lists requirements along with other related information such as acceptance criteria for each requirement, which can be either high level or very detailed using specifications in measurable terms. The requirement type suggests whether the requirement is functional, nonfunctional, or needed by a particular stakeholder. The traceability matrix also includes the status of the requirement, its priority, and who is responsible for the requirement.

On some projects, the customers may provide their ideas using one of the techniques above, and the project team can be confident that the customers' wants and needs have been captured well. On other projects, once the customers' viewpoint is captured, it makes sense to create a model or prototype of some sort so the customers can decide if their

Exhibit 7.2

Requirements Traceability Matrix

Id	Requirement	Acceptance Criteria	Type	Status	Stakeholder Group(S)	Priority	Objectives
1	The BA must be able to customize the information collected for requirements.		Stakeholder	Approved	BA	Must	PO#1
1.1	The system shall allow for the renaming of requirement attributes.	1. BA can rename an existing field. 2. Field displays the new name on input forms. 3. Field displays the new name on reports.	Functional	Approved	BA	Must	PO#1
1.2	The system shall allow new requirement fields to be identified.	1. BA on adding a new field. 2. BA can set field attributes. 3. BA can indicate field lookup values. 4. Custom field amiable for input. 5. Custom field rabble for reports.	Functional	Approved	BA	Should	PO#1
1.3	The system shall allow new requirement fields to be identified.	1. BA can enter a custom list of lookup value. 2. Lookup fields can be provided from an external system through data interface.	Functional	Approved	BA	Should	PO#1
2	The BA must be SA to provide different reports for different audiences.		Stakeholder	Approved	BA. Team. Sponsor. Stakeholders	Must	PO#1
2.1	The system shall include a base set of standard reports.	Reports include: 1. Requirements Traceability Matrix 2. Business Requirements Documents	Functional	Approved	BA. Team. Sponsor. Stakeholders	Must	PO#1
2.2	The system shall allow a business analyst to filter reports based on various requirement attributes.	1. BA can filter a report based on a. Type b. Stakeholder c. Status d. Priority e. Objective	Functional	Approved	BA	Must	PO#1
2.3	The system shall provide an option to download data to an Excel-supported file so the BA can customize.	1. BA can select to extract data to an Excel supported file 2. Extracted data is formatted as a tabular data set with no row breaks	Functional	Proposed	BA	Should	PO#1
2.4	The system shall allow for the customization of reports to include filtering and displayed fields.	1. BA can select fields to include or exclude in the resulting report. 2. BA can filter reports (see 2.2.1).	Functional	Approved	BA	Should	PO#1

BA — Business Analyst (BA) is a person responsible for defining what will bring value to the business, ensuring requirements are fully vetted and understood, and that the solution meets expectations.[1]

PO#1 — Project Objective #1: "record, manage, communicate, and update requirements so that requirements can be captured once and then managed and communicated efficiently."

Priority uses MoSCoW ratings — Must be included in the release (mandatory), Should be included in the release (highly desired), Could be included in the release (nice to have), Won't be included in the release (out of scope)

Source: Vicki James, PMP, CBAP, PMI-PBA, CSM, author of *Leveraging Business Analysis for Project Success*.

Exhibit 7.3

Requirements Translated into Specifications

Requirements	Specifications
• Unambiguous—not subject to interpretation • Complete—nothing left out • Consistent—no conflicts, which also means no duplication • Modifiable—amenable to change • Traceable—to a customer need • Verifiable—means provided to verify the requirement	• Unique set—each stated only once • Normalized—should not overlap • Linked set—shows relationships • Complete—nothing left out • Consistent—no conflicts • Bounded—specifies nonnegotiable constraints • Modifiable—amenable to change • Configurable—traceable changes • Granular—right level of abstraction

Adopted from: ISO IEEE IEC (2018)

requirements have been fully and accurately captured. Often, this extra step helps the customers become more fully vested in the project and creates a strong working relationship that is helpful when difficulties arise during project execution.

It is helpful to list requirements and their supporting information in a requirements traceability matrix such as Exhibit 7.2.

When requirements are complete, each requirement needs to be:

- Traceable back to its business reason
- Identified with the stakeholder(s)' needs
- Unambiguous
- Qualified by measurable conditions
- Validated for its value and completion
- Bounded by constraints
- Prioritized according to value, cost, time, risk, or mandate to make trade-off decisions if needed

Once these requirements are developed, they are translated into specifications, as described in Exhibit 7.3.

7.3 Define Scope

Define scope is the process of translating stakeholder needs and requirements into detailed specifications of the project outcomes and products. These specifications follow the guidelines listed in Exhibit 7.3.

Essentially, the project scope statement includes three things regarding the total scope. First, the team needs to determine what they will deliver to the project stakeholders at the end of the project and what they will deliver along the way to ensure they will be successful in the end. These are the deliverables—the *product scope*. For example, if a final project deliverable is a new computer program, intermediate deliverables may include an outline of what will be included and a prototype. Second, the team should decide what work must be done to create the deliverables. This is the project work statement—the *project scope*.

Third, the team needs to determine what will limit or influence the project work—such as exclusions, constraints, and assumptions. Scope, or total scope, is the sum of product scope and project scope, considering exclusions, constraints and assumptions.

7.3a Reasons to Define Scope

Scope definition is an important part of project planning because all other planning components are based on the project scope. While the requirements represent the customers' statement of what they need, the defined scope is the project team's response—asking the customer, "If we provide this, will it solve your problem?" It is impossible to estimate—how much a project will cost, how many (and what type of) workers will be needed, how long a project will take, what risks are involved, or what quality standards will be invoked—without first understanding what work is included in the project.

Scope definition also is vital in preventing scope creep, which happens for two common reasons. First, if the scope is not clearly defined and agreed upon, it is easy to include additional work (scope creep) to the project with or without realizing that more time and resources (additional cost) will be required. Second, sometimes when a project is going as planned, a customer is so excited that they ask an innocent-sounding question: "Can the project output also do … ?" The person performing the project work is often flattered and agrees to include this request without understanding or analyzing the implications of making this change. In contemporary business, pleasing the customer is desirable. However, the best time to gain customer understanding is when the project team is defining the scope—not while executing the project scope work.

7.3b How to Define Scope

Scope definition can vary greatly from one project to another. For a small, routine construction project, it may be quite simple to determine project outputs and the work involved in creating them. On other projects, such as one large company acquiring another, it may be difficult to determine the total amount of work. Regardless of how easy or difficult it may be to define scope and despite industry-specific methods that may help, all project teams must complete each part of this scope planning process outlined in Exhibit 7.1.

List Deliverables and Acceptance Criteria The first step is to list project deliverables. The requirements elicited from the customer often lead to some of the final deliverables, which are often many. For example, if a project entails constructing a house, the homeowners probably want not only the house but also documentation on associated systems, manuals, and warranty procedures. The project team also needs to list intermediate deliverables—those things that need to be developed while making progress to complete the project. Some of these were probably listed in the charter, but others may not yet be identified. Finally, the project team needs to determine the acceptance criteria for each deliverable.

Establish Project Boundaries The second step in defining scope is to establish the project boundaries. Think of the project boundaries as the sidelines of an athletic field. By understanding what is inbounds and what is not, athletes know clearly when to play and when to stop. Likewise, project team members need to know which tasks should be executed and which tasks should not be considered for execution.

The first part of the boundary definition is to decide which features and work elements are included (in scope) and which are excluded (out of scope). Collectively, clients and end-users often request far more features and work than a project is originally planning to deliver or can deliver. Therefore, the team needs to know and decide what is included and

what is not. Usually, the sponsor makes decisions regarding larger scope decisions, but the project manager and team still have many detailed scope decisions to make.

The second part is to manage expectations regarding any project. The project team members and the key stakeholders must try to understand the constraints imposed on the project. If the work must be completed by a certain date or if only limited resources are available, the project is constrained, and the team should be careful to promise only what it can deliver. In planning, people make assumptions about dates, times, and availability of resources; for example, a shipment of required materials will arrive by the date the supplier promised. These assumptions should be stated explicitly. If an assumption proves to be false, it manifests as a project risk and may also limit the project scope.

Create a Scope Description The final step is to create a **scope description**. This description briefly states the work that needs to be accomplished to create the project deliverables.

A project scope statement guides the project team during subsequent planning and execution. For some very small projects, a well-developed project charter could also serve as a scope statement. On most projects, a scope statement needs to be developed before the development of the WBS. An example scope statement for an archeological project is shown in Exhibit 7.4.

Exhibit 7.4

Scope Statement

Project: Mezquital Valley Project: Socio-Political Dynamics in Northern Mesoamerica. January 2019.

Project Work Statement: To understand the components of the Acahualzingo altepetl (prehispanic socio-political unit) as one of the northern-most political units of the Mesoamerican geopolitical concept, while gaining advancement in the definition of activity areas in said polity through a systematic surface survey, with total coverage and pinpoint explorations.

Key Deliverables	Acceptance Criteria
1. Report to the Archaeology Council authorities	Reports, registries, and analysis by Project members. Approval from the Archaeology Council, National Anthropology and History Institute, Mexico (INAH)
2. Next season's project, delivered to the Archaeology Council	Detailed research for an upcoming project (field season), including resources needed, schedules, etc. Approved by the Archaeology Council
3. Written report of activities, analyses, inventory, etc. by students	Written report presented before project's director and approved
4. Publication(s)	Approved draft for publication (article, book chapter, etc.)

Exclusions: This has been an ongoing project site for over 34 years, so currently the only possible exclusions considered would be denial from the local authorities and population to carry on the proposed surveys and research. In that case, a secondary research area would have to be proposed.

Constraints: The main logistical constraints for the project are the relatively "reduced" number of students allowed to participate. Although this is to guarantee a close follow-up and mentorship of the students, focused on them developing the necessary skills to carry on proper surface survey abilities, it also means taking a hit on the number of areas and overall reach of the season's field work.

Assumptions: All students participating are assumed of legal age and administratively in order with the College programs. **(At this point the field trip was carried out just days before the pandemic declaration and nationwide lockdowns due to COVID-19.)**

Source: Rodrigo Villanova, PhD, author of *Project Management for Archeology*.

David Hilbert/Alamy Stock Photo

7.4 Work Breakdown Structure (WBS)

After scope definition is complete, the project manager will have greater clarity about project work and milestones as compared to the high-level understanding of the project when the project charter is defined (discussed in Chapter 3). The milestones defined in the project charter are not necessarily accurate due to a lack of complete understanding of the total project work at the time it was created. It is important to note that the project charter must be seen as an authorization document with an accuracy of estimates (cost and time) in the range of ± 50% or more. With the definition of scope, more details about the project are available to develop the WBS and new milestones, and then time and cost estimate accuracy levels increase considerably.

A detailed understanding of the project scope and work to be performed must be simplified for execution, and it is essential to divide the total work into smaller, manageable elements. A tool that is used on virtually all traditional projects is the WBS. To understand this tool, we will first define it, tell why it is important, show common formats, and then demonstrate the steps required to construct a WBS.

7.4a What Is the WBS?

The **WBS** is, or should be, a uniform, consistent, and logical method for dividing the project into small, manageable components for planning, estimating, and monitoring (Rad and Anantatmula, 2010). It is a project planning tool defined as the hierarchical decomposition of the project scope into deliverable work elements at the lowest level. Its decomposition continues until it facilitates managing these work elements effectively and independently. The WBS helps develop an optimum project schedule and cost estimates at the work element level.

The WBS is a tool that project teams use to progressively divide the deliverables of a project into smaller and smaller components. The project team members start by identifying the major deliverables to be created and by continuously asking: "What are the components of this deliverable?" The WBS is *not* a list of work activities, an organizational chart, or a schedule. The WBS *is* a framework that is used as a basis for further planning, execution, and control. Typically, the WBS is created after the scope is defined on large projects. In contemporary project management, particularly on small- and middle-sized projects, the WBS may be created concurrently with the scope statement.

The WBS is normally developed by listing deliverables—major deliverables first and then progressively smaller ones until the team feels that every deliverable has been identified. Managers of smaller projects sometimes perform another process concurrent with WBS development: defining activities and milestones. **Define activity** is a project-planning process that identifies and determines specific actions to develop and deliver the project outcomes, such as products, services, or results. Many people find that work activities can be easily defined once the various deliverables are itemized. To clearly distinguish between the work processes of WBS development and activity development, WBS development is covered in this chapter, and activity development is covered as part of project scheduling in the next chapter. Developing the WBS and defining the activities form an example of how two separate work processes are sometimes performed together (especially on small or simple projects) and sometimes separately (especially on large or complex projects).

7.4b Why Use a WBS?

The reasons for using a WBS are many. Planning projects requires discipline and visibility. A properly developed WBS encourages a systematic planning process, reduces the possibility of omission of key project elements, and simplifies the project by dividing it into manageable units (Rad and Anantatmula, 2009).

A WBS can be used as a pictorial representation of project deliverables. By using a systematic process for creating a WBS, project team members can ensure that they include all deliverables that are required to be created. Deliverables that are not planned, but need to be, often add to schedule delays and budget overruns.

The WBS provides a framework of common reference for all project elements, for specific tasks within the project, and ultimately for better schedules and better estimates. It is the basis for all subsequent planning of such important functions as schedule, resources, cost, quality, and risk. It also serves as an outline for integrating all these planning elements. The WBS is easily modified and thus can handle the changes that often occur on projects. The impact of these changes is then shown in the schedule, budget, and other planning and control documents. If a problem occurs during project execution, the WBS is helpful in understanding exactly where and why the problem occurred. This helps to diagnose problems, manage the quality of the project deliverables, and keep all the other facets of the project on schedule while the isolated problem is fixed.

The WBS is also helpful in project communications. Typically, many stakeholders contribute to developing the WBS, and this effort helps them understand the project. Further, it clearly shows the importance of each work element, why it is required, and how it is integrated with project deliverables. In a nutshell, the WBS presents the entire scope of the project and serves as an excellent communication and integration tool. Software such as Microsoft Project enables a WBS to be shown in its entirety to people who need to understand the details, but it also allows project details to be hidden so that others can see the big picture.

Mark Herreid/Shutterstock.com

7.4c WBS Formats

There are various formats for constructing a WBS, but they all have the same purpose. The overall project is considered the first level, as shown in Exhibit 7.5. In this example, a WBS for a house is presented in the indented outline format.

Exhibit 7.5

House WBS in Indented Outline Format

House

- Project Management
- Framed House
  - Foundation
  - Custom Framing Design
  - Wood
  - Assembled Frame
- Wired House
  - Wiring Design
  - Wiring
  - Installed Wiring
- Drywalled House
  - Drywall Drawing
  - Drywall
  - Hung Drywall

The second level in this example depicts major deliverables from the house project, namely the house in its framed state, when it is wired, and when it is drywalled. This second level is indented one tab. Note that a section is included for the work of planning and managing the project.

A WBS usually has one or more intermediate levels, which generally represent items that need to be created to produce the final deliverables, such as drafts, prototypes, and designs. These are frequently called interim deliverables. All levels of the WBS with at least one level below are considered summary levels. The completion of summary-level elements is based upon the completion of all levels underneath. For example, in Exhibit 7.5, the house would not be framed until the custom framing design, wood, and assembled frame interim deliverables were complete.

Exhibit 7.5 used the indented outline format for the WBS method, but other methods are sometimes used. Another method is called free format because the facilitator is free to draw it in any manner. The same house project shown in Exhibit 7.5 in indented outline format is shown in Exhibit 7.6 in free format.

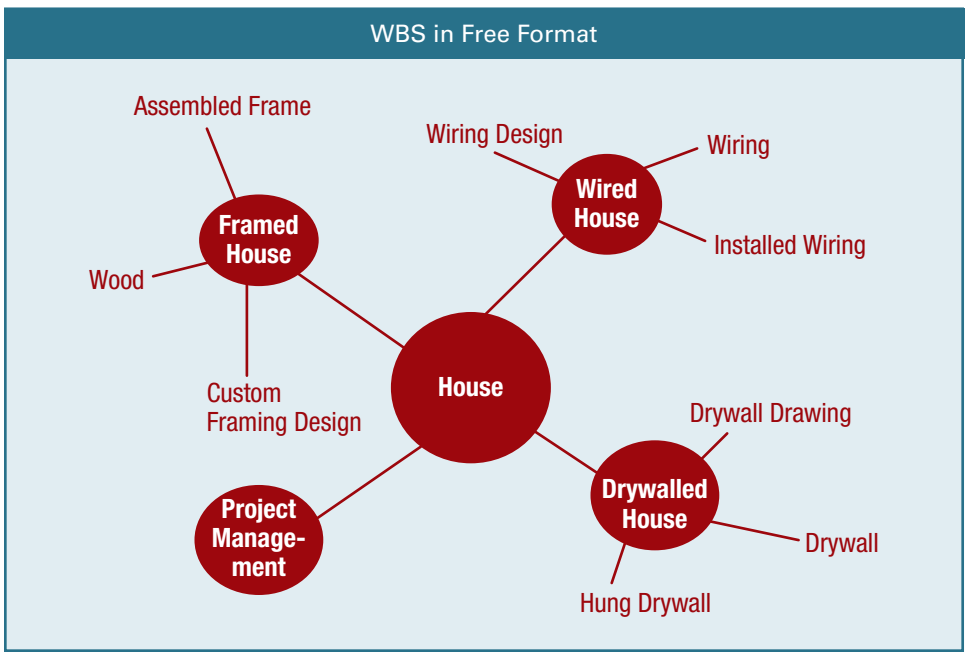
A dry-erase board or flip chart can be used to develop all these methods and also offers plenty of room to add additional elements as the scope is revised. The WBS method using indented outlines can easily be imported into MS Project. Teams using the free format methods for WBS generally translate them into the indented outline format for input into software.

7.4d Work Packages

The house example above has only three levels:

1. The first level, or project title level
2. One intermediate level, or summary level
3. The lowest level, or work package level

Exhibit 7.6



This process of dividing the deliverable items is continued until the project has been divided into manageable, discrete, and identifiable items requiring simple tasks to complete. A practical rule is to keep dividing the project until it no longer can be divided realistically. This point may differ from project to project. The lowest level is known as a **work package**, which is usually the work component at the lowest level of the WBS, for which cost and duration can be estimated and managed. A work package is the basis for subsequent planning and control activities. Exhibit 7.7 shows a WBS with work packages in solid boxes.

One frequently asked question when breaking the deliverables into work packages is, how small is small enough? The answer is, "It depends." In Exhibit 7.7, work packages occur at levels 3, 4, and 5. The work package is the point from which:

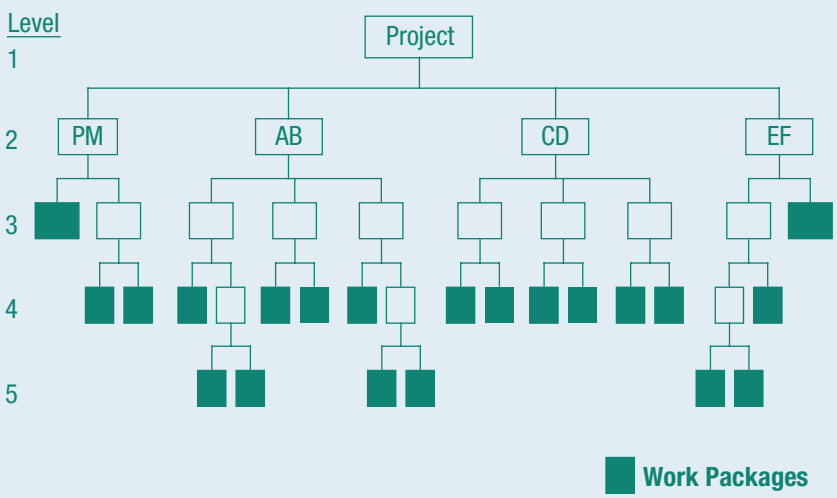
- Work activities are defined
- The schedule is formed
- Resources are assigned
- Many of the control features are developed

Work packages are detailed enough to facilitate further planning and control. If they are too detailed, the burden of tracking increases. It is necessary for the project manager to feel confident that the work to create the work package can be assigned to one person who can estimate the schedule and cost and can be held responsible for its completion. However, the work package may require multiple resources (including more than one person) for its completion.

If the work is composed of a single deliverable that is well understood, it is clear how the deliverable will be judged for its quality and completeness, and the assigned workers have a proven work record, then adding many details to the work package may not be necessary. On the other hand, if the deliverable and/or how it will be judged for its completion are poorly understood, or if the assigned worker or workers have yet to prove themselves reliable, more details are necessary.

Exhibit 7.7

WBS Depicting Work Packages



Source: Kevin P. Grant, UTSA.

For ease of communication and comprehension, work packages and other components of a WBS are usually stated in one to three words; one should avoid verbs and instead use adjectives to describe WBS elements at all levels. A **WBS component** is a work element that is part of the WBS at any level. The phrases or words to describe WBS elements should not be repeated. However, because the names are typically short, there is still a possibility to get confused by exactly what is included in a work package or WBS component. Therefore, WBS components are often defined further using a WBS dictionary and are often assigned with a number. A **WBS dictionary** is a document that provides detailed information about each work package by providing details about the associated deliverable, activity, scheduling information, predecessor, successor, person responsible for it, resources required, and associated risks. An example of a WBS dictionary entry with detailed information for a work package is shown in Exhibit 7.8. Note that some of this additional information such as activities, resource assignments, effort, and cost will be described in subsequent chapters.

7.4e How to Construct a WBS

The information for a WBS is drawn primarily from the project scope statement and from historical planning documents of past projects. When a project team needs to construct a WBS, it is desirable to include in its planning team a subject matter expert (SME) who understands how each segment of the work will be accomplished. Teams approach this task in two ways. The first approach is that teams include only the core team members and plan the WBS as in as much detail as they can. At that point, different core team members are assigned to identify and seek out the SMEs to plan the remaining details. In the second approach, teams invite the SMEs to the WBS planning meeting right from the start and utilize their input throughout the WBS development. Often, the choice of how to include SMEs is determined by the size and complexity of the project and by the cultural norms of the company.

The planning team uses a top-down approach in creating the WBS. This is easy to start when the type of project is familiar and at least some members of the planning team are likely to understand the general flow of work. If the project is similar to past projects, either

Exhibit 7.8

Work Package Detail

Project: Expansion to Full Scale Production	**Work Package: Assembly Hardware Test**		
Description: Plan, conduct, evaluate, and report results of tests to ensure proper function of the assembly hardware.	**Deliverable(s):** Test results summary. **Input(s):** Assembly hardware prototype		
Activities	**Resource**	**Expected Duration**	**Cost**
Prepare test plan	Production Analyst	**8h**	$ 720
Conduct test	Production Analyst	**16h**	1,440
Evaluate test results	Production Analyst	**6h**	540
Prepare test results summary	Production Analyst	**8h**	720
	Production Analyst		**$3,420**

Source: Kevin P. Grant, UTSA.

a template or the WBS from a previous project can be used as a starting point. Then, using this template or WBS, the project team would identify additional project needs for inclusion and irrelevant elements of the previous project for deletion. Templates and previous examples can save teams a great deal of time, but caution must be exercised because each project is unique.

Sometimes, in fact, a project is so unique and different from previous projects that the team finds it useful to jump-start the WBS construction by brainstorming to identify a list of project deliverables to understand and develop the overall structure of the project WBS. However, once the overall structure is understood, the team proceeds with the typical top-down approach for the remainder of the WBS development.

Identify Major Deliverables The team defines the project deliverables by reviewing the project planning completed thus far. The team members review the project charter, requirements traceability matrix, and scope statement to define the project's major deliverables. Remember that while many projects may have a primary deliverable such as a new house, almost all projects have additional deliverables such as training, documentation, and customer support to help the customer use the product or service effectively.

One of the first decisions is how to organize the second level of the WBS. (Remember, the first level is the overall project.) As defined earlier, the WBS is or should be, a uniform, consistent, and logical tool for dividing the project into small, manageable components. WBS development is viewed as the process of grouping all project elements into several major categories, normally referred to as level one; each of these categories will itself contain several subcategories, normally referred to as level two. Alternately, and more accurately, the development of a WBS involves dividing the project into many parts that, when combined, would constitute the project deliverables. This process of dividing the deliverable items is continued until the project has been divided into manageable, discrete, and identifiable items requiring simple tasks to complete.

Three methods of organizing are shown in Exhibit 7.9. One method is by project phase, with the second level including the signing of a contract, building the foundation, and framing the house. Alternatively, the second level can be organized by deliverable-based design components such as kitchen, bedrooms, and bathrooms. Finally, the second level can be organized by work function (resource-basis). A house project organized this way might have carpentry, plumbing, and electrical as second-level elements.

Organizing by project phase (schedule-basis) has the advantage of using the milestones in the project charter as an organizing principle, and it was a common practice for plan-driven projects. It also facilitates rolling wave planning which is often used when scope ambiguity exists. **Rolling wave planning** is a planning technique of identifying and defining

Exhibit 7.9

WBS Organization Examples

Project Phase	Design Components/ Deliverables	Work Function/ Department
Project Management	Project Management	Project Management
Contract	Kitchen	Carpentry
Foundation	Bedrooms	Plumbing
Framed House	Bathrooms	Electrical
…	…	…

the work to be completely accomplished in the near term and planning the future work at a higher level. In other words, once the near-term work is complete, the next phase of the project is planned in detail. In essence, it is an iterative process. Rolling wave planning helps a project team avoid either of two extremes. One extreme is to never start doing anything because the plan is not yet complete, which is also known as *analysis paralysis*. The opposite extreme is not planning at all because of fear that planning will take too long; this is known as *ready, fire, aim*. While rolling wave planning may be used on plan-driven projects, it is more frequently used on Agile and hybrid projects.

Organizing by either phase or design components/deliverables helps to focus communications on project deliverables and their interactions. Further, it helps in communicating with the client as the WBS is developed from the client's point of view. This deliverable organizing approach has become more common.

Organizing by work function allows the functions to focus on their specific activities, but often does not promote cross-functional discussion. Handoffs of work from one group to another are not always as smooth. Therefore, if a project manager decides to organize the WBS by work function, extra care needs to be taken in establishing inter-functional communications.

Of the three approaches, the most generally useful, and most difficult, method for developing a WBS is to use design components/deliverables as the basis of the breakdown of the project. It is also known as a deliverable-based WBS. The deliverable-basis, or design-basis, is developed by looking at the project from the client's perspective and not from the project execution perspective. Further, it makes sense to all key stakeholders and facilitates easy communication.

In this deliverable-basis or design-basis mode, the project is divided into individual distinct components that ultimately comprise the project, such as hardware, software, physical structure, concrete foundation, or roof. This deliverable-based WBS division can be based on product, function, or physical location of the deliverable (Rad and Anantatmula, 2010). As an example, a customer may be more interested in discussing specific features in the kitchen of their new home than in the timing aspects of the foundation or the specifics of what the carpenters will do.

Note that one additional second-level item is shown on all three methods—that of project management. This includes the work of planning and managing the effort and includes preparing documents, attending meetings, integrating diverse portions of the project, handling communications, and so on. Since much of the work involved in project management is the level of effort, this section may not be decomposed. However, if the work of managing the project is left out, it is more likely that the project will not be completed on time and within the budget because you will not have accounted for the time necessary for all these tasks.

It is very important to understand that, in many cases, the client is not concerned about the intricacies of project execution or project management activities. From a client's perspective, the focus is only on what is delivered as the project outcome. So, project management is not typically included in a deliverable-based WBS. However, there are exceptions to this rule. For large and mega projects, programs, and federal government contracts, it is possible that the client is also interested in project management activities and project progress reports. In such cases, including project management in the WBS may be sensible, even in a deliverable-based WBS. However, the "project management" WBS element may not be relevant for estimating cost and schedule unless project management activities are considered a deliverable by the client.

Decompose Deliverables Once the major deliverables have been defined, it is time to break them into smaller deliverables or components. This is called **decomposition**, a method of

dividing the project scope into many parts that, when combined, would constitute the project deliverable. It is the process of breaking down the project scope until it has been divided into manageable, discrete, and identifiable components that require simple tasks to complete.

The team members can use the top-down approach, asking what all the components of each major deliverable are. Alternatively, the team members may use a bottom-up approach by brainstorming a list of both interim and final deliverables that need to be created. Each deliverable can be written on an individual Post-it Note. These deliverables are then assembled on a large workspace where team members group the smaller deliverables either under the major deliverables that have been previously identified or into additional related groups that are then headed by major deliverables.

Continue Until Deliverables Are the Right Size At this point, the WBS has been formed and can be reviewed for completeness. Once it is determined to be complete, the team can ask if the deliverables at the lowest level need to be divided further for planning and control as described above. For example, in the archeological project in Exhibit 7.10, level-three components, such as the selection of dig areas, are at too high of a level to plan and control. Therefore, at least one more level should be included.

Exhibit 7.10

Partial WBS of an Archeological Project

Code	Deliverable
1.0	**Project Management**
2.0	**Budget**
3.0	**Surface Survey**
3.1	GIS/cartographic research
3.2	Previous data recompilation
3.3	Survey logistics
3.4	Data collection (Students: each student will be responsible for all data collected in their assigned routes as the correct gathering and updating of daily team data.)
4.0	**Dig**
4.1	Selection of dig areas
4.2	Stratigraphic registry
4.3	Dig and material handling
4.4	Photographic records
5.0	**Special Data Collection (Surface survey and drone handling)**
5.1	Sample proposal
5.2	Sample collecting
5.3	Special analysis
6.0	**Archaeological materials handling and storage**
6.1	Inventory
6.2	Conservation efforts and storage
6.3	Lab analysis

Source: Rodrigo Villanova, PhD, author of *Project Management for Archeology.*

Review At this point, several things should be considered to ensure that the WBS is structured properly. One consideration with WBS construction is the parent-child concept. The higher level is considered the parent and the lower-level elements are considered children. For example, in Exhibits 7.5, and 7.6, "Framed House" is a parent to the children: "custom framing design," "wood," and "assembled frame." "Framed House," in turn, is a child to "HOUSE." The framed house component is not complete until all of its children components are complete. In an effort to simplify the WBS, where only one child element for a parent exists, you would not break it down. In fact, a good rule of thumb is to have somewhere between three and nine child elements for each parent. The fewer levels a WBS has, the easier it is to understand.

To avoid confusion, each component in the WBS needs to have a unique name. Therefore, two similar components may be *"draft* report" and *"final* report," instead of merely calling each "report." Begin with a noun and add an adjective or two if necessary. The team also assigns a unique number to each component. In one common numbering system, the number for a child item starts with the number assigned to its parent and an additional digit. An example of a WBS with components numbered is shown in Exhibit 7.11.

Different organizations develop their own unique variations of project planning and control techniques. Exhibit 7.12 describes the manner in which a large, complex organization (the U.S. Central Intelligence Agency) combines stakeholder analysis with WBS.

Exhibit 7.11

Library Project WBS with Components Numbered

Library Project

1. **Project Management**
2. **Facility Needs**
   - 2.1 VISION STATEMENT
   - 2.2 STAKEHOLDER INPUT
   - 2.3 OPTIONS
3. **Building Proposal**
   - 3.1 RECOMMENDED SIZE AND SCOPE
   - 3.2 SITING
   - 3.3 COST RATIONALE
4. **Building Approval**
   - 4.1 VP OF FINANCE APPROVAL
   - 4.2 PRESIDENT APPROVAL
   - 4.3 BOARD APPROVAL
5. **Staff Education**
   - 5.1 LITERATURE REVIEW
   - 5.2 LIBRARY VISITS
   - 5.3 SUPPLIER INPUT, PROCESS, OUTPUT, CUSTOMER ANALYSIS
   - 5.4 TRAINING
6. **Fundraising**
   - 6.1 POTENTIAL DONOR LIST
   - 6.2 RELATIONSHIP BUILDING WITH POTENTIAL DONORS

6.3 EDUCATION OF POTENTIAL DONORS
6.4 DONATIONS
6.5 FOLLOW-UP WITH DONORS

7. **Building Documents**
   7.1 FACILITY AND SITE SPECIFICATIONS
   7.2 SCHEMATIC DESIGNS
   7.3 DEVELOPMENT PLANS
   7.4 CONTRACT DOCUMENTS
8. **Building Construction**
   8.1 ARCHITECT
   8.2 CONTRACTORS
   8.3 CONSTRUCTION
   8.4 FURNISHINGS
9. **Building Acceptance**
   9.1 BUILDING AND GROUNDS ACCEPTANCE
   9.2 BUILDING OCCUPANCY
   9.3 BUILDING DEDICATION
   9.4 WARRANTY CORRECTIONS

Exhibit 7.12

Stakeholder Analysis and WBS at the CIA

At the CIA, where I created and run our agency-wide project management training and certification program, I come in contact with large numbers of dedicated project managers. With enrollment averaging about 2,500 students per year, I encounter a workforce with a broad spectrum of experiences, skills, and expectations. One of the more prevalent expectations is associated with stakeholder analysis and communication; employees invariably feel that they pretty much know most or all they need to know in this area and may even begrudge somewhat the three days associated with our Project Communications Management course. What they discover are the shortcomings in their appreciation for and knowledge about project communications. Using a five-point Likert scale, we have every student perform a self-assessment of their communications proficiency prior to and after the class. To the students' surprise, proficiency increases average a full point; student feedback virtually always includes statements to the effect that they didn't realize just how much more effective they can be in project management by investing more in the project communications area.

The organizational chart plays a central role in how the CIA approaches the analysis of stakeholders. Employees learn through classroom exercises to use the organizational chart as a roadmap for identifying the stakeholders. As they march through the branches in this chart, they make conscious decisions about whether the function represented by the title or box on the chart or whether the individual performing that function is a stakeholder. Once they have identified the stakeholders and performed the associated stakeholder analysis, they then turn to the WBS to help with the planning and implementation of the communications tasks that follow. In fact, communications for the types of projects undertaken at the CIA have taken on such importance that we advocate it be placed at the first level of WBS decomposition alongside equally important components such as project management. For projects of sufficient size, a full-time leader is often assigned to the communications component; the scope of their duties includes communications within the project as well as communications outside the project.

Source: Michael O'Brochta, PMP, director, PPMC Program, CIA.

7.5 Establish Change Control

A **baseline** is the approved project plan mainly consisting of scope, schedule, and cost. It is not normally altered unless a formal change control request is approved for modifying these plans. The project team looks at the scope statement and WBS to ensure completeness and seeks to validate the scope by verifying it with the sponsor, customers, and/or other stakeholders. Simultaneously, the project team works on other aspects of the project plans such as schedule, resources, budget, risks, and quality. Once all these plans are complete and any impacts to scope have been accounted for, it is time to baseline the scope statement and the entire project plan. This is discussed in more detail at the end of the planning stage (Chapter 12).

Most projects are planned and executed in an environment of uncertainty. Projects are planned with assumptions based upon the best information available to the project team, but many things can change during the course of a project. Therefore, project teams deal with change by establishing and using a **change control system** that entails processes to receive and review change proposals and accept or reject them after evaluating their impact on project scope, cost, and schedule. In essence, it is a system of managing and controlling changes and modifications to the project plan and project deliverables. Uncontrolled or unwarranted change is known as scope creep. Sometimes, the effects of scope creep are so bad that a well-managed project can run into time and cost overruns.

The critical aspect of a change control system is the method of documenting changes. Each potential change to a project is normally documented with some form of **change request**, which is a formal written request or a formal proposal to recommend changes to any project planning component such as a document, project deliverable, or baseline (scope, cost, and time).

This means every change to a project needs to be formally proposed. The potential change is then either accepted or not. If it is accepted, the project plans are changed to reflect the impact of the change. This will result in a modified project baseline. Most people quickly understand the need to document major changes, but some resist the effort it takes to document small changes. The impact of many small changes is like the old saying, "killed by a thousand small cuts." Many small changes individually have small impacts on a project, but they may have a major impact collectively. Project managers must emphasize that all changes need to be formally documented using a simple change request form so that all team members will document proposed changes. A simple change request form is shown in Exhibit 7.13.

Change request forms typically include several sections. The top section lists basic information to track the change request to the project and to the person who submitted it. The second section contains two simple statements describing the change and the justification for the proposed change. The third section details the anticipated impact on the project baseline from the potential change and this requires time and effort to assess these impacts. This can vary in length from a simple check and comment section, as in Exhibit 7.13, to an extremely involved description of the potential impact on complex system projects such as designing an aircraft. In complex projects, small changes can sometimes have a catastrophic impact. Finally, there should be a space for the change to be approved and authorized. Regardless of the complexity and format, the most important consideration is that potential changes must be submitted and documented whether they are approved or not.

Exhibit 7.13

Change Request Form

	Originator:	Project #:
Date		
Description of change:		
Why needed:		
Impact on project scope:		
Impact on deadline dates:		
Impact on budget:		
Impact on quality:		
Impact on risk:		
Impact on team:		
Date approved:		
Project manager	Sponsor	Customer
_____	_____	_____

7.6 *PMBOK Guide 7e*

Domains:

- Team
- Development Approach
- Planning
- Delivery
- Measurement
- Uncertainty

7.6a Team

To develop an effective scope plan, it is essential that the project team work together with key stakeholders by establishing a culture of collaboration. They must work productively with stakeholders in spite of diversity and irrespective of virtual means of communication. Within the team, it is desirable to have a safe, non-judgmental environment that provides transparency, integrity, respect, positive dialogue, support, courage (to make a suggestion or disagree) while working on scope planning.

7.6b Development Approach

Scope planning differs considerably in predictive and adaptive development approaches, and the key factor that differentiates them is the uncertainty associated with requirements. In a predictive approach, scope can be defined with less ambiguity at the start of the project.

Consequently, a detailed scope planning would be possible, and the scope plan would help define schedule, cost, and risks. When uncertainty and risks are associated with defining requirements or volatility exists in requirements, an adaptive (incremental or iterative) development approach is preferred. This approach would be useful for narrowing down requirements and investigating various options.

7.6c Planning

Deliverables influence scope planning. In a predictive planning approach, it is possible to define high-level deliverables and then decompose them via a WBS down to an activity level. When requirements are unclear, an adaptive approach is used for planning, and high-level themes or epics are used to develop features that are further decomposed into stories and backlog items. This approach would reduce waste.

7.6d Delivery

Scope is the sum of all deliverables and work needed to produce them. WBS is used in a predictive plan approach to define and develop details about the scope and requirements that can be defined in definite terms. When requirements are associated with uncertainty, themes are developed, which are further translated into epics which are collections of user stories that are too large to be completed in one iteration. Epics may be decomposed into features that are sets of requirements. Each feature in turn will have multiple user stories. A user story is a brief description of an outcome for a specific user. The story is a clear and concise representation of a requirement written from the end user's perspective.

7.6e Measurement

If scope planning identifies requirements unambiguously, completion of requirements can be assessed using acceptance criteria, technical performance measures, and "definition of done." Baseline parameters are used in a predictive development approach for measurement. Promised business value and benefits are measured in an adaptive approach, and these are becoming relevant for even the predictive approach.

7.6f Uncertainty

Uncertainties associated with requirements can be a hindrance to developing an effective scope plan. Ambiguity, volatility, complexity, and risk are some of the factors which, if associated with requirements, would compel the project team to employ an adaptive approach. In a predictive approach, it is our aim to minimize uncertainty further with a detailed project plan and risk management plan.

7.7 Agile Projects

Exhibit 7.14 shows how teams performing Agile projects address several scoping processes differently than teams performing plan-driven projects do. These differences and the Agile terms defined below guide our Agile coverage on holistic scope planning.

With Agile projects, the project manager is focused on providing value to customers quickly, maintaining flexibility to meet changing business needs, and adding new requirements identified by stakeholders rather than on finalizing scope definition quickly. Scope is not initially clear to either the project team or the client.

To define scope, the Agile team starts with the project vision and then develops an understanding of customers and their desires. At the start, the various stakeholders may identify anything they want, and those items are added to a wish-list called a product backlog.

Exhibit 7.14

Comparison of Plan-Driven and Agile Approaches for Holistic Scope Planning

Holistic Scope Planning Questions	Plan-Driven	Agile
How are requirements defined?	Extensive requirements early	Emergent design using progressive elaboration
Who leads scoping?	Project manager	Product owner
How is work organized?	Work breakdown structure	Release and sprint backlogs
What is the most detailed output?	Work package	User stories based upon personas
How are changes handled?	Baseline and change-control system	Sprints after which a pivot or cancellation may occur

7.7a Agile Terms Used in Holistic Scope Planning

Progressive elaboration	First defining simply, then adding detail as needed
Simplicity	Do what is needed and no more, take small simple steps, use the sheerest possible design to meet today's requirement
Extra features	Extras not used by the customer add cost and failure possibility
Extra processes	Steps such as extra documentation or planning that add no value
Savage summary	The briefest description of an idea or tool to help people understand it
Story map	Visual with product features on top and supporting detail below
Release backlog	The work that is planned to be completed in the current release
Sprint backlog	The work that is committed to be completed in the current sprint
MoSCoW	Prioritization technique of must, should, could, and will not have
Persona	Fictional username and description of expected user of deliverables
User story	Need to be described by who wants it, how they will use it, and why

Definition of ready	Agreement that team understands a story enough to bring into a sprint
Pivot	Changing direction on next sprint based upon customer desires

In this book, we use many Agile terms and definitions from Anantatmula, V., and T. Kloppenborg, *Be Agile Do Agile* (New York, NY: Business Expert Press: 2021).[2]

Agile focuses on delivering value to the customer quickly, so customers can provide feedback quickly to the development team. This eliminates waste. Smaller iterations are used to get feedback because understanding the desired outcome tends to evolve as the customers see the work being done by the team.

Agile leverages the **progressive elaboration** mindset that allows for the project to unfold in discussions with the implementation team. It is typical to practice **simplicity** by breaking large functionality (epics) into smaller pieces by asking questions such as what is the minimum, we can do to satisfy this need? Teams strive to maximize work not done by identifying **extra features** and **extra processes** that can be eliminated, or at least not chosen immediately. A work item can be described as a **savage summary**, which is the briefest explanation that can be used to start a meaningful discussion and lead to a common understanding. Collectively using these ideas, teams find the product design emerges with more detail gradually becoming apparent. Agile teams may use rolling wave planning so that as some of the first items are being delivered, they plan for the next ones in an iterative fashion.

The product owner prioritizes work on an ongoing basis based upon business need, value, cost, and risk. One technique that product owners sometimes use is a **story map** that visually shows desired product features on top with supporting detail below. This visualization along with the overall product backlog help teams to develop backlogs for both the next a **release backlog** (work to be completed during the next release—often the next six months) and the more detailed **sprint backlog**—often the next two weeks). The product owner still makes prioritizing decisions—often using the **MoSCoW** technique of listing every potential work item as a must, should, could, or will not have.

Exhibit 7.15 is a story map example for a non-profit agency called Casa de Paz that provides a safe, communal living space for abused Latina women and their children.

When the product owner prioritizes the work that will be created early in the project, it is broken down into smaller units, often called *user stories*. Users are often described as **personas**, and a **user story** is a need described by who wants it, how they are likely to use it, and why. A persona may be a real individual person by name. However, a persona is often a fictional character who has the demographics and attributes of expected product users.

For example, a persona for a project to add a room to a house may be Yolanda is a 55-year-old who loves to garden. Her user story could be as a gardener—I want windows in the new room that let in sunlight during the winter so I can grow plants indoors.

The team needs to insure that each user story they agree to create in the upcoming sprint meets the **definition of ready**, meaning they understand it well enough to create it.

As the project progresses, the scope is described more specifically and is documented more closely. Reprioritizing requirements as business conditions change is part of the Agile approach.

Also, as the team delivers each sprint, the product owner may elect to continue work in the same manner or change. One type of change is to work on different aspects of the project and this substantial change is called a **pivot**. Another type of change could be to cancel remaining all work on the project.

Exhibit 7.15

Story Map for Casa de Paz Project

7.8 Using Microsoft Project for Work Breakdown Structures

As you have likely realized, the WBS is one of the most important and powerful project planning tools available to the project manager. It is one of the key building blocks on which all further project activities are based. By creating a WBS in MS Project, the project manager lays the foundation for automating many other planning and communication tools the software has to offer. Complete the following steps to set up a WBS in MS Project.

7.8a Set Up a WBS in MS Project

Setting up a WBS in MS Project has five basic steps:

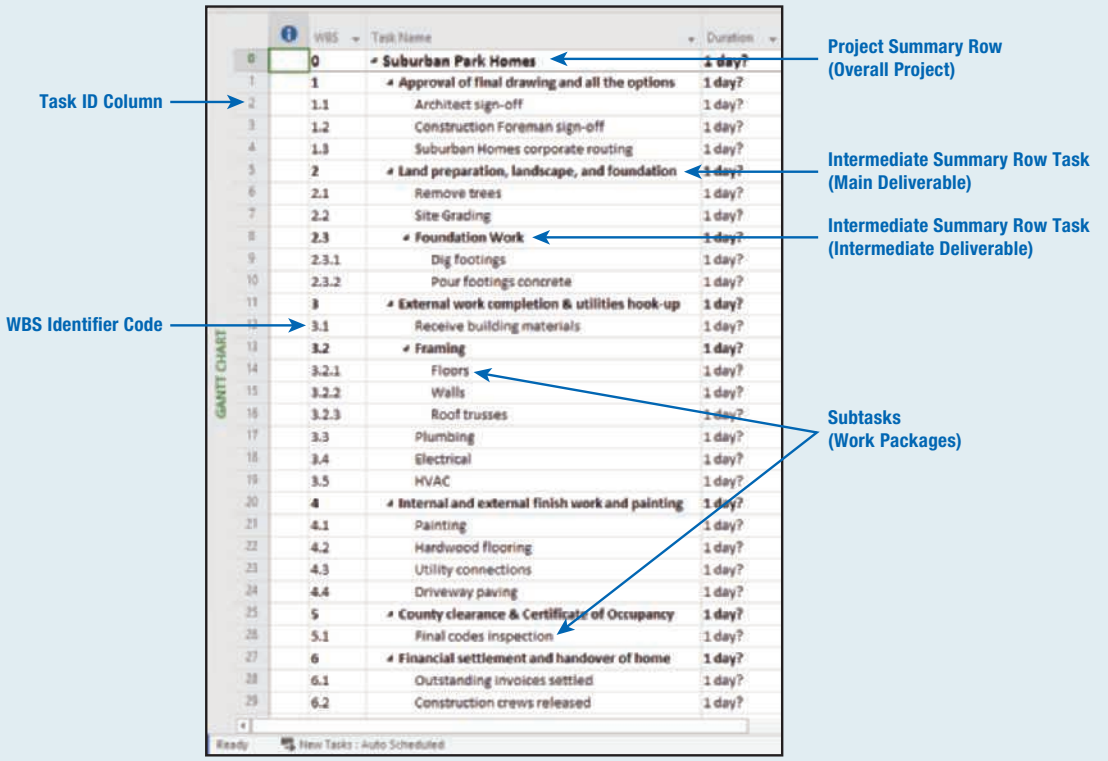
1. Understand the WBS definitions and displays.
2. Enter project deliverable and work package elements.
3. Create the outline of your WBS.
4. Insert a WBS code identification column.
5. Hide (or show) the desired amount of detail in the WBS.

Step 1: Understand the WBS Definitions and Displays MS Project refers to WBS task elements as summary tasks, tasks, and subtasks and displays them in an indented outline table format:

- Summary tasks are the main or interim WBS deliverables and are displayed in bold font.
- Subtasks are all the tasks that make up the deliverables (work packages) and are indented below their parent summary task.
- WBS tasks can also be viewed in Gantt views with different graphical shapes:
  - For instance, a summary task might also be a milestone that you would want to denote graphically in your Gantt chart (typically a diamond in MS Project).
  - You will see these graphical representations in future tutorials.

Exhibit 7.16

Enter Summaries (Deliverables)



Source: Microsoft Corporation

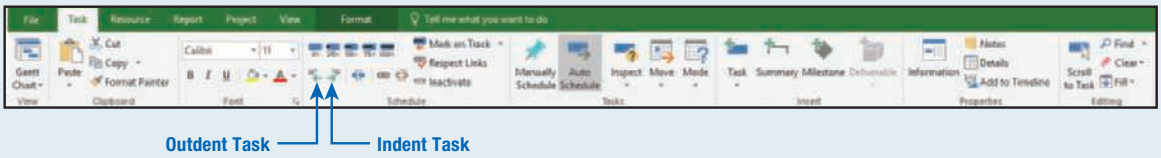
Exhibit 7.16 shows a Gantt table view of a WBS in MS Project. Note that MS Project codes the overall project (Suburban Park Homes) as level zero, not level one. The task durations have not been defined at this point and show "1 day?" for all tasks. If you are following along in MS Project, you will notice "Start" and "Finish" columns to the right of the Duration column that also have not been defined. The Start and Finish columns are not shown in the following exhibits for clarity's sake.

Step 2: Enter WBS Elements (TASKS) Exhibit 7.17 features WBS task elements added to the existing Suburban Park Homes project milestone list (from Chapter 3). In this WBS example, the existing milestones will double as the main deliverables (summary tasks). Enter these WBS elements to your project as follows.

1. In the Task Name field, select the row *below* where you want the new row to be (after making your selection, holding the **SHIFT** key and selecting a different row will highlight all rows between the two selections and result in that number of blank rows being inserted in the next step).
2. Click **Task Tab**>>**Insert Group**>>**Task**.
   a. Alternatively, you can **Right-Click**>>**Insert Task**.
3. You will see a new row (or rows if you added multiple) with the words **<New Task>** in the Task Name field. Click on **<New Task>** and enter the name of the desired WBS element (you may have to delete <New Task> before typing in your new task name).

Exhibit 7.17

Indent and Outdent Controls on the Task Tab



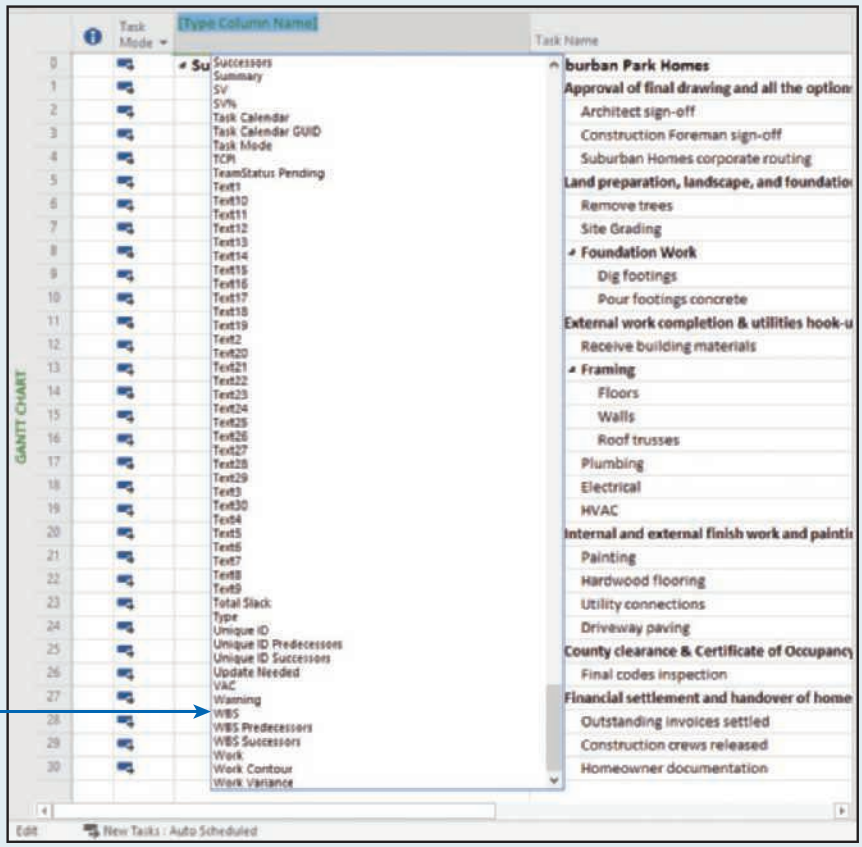
Source: Microsoft Corporation.

4. Repeat these processes as needed to enter additional tasks between the Suburban Park Homes milestones until your WBS looks like Exhibit 7.16.

Step 3: Create the Outline for Your WBS You now need to set up the outline structure of the WBS to show summary tasks and subtasks (deliverables, interim deliverables, and work packages). To do this, use the Indent and Outdent controls shown in Exhibit 7.18 (**Task Tab>>Schedule Group>>Green Arrows**).

Exhibit 7.18

Ready to Insert Selected WBS Column



Source: Microsoft Corporation.

1. Click the Task Name field of the row to be indented.
2. **Task Tab>>Schedule Group>>Indent Task (right Green Arrow).**
   a. The task element above the indented task(s) becomes a summary row as indicated by bold font.
   b. Indenting a summary row will also indent its lower-level items.
   c. Multiple rows under a summary row can be indented (or outdented) at the same time by **Shift-Click** selecting all of them before clicking the Indent control.
3. Clicking **Task Tab>>Schedule Group>>Outdent Task (left Green Arrow)** will similarly *decrease* the indentation of the selected row(s) or summary task.
4. Indent to create deliverables, interim deliverables, and work packages until your WBS resembles the outline shown in Exhibit 7.16.

Step 4: Insert WBS Code Identifier Column MS Project can automatically assign identifier codes to all your WBS tasks. WBS codes allow the Project Team to easily categorize and communicate information about project tasks in the WBS. In this example, WBS codes will be assigned in a new column to the left of the Task Name column:

1. **Right-click** the Task Name column heading and click **Insert Column**.
2. A drop-down list appears in a new column.
3. From the drop-down list, choose **WBS**, as shown in Exhibit 7.19.

Exhibit 7.19

WBS Column Inserted

GANTT CHART

	WBS	Task Name	Duration
0	0	**Suburban Park Homes**	**1 day?**
1	1	**Approval of final drawing and all the options**	**1 day?**
2	1.1	Architect sign-off	1 day?
3	1.2	Construction Foreman sign-off	1 day?
4	1.3	Suburban Homes corporate routing	1 day?
5	2	**Land preparation, landscape, and foundation**	**1 day?**
6	2.1	Remove trees	1 day?
7	2.2	Site Grading	1 day?
8	2.3	**Foundation Work**	**1 day?**
9	2.3.1	Dig footings	1 day?
10	2.3.2	Pour footings concrete	1 day?
11	3	**External work completion & utilities hook-up**	**1 day?**
12	3.1	Receive building materials	1 day?
13	3.2	**Framing**	**1 day?**
14	3.2.1	Floors	1 day?
15	3.2.2	Walls	1 day?
16	3.2.3	Roof trusses	1 day?
17	3.3	Plumbing	1 day?
18	3.4	Electrical	1 day?
19	3.5	HVAC	1 day?
20	4	**Internal and external finish work and painting**	**1 day?**
21	4.1	Painting	1 day?
22	4.2	Hardwood flooring	1 day?
23	4.3	Utility connections	1 day?
24	4.4	Driveway paving	1 day?
25	5	**County clearance & Certificate of Occupancy**	**1 day?**
26	5.1	Final codes inspection	1 day?
27	6	**Financial settlement and handover of home**	**1 day?**
28	6.1	Outstanding invoices settled	1 day?
29	6.2	Construction crews released	1 day?
30	6.3	Homeowner documentation	1 day?

Ready New Tasks : Auto Scheduled

Source: Microsoft Corporation.

a. A WBS code column is now in place.
b. Resize the column to conserve space.

4. **Right-click** the Task Mode column heading and click **Hide Column**.
5. Your result should look like Exhibit 7.20.

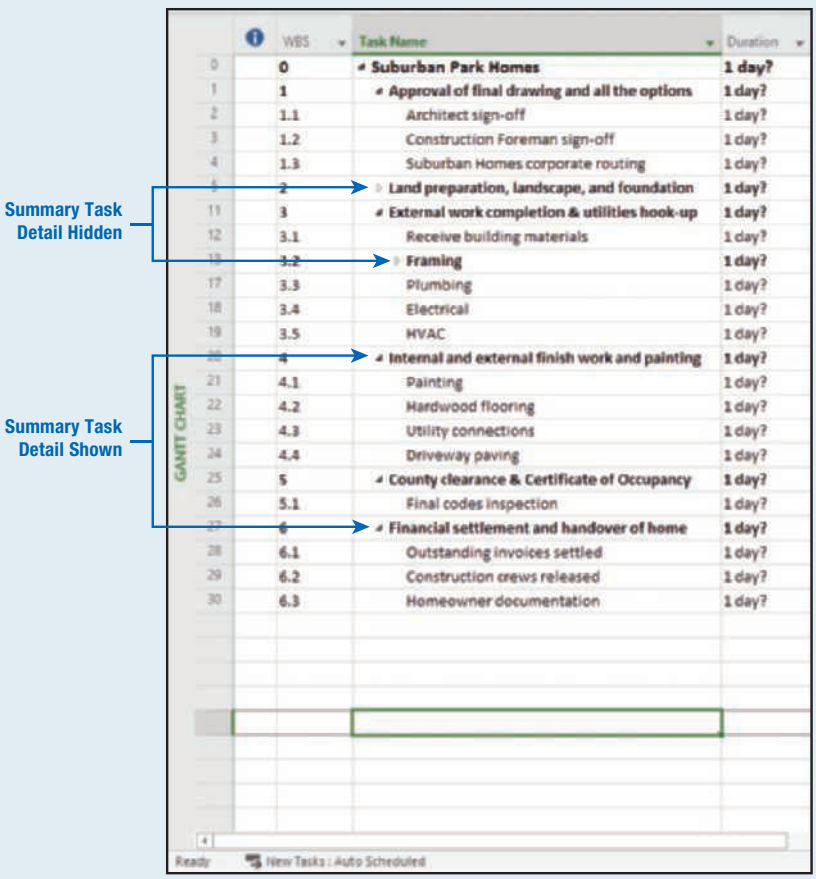
Step 5: Hide (OR SHOW) Subtasks Detail Some stakeholders will not want or need to see the lower levels of WBS detail (particularly in large, complex projects with lots of WBS detail). You can easily "roll-up" (or "un-roll") subtasks underneath their parent summary task to hide (or show) detail. To display the appropriate level of detail, complete one or both of the following steps:

- Click the tiny triangle before the task name of any summary task to hide underlying detail (all details will be "rolled-up" under the summary task).
- Click the tiny triangle again to show underlying detail (all details "un-roll" under the summary task and are again visible).

In Exhibit 7.20, the underlying detail for the "**Land preparation, landscape, and foundation**" deliverable and the "**Framing**" interim deliverable summaries has been hidden.

Exhibit 7.20

Hide or Show Underlying Detail



Source: Microsoft Corporation.

Summary

Once a project is formally approved by a sponsor ratifying its charter, it is time for detailed planning. While project planning is iterative, normally the initial steps are to identify stakeholders, plan communications, and determine the project deliverables or outcomes. Project teams start this process by asking/discussing with customers what end-of-project deliverables they want. Based on the customers' response, the planning team can determine both the interim deliverables and the total work to create all of the deliverables. Just as important as determining what will be created during the project is determining what will *not* be produced. These boundaries of what will and will not be included constitute the project's scope.

Once the scope is defined, it can be organized into a work breakdown structure (WBS). A WBS is used to progressively decompose the project into smaller and smaller work elements until each can be assigned to one person or a small group of people for planning, executing, and controlling. The WBS serves as a basis for determining the project schedule, budget, resources, quality requirements, and risks. As these other functions are planned, a few additional work elements are commonly identified and added to the WBS.

Some teams create their WBS by hand using the org chart or free format methods, while others directly type their WBS into project scheduling software such as Microsoft Project.

Key Terms Consistent with PMI Standards and Guides

plan scope management, 242
requirement, 242
collect requirements, 242
define scope, 246
scope description, 248
WBS, 249
define activity, 250
work package, 253
WBS component, 254
WBS dictionary, 254
rolling wave planning, 255
decomposition, 256
baseline, 260
change control system, 260
change request, 260

Key Terms Consistent with Agile Practice

Simplicity, 264
Extra features, 264
Extra processes, 264
Progressive elaboration, 264
Savage summary, 264
Story map, 264
Release backlog, 264
Sprint backlog, 264
MoSCoW, 264
Personas, 264
User story, 264
Pivot, 264
Definition of ready, 264

Chapter Review Questions

1. What is the first step in developing a project scope management plan? Is it different in traditional project management as compared with Agile?
2. List several common ways to solicit stakeholder opinions.
3. For a construction project, the house is the _____ deliverable, and how-to instruction sheets are _____ deliverables.
4. Why is scope definition important?
5. What are two common causes of scope creep?
6. What does the acronym WBS stand for?
7. What are the advantages of using a WBS?
8. List three ways of organizing a WBS.
9. The lowest level of the WBS is known as a(n) _____.
10. In Agile, the smallest increments are _____.
11. What is a WBS dictionary used for?
12. What is rolling wave planning?
13. What is uncontrolled change known as?
14. Why do project teams use change control systems?
15. List the major sections that should be included in a change request form and tell why each is important.
16. What is a project baseline?
17. In Agile, what is an epic?
18. Who prioritizes the product backlog in Agile?

Discussion Questions

1. Are the product scope and project scope ever the same? Give examples to support your answer.
2. Create a template of a change request form. What sections did you include and why?
3. Compare the strengths and weaknesses of the three formats of constructing a WBS: indented outline, organizational chart, and free format.
4. Give an example of scope creep from one of your own projects or from a project that has made the news in recent years.
5. What are the advantages of completing the "define activity" process *after* creating the WBS?
6. Describe the roles various executives, managers, and associates play in scope planning.
7. You are the project manager in charge of expanding a popular restaurant. How could you use voice of the customer (VOC) techniques and/or user stories to gain insight into your stakeholders?
8. Identify two projects your company or school will be performing in the future. Which one do you think will have a more detailed WBS? Why?
9. The sponsor for a project you have been managing sends you an e-mail that they would like to make a small change to the project. What is your response and why?
10. A potential client wants you to be project manager for the construction of a new house, but they are vague about the details. List a few questions you could ask them to gain a better understanding of the scope of the project.
11. When and why should you follow the Agile tenet of maximizing "work not done?"

PMP Exam Study Questions

1. The process in which project deliverables and project work are subdivided into smaller and smaller pieces is called _____.
   a. collect requirements
   b. define scope
   c. plan scope management
   d. create WBS
2. Where would you go to find supplemental information about the lowest level deliverables of a project?
   a. project scope statement
   b. WBS dictionary
   c. product backlog
   d. project baseline
3. Which of the following statements about a work package is always true?
   a. It requires the work of the entire project team.
   b. It is the responsibility of the project manager.
   c. It is the lowest level of the WBS.
   a. It consists of a single activity.
4. During WBS creation on a large, complex project, the product and project deliverables are broken down into progressively lower levels of detail. Once the WBS has been defined at the second or third level of detail, whose input is essential in order to break down the work further?
   a. sponsor
   b. subject matter experts
   c. internal stakeholders
   d. external stakeholders
5. Put the following Agile terms in order from largest to smallest:
   a. Themes, features, user stories
   b. User stories, features, themes
   c. Features, user stories, themes
   d. User stories, themes, features
6. A "component of the project management plan that describes how the scope will be defined, developed, monitored, controlled, and verified" is the _____.
   a. project statement of work
   b. requirements traceability matrix
   c. scope management plan
   d. WBS dictionary
7. A grid that links product requirements from their origins (e.g., business reason needed, stakeholder who requested them) to the deliverables that satisfy them is referred to as a _____.
   a. network diagram
   b. Gantt chart
   c. requirements traceability matrix
   d. stakeholder register
8. Which of these is *not* a component of a Project Scope Statement?
   a. summary budget
   b. project deliverables
   c. product scope
   d. project exclusions or boundaries

9. The key factor that differentiates scope planning in plan-driven and agile projects is:
   a. Stewardship of assets
   b. Uncertainty of requirements
   c. Acceptance criteria
   d. Stakeholder interviews

10. The process of breaking the WBS into smaller and smaller deliverables is called:
    a. decomposition
    b. functional design
    c. detailed specifications
    d. value engineering

Exercises

1. Create a requirements traceability matrix like Exhibit 7.2 for a project in which you plan an event on your campus.
2. Create a scope statement like Exhibit 7.3 for a project in which you plan an event on your campus.
3. Construct a WBS in indented outline format like Exhibit 7.11 for a project in which you plan an event on your campus. Be sure to number each row. Also, construct the same WBS in MS Project like Exhibit 7.18.

Integrated Example Projects

Suburban Homes Construction Project

Refer to the project charter from Chapter 3. The initial scope as identified in the project charter is mentioned below:

Building a single-family, partially custom-designed home as required by Mrs. and Mr. John Thomas on Strath Dr., Alpharetta, Georgia. The single-family home will have the following features:

- 3,200 square-feet home with 4 bedrooms and 2.5 bathrooms
- Flooring—hardwood on the first floor, tiles in the kitchen and bathrooms, carpet in bedrooms
- Granite kitchen countertops, GE appliances in the kitchen
- 3-car garage and external landscaping
- Ceiling—10′ on first floor and vaulted 9′ ceilings in the bedrooms

Summary Milestone Schedule

- Approval of final drawing and all the options: 02 June
- Land preparation, landscape, and foundation: 15 June
- External work completion and utilities hookup: 03 September
- Internal and external finish work, appliances, and painting: 10 October
- County clearance and Certificate of Occupancy: 30 October
- Financial settlement and handover of the property: 21 December

Heritage Arboretum Development Project

The Heritage Center Arboretum Vision Statement is: The Heritage Center and Arboretum is a living museum including large and small trees and woody bushes with many species of historical significance to our area. This arboretum will showcase native plants, educate citizens on native plants and ecosystems, and increase value by offering shade and beauty. We will continue to improve by creating partnerships with other arboreta and by learning from ArbNet resources and other experts.

The project scope is derived based upon this vision. At the point of this book being written, some of the scope has been completed; some parts are in progress; and other parts are in the product backlog as potential work that may be undertaken at some point in the future depending on the decisions of the product owner.

As the team defines scope, they use personas and user stories to help understand how various stakeholders may use the arboretum. For example, a persona could be Sharifa who is 28 years old and just bought her first home. Her user story could be as a new homeowner—I want to see and read information about native tree species that I might then choose to plant so I can add value, beauty, and plant diversity to my home.

Work completed includes securing acceptance for level one arboretum status. Also, a master site plan with a map of current species has been completed by the arboretum

sub-committee and approved. The site map shows the building, parking, patio, woods, lawn, and the 50 identified species. Approximately 20 additional species of trees have been planted with proper mulching and deer protection. We have conducted meetings with teachers to encourage their students to use the arboretum in school projects and assignments. We partnered with the state forester to bring in representatives from more established arboreta and from communities that are considering development of an arboreta to share ideas. We created a website with information on the arboretum: https://storymaps.arcgis.com/stories/e2436fb5e29b4f4f8f971426d1c140f1

Work approved, but not yet completed, includes planting of three more tree species and three species of woody bushes.

The product scope can be envisioned in three parts: physical facility, partnerships, and on-line presence. While there is limited space for extensive future plantings, the project team will continue to strategically identify additional species to plant and select their locations carefully. There is room for considerable work on partnerships, both with the teachers and other communities already started, but also with other groups in the community such as churches, scout organizations, local businesses, and others. There are also meaningful additions that can be included in the online presence by sharing considerably more information and potentially in different ways.

There are a few boundaries to consider when determining scope for this project. First, part of the site is designated greenspace. The greenspace ordinance states that invasive plants may be removed, but no other plants may be added, and no development may be performed on the greenspace. Second, the center is used for many events, so enough space needs to be free for chairs near the gazebo, for tents up to 20 feet on each side of the patio, and for taking pictures on the front porch of the building. There is also a request to only create plans that will be easy to maintain.

Student questions.

1. Create personas for other stakeholders to show what they want from this project and why.
2. Create a backlog of all of the things you may wish to propose for this arboretum. Include artifacts for all three aspects of scope: physical facility, partnerships, and online presence.
3. Using two releases per year (fall and spring are both great planting times), suggest the relatively few items you think should be accomplished in each of the next two releases. Use MoSCoW technique to justify how you prioritize.

Semester Project Instructions

For your example project, create the following:

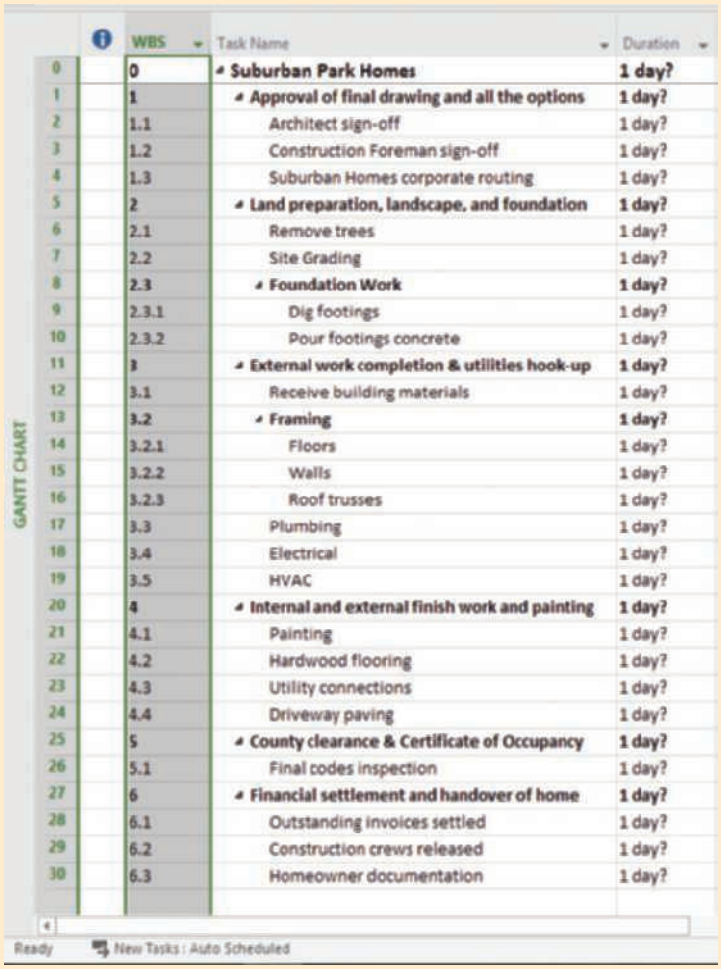
1. Scope management plan to direct your efforts
2. Requirement traceability matrix like Exhibit 7.2 to understand customer desires
3. Scope statement like Exhibit 7.3
4. Change request form like Exhibit 7.13
5. WBS first using either the free format or the org chart format like Exhibits 7.5 and 7.6
6. Story map (if your project is Agile) like Exhibit 7.15
7. Personas and user stories (if your project is Agile)
8. Sprint backlog (if your project is Agile)
9. WBS in MS Project like Exhibit 7.18

Project Management *in Action*

Work Breakdown Structure Template

This WBS for an industrial complex presents a deliverable-oriented approach to developing it by employing a consistency in the division basis for each level of the WBS. Usually, we can develop a deliverable WBS using function, product, or physical location. However, within a level of WBS, we must employ only one of these to develop WBS into the next level. The first-level division basis is physical as

an industrial complex is divided into a powerhouse, factory, office, and grounds. The division basis for the second level of the "Powerhouse" is a functional basis as it is divided into a steam-generation system, electrical-generation system, and electrical-transmission system. The division basis for the second level of the "Factory" is a product basis as it is divided into receiving equipment, processing equipment, and packaging equipment. The second level of WBS for the "Office" is a physical basis as it is divided into first floor, second floor, and third floor. Finally, the division basis for "Grounds" is again a product-basis division as it is divided into shrubs and trees, lawn, walkways, and a parking lot. This WBS is focused on the "what" aspect of the project and not on "how" we execute the project. Essentially, this WBS is developed from the client's perspective and not from the project team's perspective, which is focused on how the project is likely to be executed (schedule-oriented WBS).



GANTT CHART

	WBS	Task Name	Duration
0	0	**Suburban Park Homes**	**1 day?**
1	1	**Approval of final drawing and all the options**	**1 day?**
2	1.1	Architect sign-off	1 day?
3	1.2	Construction Foreman sign-off	1 day?
4	1.3	Suburban Homes corporate routing	1 day?
5	2	**Land preparation, landscape, and foundation**	**1 day?**
6	2.1	Remove trees	1 day?
7	2.2	Site Grading	1 day?
8	2.3	**Foundation Work**	**1 day?**
9	2.3.1	Dig footings	1 day?
10	2.3.2	Pour footings concrete	1 day?
11	3	**External work completion & utilities hook-up**	**1 day?**
12	3.1	Receive building materials	1 day?
13	3.2	**Framing**	**1 day?**
14	3.2.1	Floors	1 day?
15	3.2.2	Walls	1 day?
16	3.2.3	Roof trusses	1 day?
17	3.3	Plumbing	1 day?
18	3.4	Electrical	1 day?
19	3.5	HVAC	1 day?
20	4	**Internal and external finish work and painting**	**1 day?**
21	4.1	Painting	1 day?
22	4.2	Hardwood flooring	1 day?
23	4.3	Utility connections	1 day?
24	4.4	Driveway paving	1 day?
25	5	**County clearance & Certificate of Occupancy**	**1 day?**
26	5.1	Final codes inspection	1 day?
27	6	**Financial settlement and handover of home**	**1 day?**
28	6.1	Outstanding invoices settled	1 day?
29	6.2	Construction crews released	1 day?
30	6.3	Homeowner documentation	1 day?

Ready New Tasks : Auto Scheduled

Source: Vittal Anantatmula, PMP, PhD.

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Chapter 8

Scheduling Projects

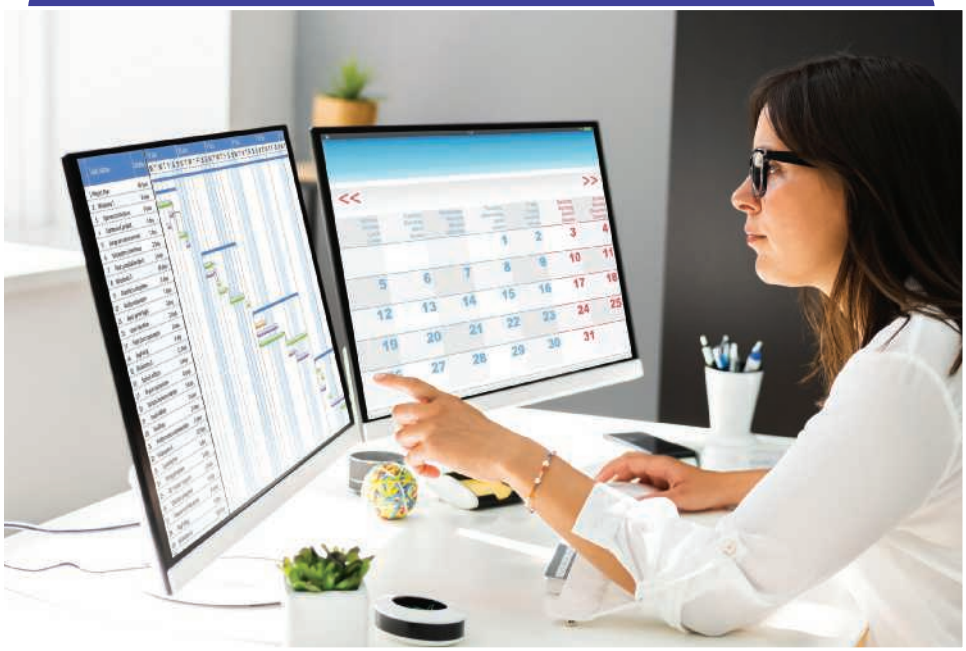
Chapter Objectives

Core Objectives:

8-1 Identify limitations of a project's schedule and discuss ways to manage them.
8-2 Learn the activity on node (AON) method to develop a project schedule.
8-3 Identify potential problems in estimating time accurately and how to overcome them.
8-4 Create a project schedule on a Gantt chart by hand, showing the critical path and all float.
8-5 Describe ways to adjust a project's sequence logic using leads, lags, and alternative dependencies.
8-6 Build and display the critical path and all float for each activity using MS Project.
8-7 Resolve potential scheduling conflicts.

Agile Objectives:

8-1 Describe the process of determining the size of a story.
8-2 Explain the product owner's process of prioritizing work based on value and risk.
8-3 Discuss how a team decides what work it will commit for an iteration.



Andriy Popov/Alamy Stock Photo

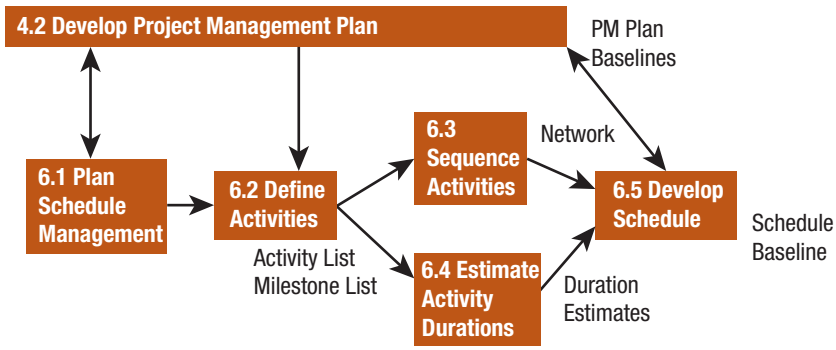
Scheduling and Agile

I've worked with people who mistakenly think Agile methodology makes project management principles irrelevant or that it is incompatible with concepts like Schedule, Scope, and Cost. Nothing could be further from the truth—the *"triple constraint"* still applies, whatever methodology is used. I've managed projects the enterprise decided should be schedule-driven but team members delivered as though they were scope-driven and sponsors monitored like they were cost-driven. As Project Manager, I've had to recognize those gaps and realign people.

The need to comply with government regulations by mandated deadlines does not change when a company switches from waterfall to Agile. So most of my projects have been schedule-driven, due to expectations set with customers. In fact, my PMO requires approval of a formal change request whenever an end date will be delayed more than two weeks!

With a company using Agile teams for each of its products, I saw developers take more ownership of projects, estimate activities better, and learn how to apply

PMBOK Guide 6e Coverage



Note: Refer to Appendix A to view the entire *PMBOK Guide 6e* flowchart.

PMBOK Guide 7e

Performance Domains:

- **Team**
- **Development Approach**
- **Planning**
- **Delivery**
- **Measurement**
- **Uncertainty**

dependencies, leads, lags, and float within their daily stand-ups. Those teams were on the same iteration cycles, so ceremonies like sprint retrospectives became milestones in our project schedules.

But most of my projects have been multi-year efforts where the varying methodologies and terminologies used by different Agile and Waterfall teams hampered communication, as did differing iteration cycles. For example, one team was on two-week sprints and another four weeks with Agile teams on entirely different planning cycles. Add varying geographic locations, vocabulary, and systems, and it was challenging to give team members a consistent view of our Schedule that allowed them to respond when changes inevitably affected it.

As PM, I must facilitate collaboration among all those team members who depend on one another to deliver results according to the expectations set for our project. In Planning, we review all identified activities and discuss dependencies, determining whether they are Finish-to-Start (FS), Finish-to-Finish (FF), and Start-to-Finish (SF) before sequencing tasks and setting key milestone dates. We have always found gaps caused by teams' varying iterations that extended schedule duration with no corresponding benefit. And I've been impressed by how creatively team members found ways to close them and improve our schedule while making everyone more accountable to it!

People seem to focus most on their own work, even when everything is on one Kanban board. Whether a project is that simple or more complex, everyone working on it *must* be aware of how changes to the sprints in which they deliver functionality will affect other project tasks and delivery of overall Scope. While Agile team members may feel successful as long as they make incremental progress every day when on a project team, they must understand how that might still cause delays to the critical path and failure to meet our Schedule!

As PM, while I may use tools like Microsoft Project to understand the ripple effect of one task's changes on others, I'm usually the only one who views the Schedule that way! To avoid distracting team members with tasks irrelevant to their work, I translate what I've learned into a simplified timeline for the team, in the form of a high-level Gantt chart, with a list of key dates to make sure everyone knows when key handoffs should take place or a change will warrant team engagement around Schedule implications. On longer-duration projects, I may even limit this to the next milestone when deliverables are due.

I stay focused on these two things that haven't changed in the 25 years I've managed projects:

1. Tools and methods flexible enough to accommodate Schedule changes throughout the project's duration
2. Team member awareness of when changes in their Schedule timing will affect others (*or not*).

Investing team members in the Schedule beyond just completing their own activities is worth the effort I put into it because it results in better teamwork and improved delivery.

—Carol A. Abbott, PMP

8.1 Plan Schedule Management

As is true with other project planning knowledge areas, planning for time or developing a schedule is iterative. A project manager and team usually develop as much of the schedule as they can be based upon the information in the work breakdown structure (WBS). The communication plan, requirements traceability matrix, and scope statement are often either complete or at least in draft form at this point. Once a project is scheduled, resource needs can be identified and resources assigned, risks can be identified and plans developed to deal with the identified risks, and a quality management plan can be created. In many projects, these are not all treated as discrete activities, and some of them may be performed together. However, for clarity, each of these planning processes will be described individually.

The building blocks of a project schedule are activities. An **activity** is a unique and distinct part of work with a duration greater than zero time period, which is scheduled to be performed during the course of a project.[1] For activities to be useful as schedule building blocks, they should have the following characteristics:

- activity scope is independent with clear boundaries to the work
- defined start and endpoints
- output can be independently verified and measured
- small enough to be delegated and controlled
- resources, cost, and time can be estimated exclusively
- an individual is accountable for its completion

Since activities represent work that needs to be performed, they should be listed in a verb–noun format, such as "prepare budget," "build frame," "test code," "transmit information," "analyze data," and "develop plan." Each activity should be clearly differentiated from other activities, so it is often helpful to write the activities in verb–adjective–noun formats, such as "write draft report" and "write final report."

The Project Management Institute (PMI) has divided project time management into the following six work processes.

1. **Plan schedule management**—arranging how to develop, manage, execute, and control the project schedule.
2. **Define activities**—a project planning process that identifies and determines specific actions to develop and deliver the project outcomes, such as products, services, or results.
3. **Sequence activities**—determining the predecessor and successor relationships among the project activities.

4. **Estimate activity durations**—the process of estimating the number of work periods that are needed to complete individual schedule activities.[2]
5. **Develop schedule**—the process of analyzing schedule activity sequences, schedule activity durations, resource requirements, and schedule constraints to create the project schedule.[3]
6. **Control schedule**—the process of monitoring and regulating changes to the project schedule.

Planning schedule management, defining activities, sequencing activities, estimating activity durations, and part of developing schedules will be covered in this chapter. The remainder of developing schedules will be discussed in Chapter 9 (Resourcing Projects). Chapter 14 (Determining Project Progress and Results) will focus on controlling the schedule.

8.2 Purposes of a Project Schedule

Projects are undertaken to accomplish important business purposes, and people often want to use the project results as early as possible. Many specific questions such as the following can be answered by having a complete and workable schedule:

- When will the project be complete?
- What is the earliest date a particular activity can start, and when will it end?
- What activity must be complete before an activity can start?
- What would happen if the delivery of material is late?
- Can a key worker take a week of vacation when their activity is in progress?
- If a person is assigned to do two activities, which one must be done first?
- How many hours do we need from each worker next week or month?
- Which worker or other resource creates a bottleneck that can halt or delay our project?
- What will the impact be if the client wants to add an additional module?
- If the client is willing to spend an extra $10,000, how much faster can the project be completed?
- Are all of the activities that should have been completed by now actually completed?
- How many resources are required for the project, and are they available?
- How much time and effort are required from each resource?
- What time constraints are the project likely to encounter?

The development of a project schedule is designed to address all these questions, and the final schedule provides answers to all of them.

8.3 Historical Development of Project Schedules

Throughout history, projects have been performed, but many early projects such as cathedrals in Europe took decades or longer to complete. As competition drove the need for more rapid completion, systematic methods were developed for scheduling projects.

In the 1950s, two project scheduling methods were developed: program evaluation and review technique (PERT) and critical path method. The **critical path method (CPM)** is "A method used to estimate the minimum project duration and determine the amount of schedule flexibility on the network paths within the schedule model."[4]

Both CPM and PERT were founded on the concepts of identifying activities, determining their logical order, and estimating the duration for each. Networks representing the sequencing of activities were developed and the schedule calculations were performed. Each technique has a few unique features.

PERT was developed in the Navy's Special Program Office when the Navy was developing the large and complex Polaris Weapons System. To complete it as quickly as possible, many activities need to be performed simultaneously. Furthermore, many aspects of the Polaris used unproven technology. There was considerable uncertainty regarding how long it would take to develop some of the new technologies. PERT-enabled project managers to estimate the most likely amount of time required to complete a project with an estimated confidence level. This was proven to be useful in research and development projects involving individual activities that are hard to estimate precisely. Uncertainty in PERT project schedules will be discussed in Section 8.9.

CPM was developed by the Engineering Services Division of DuPont in their effort to plan large projects such as building and refurbishing enormous plants. CPM assessed the time for each activity using a single-time estimate. The focus was on understanding the longest sequence of activities, which determined how long the project would take. CPM-enabled project managers ask what-if questions such as "if the project needs to be finished three weeks early, which activity duration should be shortened and how much will it cost?" This method proved to be useful in the construction industry where delays such as rain and other weather-related issues often necessitate the acceleration of a project.

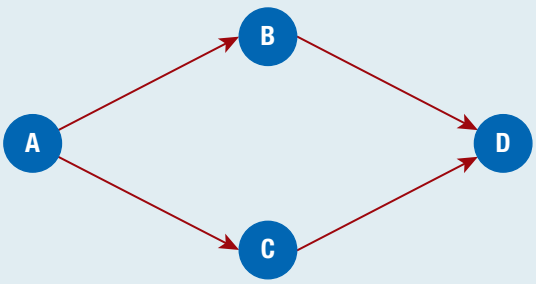
PERT and CPM originally used a method for displaying the work activities in a network diagram called activity on arrow (AOA) or arrow diagramming method (ADM), in which schedule activities are represented by arrows and connected at points called nodes. Because it is often confusing to draw an accurate AOA network, this method is rarely used today. The more commonly used method is called activity on node (AON) or the **precedence diagramming method (PDM)**. AON or PDM represents scheduled activities with nodes and connects each activity to one or more other activities with logical relationships or sequences of performance from left to right. The arrow denotes the predecessor–successor relationship only and the length of the arrow does not mean anything.

A small project schedule is shown in Exhibit 8.1 with work activities A through D connected by arrows showing logical relationships (A must be complete before B and C can begin and both B and C must finish before D can begin).

The basic logic of these techniques still serves as the backbone of many project schedules today. However, technological advances and computers now allow us to add many additional features to project schedules. Another trend is that many organizations are operating in a "lean" mode, and resource limitations rather than just the logical order of activities can be major determinants of the project schedule.

Exhibit 8.1

AON Format Schedule Example



8.4 How Project Schedules Are Limited and Created

There is generally a trade-off among the three constraints—scope, cost, and schedule—and the project should have the flexibility to manipulate at least one of these three constraints. For example, a project schedule gets higher priority over scope and cost when it is a time-constrained project. In addition to these constraints, the project schedule is constrained by other factors. One way to understand project schedules and how they are constructed is to recognize that five factors may limit how fast a project can be completed:

1. Logical order
2. Activity duration
3. Resource availability
4. Imposed dates
5. Cash flow

- The first factor is the logical order in which activities need to be completed. For example, one needs to dig a hole before cement can be poured into it. This is covered in the section on sequencing activities.
- The second factor is how long each activity will take to complete. This is discussed in the section on estimating activity duration. It includes methods for estimating durations, problems with estimates, and remedies to those problems.
- The third factor is how many key resources are available at specific times in the project. For example, if six rooms were available to be painted at the same time, and fewer than six painters were available, progress would be slower. This is discussed in Chapter 9 in the section on resource availability.
- The fourth factor is imposed dates. For example, a project working on a government contract may not be able to start until the government's new fiscal year, which starts on October 1.
- The fifth and final factor is cash flow. Projects may not start until the budget is approved, but progress may also be slowed until enough revenue arrives to cover expenses. This is covered in Chapter 10.

Because project schedules are limited by these five factors, creating a realistic schedule is an iterative process. A common method of developing the schedule is to do the following.

1. First, identify all of the activities and then determine the logical order by creating a network diagram. The logical sequence is dictated by both hard and soft logic (explained in section 8.6).
2. Once the order is determined, estimate the time required for each activity.
3. Then, assign resources to each activity, and if an assigned (required) resource is not available when the activity is scheduled, make an adjustment to the schedule or find an alternative way to execute the activity. The schedule can be computed with all of this information.
4. Next, it is time to compare the emerging schedule with any imposed dates and cash flow estimates.

Any inconsistencies may cause the team to adjust the schedule. Other factors such as quality demands and risk factors may also need to be considered. When all of these have been planned, the final schedule can be approved.

The pressure to complete a project as quickly as possible is often significant. The sponsor or customer may try to dictate a schedule before ascertaining whether it is feasible. Before agreeing, the project manager must first understand what makes sense in terms of

a schedule before they are in a position to know whether to accept a sponsor's suggestion or to discuss why it may be impractical. A project manager has the ethical responsibility to determine a schedule that is possible to achieve, persuade all stakeholders that the schedule makes sense, and then see to it that the project is delivered according to that agreed-upon schedule.

The remainder of this chapter and the other planning chapters describe in detail how to plan for time, resources, and estimated costs, culminating in an approved schedule and project plan that all stakeholders believe is reasonable. The project manager is then accountable to deliver the project on schedule and within budget. That project delivery is the essence of the final three chapters of this book.

8.5 Define Activities

The first process in developing a project schedule is to define all of the work activities. The bottom level of a WBS represents the work packages or the lowest-level deliverables. Now is the time to ask: "What work activities must be completed to create each of these lowest level project deliverables?" Exhibit 8.2 shows a WBS with the deliverables identified by numbers 1 through 9, and Exhibit 8.3 shows the same WBS with the activities required to create the deliverables listed. Notice that project management is the first section of the WBS. The remaining WBS elements (2 to 9) and their lower-level elements are assigned a unique number. The number of each activity shows the deliverable it helps to create. For example, activity 4.2, *contact local bands*, is needed for higher-level deliverable 4, *entertainment*.

As teams define activities, they need to be careful not to omit any work elements. It is a good idea to have someone on your project team play devil's advocate to challenge the team to identify additional activities. It is better to identify activities that need not be accomplished than to forget activities that will have to be added later. The team may think all of the activities have been identified after the initial planning; however, when the activity sequencing is performed, it may become obvious that some activities have been forgotten or not considered. It is better to discover a missing activity in this phase of planning than after the schedule is approved. Newly added activities, after the final schedule is approved, will increase time and cost to the project, driving it over budget and delaying the schedule.

If the project at hand is similar to previously executed projects, the team may review the project plans for defining activities, identifying risks, and estimating costs to develop a better and more accurate schedule. Some organizations develop templates or checklists for

Exhibit 8.2

Work Breakdown Structure with Deliverables Only

College Fundraiser Project

1. Project Management
2. Location
3. Promotion
4. Entertainment
5. Safety
6. Parking
7. Food
8. Sanitation
9. Volunteers

Exhibit 8.3

Work Breakdown Structure with Activity List Added

College Fundraiser Project

1. **Project Management**
2. **Location**
   - 2.1 Contact university for permission
   - 2.2 Determine ideal location to meet capacity
   - 2.3 Determine contingency plan in case of inclement weather
3. **Promotion**
   - 3.1 Provide team information
   - 3.2 Produce pre-event advertisements
   - 3.3 Display welcome signs at all entrances
   - 3.4 Set up sign-in table
   - 3.5 Display signs with rules
4. **Entertainment**
   - 4.1 Find information about local noise ordinances
   - 4.2 Contact local bands
   - 4.3 Set up stage, speakers, fun booths
5. **Safety**
   - 5.1 Determine lighting needs
   - 5.2 Contact local fire department (ems)
   - 5.3 Contact local police department
   - 5.4 Obtain permission to use walkie-talkies
   - 5.5 Set up first-aid booth
6. **Parking**
   - 6.1 Find adequate lots to accommodate capacity
   - 6.2 Coordinate shuttle service from lots to site
   - 6.3 Reserve special places for handicapped
7. **Food**
   - 7.1 Contact food/beverage vendors for concessions
   - 7.2 Make goodie bags for children
   - 7.3 Order sufficient drinking water
8. **Sanitation**
   - 8.1 Provide trash receptacles
   - 8.2 Provide adequate number of porta-johns
   - 8.3 Coordinate post-event clean-up
   - 8.4 Purchase paper products and soap
   - 8.5 Provide washbasins
9. **Volunteers**
   - 9.1 Recruit volunteers
   - 9.2 Produce a master volunteer assignment list
   - 9.3 Make name tags for all volunteers

certain types of projects or certain project deliverables that can be used as a starting point. Nevertheless, team members should keep on asking how the project at hand is different from previous ones. Often, a new project includes a few unique activities.

In addition to the activity list, the project milestones should be listed. A milestone is an important stage or phase in a project schedule that the project sponsor and manager want to use as a checkpoint. Common milestones include completion of a major deliverable, completion of a critical activity, or the time just before a large amount of money or resources must be committed to the project. A few major milestones are often identified in the project charter, but quite commonly more milestones are identified in the project schedule. A team may also decide to put a milestone at a merging point in the project schedule where multiple activities need to be completed before any further progress can be made. The common denominator in each of these decisions is to identify a few key points in the life of a project at which management can determine if the project is progressing as planned or not.

A milestone list is shown in Exhibit 8.4. Note that the line numbers assigned to the milestones are one greater than the line numbers of the activities that must be completed for each milestone. For example, the milestone "Promotion finalized" (item 3.6) represents the point in time that all of the promotion-related activities (items 3.1 through 3.5) are completed. For clarity, items 3.1 through 3.5 have been imported from Exhibit 8.3 and set in a lighter font. Notice also that the verb choice on the milestones is past tense, such as "confirmed," "finalized," and so on. This indicates that the activities leading up to each milestone must be complete.

Exhibit 8.4

Work Breakdown Structure with Milestone List

College Fundraiser Project

1. **Project Management**
2. **Location**
   2.4 Location confirmed
3. **Promotion**
   3.1 Provide team information
   3.2 Produce pre-event advertisements
   3.3 Display welcome signs at all entrances
   3.4 Set up sign-in table
   3.5 Display signs with rules
   3.6 Promotion finalized
4. **Entertainment**
   4.4 Band contract signed
   4.5 Entertainment arranged
5. **Safety**
   5.6 Safety requirements completed
6. **Parking**
   6.4 All parking needs arranged
7. **Food**
   7.4 Food and beverages readied
8. **Sanitation**
   8.6 All sanitation needs in place
9. **Volunteers**
   9.4 Volunteers prepared

Design Pics Inc/Alamy Stock Photo

8.6 Sequence Activities

Once the activities have been identified, it is time to determine the logical order in which they can be accomplished. This process is called **sequence activities**, and it entails determining the predecessor and successor relationships among the project activities. This sequencing activity is routinely developed and performed in traditional (plan-driven) projects for the entire project and developed for each iteration of Agile projects.

A common method of determining this sequence is to put each defined activity on a Post-it Note and to display them on a large workspace such as a whiteboard or several flip-chart sheets on a wall. The activities that are expected to be accomplished early in the project can be placed on the left portion of the work surface, those activities expected to be accomplished midway in the project near the middle, and those expected to be last on the right. Then, one person can serve as a facilitator by asking, "What activity or activities can be started right away and do not depend on any others?" Once one or more of these initial activities have been identified, the facilitator asks, "What activity or activities can we start now?" The initial activity is called a **predecessor activity**. The following activity is called a **successor activity**, The facilitator then places the successor activity after its predecessor and draws an arrow to show the relationship, such as finish-to-start.

Four types of relationships are possible (discussed below), and the default relationship is finish-to-start. The team continues with this analysis until all activities have been placed on the work surface with arrows showing the predecessor–successor relationships. At that time, the team should mentally go through the network to ensure that no "dead-ends" are present in which the chain of arrows from the project start to end is broken. Such dead-ends are not acceptable and should be corrected by revisiting the schedule logic as explained above.

Exhibits 8.5 and 8.6 illustrate sequencing activities with the simple example of upgrading a product. The activities are identified in Exhibit 8.5, and their sequence is shown in Exhibit 8.6. The first activity is to determine the product features. As soon as that is done, two other activities can be performed.

This product upgrade example illustrates the basic logic of showing predecessor–successor dependency relationships. Dependencies can be either mandatory or discretionary. A **mandatory dependency** is "a logical relationship between activities that

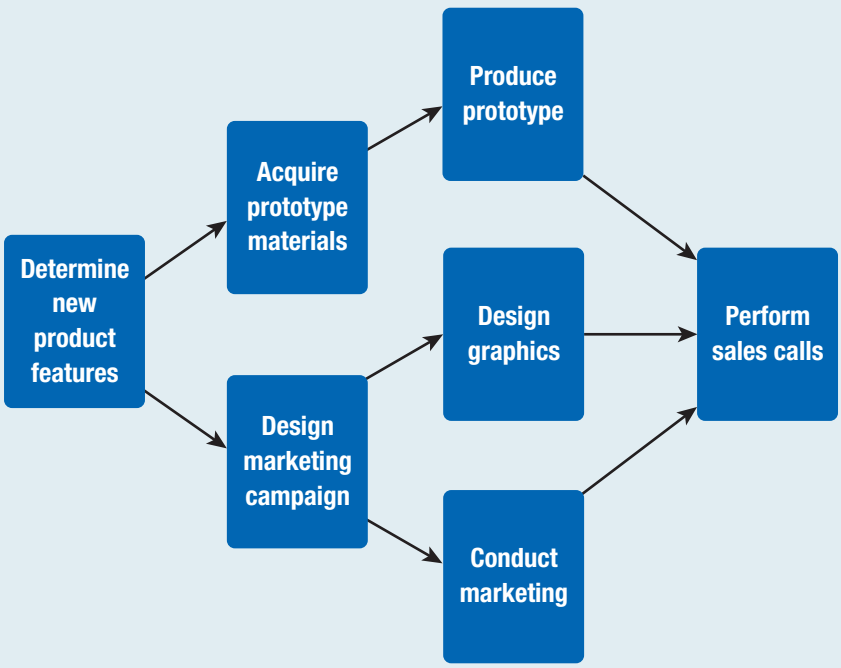
Exhibit 8.5

Activity List for Product Upgrade Project

- Determine product features
- Acquire prototype materials
- Produce prototype
- Design marketing campaign
- Design graphics
- Conduct marketing
- Perform sales calls

Exhibit 8.6

Network for Product Upgrade Project



must happen—usually due to a physical or legal demand." A mandatory discrepancy is also known as hard logic, and it could be physical, legal, or technical. A **discretionary dependency** is "a logical relationship between activities that is considered desirable, usually based upon experience or best practice." A discretionary dependency is also known as soft logic, and it is employed at the discretion of the schedule planner based on prior experience and common sense.

A mandatory dependency or hard logic example is "the hole must be dug before concrete can be poured into it." A discretionary dependency or soft logic example is "past experience tells us it is better to delay designing product graphics until the marketing plan is complete." The team includes all of the mandatory dependencies in schedule logic and uses its judgment on which discretionary dependencies to include. Most teams include no more dependencies than necessary since dependencies give fewer choices as the project progresses.

8.6a Leads and Lags

Exhibit 8.6 shows the most common type of logical dependency, **finish-to-start (FS)**, which is "a logical relationship in which a successor activity cannot start until a predecessor activity has finished."[5] In this example, the *marketing plan* must be completely designed before the *graphics design* starts. However, maybe the *graphics design* could start five workdays before the *marketing campaign design* is complete. This could be modeled as a **lead**, which is "a modification of a logical relationship that allows an acceleration of the successor activity."[6] With this lead of five workdays, the arrow connecting *design marketing campaign* and *design graphics* would still represent a finish-to-start relationship, only with a five-day overlap during which time people could work on both activities. A lead is possible as the relationship between these two activities is discretionary. Leads are helpful if a project needs to be completed quickly since they show how a successor activity can be overlapped with its predecessor instead of waiting until the predecessor is completely finished. However, relationships among activities on the critical path are often based on mandatory logic and, therefore, lead time is zero.

Perhaps in the example, the salespeople are more effective if the *design graphics* are completed ten days before they start *performing sales calls* so they have extra time to better understand the graphics and develop a promotion strategy. This could be shown by a **lag**, "a modification of a logical relationship that imposes a delay of the successor activity."[7] In this example, the arrow connecting *design graphics* and *perform sales calls* would still represent a finish-to-start relationship, only with a ten-day gap during which no one could work on either activity. This is possible if *design graphics* activity is not on the critical path; otherwise, the project will be delayed by ten days.

8.6b Alternative Dependencies

Other types of relationships exist besides finish-to-start (FS), including the following:

- **Finish-to-finish (FF)** is "the logical relationship in which a successor activity cannot finish until a predecessor activity has finished."[8] For example, perhaps the graphics could be designed while the *marketing campaign* is being designed, but could not be completed until the *marketing campaign* is completed.
- **Start-to-start (SS)** is "a logical relationship in which a successor activity cannot start until a predecessor activity has started."[9] For example, perhaps the *graphics design* could not start until the *design marketing campaign* started.

- **Start-to-finish (SF)** is "a logical relationship in which a successor activity cannot finish until a predecessor activity has started."[10] This is the least used relationship. An example is for a project to replace an old system where the new capability must be started before the old one is completely discontinued.

8.7 Estimate Activity Duration

You can begin **estimating activity durations** once the activities have been defined and sequenced. Estimating activity durations is the process of approximating the number of work periods needed to complete individual activities with estimated resources. **Duration** is "the total number of work periods (not including holidays or other non-work periods) required to complete an activity or project, expressed in hours, days, or weeks."[11]

It makes sense to identify the people who will work on each activity as soon as possible since they often have the most knowledge about how to actually do the work and how long it will take, and a delay in assigning resources may result in the non-availability of those people and other resources, as they might be assigned to another activity or project. Also, the length of time to perform an activity is often dependent upon who will do that work. We discuss resource assignments in Chapter 9.

When estimating how long activities are expected to take, each activity should be evaluated independently. All assumptions and constraints—made when estimating—should be documented since a change in one of these assumptions could change the estimate. For the first estimate of each activity, a normal level of labor effort and equipment and a normal workweek should be assumed. If overtime is planned right from the start, the project manager is unlikely to have much flexibility if the schedule needs to be accelerated. For each activity, the required skill levels of the people assigned to perform the work should be identified. Any predetermined completion date can be disregarded at this point. Negotiation with a customer or supplier may be necessary, but the project manager and team must understand what is reasonable under normal circumstances before entering into those negotiations. When a past project is used as a guide for estimating, it is preferable to use the actual time taken to perform the activities and not the estimated or planned time. Additional suggestions for creating good estimates include the following:

- Use a WBS that is complete to understand deliverables.
- Exclude any activity that is not part of the WBS in the estimate.
- Identify each activity clearly.
- Include appropriate contingencies.
- Use relevant and sufficient data.
- Consider input from all relevant stakeholders, including subject matter experts (SMEs) in making estimates.
- Conduct an independent review.
- Revise the estimate if there is a major project change.

Exhibit 8.7 is a continuation of the product upgrade example with the times estimated for individual activities. Note that the estimated times in this example are in workdays. It is important to keep time estimates in the same unit of measure, be it hours, days, weeks, or another increment of time. Exhibit 8.8 includes suggestions for creating realistic time estimates.

Exhibit 8.7

Activity Duration Estimate Example

Time Estimate in Workdays	Activity Name
5	Determine new product features
20	Acquire prototype materials
10	Produce prototype
10	Design marketing campaign
10	Design graphics
30	Conduct marketing
25	Perform sales calls

Exhibit 8.8

Suggestions for Creating Realistic Time Estimates

1. Verify all time estimates with the people who are doing the work. Or, even better, have the people doing the work provide the initial estimates of the activity completion time.
2. Estimate times of completion of work without initial reference to a calendar. Just consider how long you believe each activity will take under normal working conditions.
3. Make sure all time units are identical: hours, workdays, work weeks, months (consider time off for company holidays), etc.
4. Some people tend to estimate optimistically. Keep in mind the following time constraints:
   - Unexpected meetings
   - Learning curves
   - Competing priorities
   - Vacation
   - Resources or information not available on time
   - Inaccuracy in work instructions
   - Interruptions
   - Emergencies and illness
   - Rework
   - Uncertainties or unknowns
5. Contrary to point 4, some people estimate pessimistically in order to look good when they finish their project or activities under budget and/or ahead of schedule. Try to develop an understanding of the estimator's experience along with their optimistic or pessimistic tendencies, and try to encourage realistic estimates.
6. Don't initially worry about *who* is going to do the work, and don't worry about the mandatory deadline. Figure out a realistic estimate first, and then figure out what to eliminate later.

When using the actual time from a previous project, adjust the estimate up or down based upon various influencing factors such as size, familiarity, and difference in complexity.

8.7a Problems and Remedies in Duration Estimating

Many factors can impact the accuracy of activity duration estimates. A list of potential problems, remedies for those problems, and the chapter in which each is discussed are shown in Exhibit 8.9. These remedies are not mutually exclusive. Many organizations use

Exhibit 8.9

Activity Duration Estimating Problems and Remedies

Potential Activity Duration Estimating Problem	Remedy	Chapter
Omissions	Refining scope and WBS Checklists, templates, devil's advocate Lessons learned	7 8 15
General uncertainty in the estimate	Rolling wave planning Reverse phase schedule Learning curve Identify and reduce sources of uncertainty Manage schedule aggressively	7 9 8 11, 12 14
Special cause variation	Risk analysis Resolve risk events	3, 11 14
Common cause variation	PERT Monte Carlo Project buffer	8 8 9
Merging (multiple predecessors)	Milestones Reverse phase schedule Feeding buffer Manage float	3, 8 9 9 14
Queuing	Staggering project start dates Resource leveling Resource buffer	2 9 9
Multitasking	Prioritizing projects Carefully authorize start of non-critical activities	2 9, 14
Student syndrome (starting late)	Float Critical path meetings	8 14
Not reporting early completion of rework	Project culture Project communications Contract incentives Project leadership Progress reporting	4 6 13 5 14

Source: Adapted from Larry Leach, "Schedule and Cost Buffer Sizing: How to Account for the Bias between Project Performance and Your Model," *Project Management Journal* 34 (2) (June 2003): 44.

several of them; however, few organizations use them all. Students need to be aware of these remedies and their potential benefits. Many companies customize the mechanics of how they use these remedies.

8.7b Learning Curves

The concept behind learning curves is simple: The more times a person performs an activity, the better, faster, and more effective they become. This concept can be utilized for activity duration estimating, as the rate of improvement can be studied and predicted. Therefore, on some projects where certain activities are performed routinely or repetitively, a project

Exhibit 8.10

Learning Curve Table

Activity	60%	70%	80%	90%
1	100	100	100	100
2	60	70	80	90
4	36	49	64	81
8	21.6	34.3	51.2	72.9

planner can predict how long it will take each time to perform the activity. The rate of improvement can vary widely depending on many factors, such as:

- the culture of the organization stresses continual improvement
- skill involved in the activity
- complexity of the activity
- the activity depends on the worker versus dictated by the pace of a machine
- frequent job rotation

The time necessary to perform an activity is based on a rate of improvement due to repetition and learning. This rate of improvement occurs when the number of repetitions doubles. For example, if the learning rate is 80% and the first time the activity was performed (by producing the first unit), it took 100 minutes, then after doubling the number of units produced, the second unit would require 80 minutes. To double the repetitions again, the fourth unit would require 64 minutes. The time estimates for each time the activity is performed can be found in learning curve tables such as the one shown in Exhibit 8.10. Notice that the rate of learning is very important since more rapid learning leads to much faster performance times for successive times an activity is performed.

For consumers, one result is rapidly declining prices when an industry has a steep learning curve. For example, people expect prices to decline for new electronics and other consumer items. As a project manager, you also need to plan for the amount of learning that may take place. Further, as a project manager, you need to create and sustain an environment that encourages and expects rapid learning so you can always become more competitive.

8.8 Develop Project Schedules

All the scheduling processes discussed thus far must be completed, as this information is required before using any scheduling tool like Microsoft Project. At this point, you have defined, sequenced, and estimated the duration for all the schedule activities. Now is the time to use all of this information to develop a project schedule. Once the schedule is developed based upon this information, constraints such as resource needs and availability, and cash flow often extend the proposed schedule, while imposed date constraints often suggest the need for schedule compression.

The first major task in developing the project schedule is to identify the **critical path**, which is the longest sequence of activities from the project start date to the finish date.[12] Because it is the longest succession of activities, the critical path determines the earliest

possible completion date or the shortest possible duration of the project. Any time change to an activity on the critical path changes the completion date of the project. If the project manager changes an activity on the critical path to start at a later date, then the project will end at a later date. If the amount of work for an activity on the critical path is increased, then the project will be delayed and will end at a later date. If, on the other hand, an activity on the critical path is performed faster than planned, the entire project could be completed sooner. The critical path gets its name not because critical path activities are the most critical in terms of cost, technical risk, or any other factor, but because they are critical in terms of time. Since virtually everyone wants to complete projects at the promised time, the critical path gets a great deal of attention.

The two methods for determining the critical path are the two-pass and enumeration methods. Each uses the same activity identification, duration estimate, and activity sequencing data but processes the data differently. While both determine the critical path, each also determines other useful information.

8.8a Two-Pass Method

The two-pass method is used to determine the amount of slack or float each activity has, which is defined and explained through this method. To perform this method, two logical passes should be made through the network. The first pass is called the **forward pass**. The forward pass is "a critical path method technique for calculating the early start and early finish dates by working forward through the schedule model from the project start date or a given point of time."[13] On the forward pass, the project team starts at the beginning of the project and asks how soon each activity can begin and end. If the project is being scheduled with software, actual calendar dates are used. Often, when calculating the schedule by hand, a team starts at date zero. In other words, the first activity can begin after zero days. To envision this, consider Exhibit 8.11, where all of the previously determined information has been displayed.

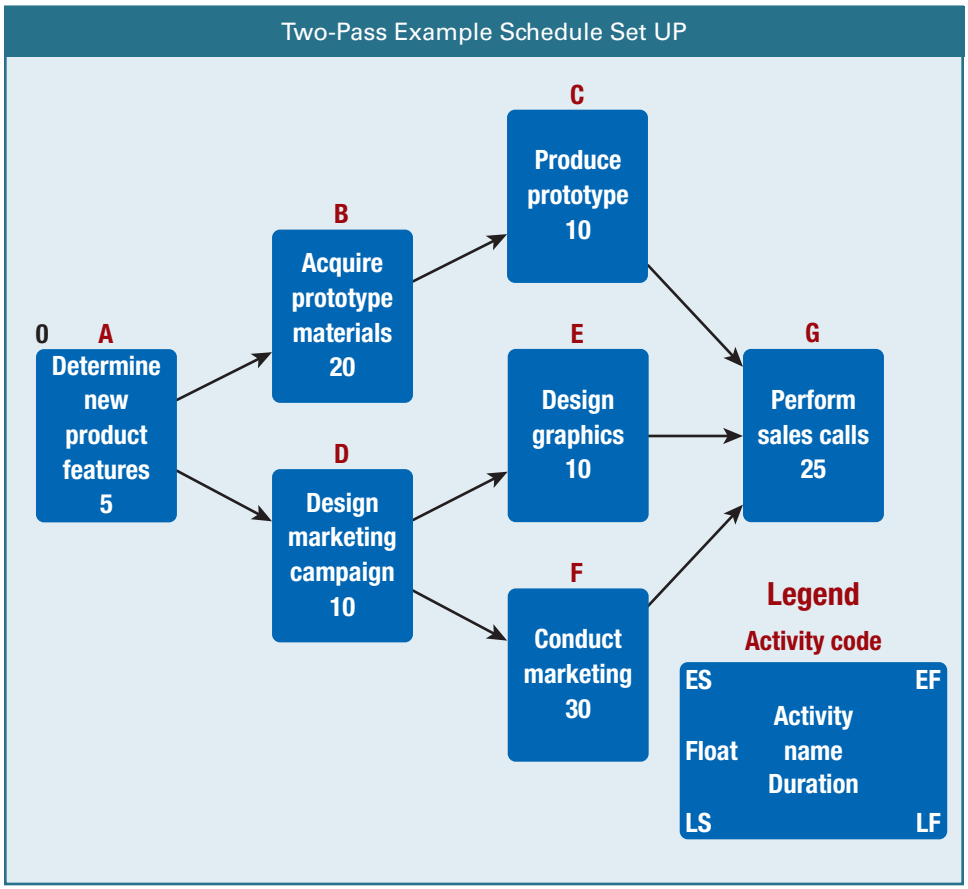
A legend is shown in the lower-right corner of Exhibit 8.11. This explains each bit of information that is displayed for each activity, and we will show you how to calculate each item below. For example, the first activity name is "Determine new product features." The estimated duration for this activity is five days. This activity is coded with the letter A. The four corners of each block display four important times for each activity:

- **Early start date (ES)**—"the **earliest** possible point in time when the schedule activity can begin based on critical method (CPM) forward pass of schedule model logic."[14]
- **Early finish date (EF)**—"the **earliest** possible point in time when the uncompleted portion of the schedule activity can be completed given the assigned resources."[15]
- **Late start date (LS)**—"the **latest** possible point in time when the schedule activity can begin without violating schedule constraint or delaying the project end date."[16]
- **Late finish date (LF)**—"the **latest** possible point in time when the schedule activity can be completed without violating schedule constraint or delaying the project end date."[17]

"Determine new product features," for example, has an early start time of **zero** since it can begin as soon as the project is authorized.

First or Forward Pass The first pass is then used to calculate the early finish, which is the early start plus the estimated duration (ES + Duration = EF). In this case, 0 + 5 = 5 means the activity "Determine new product features" can be completed after five days.

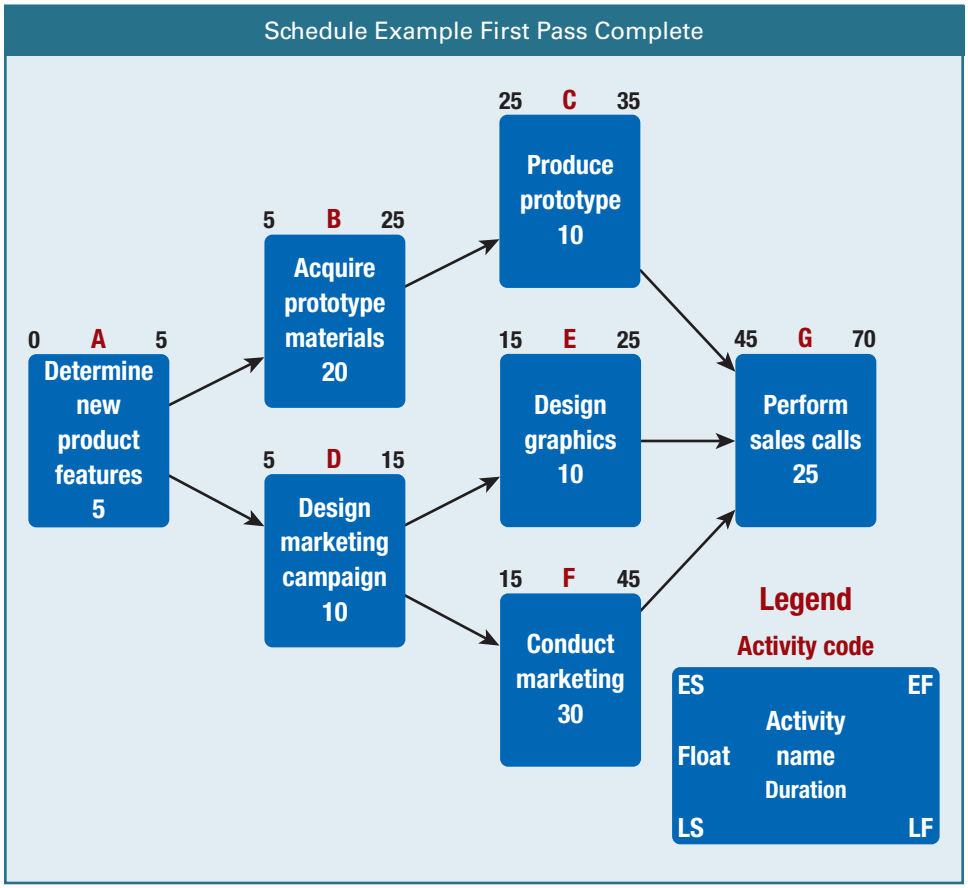
Exhibit 8.11



(The zero for the first activity means it can start after zero days—meaning at the beginning of the first day.) Each activity that is a successor can start as soon as its predecessor activity is complete. Therefore, the next two activities can each start after five days. (That means at the start of the sixth day.) To calculate the early finish for each of these activities, add its duration to the early start of five, for early completion times of twenty-five and fifteen, respectively. The difficult part of calculating the first pass comes when an activity has more than one predecessor. For example, "Perform sales calls" cannot begin until *all three preceding activities* ("Produce prototypes," "Design graphics," and "Conduct marketing") are complete. Therefore, its early start is forty-five. This is true even though "Produce prototypes" and "Design graphics" have earlier finish times, because "Conduct marketing" cannot be completed until day forty-five. The later time is always taken. The results of the first pass are shown in Exhibit 8.12. Note that the earliest the entire project can be completed is seventy workdays.

Second or Backward Pass The second pass is sometimes called the **backward pass**. The backward pass is "a critical path technique for calculating the late start and late finish dates by working backward through the schedule model from the project end date."[18] When performing the backward pass, teams start at the end and work

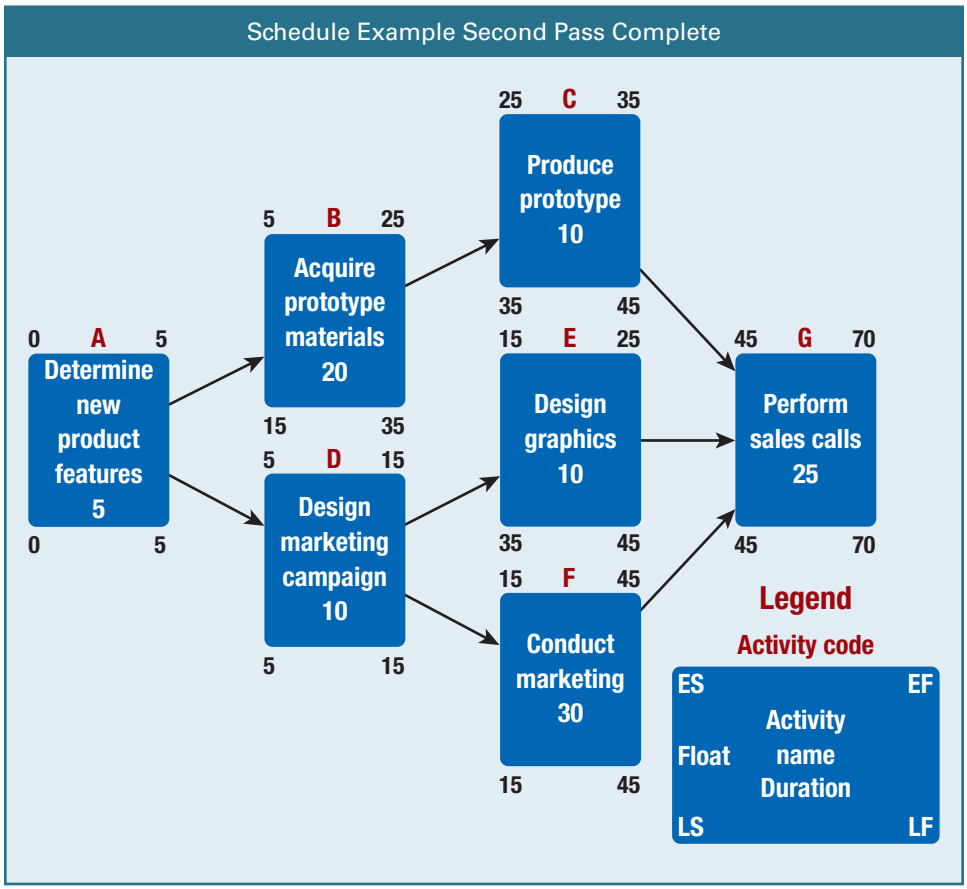
Exhibit 8.12



backward, asking, "How late can each activity be finished and started?" Unless there is an imposed date, the late finish for the last activity during planning is the same as the early finish date. In our example, we know the earliest we can finish the entire project is seventy days, so we will use that as the late finish date for the last activity. If the activity "Perform sales calls" must end no later than seventy and it takes twenty-five days, then it must start no later than day forty-five. In other words, calculate the late start by subtracting the duration from the late finish (**LF – duration = LS**). The confusing part of calculating the second pass is when there is more than one successor. In Exhibit 8.13, one place this occurs is at the first activity, "Determine new product features," since two activities are immediate successors. Enough time must be left for all of the successors, so whichever one must start soonest dictates the late finish date of the predecessor. In this example, "Design marketing campaign" must start no later than after day 5; therefore, five days is the late finish for the first activity.

Float and the Critical Path Once both passes are complete, the early and late start dates for every activity and the amount of time the entire project will take to complete are known. However, the team also wants to know the critical path. This is calculated easily by first determining each activity's float (sometimes float is called slack). Float

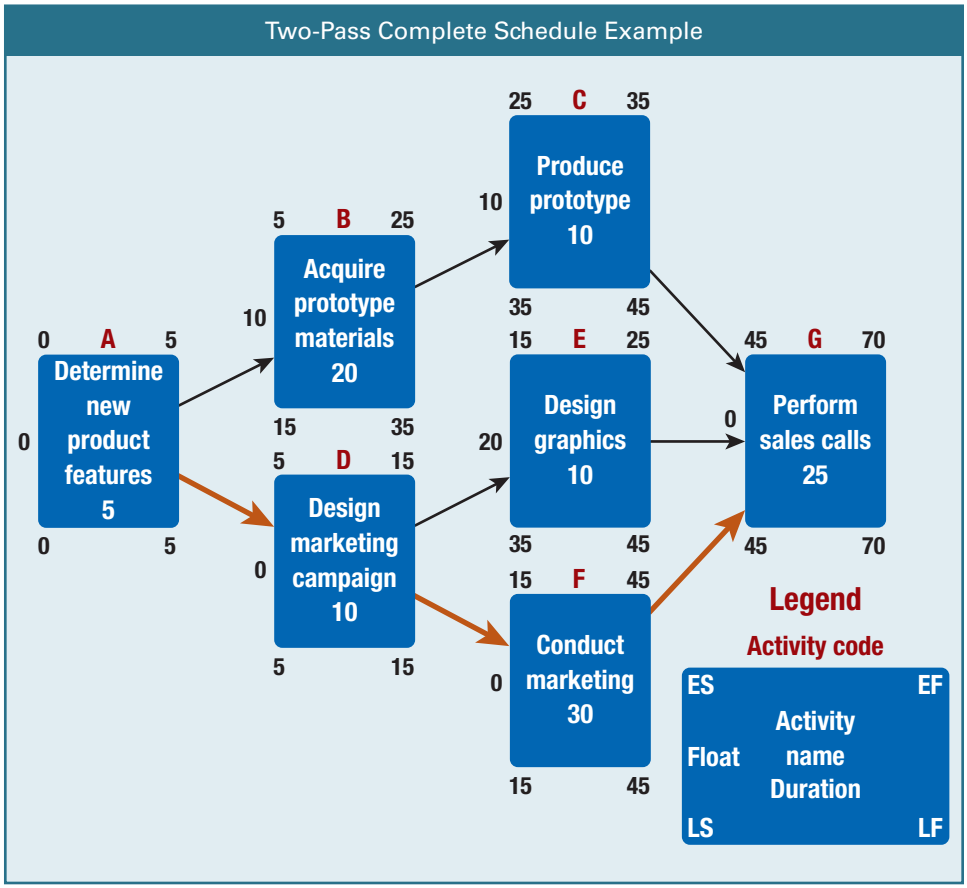
Exhibit 8.13



can be **total float**, which is "the amount of time a schedule activity can be delayed from its early start date without delaying the project end date or violating a schedule constraint"[19] or **free float**, which is "the amount of time a schedule activity can be delayed without delaying the early start of any successor or violating a schedule constraint."[20] A project manager wants to know how much float each activity has to determine where to spend her time and attention. Activities with a larger float can be scheduled flexibly without much concern. Activities with no float or very little float, on the other hand, need to be scheduled and managed very carefully.

Float is calculated by the equation Float = Late start-Early start (Float = LS – ES). The critical path is the sequence of activities from start to finish in the network that have no float. In Exhibit 8.14, activities A, D, F, and G have no float and, therefore, create the critical path. It is typical to mark the critical path in red and/or in boldface to call attention to it. Activities B, C, and E each have float so they are not on the critical path. If activity B is delayed, it will delay the start of activity C; therefore, activity B has total float. While activity B can be delayed up to ten days without delaying the entire project, any delay to activity B would delay the start of activity C. On the other hand, activities C and E can be delayed by ten and twenty days, respectively, without causing any other activity to be delayed. Therefore, their float is free float—impacting neither the overall project nor any activity in it.

Exhibit 8.14



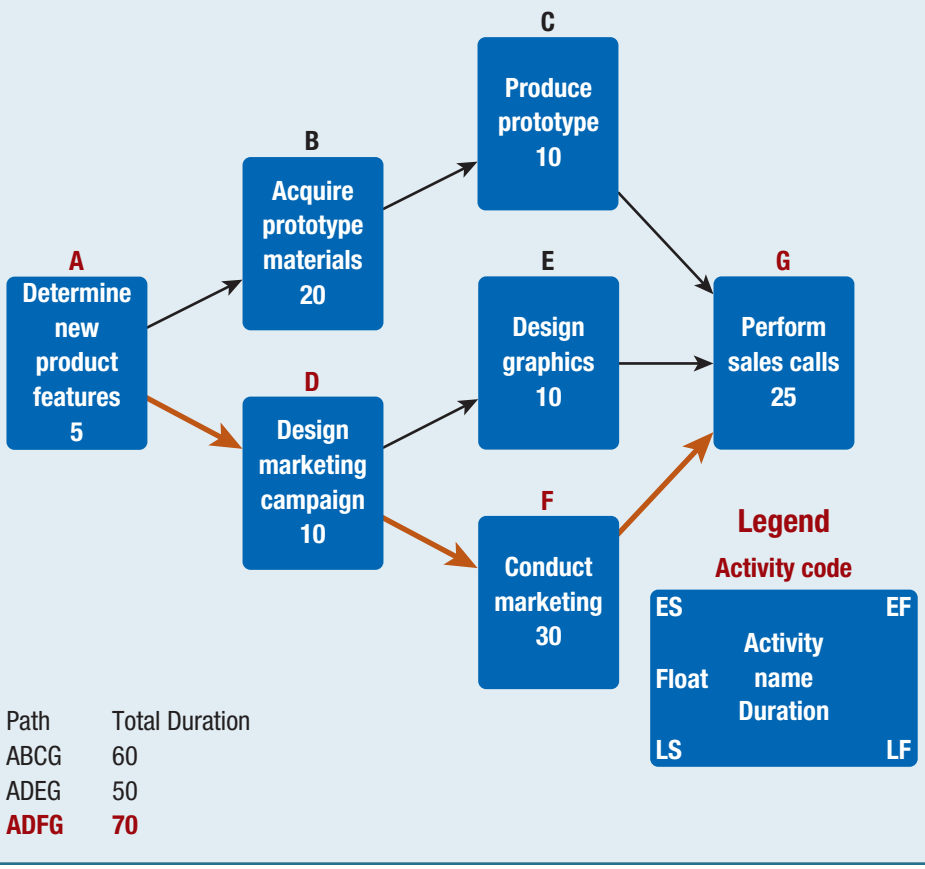
Project managers can sometimes "borrow" resources from an activity with plenty of floats to use first on an activity that is either already critical or nearly critical. However, project managers carefully monitor the critical path activities. They also closely watch activities with little float—think of these as "near-critical" activities. A project with many activities that have little float is not very stable. Even small delays on near-critical activities can change the critical path. Chapter 9 discusses resource scheduling in detail.

8.8b Enumeration Method

The second method of determining the critical path is the enumeration method. To complete this, we list or enumerate all of the paths through the network. The advantage of this method is that since all of the paths are identified and timed if a team needs to compress the project schedule, they will know both the critical path and the other paths that may be nearly critical (or those with very little float). It is imperative to keep track of both critical and near-critical paths when compressing a schedule. In Exhibit 8.15, three paths are identified, and the total duration for each is calculated. ADFG is the critical path, with an expected duration of seventy days, just as was determined with the two-pass method. Now, however, we also know that path ABCG is expected to take sixty days (ten fewer than the critical path), and path ADEG is expected to take fifty days (twenty fewer than the critical path).

Exhibit 8.15

Enumeration Method Example Schedule



8.9 Uncertainty in Project Schedules

On some projects, it is easy to estimate durations of activities with confidence. On others, many uncertainties exist and managers will have far less confidence in their ability to estimate the duration accurately. Nevertheless, project managers must predict the total duration of the project to sponsors and clients and then be held accountable for meeting the schedule target. One common strategy for addressing this challenge is to construct the best schedule possible and then manage the project very closely. A different strategy is to estimate a range of possible times each individual activity may take and then see what impact that has on the entire schedule. PERT and Monte Carlo are two methods used for this strategy.

8.9a Program Evaluation and Review Technique

Program evaluation and review technique (PERT) was developed during the 1950s to better understand how variations of individual activity durations impact the entire project schedule. A project team starts using PERT by sequencing the activities into a network, as described in Section 8.6 earlier in this chapter. However, instead of creating a one-time estimate to complete each activity, three estimates are used to address uncertainty: optimistic,

most likely, and pessimistic. For example, the first activity, "Determine new product features," will most likely take five days, but it could take as little as four days if everything works well (optimistic) and as long as twelve days (pessimistic) if a variety of things interfere. The person scheduling the project then calculates the estimated time to perform each activity as shown in Exhibit 8.16 using the following equation:

$$\text{Estimated time} = \frac{\text{Optimistic} + 4(\text{Most likely}) + \text{Pessimistic}}{6}$$

$$\text{Therefore, for the first activity the estimated time} = \frac{4 + 4(5) + 12}{6} = 6$$

The primary advantage of PERT is that it helps everyone realize how much uncertainty exists in the project schedule. When people use single-time estimates, they tend to believe that the estimates foretell exactly what will happen. However, a great deal of uncertainty exists on many projects, and PERT helps to make it apparent. Additionally, calculations often show that the expected time is actually longer than the most likely time. If things go as planned, only a little time can be saved but if many things go terribly wrong, a great deal of time can be lost in completing an activity.

However, using PERT involves challenges. First, it is often hard enough to create *one* estimate of how long an activity will take, so it takes even more effort (and therefore money) to create *three* estimates. Second, there is no guarantee of how good any of the three estimates can be. In other words, it is not necessarily the case that a three-point estimate would be more accurate than a single duration estimate. Third, PERT can underestimate the risk of a schedule running long because it does not accurately address when two or more activities need to be completed before a third one can begin.[21]

PERT is useful for project managers as it attempts to eliminate uncertainty in activity duration and the total duration of a project. However, it presents a few problems as discussed

Exhibit 8.16

PERT Time Estimate Example

Activity	Optimistic	Most Likely	Pessimistic	Expected
Determine new product features	4	5	12	6
Acquire prototype materials	16	20	30	21
Produce prototype	8	10	12	10
Design marketing campaign	9	10	14	10.5
Design graphics	6	10	20	11
Conduct marketing	28	30	50	33
Perform sales calls	20	25	30	25

above, and few project managers use it to calculate and monitor project schedules. Some project managers informally use three-time estimates for a few key activities on the critical path to get a sense of the amount of uncertainty and to better understand the activities that demand close monitoring. Other project managers who prefer to understand the potential variations use Monte Carlo simulation. Project management students and professionals need to be aware that both PERT and Monte Carlo simulations are used to help understand uncertainty in project schedules.

8.9b Monte Carlo Simulation

Monte Carlo simulation is "a computerized mathematical technique that allows people to account for risk in quantitative analysis and decision making."[22] Monte Carlo simulation presents a range of possible outcomes with associated probabilities to make decisions. Monte Carlo is more flexible than PERT as an entire range of possible time estimates can be used for any activity or the project itself. The project schedule is calculated many times (perhaps a thousand or more), and each time, the estimate for a particular activity is generated based upon the likelihood of that time as determined by the project manager. For example, a specific activity duration has a 10% chance of five days, a 30% chance of six days, a 40% chance of seven days, and the remaining 20% chance of eight days. Then, for every one hundred times the computer generates a project schedule, ten times it would choose five days for that activity, thirty times it would choose six days, forty times it would choose seven days, and twenty times it would choose eight days. The simulation output would include distribution of how often the project would be expected to take each possible length of time. Many other possible outputs can also be generated from Monte Carlo simulations.

Monte Carlo analysis provides flexibility and allows more realistic estimates. Also, it can provide more information regarding individual activities, the overall project, and different paths through the project that may become critical.

A minor disadvantage of Monte Carlo simulation is the amount of time necessary to estimate not just a most likely duration for each activity, but an entire range of possible outcomes. Further, it requires an understanding of software and statistical analysis to effectively use Monte Carlo. This disadvantage is not as large as it once was because more software features are available and most students are learning the fundamentals of simulation in other courses such as statistics or operations.

A project manager will have to decide when some of the more specialized techniques are worth the extra effort. The old saying that a person should "spend $100 to save $1,000, but should not spend $1,000 to save $100" applies. If the savings on a project from using techniques such as learning curves, PERT, or Monte Carlo are significant, project managers should consider using one of them. If not, they should create the best possible estimates without the specialized techniques, incorporate risk management by carefully identifying and planning for specific risks as discussed in Chapter 11, and manage the project schedule very carefully as discussed in Chapter 14.

These specialized techniques are sometimes used in research and development (R&D) projects. Exhibit 8.17 shows an actual R&D project schedule used by D. D. Williamson of Louisville, Kentucky when a Chinese customer asked it to develop a new product somewhat different from any it had previously developed. Once D. D. Williamson decided to take the job, it developed and communicated the project schedule to all stakeholders both in its company and the customer's company within the first week.

Exhibit 8.17

New Product Development Schedule in China Example

Week one—Request is received from the customer for a product that is darker than anything we have in our current offering. Our sales manager forwards the request to our VP of Sales and our R&D department. A quick review of the potential price versus the cost of materials is completed by the VP of Sales (with finance input), and the product is deemed saleable at an acceptable margin.

Week two—A trial cook in our "baby cooker" is conducted by our R&D department. Within two attempts, a product that is within the customer-requested specs is produced. An additional trial is conducted to quickly check repeatability. The trial product is express shipped to the customer and our China facility for comparison purposes.

Week three—The formulation and related instructions for cooking are communicated to our China operations with a "red sheet" process. China has anticipated the receipt of this red sheet and can schedule time in production within a week.

Week four—The initial red sheet production is successful and passes the specification tests in China and Louisville.

Week five—Customer confirms purchase order and the first shipment is sent. The product contributes significantly to the revenues and profitability of the China facility. Success!

Key factors—Strong communication between all the players and a clear understanding of the customer expectations upfront.

Source: Elaine Gravatte, D. D. Williamson.

Australian researchers have discovered that two primary causes of late delivery of IT projects are variance in time to complete individual work activities and multiple dependencies for some activities. Suggestions for overcoming these two problems are shown in Exhibit 8.18.

Exhibit 8.18

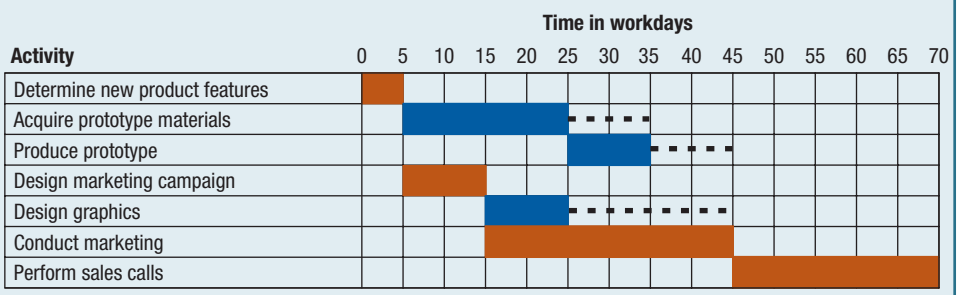
Initiatives to Improve On-Time Schedule Delivery

Cause of Late Delivery	Initiative	Explanation
Activity variance	Increase activity transparency	Allows for better planning
	Increase user participation	Ensures that the product delivered meets the users' needs
	Reduce project size	Ensures that estimates for tasks are more accurate
	Manage expectations, e.g., set realistic goals by drawing from "outside views"	Mitigates optimism bias and misrepresentation
	Use packaged software	Provides a standard within which to develop the system
Activity dependence	De-scope	Reduces the number of dependencies
	Improve requirements definition	Ensures that there is no confusion over what is to be developed and when
	Reduce activity coupling	If activity links are reduced, then dependencies exert less influence
	Stage projects (incremental development or iterative development)	Reduces delay bias by minimizing multitasking, merging, queuing (i.e., reduces the dependencies)

Source: Vlasic, Anthony and Li Liu, "Why Information Systems Projects Are Always Late," *Proceedings Project Management Institute Research and Education Conference 2010* (Oxon Hill, MD, July 2010).

Exhibit 8.19

Gantt Chart Example



8.10 Show the Project Schedule on a Gantt Chart

The discussion in this chapter so far has been how to determine the project schedule. While this is necessary, a network diagram can be confusing. A tool for communicating a project schedule that is simple and much easier to understand is a Gantt or bar chart. A **Gantt chart** is a horizontal bar chart that shows each work activity on a separate line with the bar placed from the early start date to the early finish date from left to right for each activity on a timescale. It is not uncommon to use a Gantt chart for small projects.

The simplest Gantt charts show a bar for each activity stretched out over a timeline. Many stakeholders also want to see which activities are critical and the amount of float for non-critical activities. Therefore, critical activities are normally shown in red or boldface, non-critical activities are normally shown in blue or normal face, and the amount of float is shown in a muted, thin, or dashed line out to the late finish of each non-critical activity. The units of time are the units the project team used in creating the schedule, be it hours, days, weeks, or any other unit of measure that makes it practical. A Gantt chart is shown in Exhibit 8.19. It is easy to understand when each activity should be performed. However, the basic Gantt chart does not show other useful information such as predecessor–successor relationships, late start dates, and so forth. These can all be easily displayed on a Gantt chart that is developed using scheduling software such as Microsoft Project. The instructions for using MS Project to create and print Gantt charts are covered in section 8.13.

8.11 *PMBOK Guide 7e*

- Team
- Development Approach
- Planning
- Delivery
- Measurement
- Uncertainty

8.11a Team

A project schedule is developed with a collaborative effort from the project team. Individual team members possess knowledge about resources, time required to complete a task,

and the task's interdependencies with other tasks. Every member of the project team must work with other team members in deciding resource allocation, sequencing tasks, and optimizing the project duration. Experience and knowledge about similar projects executed in the past are of immense help. A servant leadership style facilitates the development of a more realistic schedule, and teams must be allowed to self-manage for this purpose.

8.11b Development Approach

Developing a project schedule differs significantly based on the project type, resource availability, and uncertainties associated with requirements and resources. In the predictive approach, scope can be defined with less ambiguity at the start of the project, so a comprehensive and accurate schedule development is feasible through the use of detailed scope planning and WBS creation. In turn, the WBS would also help in determining resources required and costs associated with each activity. However, when uncertainty and risks are associated with defining requirements or volatility exists in requirements, an adaptive (incremental or iterative) development approach is preferred. In this case, the schedule is planned and limited to a single sprint, which attempts to meet one requirement at a time; the team and all available resources will be dedicated to this sprint to minimize further uncertainty and waste.

8.11c Planning

Deliverables influence schedule, so a predictive planning approach that creates a WBS broken down to the lowest level deliverables could be relatively comprehensive and complete. In adaptive methods, high-level themes or epics are used to develop features that are further decomposed into stories and backlog items. A schedule is developed for each story, one at a time, to reduce waste and eliminate uncertainty. An adaptive approach uses incremental planning and often uses timeboxes for scheduling. Work in each time box is based on a prioritized backlog.

8.11d Delivery

The WBS is used in a predictive plan approaching to develop a comprehensive schedule, so a realistic timeline for project deliverables can be developed. However, while using an adaptive approach wherein a full-blown schedule is not opted for, a checklist of all the criteria required to be met is developed so that a deliverable can be considered ready for customer use or "definition of done" is fulfilled. In this case, requirements are associated with uncertainty. So themes are translated into epics and then features, and each feature will have multiple user stories. A story is a clear and concise representation of a requirement written from the end user's perspective, and a schedule is developed only at the story level.

8.11e Measurement

A project schedule includes milestones along with a timeline and success criteria for project deliverables in a predictive approach. This schedule and timeline are used to measure progress. However, in an adaptive approach, we follow a different measurement of work progress based on a schedule developed for a story and a measurement of promised business value. In this approach, schedules prepared for a sprint are used for the measurement of progress.

8.11f Uncertainty

An effective schedule is not always possible when uncertainty exists in defining requirements. Ambiguity, volatility, complexity, and risk are some of the factors associated with requirements that may compel the project team to employ an adaptive approach of developing a schedule one story or sprint at a time.

8.12 Schedules for Agile Projects

In Agile projects, schedules are created using the product backlog. The overall project schedule may be developed only at a high level. The sequencing in Agile projects is performed at a high level for the entire project or the product release (often three to six months). Then for each iteration, the team develops the sequence of detailed activities to be completed.

As compared to a plan-driven project management approach, an Agile project schedule is set up based on the expectations of the product owner (refer Exhibit 8.20). Since neither owner nor project team has a clear understanding of scope, it is usually impossible to commit to a final schedule at the project outset. Rather, both parties understand that the schedule is largely driven by the size and experience of the project team.

As stated in the previous (scope) chapter, scope is defined as user stories (what each user wants) and those are prioritized by the Product Owner. Those stories then are sized by the project team who commits to the amount of work they can accomplish in the upcoming iteration.

Stories are usually sized by the team collectively estimating the number of story points required to build each story. A **story point** is not an estimate or number of work hours,

Exhibit 8.20

Comparison of Plan-Driven and Agile Approaches for Scheduling Projects

Scheduling Topics	Plan-Driven	Agile
What are the purposes of a project schedule?	Agree on end date and establish governance	Set expectations
What primarily limits schedules?	Logical order and individual activity duration	Resources assigned
How are activities defined?	Output of WBS	Output of user stories
How are activities sequenced?	Dependencies with leads and lags	Prioritized by Product Owner, committed by team
How are durations estimated?	Team and project manager work on details	Team supported by scrum master use planning poker
How are schedules developed?	Critical path method	Team commits one iteration at a time
How are schedule uncertainties handled?	PERT or simulation	Prove viability early by prioritizing high-risk work
How are schedules communicated?	Gantt charts and MS Project	Kanban boards and sticky notes

8.12a Agile Terms

Story point	Estimate by team of complexity and size of specific work in story form
Planning poker	Method for team to size-specific stories quickly and relatively
Right-sized	Ensuring stories are small, understood, and testable
Definition of ready	Agreement that team understands a story enough to bring into a sprint
Risk-based spike	Short time-boxed work to address a specific risk
Kanban board	Visible information register that communicates work status as to do, in progress, or done
Task card	Sticky note or index card showing work item name and other info
3C process	Task card with conversations and confirmation of understanding

In this book, we use many Agile terms and definitions from Anantatmula, V., and T. Kloppenborg, *Be Agile Do Agile* (New York, NY: Business Expert Press: 2021).[23]

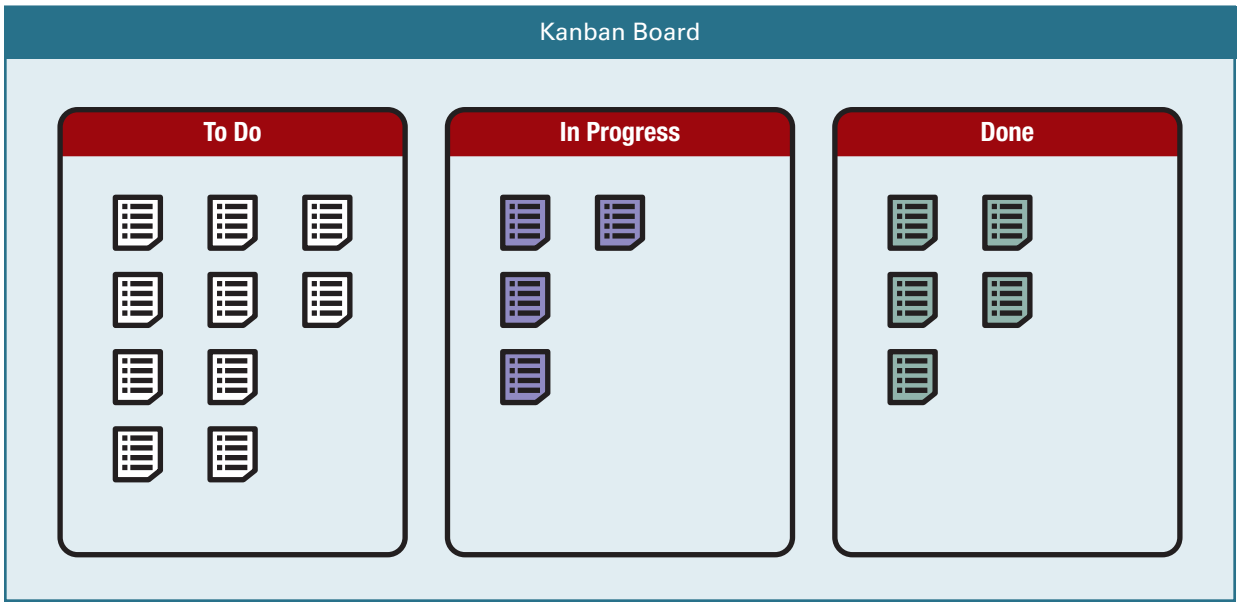
but a comparison of how the work required compares with the work that was expended on previous stories. This size and complexity consideration the team goes through helps the members estimate how much work they can accomplish in the iteration.

Team members often use **planning poker** to help them estimate. Each team member has a series of cards with different numbers on them. After a brief discussion of a story, at the same time, each team member shows the card with the number of story points they think it is worth. If most of the team estimate similarly, that is the number assigned. If there is a large difference (perhaps one member showed a one while another showed an eight), then the people with the high and low estimates are asked for their thoughts. Often, one team member knows or suspects something others do not know. After discussion, the team votes again. This process yields both better understanding and consensus. The stories agreed upon in this manner are described as being **right-sized**—small enough to be understood, completed in a single iteration, and testable. These stories also meet the **definition of ready**—the team understands them well enough to begin working on them.

Duration estimates improve with each iteration and as early iterations are completed. Armed with more specific knowledge of how long certain activities take, later iterations can be estimated more accurately.

As opposed to plan-driven projects where the schedule is largely driven by the logical order of activities, on Agile projects the schedule is set by how much work the team can accomplish in each iteration. On plan-driven projects when there is a high risk, teams may use PERT or simulation to model the uncertainty or aggressively manage the estimated

Exhibit 8.21



schedule. On Agile projects, when there is significant risk, the Product Owner often first has the team work exclusively on the high-risk item. This is called a **risk-based spike** and the idea is to either prove that an approach will work so the team can continue on that path or to determine an approach will not work and have the team pivot to something else.

Schedules on Agile projects are communicated as transparently as possible, often using **Kanban boards** to display the work that is in the backlog (to do), the work that is currently in process, and the completed work. Each item of work is a user story and is shown in savage summary form on a task card. The **task card** is the first part of the **3C process**, which is briefly stating the work to be done, holding a conversation about it, and then committing to understanding it. Any team member can update the Kanban board by moving or modifying a card. All team members feel responsible for the entire project schedule, not merely the portion they perform. An example of a Kanban board is shown in Exhibit 8.21.

8.13 Using Microsoft Project for Critical Path Schedules

As you begin to work with schedules, remember there are five major elements affecting project completion: logical order (or sequence) of project tasks, duration of each task, the number of resources available when needed to complete those tasks, imposed dates, and cash flow. When building schedules in MS Project, you will find it helpful to keep these limitations in order. In the following tutorial, we will determine the sequence of tasks before coming up with durations for them. Since the bottom line for many stakeholders is often "How long is this going to take and how much will it cost me?" you may find more success if you allow decision-makers to focus on determining the sequencing order of tasks *first*, rather than how long each activity will take.

Keep in mind that we are continuing with the Suburban Parks Home project from the tutorial in Chapter 7 (if you have not completed that tutorial, this one will not make much sense). First, we will inspect the project calendar to make any adjustments necessary. Next, the steps to develop the network diagram will be explained. Finally, the critical path will be discussed as well as how to view and manage the developing schedule.

8-13a Set Up the Project Schedule

Setting up the project schedule begins with ensuring the correct start date for the project is set, and then defining your organization's working days, hours, and holidays.

Set (Or Update) the Project Start Date In the Chapter 3 tutorial, we set the start date for the project. Often, that time can change once planning begins and needs to be updated. To do that:

1. Click **Project Tab>>Project Information**.
2. Set the start date to **12/4/21**.
3. Click **OK**.

Define Your Organization's Working and Non-working Times MS Project's calendar system defines working and non-working time. The calendar system consists of a default **project calendar** and a **resource calendar** for each resource. The project calendar refers to what you think of as a normal calendar: the working and non-working dates for a project, including holidays. The resource calendar pertains to the resources of a project—that is, the *people*, *equipment*, *space*, or *materials* used in a project. In this tutorial, we are focused on the project calendar (the resource calendar will be addressed in a future tutorial).

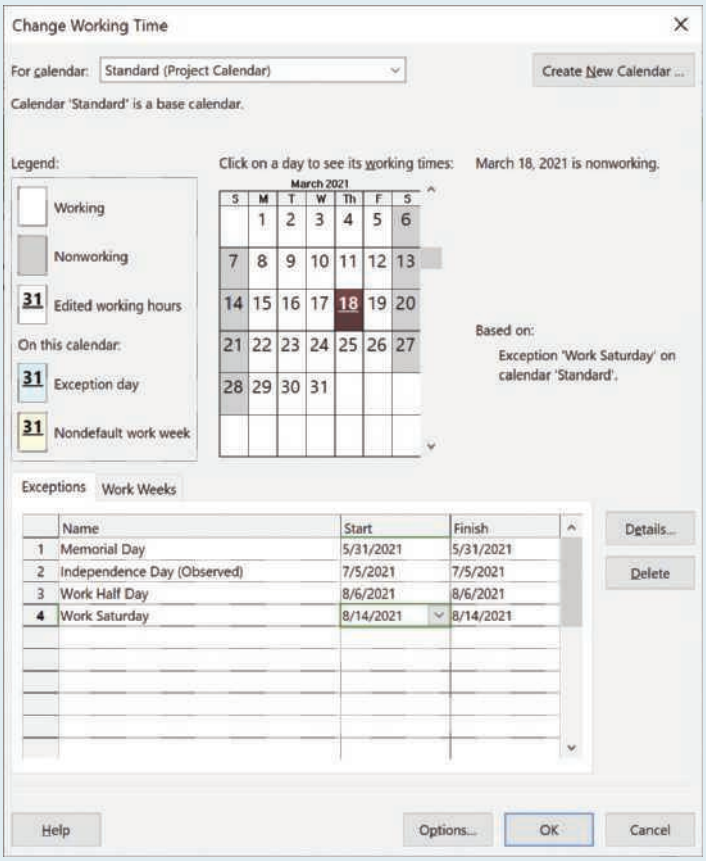
To avoid unrealistic project schedules, you must ensure your organization's working and non-working times are defined in the project calendar (as well as resource vacations in resource calendars). The default project calendar has all days, except Saturday and Sunday, defined as eight-hour working days. The working hours during the day are 8:00 to 12:00 and 1:00 to 5:00. By default, **no holidays are defined** and must be defined as non-working days. All project calendar content is copied into all resource calendars. Resource calendars are used to block out vacation days and other *resource-specific* non-working days. Resource calendars are then used to determine when a resource assignment can be scheduled. If there are no resource assignments, the project calendar is used to determine scheduling.

Use the following steps to change a working day to non-working in the Suburban Parks Home project, as shown in Exhibit 8.22. The legend explains the different shadings on the calendar days. To open the project calendar:

1. Click **Project Tab>>Change Working Time**.
2. Make sure "**Standard (Project Calendar)**" is selected in the "For calendar:" box.
3. Use the scroll bar to the right of the calendar to find the date you want to edit.
4. Click on the date you want to edit.
5. Click the **Exceptions Tab** in the table below the calendar, then click an empty row.
6. Enter a description for the non-working day in the Name column.
7. Click another cell in the same row (or **Tab**) to review the results.
8. Repeat these steps until all non-working days are defined as in Exhibit 8.20.
   a. You can also type your non-working days into the table and set the Start and Finish dates without clicking on them in the calendar.
9. Deleting a row restores the default working hours for that day.
10. Click **OK** to close the project calendar options.

Exhibit 8.22

Standard Calendar with Two Holidays Plus a Half Day and a Working Saturday



Source: Microsoft Corporation.

To change the working time for a day, as shown in Exhibit 8.23:

1. Select the day and enter a description in the table below the calendar.
2. Click the **Tab** key to fill in the Start and Finish dates.
3. Click Details...
4. Choose the "**Working Time"** radio button and modify the "**From:**" and "**To:**" values in the table.
5. To eliminate one set of work times (such as afternoon), select those times and click the delete key so only morning times are working.
6. Click **OK** twice.

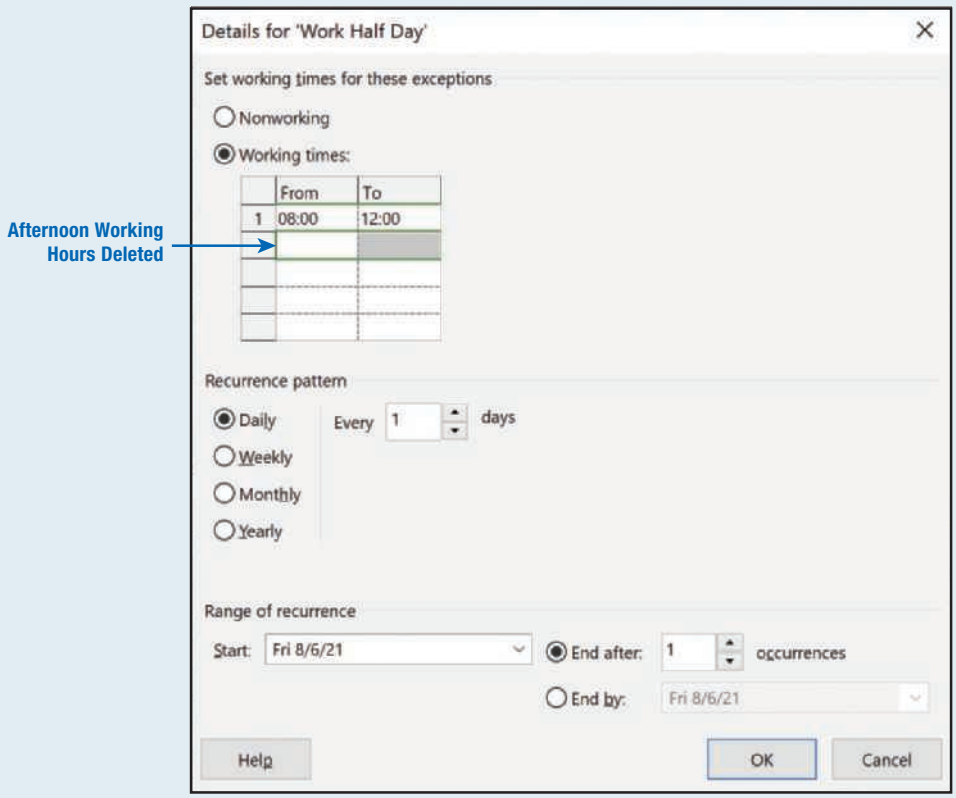
8.13b Build the Network Diagram and Identify the Critical Path

We will now begin to build the network diagram for the Suburban Parks Home project. The steps to create a network diagram in MS Project are as follows:

1. Enter tasks and milestones.
2. Edit the timescale.
3. Understand and define task dependencies.

Exhibit 8.23

Details Dialog for Half Working Day



Source: Microsoft Corporation.

4. Assign task duration estimates.
5. Identify the critical path.
6. Understand the network diagram view.

Step 1: Enter Tasks and Milestones In the Chapter 7 tutorial, the Gantt chart's table was populated with project tasks and used the milestones from the Suburban Parks Home project as WBS deliverables (summary tasks). We will now add two milestone tasks so they will show graphically (as a diamond) on the Gantt chart.

To add a milestone task, do the following:

1. Click on the intermediate summary task "Foundation Work" (WBS ID 2.4) to select it.
2. Click **Task Tab>>Insert Group>>Milestone**.
3. You will see a new milestone added to the task list; name it "**Construction Begins**".
4. Tab over to the **Start** date column, and type in the date **1/10/18.**
   a. Note since a milestone typically has zero days of duration, MS Project automatically populates the **Finish** column with the same date.
5. On the Gantt chart's right side, you should see a diamond appear along with a date.
6. Repeat this step for the summary task "County clearance" (WBS ID 5) and type "**Construction Complete**".

7. To show the name of the milestone (instead of the date) on the Gantt chart's graphical side, do the following:
   a. **Format Tab>>Format>>Bar Styles**
   b. Select **Milestone** from the list; click the **Text Tab**.
   c. In the "**Right**" field of the table, change to **Name**.
   d. Click **OK**.
   e. The milestone name should replace the date on the right side.

Step 2: Edit the Timescale Along the top of the right side of the Gantt chart is the timescale. This is different from the Timeline v*iew*. If the Timeline view is showing above your entire Gantt chart, you can hide it by clicking **View Tab>>Split View Group>>Uncheck Timeline**.

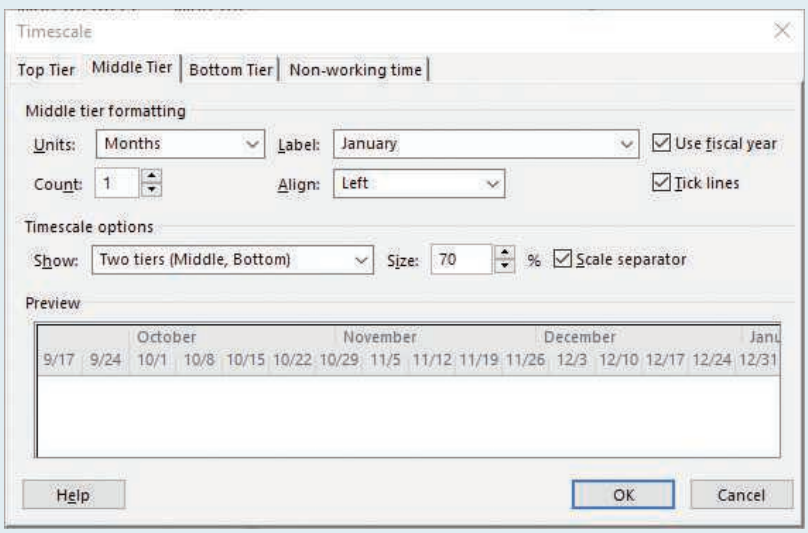
The default view of the timescale is likely set to show the Year and Quarter in a "two-tier" layout. For our project, we want to show Months and Weeks. To change the timescale:

1. **Right-Click** the time scale>>**Timescale…**
2. Click the **Middle Tier Tab**.
3. Change Units to **Months**; Label to **January**; set Count to **1**; set Size to **55**.
   a. Note: Size sets the space between each tick mark on the timescale for that item.
4. Click the **Bottom Tier Tab**.
5. Change Units to **Weeks**; Label to **1/25, 2/1, …**; set Count to **1**; set Size to **55**.
6. Click **OK**.
7. Your timescale should now resemble the one in the Preview window of Exhibit 8.24.

Step 3: Understand and Define Task Dependencies As related earlier in this chapter, a task dependency definition includes both a logical link type (finish-to-start, start-to-start, finish-to-finish, or start-to-finish) and any associated lead or lag value. The default link type

Exhibit 8.24

Gantt Chart View with WBS Elements, Tasks, and Milestones



Source: Microsoft Corporation.

in MS Project is finish-to-start. The default lead or lag value is zero days. Task dependencies may be established and viewed graphically in the Network Diagram view and several different Gantt views.

For the Suburban Parks Home project example, determining dependencies and sequencing is fairly straightforward. Most deliverables in this example must be completed before the next one can be started. Subtasks of each deliverable likely need some sequencing, and it is helpful to think about what tasks could be done in parallel or where there could be overlap. Sequencing decisions are usually made with the input of the project manager, the sponsor, and other key project stakeholders. Projects of any real size are rarely as straightforward as this example.

Before defining dependencies, ensure the "Start," "Finish," and "Predecessors" columns are visible. You can show more columns on the Gantt chart to the right of the "Duration" column by sliding the view divider to the right. The "Predecessors" column shows the Task ID number (not the WBS code) for predecessor tasks.

Dependencies can be defined using the following steps:

1. Click on the **Task Name** field to select the predecessor task row.
2. Press and hold **Ctrl** while selecting the successor task.
3. Release **Ctrl** after you click your selection.
4. Click the **Task Tab>>Schedule Group>>Link Tasks** (chain icon).

a. Delete a dependency definition by again selecting both tasks and then clicking on **Unlink Tasks** (broken chain icon).

5. Adding (or deleting) Task ID numbers in the "Predecessor" column is another way you can define task dependencies.

A series of dependencies can also be defined or deleted similarly:

1. Select all of the tasks to be linked in a series.
   a. Click and drag with the mouse or **Shift-Click** the first and last task in the series.
2. Click the **Task Tab>>Schedule Group>> Link Tasks or Unlink Tasks**.

As you start defining task dependencies, you will notice the durations and the start/finish dates change as MS Project begins to build the schedule. The right side of the Gantt chart also begins to take shape. Task relationship arrows show finish-to-start links. Using the **Predecessors** column as a guide, update your task dependencies to match those in Exhibit 8.25.

Step 4: Assign Task Duration Estimates Once the logical sequence of project tasks is established, it is time to assign duration estimates to those tasks so the critical path can be identified and the actual working schedule can be determined. This is accomplished by first assigning duration estimates and then by instructing MS Project to identify the critical path.

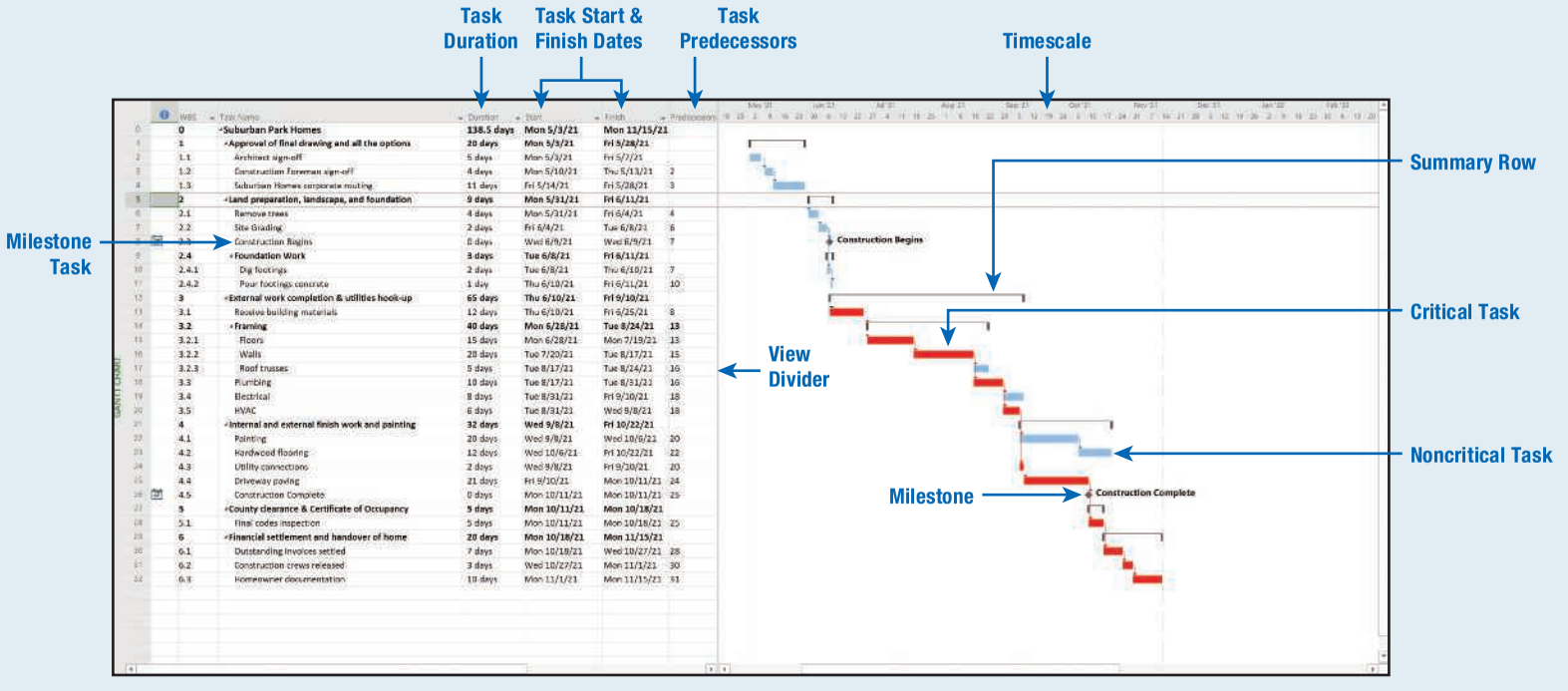
The first principle to keep in mind is to ***use the same unit of time for each task***. Mixing up hours, days, or weeks will create confusion. The default time unit is days, so this tutorial uses days. The second principle is to ***only assign duration estimates to subtasks, not their summaries***. MS Project calculates the duration for WBS summaries based on the durations selected for the tasks that comprise each summary.

To assign duration to a task:

1. Click the **Duration** cell of the task and enter the duration value.
   a. If days are being used, an adjustment can be made up or down with the arrows.
   b. A number can also be deleted and then another number typed in the cell.
2. MS Project will automatically determine the duration for each summary task as you adjust subtask durations.
3. Assign durations to your project using Exhibit 8.25 as a guide.

Exhibit 8.25

Partial Network Diagram



Source: Microsoft Corporation.

Step 5: Identify the Critical Path In most graphical task views, MS Project can mark Gantt bars of critical path tasks and network diagram task nodes in red. Unfortunately, this is not the default behavior. To enable this visual cue, do the following:

1. Click the **Task Tab>>Format Tab>>Bar Styles Group>>**check **Critical Tasks**.
2. You should now see all your critical tasks shown in red (as in Exhibit 8.25).

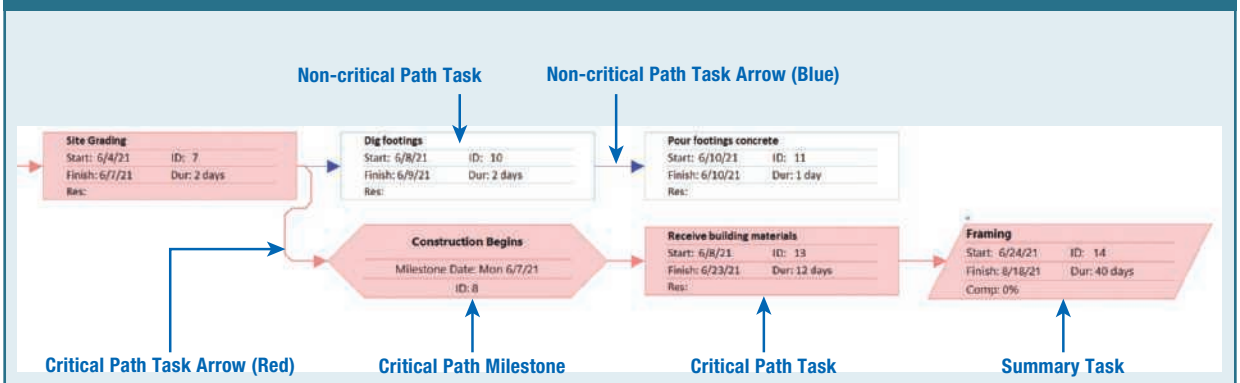
Step 6: Understand the Network Diagram View The Network Diagram view shows all tasks, summary tasks, and milestones as shown in Exhibit 8.26. The network diagram can be used to verify the logical flow of the project, find tasks with no predecessor or successor, spot opportunities to complete tasks in parallel or overlap, and see the critical path across the project. Again, the Suburban Parks Home project is a straightforward example, so the network diagram is not as useful as it could be in more complex projects.

Although they can be printed, network diagrams in MS Project are best viewed on the computer as they can become quite large. Printing the entire diagram usefully requires piecing multiple sheets of paper or a large-format printer. Network diagrams in MS Project can be unwieldy and difficult to work with, but there are a few ways to make them slightly more user-friendly:

1. Click the **View Tab>>Task Views Group>>Network Diagram**.
   a. The network diagram appears.
   b. Logical links between tasks can be seen as link lines in blue (non-critical path) and red (critical path).
2. Zoom the view out using the zoom slider at the bottom right of the screen (or **Ctrl-Scroll**).
3. Click the **Format Tab>>**uncheck **Summary Tasks**.
4. Click the **Format Tab>>Format Group>>Layout>>**uncheck "**Show page breaks**" and check "**Hide all fields except ID**" (tasks are denoted by Task ID).
5. Click **OK**.
6. Zoom in to see the simplified network diagram as in Exhibit 8.27.

Exhibit 8.26

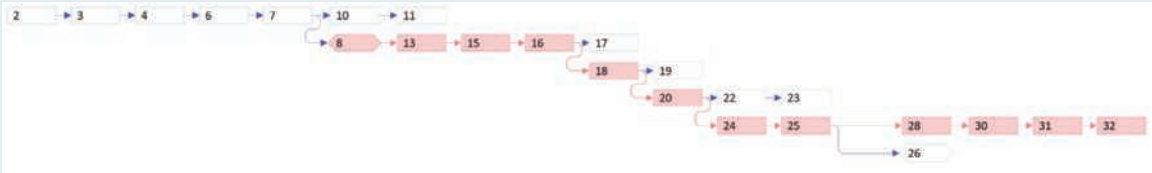
Bank Project with Startup and Initiation Details



Source: Microsoft Corporation.

Exhibit 8.27

Bank Project with Executing and Closing Activities



Source: Microsoft Corporation.

Summary

Project schedules for plan-driven projects are created by listing all of the activities that need to be performed. This information should be derived from the work packages at the lowest level of the work breakdown structure. Each work package may require one or more activities to be completed to create the required deliverable. Each activity needs to be defined in enough detail that it can be assigned to one person who can accurately determine how it will be accomplished and by whom, estimate how long it will take and how much it will cost, and then be held accountable to ensure it is accomplished.

Once all of the activities have been defined, they need to be sequenced—that is, the team must determine which activities must go first (predecessors) and which activities depend on others to be accomplished before they can start (successors). Many people find that determining these relationships is easiest with Post-it Notes and a large workspace.

A person on the planning team needs to estimate how long each activity will take. This is greatly dependent on who will do the work, which is discussed in the next chapter. Care should be taken when creating the estimates since some people tend to be optimistic and many things can interfere with the ability to work on a specific activity. Other people tend to pessimistically pad their estimates to make sure they can finish early and look good.

The three time-management processes described above—activity definition, activity sequencing, and activity duration estimating—need to be accomplished even if scheduling software will be used since the scheduling software is only as good as the logic behind it! The next step is schedule development. Some teams use Post-it Notes to develop this schedule manually by making two logical passes through the network to determine both the earliest and latest any activity can be started and ended. However, this requires tedious calculations and is greatly simplified by using software such as MS Project.

Schedule development is an iterative process. Once an initial schedule is developed, it needs to be compared to resource limits, imposed dates, and cash flow. Often, a sponsor or customer wants the project sooner than the original schedule suggests. In these cases, many approaches may be considered to expedite the schedule. These schedule adjustments will be considered in Chapters 9 and 10.

On Agile projects, the Product Owner progressively prioritizes the work to be performed, and the team commits to how much they can perform during each iteration. Results from early work often lead to the Product Owner reprioritizing and the team to better estimating how much they can deliver. Agile schedules are often communicated using Kanban boards.

Key Terms Consistent with PMI Standards and Guides

activity, 278
plan schedule management, 278
define activities, 278
sequence activities, 278
estimate activity durations, 279
develop schedule, 279
control schedule, 279

velocity, 258
critical path method (CPM), 279
precedence diagramming method (PDM), 280
sequence activities, 285
predecessor activity, 285
successor activity, 285
mandatory dependency, 286
discretionary dependency, 287
finish-to-start (FS), 287
lead, 287
lag, 287
finish-to-finish (FF), 287
start-to-start (SS), 287
start-to-finish (SF), 288
estimating activity durations, 288
duration, 288
critical path, 291
forward pass, 292
early start date (ES), 292
early finish date (EF), 292
late start date (LS), 292
late finish date (LF), 292
backward pass, 293
total float, 295
free float, 295
Monte Carlo simulation, 299
Gantt chart, 301

Key Terms Consistent with Agile Practice

Story point, 303
Planning poker, 304
Right-sized, 304
Definition of ready, 304
Risk-based spike, 305
Kanban boards, 305
Task card, 305
3C process, 305
project calendar, 306
resource calendar, 306
no holidays are defined, 306

Chapter Review Questions

1. When can the first draft of a project schedule be constructed?
2. What is the difference between an activity and a work package?
3. What is another name for *activity on node* diagramming?
4. What purpose do project milestones serve?
5. Describe the relationship between a predecessor activity and a successor activity.
6. Describe the four most common types of logical dependency.
7. One potential problem that can occur with activity duration estimating is having omissions. What are three potential remedies for this problem?
8. What two methods can be used to determine the critical path of a schedule?
9. If an activity on the critical path falls behind schedule, what effect will this have on the entire project?
10. If a painted room must dry for four hours before work can continue, the result is a delay in the successor activity. The wait for the paint to dry is an example of a _____.
11. A professor cannot grade his students' exams until the students have completed taking the test. What kind of relationship is this?
12. What is one advantage and one disadvantage of Monte Carlo analysis for predicting a project schedule?
13. How can a Gantt chart be helpful in project planning?
14. A lead is a change in the logical relationship that results in the _____ of the successor activity.
15. How do you calculate float? What is the difference between free float and total float?
16. What do Agile projects use instead of a Gantt chart to measure project progress?
17. What is used to create an Agile project schedule?

Discussion Questions

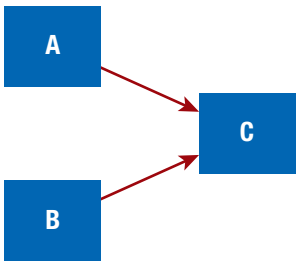
1. Describe the five factors that may limit how fast a project can be completed. Give an example of each.
2. What is meant by the Agile term velocity? How is it used to estimate a project's schedule?

3. Discuss at least four potential problems in creating accurate duration estimates for activities and two methods for dealing with each potential problem.
4. Describe how a WBS and a schedule work together.
5. Why is an Agile project planned in detail just one iteration at a time? Give an example of a project that would work well using Agile scheduling and another example of a project for which traditional project management planning would be better.
6. You are the project manager assigned to build and decorate a model home. What might be an example of a lead you encounter when scheduling work activities? A lag?
7. Describe the process used to calculate *float*. Describe how you can tell if it is *total float* or *free float*.

Exercises

1. Label the box below to create a two-pass schedule legend.

2. If the learning rate is 60% and the first time the activity was performed took 200 minutes, the second time performing the activity should take _____ minutes, and the fourth time should take _____ minutes.
3. In the example below, label which activities are predecessors and which activities are successors.

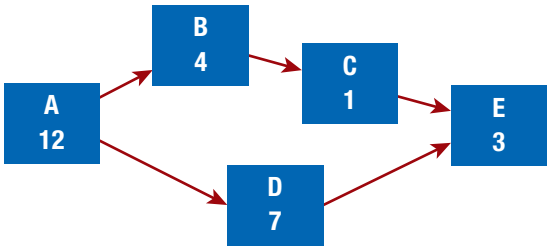


4. Create a logical network using the activities listed below.

Planting a Flower Bed

1. Purchase flowers, potting soil, and tools.
2. Water flowers.
3. Prepare soil by weeding and adding fertilizer.
4. Plant flowers.
5. Dig hole.

5. Calculate early start, early finish, late start, late finish, and float for each of the activities in the network below. The duration of each activity is given.



6. Identify the critical path for the network in Exercise 5. How long should the project take?
7. Display the schedule from Exercise 5 on a Gantt chart showing critical activities, non-critical activities, and float.
8. Given the information below, create the project schedule network. Then, using the two-pass method, calculate and show the early and late starts and float for each activity and the critical path. Show the schedule on a Gantt chart showing critical and non-critical activities and float.

Activity	Days	Immediate Predecessor
A	5	
B	2	A
C	4	A
D	7	A
E	3	B
F	6	B, C
G	8	D, E, F

9. Given the information below, create the project schedule network. Then, using the enumeration method, calculate and show all of the paths through the network. Show how long each path will take. Identify the critical path. Show the schedule on a Gantt chart showing critical and non-critical activities and float.

Activity	Days	Immediate Predecessor
A	7	B
B	2	-
C	3	A
D	5	A
E	7	B
F	3	C
G	4	D
H	6	E, F
I	5	G, H

10. Using the data below, schedule the problem in MS Project. Display and print the schedule in a Gantt chart showing the critical path and the predecessors.

WBS	Activity	Immediate Predecessor	Duration in Weeks
1	**Operational definition**		
1.1	Research literature		3
1.2	Identify and define terms	1.1	1
1.3	Obtain approval of definition	1.2	2
2	**Target selection**		
2.1	Solicit partners for pilot		2
2.2	Hold brainstorming meeting	2.1	2
2.3	Identify characteristics of targets	2.2, 3.1	1
2.4	Obtain approval of partners	2.3, 1.2, 3.4	1
3	**Question set**		
3.1	Identify process group members		2
3.2	Develop question set	2.3	4
3.3	Prototype and validate question set	3.2	3
3.4	Add partners	3.1, 2.1	3
4	**Pilot process**		
4.1	Schedule with target audience	2.4	2
4.2	Conduct beta test	3.4, 2.4	2
4.3	Process feedback from target audience	4.2	2
4.4	Conduct pilot	4.3	2
4.5	Analyze results	4.4	2

11. Using the data below, schedule the problem in MS Project. Display and print the schedule in a Gantt chart showing the critical path and the predecessors.

	Activity	Immediate Predecessor	Duration in Days
A	Evaluate freezers		2
B	Chart temperatures		6
C	Review service record		2
D	Consult with HVAC engineer	A, B, C	3
E	Develop construction plan	D	10
F	Complete IC assignment	E	2
G	Complete ROI analysis	E	5
H	Conduct regulatory review	E	4
I	Obtain construction approval	F, G, H	2

12. Using the information for Exercise 8.8, input the data into MS Project. Display and print the schedule in Gantt chart format, as shown in Exhibit 8.19.

13. Using the information for Exercise 8.9, input the data into MS Project. Display and print the schedule in Gantt chart format, as shown in Exhibit 8.19.
14. Create a project schedule on a Gantt chart by hand, showing the critical path and all float for a project in which you plan a campus event. You may use the scope statement and/or WBS from exercises 2 and 3 in the previous chapter.

PMP Exam Study Questions

1. The Midlands Company is eager to develop a project schedule. They have already completed the scope statement, work breakdown structure, and schedule management plan. What is the next thing they should do to start creating a project schedule?
   a. define activities
   b. nothing; they are ready to proceed
   c. sequence activities
   d. estimate activity durations
2. Which of the following is *not* a characteristic of an activity?
   a. It is a distinct, scheduled portion of work performed during a project.
   b. It has clear starting and ending points.
   c. It is defined using a verb/noun format.
   d. It is one of the deliverables at the lowest level of the WBS.
3. Another term for "activity on node," the most commonly used technique for constructing a schedule model, is:
   a. precedence diagramming method (PDM)
   b. arrow diagramming method (ADM)
   c. activity on arrow (AOA)
   d. activity attribute method (AAM)
4. You are planning the schedule and come to an activity that you are unfamiliar with. Your SMEs give you the following time estimates: most likely = 5 hours; optimistic = 2 hours; pessimistic = 14 hours. Using PERT, which activity duration do you use in your plan?
   a. 6 hours
   b. 2 hours
   c. 5 hours
   d. 10 hours
5. A critical path activity has _____ float during the planning process.
   a. the most
   b. zero
   c. negative
   d. positive
6. The Bluestar Creative Agency is developing a new marketing campaign for a client. They have determined that the client's marketing plan must be completed before the graphic design can begin. This situation describes what type of dependency?
   a. start-to-start (SS)
   b. start-to-finish (SF)
   c. finish-to-start (FS)
   d. finish-to-finish (FF)
7. In Agile planning, a(n) _____ is a requirement that is written from the end user's perspective.
   a. epic
   b. iteration
   c. story
   d. theme
8. A Gantt chart represents project schedule information in an easy-to-read, graphical format. Which of these is *not* a component of this type of Gantt chart?
   a. activities
   b. budget data
   c. start and end dates
   d. durations
9. As a project manager, which of the following situations would concern you the most?
   a. a three-day delay on an activity with five days total float
   b. realizing that an activity on your critical path only took two days instead of the four you assigned it using the PERT method
   c. a one-day delay to an activity with zero total float
   d. a two-day delay to a non-critical path activity with two predecessor activities
10. How do you calculate Late Start, using the two-pass method?
    a. Late Finish – Duration
    b. Duration – Early Start
    c. Early Finish – Early Start
    d. Late Finish – Early Finish

Integrated Example Projects

Suburban Homes Construction Project

Refer to the project charter from Chapter 3 and the WBS in Chapter 7. The initial scope as identified in the project charter is mentioned below.

Building a single-family, partially custom-designed home as required by Mrs. and Mr. John Thomas on Strath Dr., Alpharetta, Georgia. The single-family home will have the following features:

- 3,200 square-feet home with 4 bedrooms and 2.5 bathrooms
- Flooring—hardwood on the first floor, tiles in the kitchen and bathrooms, carpet in the bedrooms
- Granite kitchen countertops, GE appliances in the kitchen
- 3-car garage and external landscaping
- Ceiling—10 feet on the first floor and vaulted 9-feet ceilings in bedrooms

In the previous chapter (Chapter 7), you were asked to develop a WBS. If you have not already done so, Suburban Homes is requesting that you complete the WBS to several levels such that the lowest level represents work packages and activities. Also, you need to make sure that no work components are missing to deliver the project outcome: a single-family home. You are asked to exclude the project management part of it and instead focus on the *what* aspect of the project and not on the *how* aspect of the WBS. Once the WBS is completely developed, please perform the following tasks:

Tasks to complete

- Expand the WBS (Chapter 7) so that work packages or activities are defined at the lowest level.
- Develop a project schedule at the lowest level of WBS work elements after defining logical relations.
- Estimate durations of each element in the network.
- Compute forward pass and backward pass to determine project duration.
- Determine critical path for the project.

Heritage Arboretum Development Project

As of writing this book, four releases of six months each have been accomplished, and a fifth six-month release is in progress. By agreement with various stakeholders, future releases will be every twelve months, with new planting only during autumn. A substantial amount of progress has been made as can be seen by the Kanban board in Exhibit 8.28.

Exhibit 8.28

Arboretum Project Kanban Board

To Do	In Progress	Done
Create communication plan	Remove invasives along woods edge	32 original species identified
Identify potential species to add	Transplant 5 species from other site	22 additional species planted
Select additional species	Plant trees along drive	Deer protection installed
Determine sites for more planting	Identify new species along woods edge	Signs with QR codes placed
Conduct garden tour	Assess size and condition of trees	ArbNet certification achieved
Record video tour	Update site map	High-res site map created
Take additional photos	Print and post large high-res map	Master plan created
Add more info to website		Tree conclave conducted with state forester
Remove more invasives		Buffer zone planting started
Conduct routine maintenance		Invasives removed
Create more partnerships		Hazardous trees cut
Plan and conduct programming		Science teacher meeting conducted
Update master plan		Website with map, pictures, and descriptions created
		Trustees plant two trees
		Announcements made in local media

Questions:

1. Why do you think the decision was made to change to a twelve-month release instead of a six-month release?
2. In what order would you suggest completing the in-progress activities? Why?
3. If your product owner limits you to three stories from your to-do list for the next iteration, which would you choose and why? If the limit is five stories, which would you choose and why?
4. Given what you know about this project from the previous chapters, what additional stories should be added to the to-do list, and which, if any of these, would you recommend be included in the next release?

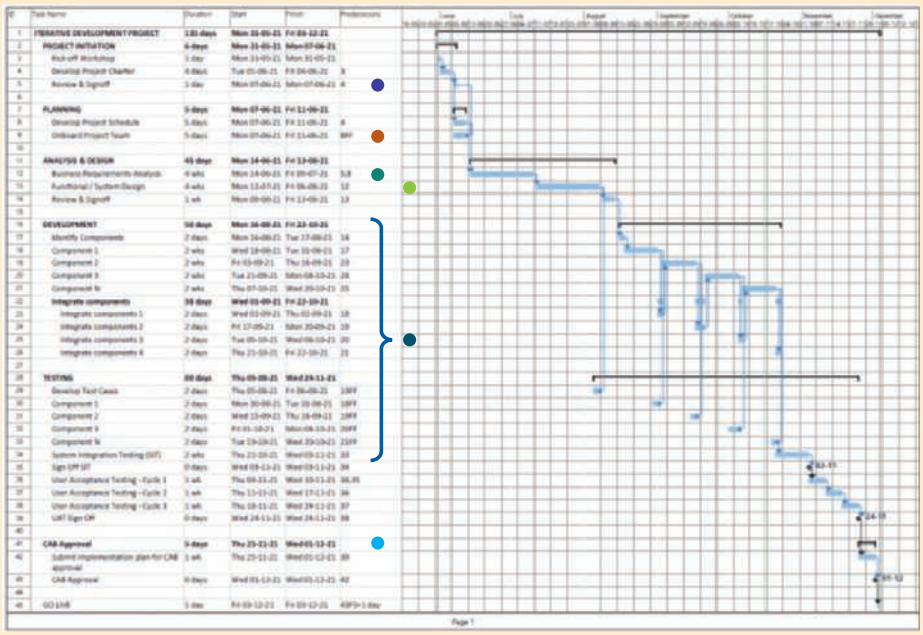
Semester Project Instructions

Take the WBS you have already developed. Define all of the activities that will be necessary to create each deliverable in your WBS. Create a schedule for your sample project. First, create the schedule by hand using Post-it Notes and then put the information into MS Project. Create a printed copy of the schedule on a Gantt chart with no more than forty lines per page. Do not use more pages than necessary. Sponsors do not like to flip pages. Be sure to include all of the summary rows (including the first row for the project title) and any key milestones. Make sure the critical path is easy to see.

Project Management *in Action*

Sample project schedule for an Iterative/Incremental software development project.

This is a typical schedule for an Iterative/Incremental software development project as used by an African consulting company. It can be easily modified depending on the complexity of the project. The schedule is shown below with notes that follow to explain several sections.



Review and Signoff (Project Charter)

Depending on the organization and the project, the process to review and sign the project charter may take longer than a few days. The project may be critical in nature and may require a signoff by senior stakeholders in the organization who may not be easily available. This should be considered and communicated by the project manager during the project kick-off meeting. Should the project manager choose to continue the project before signing off the charter, they should identify and communicate relevant risks of doing so to the steering committee.

Onboarding Project Team

The period between signing off the project charter and commencing the analysis of the business requirements should be used to work out a more detailed plan and communicate the project objectives, milestones, deliverables, and timelines, as well as roles and responsibilities, with the project team.

Business Requirements and Functional System Design

At the end of each of these stages in the project, the project manager may want to reassess the development and testing estimates communicated earlier in the project. More detailed information regarding the complexity of the project will be revealed during these project stages.

Development and Component Testing

The development stage is broken down into multiple components that may be developed independently. If a USE CASE approach is followed, these components could represent individual USE CASES. Following the development of each component, a time period should be set aside to test the component. In the example, testing is done at the end of each component development. In addition, time has been set aside for integration tasks to prepare or combine the last developed component to what has been developed thus far. The development of the next component commences as soon as the previous component, testing, and integration tasks are completed. Depending on the number of resources available and the system being developed, the development and testing of these components may be arranged differently.

It may also be possible to commence some development of foundational components during the design phase before the features and functions of the system are developed.

CAB (Change Approval Board)

Information Technology (IT) departments usually have a committee that meets regularly to assess, approve, or reject any system changes planned for implementation. Such a committee is typically called a Change Approval Board (CAB). One of the criteria assessed by this committee is the User Acceptance Testing (UAT) signoff. The project manager needs to ensure that the correct dates for submission of documents and the sitting of the CAB are plotted correctly on the project schedule. It must be borne in mind that delays in UAT will mean that submission to the CAB will be delayed. Alerting the CAB of delays as soon as possible OR booking an approval request as close to the end of UAT as possible is advised. You do not want to repetitively change the request for approval dates as this will attract a negative perception of the project management's ability on the project.

Source: Clive Enoch, PhD, PMP, PfMP.

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6. *Practice Standard for Scheduling (2019)*: 81.
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9. *Practice Standard for Scheduling (2019)*: 191.
10. *Practice Standard for Scheduling (2019)*: 191
11. *Practice Standard for Scheduling (2019)*: 179.
12. *Practice Standard for Scheduling (2019)*: 178.
13. *Practice Standard for Scheduling (2019)*: 181.
14. *Practice Standard for Scheduling (2019)*: 173.
15. *Practice Standard for Scheduling (2019)*: 173.
16. *Practice Standard for Scheduling (2019)*: 176.
17. *Practice Standard for Scheduling (2019)*: 173.
18. *Practice Standard for Scheduling (2019)*: 173.
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Chapter 9

Resourcing and Accelerating Projects

Chapter Objectives

Core Objectives:

9-1 Assign resources on a RACI chart, Gantt chart, and resource histogram.

9-2 Develop an effective project schedule with resources and resource constraints.

9-3 Compress a project schedule using crashing and fast tracking.

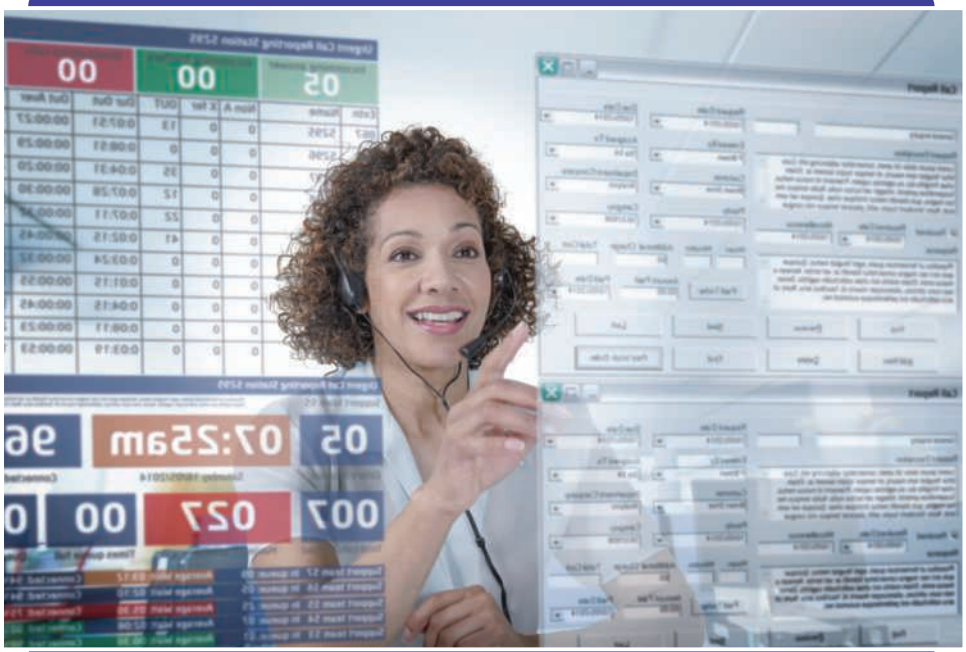
9-4 Compare various scheduling methods.

9-5 Assign resources, pinpoint overloads, and describe methods of dealing with them using MS Project.

9-6 Create a human resources management plan and a staffing management plan.

Agile Objective:

9-7 Describe Agile concepts and tools that enable teams to deliver value quickly.



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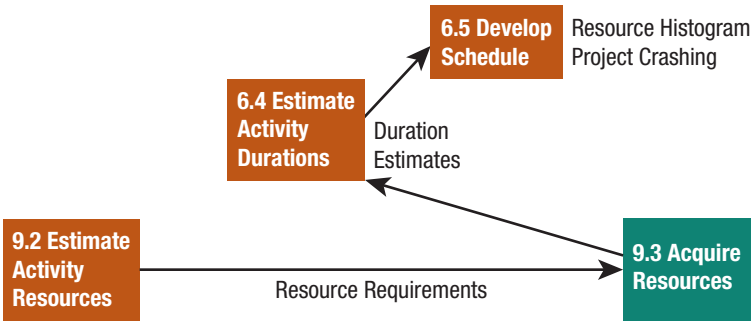
Resourcing and Accelerating Projects

Employment and Social Development Canada (ESDC) is a Government of Canada department responsible for administering the Employment Insurance and the Canada Pension Plan programs with an annual spend of over $122B in benefits and client service delivery. There has been a strong impetus for change at ESDC for several years, driven by growing client expectations of government services, changes in workforce demographics, aging business systems, and limited agility and flexibility in policy development and management. As a result of the need for service transformation, ESDC has embarked on a large-scale, multi-year, benefits delivery modernization (BDM) project to enhance service excellence for the delivery of government benefits programs. ESDC envisioned the future state to include establishing an omnichannel (e.g., phone, e-mail, chat, web) experience, the use of artificial intelligence for risk-based processing and advanced data analytics, enabling technology, and policy agility to deliver a world-class client experience.

PMBOK Guide 6e Coverage



Note: Refer to Appendix A to view the entire *PMBOK Guide 6e* flowchart.

PMBOK Guide 7e

Performance Domains:

- **Team**
- **Development Approach & Life Cycle**
- **Project Work**

The design and development of solutions to achieve the BDM outcomes were guided by a set of foundational design principles that informed every aspect of the BDM project, from early planning and design of new benefit programs to frontline service deployment. A fundamental principle was AAgile development, where the multi-disciplinary and cross-functional project teams used an iterative delivery approach and collaboration to allow for a rapid and flexible response to issues as they arose to support continuous improvement and adaptive planning.

At the outset of the project, ESDC had recognized the scarcity of appropriately skilled resources to sustain a multi-year project road map. Insufficient resources would put the organization and project at risk of being unable to achieve the desired goals. While skilled resources who fit the project profile were already engaged in critical roles within the organization, ESDC needed to allocate the necessary staff with subject matter expertise to safeguard success.

Since March 2020, the need for change was exacerbated by the COVID-19 pandemic, driven by an exponential increase in demand for government services. This increased demand for benefits placed immense strain on the organization's ability to deliver timely services to those in need and increased urgency on the project team to quicken its pace. The need to compress the project schedule by adding resources and concurrently executing multiple workstreams became clear. However, crashing and fast-tracking techniques required significant agility within the organization, to which ESDC was not yet culturally adept.

Each BDM workstream lead needed to tap into both internal resources where available, and external system integrators and management consultants who held vendor-of-record status. In this way, they were able to contract a specified number of resources for each two-week sprint over one year to advance the project. Active recruitment took place internally to secure more resources by hiring permanent and temporary staff, including searching the active talent pools, launching competitions, and providing development opportunities to existing staff. Most of the recruited internal and external resources were dedicated full-time to the project. ESDC also implemented a team-lending model as an alternative means to deploy resources to projects. The team-lending model favored using small, dedicated multi-disciplinary teams and allowed for an acceleration of activities within and across workstreams. ESDC also scoured the organization for hidden stars—people who had lower visibility within the organization but could help the project team provide expertise on a contingency basis.

—Mark Alpern, DBA

Several questions come to mind when it comes to identifying appropriate resources for planning and executing a project.

- How do you decide what resources (people, materials, tools) are needed for your project?
- How do you know when you need each project team member and resources (materials, tools, equipment, etc.)?
- How do you secure the services of those people and other resources?
- How do you make sure each person has a steady amount and consistent type of work to do, but not an overwhelming amount at any time?
- How do you make sure that each project team member is challenged to perform at the optimum level?
- How do you make sure your project schedule is realistic, considering who will do the work?

These and many other related questions are answered when you resource a project accurately. Resources include people (human resources), along with machines, materials, tools, equipment, space, and other things that you require to execute the project plan.

The total means available to a company for increasing production, service, or profit are considered resources. For projects, a resource refers to anything necessary for the completion of work that will cost money to obtain. Therefore, money is not a resource, but it is a means to acquire resources, and it is a common denominator for all resources. If required resources are abundant, managing resources will not be an issue. However, that is not the case in most situations and organizations (Anantatmula, 2014). In this chapter, we will primarily focus on human resources.

9.1 Abilities Needed When Resourcing Projects

Project managers look for two types of skills to resource a project for effective and efficient execution of a project. The first type of skill is technical. Various techniques can be used to estimate resource demands, assess competencies required, create a staffing management plan, assign one or more persons for each activity, ensure that each team member's workload is at an optimum level, schedule a project with optimum resources, and compress (speed up) a project schedule.

The second type of skill needed is behavioral. As you might guess, many behavioral issues are involved in completing project resourcing tasks, such as:

- Selecting people who work well in teams
- Identifying exactly what each person needs to accomplish (individually and collectively)
- Ensuring that each person has the desire to improve
- Dealing with difficult individual work schedules
- Getting people to work overtime when there are schedule conflicts
- Making honest and open estimates of the amount of work required
- Assembling an effective team
- Dealing with people from diverse backgrounds
- Deciding where each person will work
- Deciding how a geographically dispersed team can work virtually and effectively

The most important behavioral aspect is to ensure that each person works well within the team collaboratively. The ability to work with teams is one of the most critical attributes of a person for selecting individuals for the project team. We discussed these issues in Chapter 5.

9.1a The Science and Art of Resourcing Projects

The science and art of project resourcing are to perform the technical and behavioral aspects together in a manner that reinforces and complements each aspect. A resource-based schedule that is technically brilliant but has little acceptance from those who must do the work has little value. Likewise, an effective project team, whose members have impractical resource assignments, is still likely to struggle. If one needs to choose between the two, a motivated team with poor assignments or very challenging assignments is more likely to be a better option for success. However, when both the technical and behavioral aspects are addressed well, the project will have a higher probability of achieving desired results.

This chapter covers both technical and behavioral aspects of determining and securing effective human resources for a project. While each specific skill and behavioral consideration is introduced separately, keep in mind that people are inclined to support what they have helped to plan. Therefore, when possible, identify your key people as soon as possible and get them engaged in the project planning process.

9.1b Considerations When Resourcing Projects

As we cover the specific skills and behavioral aspects of resourcing projects, the following ideas should be kept in mind if some of the key people on a project do not have the skills to participate, managers should help them develop those skills.

- Projects always have trade-offs, with respect to resources, trade-offs among schedule, human resources, costs, quality, and scope. Which of these takes precedence on the project you are planning?
- Resources are limited and project managers must recognize resource limitations to prevent overpromising. Often, after activities are tentatively scheduled, as discussed in the previous chapter, it appears that the project can be completed by a specific date. However, the schedule may become unrealistic if required resources are not available when they are required and at key points in time.
- People often constitute a large portion of the total project cost. This is especially true when special knowledge is required for projects such as research and development and advanced software development. The cost associated with people varies depending on the type of project and the industry in which the project is executed.
- Of all the resources, managing people is the most challenging aspect of a project. Resource availability, specifically human resources, is a major constraint for projects. Many times, we need these resources for simultaneous execution of project activities to reduce project duration and to utilize resources efficiently. Caution must be exercised to avoid overloading or assigning multiple tasks at the same time.

9.1c Activity- versus Resource-Dominated Schedules

All project schedules are based in part on the individual activities (both the estimates of how long each activity will take and their logical order, as discussed in Chapter 8) and in part on the number of human resources who are available when needed (the topic of this chapter). However, in some circumstances, the schedule is based more on the activities (scope-constrained schedule) or the resource limits (resource-constrained schedule), which may be cost-constrained by budget availability. Exhibit 9.1 lists situations where schedules are based more on activities or more on resources, as generally it is assumed that the budget is available for project execution. Some organizations use critical chain (explained in Section 9.8) or AAgile in situations where the schedule is dominated more by resources.

Exhibit 9.1

Activity- versus Resource-Dominated Schedule Basis Comparison

	More on Activity	More on Resource
Time in project when scope is determined	Early	Late
Confidence in duration estimates	High	Low
Rate of resource learning	Small	Extensive
Specialization of resources	Commodity	Unique
Availability of resources	Easily available	Tight availability
Firmness of activity predecessors (order)	Absolute	Optional
Concurrency of activities	Little	Significant

9.2 Estimate Resource Needs

A starting point in resourcing a project is to estimate how many resources of each type and skill or knowledge level are needed to create all the project deliverables identified by the WBS. The WBS includes no listing of activities nor estimates of time, required resources, or project costs. However, it starts the process of integrating project plans for scope, time, and resources.

Estimating activity resources is a process of assessing all types of resources—people, materials, tools, and equipment (along with quantities)—required to complete each activity as specified in the project scope. This can be accomplished at either a detailed or an overview level. When a project team determines a detailed list of activities that must be performed, it makes sense to ask what type of person (by specific knowledge or skill) is needed to perform each of these activities. However, when a project team does not identify individual activities, they still need to determine the number of people, knowledge, and skill required to complete the project.

When estimating resource needs, the team must also consider support needs such as information systems and other support services. Specific constraints are placed on some types of people as to how they are hired, scheduled, and released. Further, co-located teams and highly skilled people often demand more detailed resource planning. When estimating resource needs, it is wise to include time to communicate between activities as well as time to perform activities. "Handoffs" occur when one person or group passes work on to another group, which also requires time.

9.3 Plan Resource Management

Plan Resource Management is the process of identifying resources and required skills for the project, defining and assigning roles and responsibilities to all the resources, developing a reporting hierarchy, and communicating expectations. Exhibit 9.2 describes how a global consulting company performs resource planning.

Exhibit 9.2

Resource Planning at Atos

Adequate resourcing is perhaps the most critical activity required on a project at Atos.

It starts with a successful estimation while bidding for a contract. Levers such as onshore/offshore mix, specific location, skill required on a year-by-year basis (for long-term engagements), current availability of staff, and ease of recruitment are all considerations while staffing projects. Based on these parameters, internal placements/movements are first done. If there are any gaps in skills, recruitment is initiated. The timeline for recruiting is taken into consideration for resource planning as well. For example, in India, hiring from the market could take anywhere from two to four months. In Mexico, it is usually six to eight weeks, whereas in the United States, it could be as low as three weeks. Global mobility of resources within Atos is heavily encouraged, especially for key roles. If it is determined that the skill set required cannot be available on time, for whatever reason, subcontracting is an acceptable alternative. Resource costs are a big part of the decision made to allocate people. For example, if work requires client site presence, it is impractical to assign a resource that lives in California to work for a project in New York. (Travel costs would be too heavy).

Resource Planning is emphasized so that required skills can be forecasted and made available as projects/contracts are won. Proactive investments in niche or growing areas are made as needed. Resource planning is done yearly, with a monthly review to align with changing business needs. There is an emphasis on training and job shadowing while resources are waiting for work. Graduate programs are emphasized in most countries as well, thereby ensuring a good mix of available resources for projects.

Resourcing strategies are visited quarterly, e.g.: what type of skills should we invest in versus partner on; which locations should be our focus; what level of experience do we need within the organization; how can we pay competitively to attract the best talent; and how do we keep employees happy so that they can continue to grow.

The ultimate aim is to ensure that Atos can deliver on the commitments made to the client for the project timeline and deliverables, and this is not possible without the right resources at the right time, place, quality, and cost. Client satisfaction is one of the most important KPIs (key performance indicators) of any consulting company, and it often is directly a result of having the right people delivering what was promised.

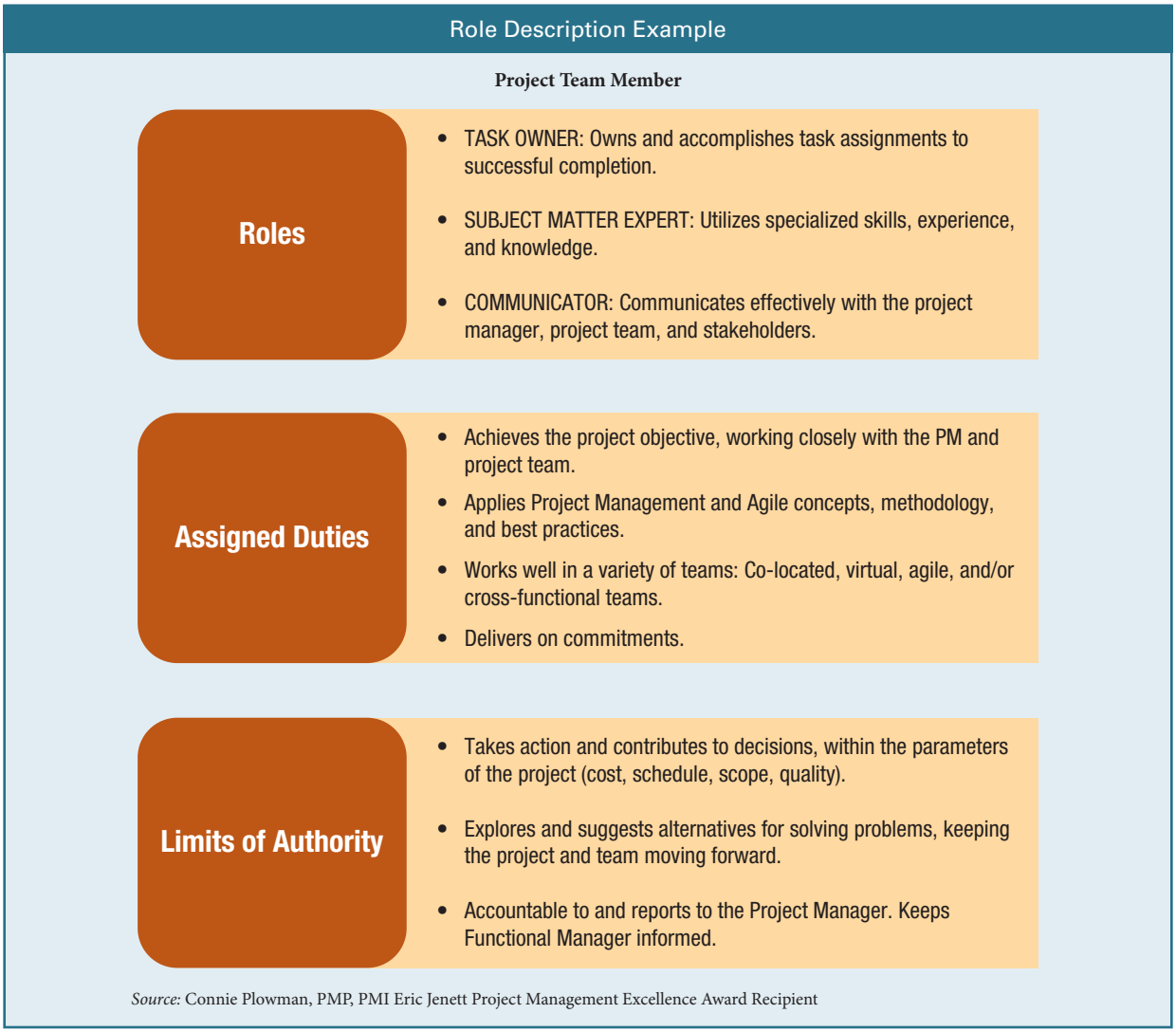
Source: Rachana Sampat (*MBA, PMP*), Head of Workforce Management, Atos, North America.

A **staffing management plan** is a proposal focused on acquiring, developing, and retaining human resources as long as you need them on the project. The staffing management plan addresses how to identify potential internal and/or external human resources for the project; determine the availability of each; and decide timing issues regarding building up, developing, rewarding, and releasing the project team.

It is important to document roles and responsibilities, authority, and the required competency for each role. Then reporting relations can be established using a project organization chart and, subsequently, a staff management plan can be developed.

Roles and responsibilities for project participants can be documented in role descriptions. These often include roles, assigned duties, and limits of authority, as shown in Exhibit 9.3. For clarity and aligning expectations, there should be role descriptions for all project participants—project manager, team member, project sponsor, and others. While a project participant may have a specific title (such as project manager), this individual may take on a variety of roles on the project team (such as communicator, coach, subject matter expert, scrum master, etc.). The role descriptions should be developed as a team at the start of the project and referred to, as needed, throughout the life of the project.

Exhibit 9.3



Once the roles and responsibilities of project team members are identified with all the WBS activities, it is captured as a **responsibility matrix**. It serves as a good staff management plan and helps the project manager to promote teamwork and productivity.

9.3a Identify Potential Resources

The project manager should plan, estimate, and manage all tasks and their respective resources independent of where the resources reside, administratively or physically. Identifying people who might work on a project differs significantly from one organization to another. Often, many organizations practice a lean approach for staffing and have few people from whom to choose. In a small organization, a specific person may often be the logical choice for certain types of work on a project. However, in larger organizations and in situations where outside resources may be hired, identifying potential resources

becomes a challenging issue. Whatever the situation may be, a project manager must know who is potentially available to work on their project. A project manager also keeps in mind the estimated resources needed when identifying the people who could potentially work on the project. This information can include factors such as:

- Work functions (may include job titles and range of responsibilities)
- Professional discipline (may include degrees and professional certifications)
- Skill level (may include experience and performance ratings)
- Physical location (may include willingness to relocate and travel)
- Organizational/administrative unit (may include costs and contractual issues)[1]

Once the required information is identified for the most likely pool of people, a project manager can compare the available people to the estimated resource needs to identify both gaps in specific skills that are needed and gaps in the number of people available versus those needed.

A **resource breakdown structure (RBS)** is defined as grouping all resources into main categories in level one and populating each main category with resources based on either function or skill level. Consistency in the division bases remains a crucial component of the structure. RBS is a very useful tool for developing a staff management plan. Like WBS, the in-house resources of the project should be scrutinized and categorized by creating the RBS. It classifies and catalogs the resources that are required to meet project objectives. In many ways, the RBS improves communication, integration, planning, and estimating. Similar to the WBS, the RBS provides a consistent framework for dividing the resources into small units for planning, estimating, and managing. Exhibit 9.4 is an example of an RBS.

Identifying required resources for an internal project that mostly requires resources within the organization can become easy by developing a resource breakdown structure (RBS). Once all resources within the organizations are identified and listed in the RBS, it can serve as a good reference document for all projects. Using the organizational RBS, one can develop an RBS specific to a project.

It must be remembered that RBS requires periodical updates, as rates keep changing.

If it is clear that more and/or different people are needed in addition to internal resources that are listed in RBS, then the project looks for additional options. That could mean other departments or divisions of the company, or it could mean looking outside the organization. A project manager, perhaps with help from the sponsor, continues the identification of potential resources until an adequate number and mix of potential people have been identified.

Key people for a project should be identified as early as possible. The project core team is ideally identified and assigned soon enough to participate in chartering the project and in eliciting requirements from the client and defining the scope based on the client's requirements. Beyond the core team, it is helpful to get key subject matter experts (SMEs) on board early if possible, not only to help plan the project but also to help in developing the project culture and getting it off to a quick start. People are more likely to be enthusiastic about performing work they helped to plan, and this motivation often comes in handy during difficult stretches of a project.

When possible, create options for people—try not to assign people who are unwilling participants. Experienced project managers understand that the better they take care of people who work with them on one project, the more effective the project team performance is, and the easier it is to recruit capable and enthusiastic people for their next project.

Exhibit 9.4

Resource Breakdown Structure Example

			Unit	Rate
1.0	**Personnel**			
	1.1 Management			
	1.1.1	Project Manager	hour	$100.00
	1.1.2	Project Engineer	hour	$ 80.00
	1.2 Design			
	1.2.1	Civil Engineer	hour	$ 80.00
	1.2.2	HVAC Engineer	hour	$ 80.00
	1.3 Construction			
	1.3.1	Foreman	hour	$ 70.00
	1.3.2	Draftsman	hour	$ 50.00
	1.3.2	Electrician	hour	$ 60.00
	1.3.3	Carpenter	hour	$ 40.00
	1.3.4	Mason	hour	$ 35.00
2.0	**Materials**			
	2.1 Civil/Architectural			
	2.1.1	Lumber	each	$ 4.00
	2.1.2	Paint	gallon	$ 20.00
	2.1.3	Drywall (0.5″ × 4′ × 8′)	each	$ 8.50
	2.2 Electrical			
	2.2.1	Wire	foot	$ 0.75
	2.2.2	Switches	each	$ 4.75
	2.2.3	Lighting fixtures	each	$ 55.00

Project managers must make opportunities available to qualified candidates equally. First of all, project managers need to do this both from legal and ethical perspectives. Successful project managers also find many advantages in having teams with diversity. It is beneficial to consider different perspectives in making decisions, as it may help avoid major risks that a single perspective would not have uncovered. In addition, diverse opinions help to consider more creative approaches due to different thinking styles. Further, a diverse

group of project team members sometimes relate better to various stakeholders, leading to effective stakeholder management.

9.3b Determine Resource Availability

Once the potential resources have been identified and compared to the estimated resource needs, it is necessary to ensure the identified people are available and secure their commitment. This is necessary even for internal projects because multiple internal projects often choose resources from the same resource pool. An RBS is very useful in identifying resources that are available for the project. The project manager and project team must recognize that a schedule is preliminary until all the required resources are committed to the project.

In terms of resource availability, full- and part-time resources, as well as internal and external resources, may be available. If the new project is of higher priority than an existing project, resources that were already committed may be freed up. Regarding the ability to commit at a very detailed level, some people have individual calendars with specific vacations or other unavailable times. Exhibit 9.5 shows how a consulting company determines resource availability.

9.3c Decide Timing Issues When Resourcing Projects

Projects, because of their time-bound nature and unique deliverables, have timing issues unlike those of ongoing operations. Early in the project, one timing issue is when to bring people on board. Bringing them on before they are needed results in idle time and can be costly; however, if the project manager decides to wait for the appropriate time, it is possible that the person is not available when required and the project schedule will probably be delayed. The general solution to this timing issue is to assign key players as quickly as possible. This helps establish good project planning, effective project culture, and the early progress of the project. Of course, a project manager may need to negotiate not just for who will be assigned to his project, but also when they will be assigned.

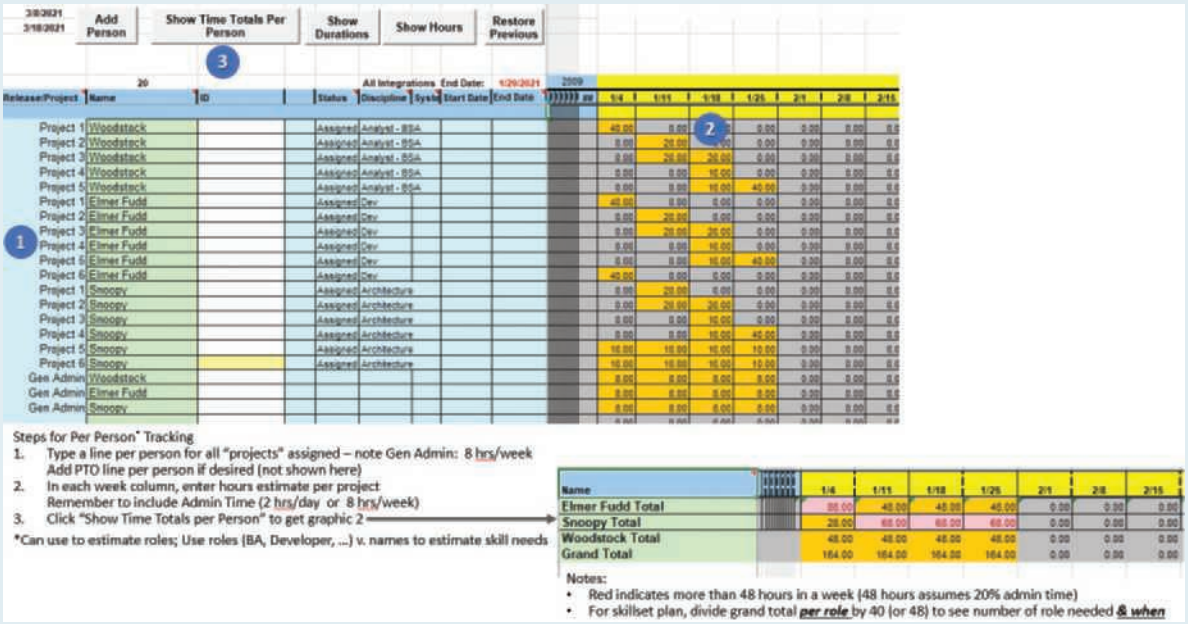
PhotoAlto/Alamy Stock Photo

Exhibit 9.5

Managing Resource Availability

This is an Excel spreadsheet used for project or department resource management. "Resource": Persons by name or roles (BA, Developer, Architect…) based on skill sets for a project or within a department. The graphic steps are the process. The spreadsheet has a "Resource Plan-Detail" tab and an "Allocation" tab. Enter data on the "Resource Plan-Detail" tab. Do step 3 to auto-generate the "Allocation" tab for ***actionable information***. Plan in detail as far out as needed or in a rolling fashion.

Graphic:



Source: John Stark

As members are brought on board, timing issues involve getting the team functioning effectively and keeping them motivated and on schedule. Team development is covered in Chapter 5.

Near the end of a project, timing issues include rewarding, recognizing, and releasing project team members. How are they rewarded? Under what circumstances are they released from the project, and what provision is made for them to be assigned to new work and/or promoted? These issues are addressed in Chapter 15.

The staffing management plan deals with these three issues: how the project planners identify potential people for the project, how they determine who is available and when to secure their services, and how to deal with timing issues of building up and then releasing the project workforce.

9.4 Project Team Composition Issues

Project teams are often composed of people from many sources—both inside and outside an organization executing the project. Several of these issues, such as who will be on the project and where each will be physically located, are best considered when selecting team members. These issues are introduced here, and the management of teams with these compositions is discussed in Chapter 5.

9.4a Cross-Functional Teams

Projects typically require inputs from multiple disciplines and, therefore, require cross-functional teams. When people representing different disciplines and skills work together, misunderstandings often arise. An engineer may be predisposed to look at an issue one way, while an accountant may look at the same issue a different way. This could be due to different thinking styles and perspectives based on education, experience, culture, and/or personality. A project manager may feel sometimes that they are a mediator among various functions that are working on the project. It is useful for project managers to develop the ability to understand and speak effectively with people representing different disciplines and various technical experts. A project manager may not be the expert, but they must understand the experts, communicate with them effectively, and instill trust in their leadership and judgment among all the subject matter experts on the team.

9.4b Co-Located Teams

Another team issue involves *where* everyone physically performs work. In co-located teams, the members are assigned workspaces near each other or in proximity to each other, such as being in the same building or another building in the vicinity. Many minor decisions are made informally every day. Often, a person might not feel that something is important enough to create a document or make a phone call, but they might ask the person sitting at the next desk or someone they come across in the hall or meet at a coffee machine in the building. Sometimes a person does not want to interrupt their thought process, but would casually ask a person at the next desk a question. Co-location helps to create these opportunities for easy and quick communications, relationship building, teamwork, and productivity improvement. On some projects, members of a supplier company and/or representatives from the customer may have a desk in the project workspace. A major and important advantage of co-located teams is networking and an informal structure that promote a work culture of sharing, collaborating, and supporting each other.

However, project managers and co-located teams can often take advantage of many modern information and communication technologies for communicating remotely and from anywhere on the planet. These methods are used often for global projects, and sometimes for big decisions. With the pandemic restrictions in place these days, many organizations switched to virtual work wherever possible, and it has become a necessity.

9.4c Virtual Teams

Due to advances in information and communication technologies, virtual teams are commonly engaged and represent the opposite approach from co-location. Virtual teams are the norm for global projects and multinational organizations. However, co-located teams sometimes also communicate virtually, and with the COVID pandemic, working on virtual teams is becoming a norm all over the world. Members of virtual teams do not meet face to face very often. Sometimes a project requires the expertise of many people who are geographically dispersed, and it is impractical to have them all work in the same location or proximity.

These teams require many forms of communication. Many people report that if they have met another person face to face even once, they feel they can relate better to that person. Therefore, even for geographically dispersed teams, it is common to bring people together for project chartering or project kick-off sessions. Of course, some project managers travel frequently to allow for regularly scheduled face-to-face contact with important team members, customers, and suppliers.

Indiapicture/Alamy Stock Photo

9.4d Outsourcing

Project managers often are faced with the prospect of not finding the necessary talent within their organization. When that is the case, project managers often need to hire expertise from other organizations. This is discussed in Chapter 13. For example, call centers and technical help for many major organizations like Banks, Facebook, Google, Apple, Microsoft, and many U.S. airlines are often provided from other nations such as India and Malaysia. These are examples of operations, but one can find similar examples for projects as well, specifically for software development and R&D projects. Outsourcing can allow a project to bring in talent from anywhere in the world.

9.5 Assign a Resource to Each Activity

Once the people needed for the project are identified, it is easy to get them if the project is a high priority for the organization or if the project manager has developed a good reputation and many people want to work with them. However, on many projects, a project manager is unlikely to immediately secure all the necessary highly qualified resources they need. They are expected to negotiate to acquire the desired people.

Hopefully, the core team was assigned during the initiating stage and participated in chartering the project. Now is the time to ensure that the core team is complete. It is also the time to assign team members to activities and define their roles. On

small projects, most of these assignments are assigned to core team members. On larger projects, subject matter experts may be involved. It is also helpful to specify exactly what degree of authority, responsibility, and accountability all project team members have.

9.5a Show Resource Responsibilities on RACI Chart

A **responsibility assignment matrix (RAM)** is "a matrix that shows all the work packages and the resources assigned for various responsibilities regarding each work package." A **RACI chart** is a popular form of RAM that presents the key stakeholders and their roles defined as responsible (R), accountable (A), consult (C), and inform (I) for project activities in a matrix form. The first column on the RACI is usually the WBS coding of work packages and activities. The second column includes the names of the work packages and project activities that correspond to the WBS. The remaining columns each represent a person who is involved with the project. A partial RACI chart example is shown in Exhibit 9.6.

In Exhibit 9.6, many activities involve more than one person, so primary and secondary responsibilities are defined. In a RACI chart, only one person should have primary accountability for any activity. If more than one person has accountability, it is too easy for them to blame each other when something goes wrong.

RACI charts are extremely useful for assigning activities to project core team members, subject matter experts, and the project manager. They are also useful in managing project communications. They go further than the original communications plan, as they identify every project activity and specify the exact involvement of each stakeholder.

9.5b Show Resource Assignments on Gantt Chart

Once it has been decided who will perform each activity, it is easy to show the assignments on a project schedule. For example, the responsible person for each activity for a portion of a space utilization project is listed right next to the activity in the Gantt chart schedule

Exhibit 9.6

RACI Chart

The aerospace industry competes for work from the U.S. Government through competitive solicitations. As such, our work relies on a bid and proposal process to start our projects. The government releases a Request for Proposal (RFP) that contains details on the scope of their project and contract, and prospective bidders respond with proposals describing their technical solution as to how they plan to achieve the goals of the project and what that will cost.

Developing a proposal is in essence a project unto itself, with scope defined by the RFP, a budget to support the efforts associated with preparing the proposal, and a schedule determined by the proposal due date. Proposal development efforts are generally short, from two weeks to two months, so team members need to understand roles and responsibilities to effectively coordinate and communicate. As such, RACI charts are an effective communication tool for proposal projects. However, since proposal teams are comprised of people with broad backgrounds and varying degrees of project management background, we simplify the RACI construct to make it easier for everyone to understand.

For example, we use a form of the RACI chart as below for proposal projects, identifying primary and secondary roles for each task area. There can only be one primary person for each task, but there can be multiple secondary people. The primary person identified is the person who has the authority to approve and complete the task, which combines the "R" and "A" roles in a traditional RACI chart. We identify people that are involved in the task in any form as secondary, which would be the "C" and "I" roles. Combined with a proposal team organizational chart, this helps everyone understand their role and who are the approval authorities for interim products.

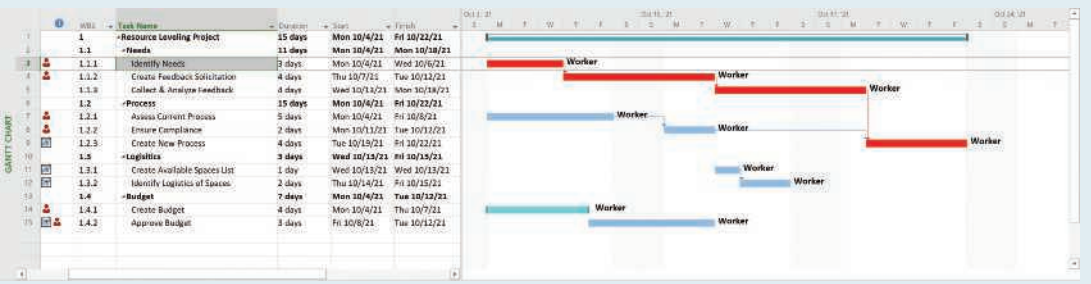
Proposal Team Roles & Responsibilities • Primary o Secondary	Lydia (capture lead)	Kathryn (Cost/IMS/PM lead)	Erich (proposal manager)	Donna (contracts)	Danielle (Security)	Barbara (Cost Volume lead)	Gary (Tech Vol lead)	Mike (trades)	Rich (Systems)	Jack (scheduler)	Estimators	Peter (review team)	Aaron (review team)	Mark (approval authority)	Joe (financial review)
External stakeholder management															
Competitive analysis	•	o	o									o	o		
Develop customer communication	o	o		•	o										
Internal stakeholder management															
Conduct internal reviews	•		o									o	o		o
Monitor expenditures	•	o	o									o	o		
Final proposal approval	o	o	o	o		o						o	o	•	
Develop proposal schedule	o		•	o	o		o								
Coordinate/particpate internal proposal meetings	o	o	•	o	o	o	o	o	o	o	o	o			
Schedule management reviews	o		•												
Contracts/subcontracts															
Gather list of subcontractors		•		o											
Complete model contract	o	o		•											
Complete proposal cover letter	o	o		•											
Cost volume															
Develop WBS	o	o				•									
Develop cost targets	o	•				o									
Develop basis of estimates						o					•				
Review basis of estimates	o	o	o			•									
Develop cost volume		o				•									
Review cost volume	o	•	o												o
Tech volume															
Identify key mission trades	o	o					o	•	o						
Develop outline	o						•		o						
Write mission/system trades section	o						o	•	o						
Write sections on architecture							•	o	o						
Write schedule narrative	o						o		o	•					
Write risk section	o						•		o						
Write sections on interface understanding							o	o	•						
Write sections on deliverables							•								
Develop compliance table	o						o		•						
Schedule															
Provide schedule inputs		•					o	o	o		o				
Develop initial schedule		o								•					
Develop IMS		o								•					
Review schedule	o	•										o	o		o
Proposal delivery															
Conduct security review	o	o			•										
Compile proposal package	o	o		•	o										
Submit proposal	o	o		o	•										

Source: Lydia Lavigne, Ball Aerospace.

in Exhibit 9.7. Showing the responsibilities directly on the schedule is a simple, visual way to communicate. For simplicity's sake, we are saying either of our two workers can do any activity and each is available full time for this project. In some projects, some people will spend a small percentage of their time on a project since they have other responsibilities, and because some activities may require only a small fraction of their time. Generally, people are available for work on a project less than 100 percent of their time for many reasons. Nevertheless, this demonstrates how to keep track of the time a person spends

Exhibit 9.7

Schedule with Resources Example



Source: Microsoft Corporation.

working on a project. Directions for how to construct each of the exhibits regarding resources in MS Project are presented in Section 9.10.

9.5c Summarize Resource Responsibilities by Time Period with Histogram

Once it is clear who is responsible for each activity, it is time to understand how the multiple demands add up for each resource. Are any of the resources overloaded? To answer this question, the demands for each resource at each time period should be added. Note that a resource can be an individual worker such as *Mary*, or a resource could be a class of worker such as *carpenter*. Exhibit 9.8 shows the responsibilities for our resource, who we call *worker* for the various activities.

Note a couple of things regarding this resource histogram. First, we are using our two workers for whichever activities are needed, so the 100 percent capacity of the resource means two people working full-time (80 hours per week). If we had only one person working 10 hours per week on our project, the 100 percent line would then be 10 hours per week. Second, we show the amount of work within the resource's capacity in blue and the amount of overload in red. You can see that the worker is overloaded by 50 percent for the first seven workdays. Another thing to note is that we use the same timescale for the resource histogram that we used on the Gantt chart, making it easy to see which activities contribute to the overload.

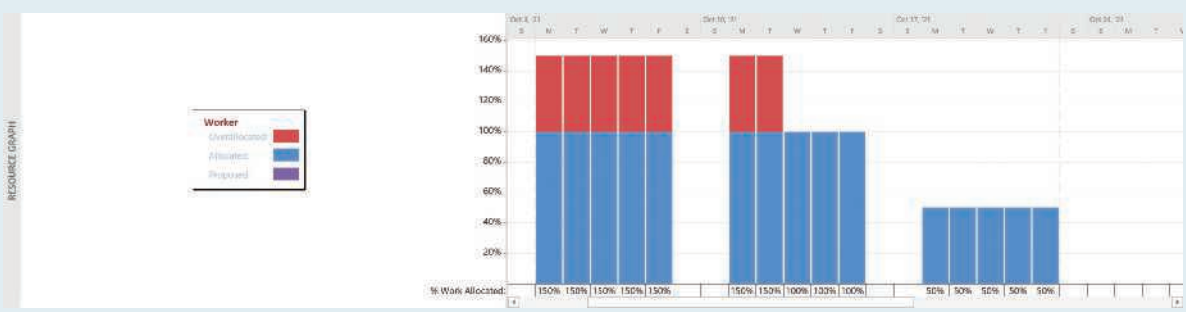
9.6 Dealing with Resource Overloads

Once it is obvious that a particular person has been overloaded at a given point in time, it is helpful to pinpoint exactly which activities are involved. One easy way to do that is to compare the resource histogram, such as the one in Exhibit 9.8, to the Gantt chart schedule, shown in Exhibit 9.7. It is desirable and helpful to view both charts together using the same timescale, as shown in Exhibit 9.9.

Clearly, our workers were scheduled to perform three activities at the same time during the first seven workdays and are overloaded at that time. Project scheduling software helps to deal with resource overloads by pinpointing when the overloads occur for each worker and by identifying which activities that worker is assigned to perform. How should this be resolved? Software greatly assists in identifying and understanding the problem, but it takes management decisions to solve the problem.

Exhibit 9.8

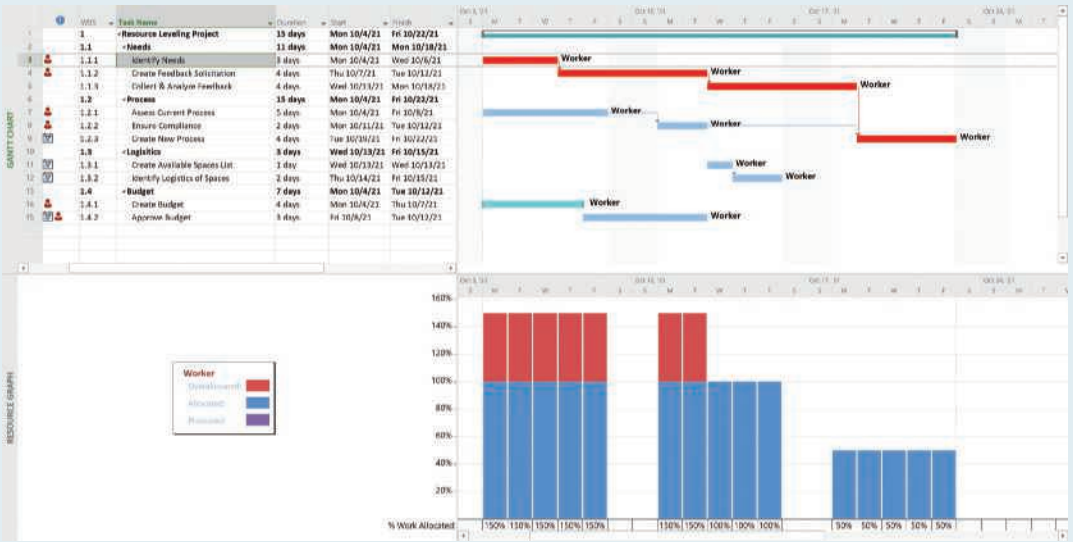
Responsibility Histogram Example



Source: Microsoft Corporation.

Exhibit 9.9

Partial Schedule and Resource Histogram Example



Source: Microsoft Corporation.

9.6a Methods of Resolving Resource Overloads

Once a project manager understands who is overloaded and what activities are involved, they can employ many possible methods to rework the project schedule so the worker is not too overloaded. Some of these methods are as follows.

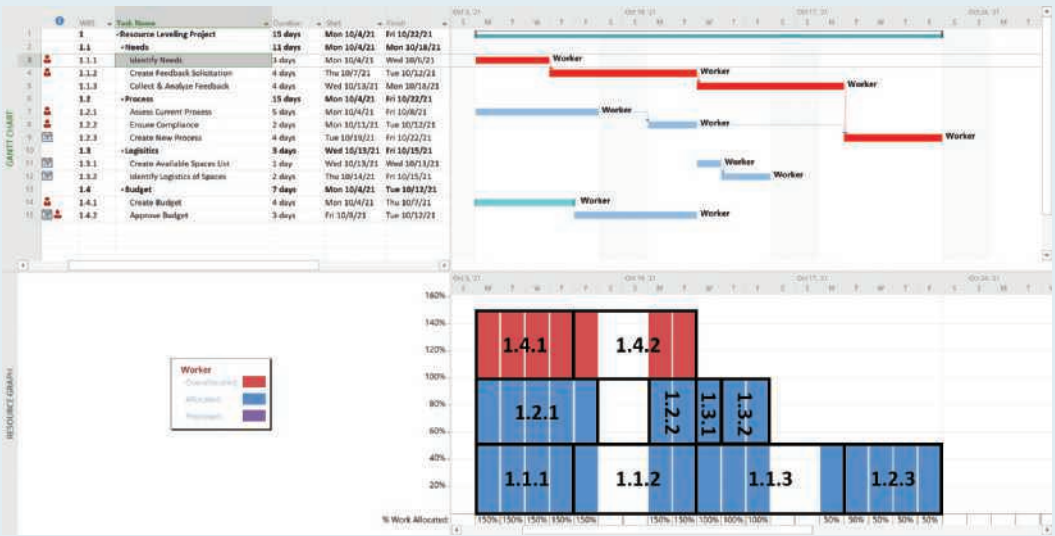
- Assign certain activities to other workers.
- Sometimes an activity can be split into two activities, with the first part being performed as scheduled and the last part delayed. This is often not an attractive strategy because many activities take more total time when split. It also takes people a little time to remember where they left off when they resume work. However, it would be productive if you split an activity into two activities and then execute them in parallel, but with different resources. We will discuss this concept later in this chapter.
- Another method of resolving the overloads is to reorder the activities. This may include questioning the logic that was used when creating the schedule. One means of reordering activities, *fast tracking*, is covered in Section 9.8 on compressing schedules.
- Sometimes when people understand how badly overloaded a resource is, they decide to acquire or borrow additional resources.
- If a resource is impossibly overloaded, perhaps the project scope needs to be reduced or the schedule needs to be extended.
- If there is a severe overload and one of the above strategies needs to be employed, it usually makes sense to inform the sponsor. The project manager needs to understand who is overloaded when the overload occurs, and what activities cause the overload. Good project managers will then be able to determine possible courses of action. However, it may be up to the sponsor to make the final decision on how to resolve the overload.
- It is often helpful to resource-level the overloaded person's schedule as described below.

Resource leveling is a project execution technique of adjusting the use of resources based on resource availability and the amount of float on activities to accomplish work as soon as possible, given the limited resource availability. The most common form of resource leveling is delaying activities so the person does not need to perform as many activities at the same time. Normally, non-critical activities are delayed by an amount no more than their slack period in the hope that the overloads can be resolved without extending the overall project schedule. However, if none of the alternative strategies discussed above is feasible and delaying the non-critical activities within their slack is not sufficient, the project schedule will slip. Essentially, this delay reduces peak demand and smoothens the period-to-period resource usage. An example follows, starting with Exhibit 9.10.

This is the same example we have been using, but we now put blocks around the amount of time needed for each activity. For example, Activity 1.1.1 (Identify Needs) takes one worker four days and can start right away, so it is shown during the first four days. The easiest way to understand the work demands and be able to adjust the schedule within the limits of the available work time starts with creating a critical path schedule, as shown in the top portion of Exhibit 9.11. It is helpful to clearly mark the critical path and to "front load" the schedule—that is, to show every activity starting as soon as the activities that precede it are complete. Then, a resource histogram can be built for each person who may be overloaded. Start by placing the critical path activities on the bottom, because those activities need to be completed as scheduled or the entire project will be late. In our example, these critical path activities are 1.1.1, 1.1.2, 1.1.3, and 1.2.3. Next, place all of the non-critical path activities above the critical path activities at the earliest time they can be scheduled. In our example, these are 1.2.1, 1.2.2, 1.3.1, 1.3.2, 1.4.4, and 1.4.2. For example, all of the other activities have some float and can be delayed if needed. With the 100 percent line showing our workers' maximum available time, it is easy to see that they cannot complete everything as scheduled.

Exhibit 9.10

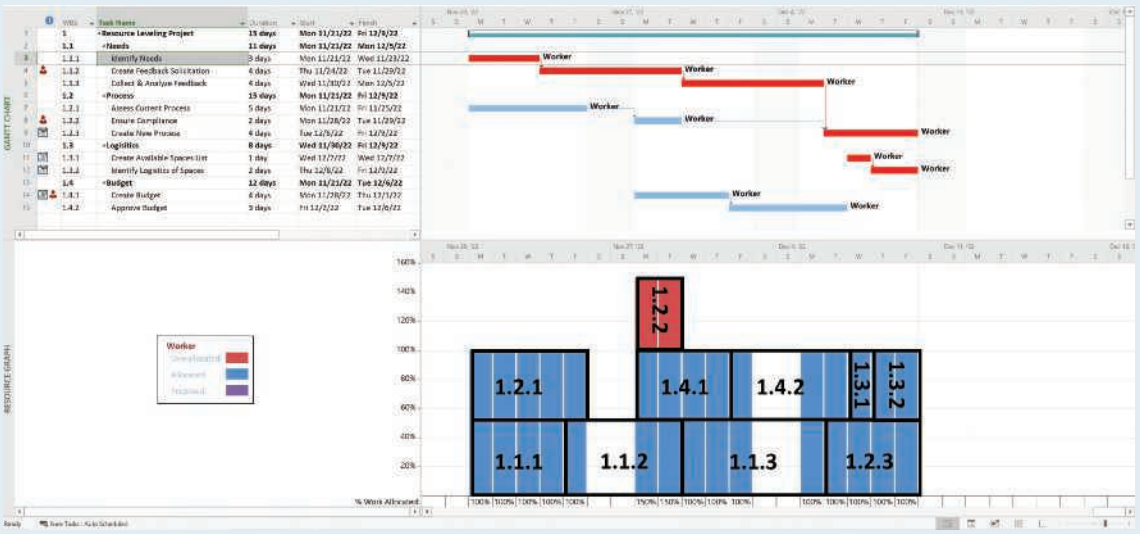
Resource Leveling Example



Source: Microsoft Corporation.

Exhibit 9.11

Partially Leveled Resource Schedule



Source: Microsoft Corporation.

To visualize resource leveling, think about the game Tetris. In that game, one tries to fit shapes into spaces. That is exactly what we are doing here. If you can play Tetris, you can level resources. In our initial schedule, we have seven workdays of more work than our workers can handle, as shown by the blocks around activities 1.1.1 and 1.4.2. Note also that we are only working Monday through Friday, so weekends are shown as non-work days. The question is, can we level the demand for our workers without extending the project? In this example, you can see the critical activities on the bottom are still scheduled as originally planned and Activities 1.2.1 and 1.2.2 are both still scheduled as originally planned. All of the other activities have been delayed a bit without violating their constraints. Each has been delayed by no more than the amount of float. The result is that the project is still scheduled to be completed on time, but now instead of seven workdays of overload, there are just two days. Resource leveling often reduces an overload, but it does not always eliminate it entirely.

If the non-critical activities must be completed at the rate of effort shown in the original schedule, some of them may need to be assigned to another worker. Resource leveling can be as much art as science. The combination of the critical path schedule and resource histogram allows a project manager to understand who is overloaded, at what time, and by what specific activities. Then, the project manager seeks to move some of the non-critical activities within their slack to level the demand for that worker. If enough leveling can be done, the project can proceed as scheduled. If not, some activities must be accomplished by other means, the schedule will slip, or perhaps the scope will need to be reduced.

9.7 Compress the Project Schedule

Once the schedule is prepared and loaded with resources, the project manager will know the project duration. Then they can compare it with what the sponsor or customer wants.

If the expected time is too long, they will need to shorten the critical path to reduce the total completion time (remember that because the critical path is the longest path, it dictates the shortest possible total project duration). Sometimes, this adjustment must be done when the completion of project activities during the initial phase takes longer than planned. Also, when the scope of the project is increased but the customer requests the project completion as originally planned, the project manager needs to explore options for schedule compression.

9.7a Actions to Reduce the Critical Path

A variety of actions can be taken to reduce the critical path as follows.

- Reduce the project scope and/or quality.
- Overlap sequential activities using finish-to-finish (FF), start-to-start (SS), or start-to-finish (SF) relationships.
- Partially overlap sequential activities by using time leads.
- Increase the number of work hours per day or workdays per week.
- Schedule activities that are normally in sequence at the same time (execute simultaneously).
- Shorten duration of activities that cost the least to speed up by loading more resources.
- Shorten the duration of activities with the least probability of increasing project risk.

The first item, reducing scope and/or quality, normally requires permission from the sponsor and/or customer. Scope reductions are common. Sometimes, the original scope includes features that are nice to have but are not essential, and the sponsor may be willing to give them up when they understand the schedule impact. Quality reductions are far less common and are discussed in Chapter 12.

The next two items, time leads and alternative dependencies, are discussed in Chapter 8. The last five items, on the other hand, describe two well-known techniques to compress schedules, which are generally recognized categories or methods:

- Fast Tracking
- Crashing

Fast tracking is a method to expedite a project by executing activities at the same time that ordinarily would be done one after the other. In a design-to-production project, one way to accomplish this is to overlap the design and production phases. In other words, the design is not complete when construction starts, which is against the conventional approach of completing the design and then moving on to the construction phase. Research has shown that this can be an effective method of expediting.

Crashing is speeding up the critical path, often by adding additional resources or employing existing resources for longer hours and/or more days per week. Increasing the number of work hours in a day and workdays per week is commonly employed during the project execution when a project is behind the schedule. While these two strategies of crashing may shorten a schedule, they do so at an additional cost, both in terms of the costs of labor (in terms of overtime pay) and also in lost productivity or efficiency.

One simple way to understand the differences between crashing and fast tracking is to determine what is given up in return for the faster schedule. Crashing almost always costs more money to speed up the schedule. Fast tracking almost always increases the risk to speed up the schedule. Both approaches result in making the project more difficult to manage since more activities take place at the same time, more people are assigned to project work, and/or more activities have workers on overtime. Let us turn to the specifics of each.

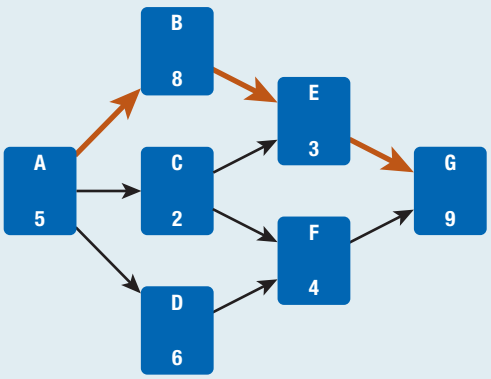
9.7b Crashing

When crashing a project schedule, certain activities are performed at a faster-than-normal pace. This often requires overtime pay, but could also require extra charges for expedited deliveries, more expensive machinery, or employing more skilled people who can do the activity faster and better. When deciding which activities to speed up, two questions must be asked: First, which activities are on the critical path? Since the critical path determines how long the project takes, speeding up any activity, not on the critical path makes no difference to project duration. Second, which critical path activity costs the least on a per-day basis to speed up? There is no sense in paying more than necessary. We will use the project in Exhibit 9.12 to illustrate crashing.

Note that the enumeration method was used to identify each path and its duration. Path ABEG at 25 days is the critical path. This example is in days, but it works equally well with weeks or any other unit of time. Also, note that three small tables of information are included in Exhibit 9.12 to help us keep track of times and costs as we make the crashing decisions. The first table is the list of the paths with duration. Remember, we only want to crash activities on the critical path. Every time we reduce the length of an activity, we

Exhibit 9.12

Crashing Example Set-Up



Path	Duration
ABEG	25
ACEG	19
ACFG	20
ADFG	24

Activity	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
▸ A	5	$300	5	$300	N/A
▸ B	8	250	5	400	50
C	2	100	2	100	N/A
D	6	300	3	600	100
▸ E	3	150	2	300	150
F	4	275	3	300	25
▸ G	9	700	8	900	200

Project Duration	Activity(IES) Crashed	Incremental Crash Cost	Cumulative Crash Cost
25	-	0	0

record the impact on the affected path(s). As you speed up activities on the critical path, you may find yourself left with a new critical path (or paths), which is now the longest in terms of duration.

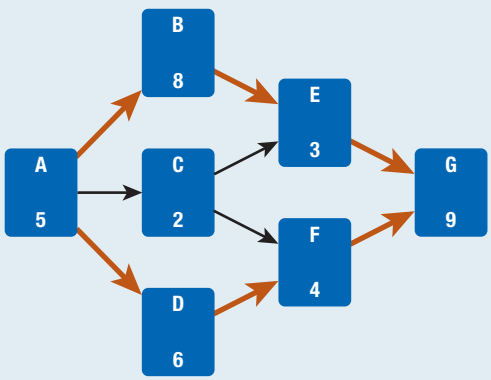
The second information table lists each activity along with the normal time and cost (the expected time and cost if this activity is not crashed), the crash cost and time (the fastest the activity could be accomplished and the total cost incurred if it is crashed), and the crash cost per unit of time (in this example, per day). The activities that are on the critical path are identified by a triangle symbol. Two activities, A and C, have the same crash time as normal time. This means they cannot be crashed and are crossed out. We need the information in this table to identify which critical path activities cost the least to speed up.

We use the third small table to keep track of how long the project is, which activity (ies) we choose to speed up, and how much it costs. Using the normal time for all activities, the project is expected to take 25 days. We crash activities one day at a time. Note that path ADFG requires 24 days—only one day less than the critical path.

Activities A, B, E, and G are on the critical path. Activity A cannot be crashed. Some activities are impractical to speed up, even for an extra cost. Activity B at $50 is the least expensive of the choices, so that is the one to crash first. Note that activity F only costs $25 to speed up, but it is not on the critical path, so it is not chosen. Once we speed up B by one day, the resulting information is placed into the tables, as shown in Exhibit 9.13.

Exhibit 9.13

Crashing Example After One Round



Legend: Activity Code / Duration

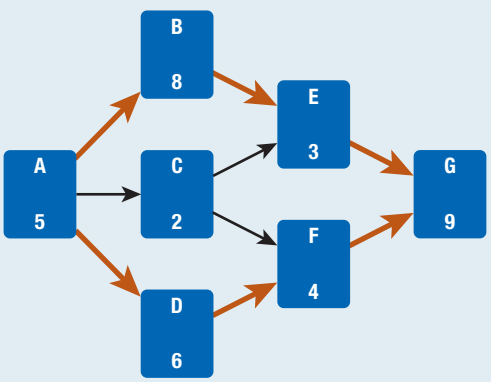
Path	Duration
ABEG	~~25~~ 24
ACEG	19
ACFG	20
ADFG	24

Activity	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
▶ • A	~~5~~	~~$300~~	~~5~~	~~$300~~	~~N/A~~
▶ B	~~8~~ 7	250	5	400	50
~~C~~	~~2~~	~~100~~	~~2~~	~~100~~	~~N/A~~
• D	6	300	3	600	100
▶ E	3	150	2	300	150
• F	4	275	3	300	25
▶ • G	9	700	8	900	200

Project Duration	Activity(IES) Crashed	Incremental Crash Cost	Cumulative Crash Cost
25	-	0	0
24	B	$50	$50

Exhibit 9.14

Crashing Example After Two Rounds



Legend: Activity Code / Duration

Path	Duration
ABEG	~~25~~ ~~24~~ 23
ACEG	19
ACFG	~~20~~ 19
ADFG	~~24~~ 23

Activity	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
▸ • A	~~5~~	~~$300~~	~~5~~	~~$300~~	~~N/A~~
▸ B	~~8~~ 7 ~~6~~	250	5	400	50
~~C~~	~~2~~	~~100~~	~~2~~	~~100~~	~~N/A~~
• D	6	300	3	600	100
▸ E	3	150	2	300	150
~~• F~~	~~4~~ 3	~~275~~	~~3~~	~~300~~	~~25~~
▸ • G	9	700	8	900	200

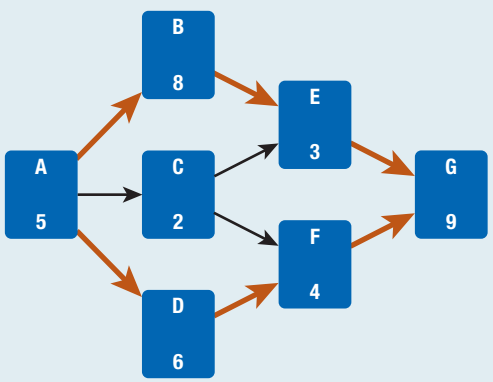
Project Duration	Activity(IES) Crashed	Incremental Crash Cost	Cumulative Crash Cost
25	-	0	0
24	B	$50	$50
23	B & F	75 (50+25)	125

In the first table, path ABEG has been reduced to twenty-four days since B is now being crashed. In the second table, activity B is now shown as seven days since it has been crashed one day. In the third table, the duration is now twenty-four days, B is crashed, the incremental cost is $50, and so is the cumulative cost because that is the only activity that crashed so far. Now there are two critical paths of twenty-four days each. The activities on the second critical path, ADFG, are identified by a circular symbol. To further crash the project, both paths need to be shortened. This could be accomplished by crashing one activity on each critical path, such as B or E on the first path and D or F on the second path. It could also be accomplished by crashing one activity that is on both paths, such as activity G. The least expensive of these alternatives is B and F for a total cost of $75. The results of this are shown in Exhibit 9.14.

After two rounds, both critical paths are twenty-three days. Note that path ACFG is also reduced, as F is on it and F was crashed. Since F cannot be crashed any further, a line is drawn through it. The cumulative cost of crashing the project for two days is $125. Exhibit 9.15 shows the choices of continuing to crash activities until it is no longer worthwhile. That is called an "all-crash" schedule. Note that even in that circumstance, activity D is not reduced to the full amount possible since reducing it further would not make a difference in the length of the overall project.

Exhibit 9.15

Crashing Example in All-Crash Mode



Path	Duration
ABEG	~~25~~ ~~24~~ ~~23~~ ~~22~~ ~~21~~ 20
ACEG	~~19~~ ~~18~~ 17
ACFG	~~20~~ ~~19~~ 18
ADFG	~~24~~ ~~23~~ ~~22~~ ~~21~~ 20

Activity	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
~~• A~~	~~5~~	~~$300~~	~~5~~	~~$300~~	~~N/A~~
~~B~~	~~8 7 6 5~~	~~250~~	~~5~~	~~400~~	~~50~~
~~C~~	~~2~~	~~100~~	~~2~~	~~100~~	~~N/A~~
• D	6 5 4	300	3	600	100
~~E~~	~~3 2~~	~~150~~	~~2~~	~~300~~	~~150~~
~~• F~~	~~4 3~~	~~275~~	~~3~~	~~300~~	~~25~~
~~• G~~	~~9 8~~	~~700~~	~~8~~	~~900~~	~~200~~

Project Duration	Activity(IES) Crashed	Incremental Crash Cost	Cumulative Crash Cost
25	-	0	0
24	B	$50	$50
23	B & F	75 (50+25)	125
22	B & D	150 (50+100)	275
21	G	200	475
20	D & E	250 (100+150)	725

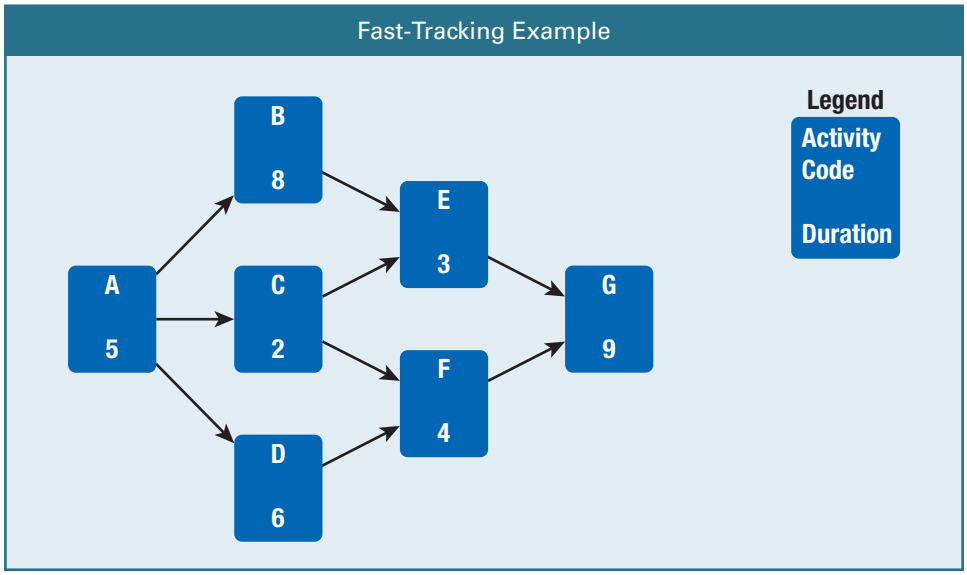
Many questions can be answered with this information, such as the following.

- How fast can the project be completed?
- To crash the project one day, what activity would be crashed, and what would it cost?
- To crash the project two days, what activities would be crashed, and what would it cost in total?
- If there is a bonus of $125 per day for finishing early, what activities would be crashed, and how fast would the project be completed?
- If there is a bonus of $225 per day for finishing early, what activities would be crashed, and how fast would the project be completed?

9.7c Fast Tracking

Fast tracking occurs when activities that are normally performed in series (one after the other) are performed at the same time. In Exhibit 9.16, fast tracking could potentially be accomplished at several points. For example, while A is being done, B could also be performed. This certainly can speed things up as more things can be done at the same time. There is a risk, however. For example, if activity A is to design a part and activity B is to

Exhibit 9.16



order material for the part, the normal routine would be to wait until the part is designed to be sure to order the correct materials. By performing both at the same time, there is a risk that the design will call for different materials than expected and the materials will need to be reordered. One strategy to gain benefits of fast tracking while attempting to control risk is to use a combination of alternate dependencies with time leads and lags to only partially overlap activities, as described in Chapter 8. Partial activity overlaps entail less risk than full overlaps. Another strategy is to overlap only a few activities so you can manage them closely. One would ordinarily look for long-duration activities on the critical path for this overlapping.

9.8 Alternative Scheduling Methods

Several alternative approaches are used in certain industries or in certain situations to create project schedules, including critical chain, reverse phase, AAgile, auto/manual, and rolling wave scheduling. These approaches are not mutually exclusive—a person can use some of the logic from more than one of these methods on the same project.

9.8a Critical Chain Project Management (CCPM)

There are several problems with scheduling projects in many organizations that the traditional critical path method, even with resource leveling, does not always address satisfactorily. Some of these problems are as follows.

- Many people make conservative duration estimates. Often, people are punished for completing work late, so they give themselves plenty of time in their estimates.
- Durations of some activities vary greatly. The part of this variation that is due to specific possible events that may take place can be managed by risk management techniques, as discussed in Chapter 11. The other part of the variation, known as a

common cause or random variation, is not easy to predict and difficult to estimate the associated time.
- Many project team members tend to use all the time available to them. Instead of finishing early and getting the work to the next person, they keep fine-tuning their work and turn it in on time. It is partly due to a belief that if you complete the work early, it may be perceived as poor quality.
- To keep multiple projects moving, many workers are asked to multitask. Up to a point, multitasking helps keep multiple projects moving and keep the workers stimulated. However, many people are asked to multitask far beyond that point; by not focusing on a limited number of things, they sometimes cannot give adequate attention to any.
- People on the project team delay the start of an activity (student syndrome), although there is no justifiable reason to postpone the activity.

One approach to address problems such as these is called critical chain project management (CCPM). CCPM is also sometimes known as the critical chain method. The **critical chain method** is an alternate scheduling technique that modifies the project schedule by taking resource constraints into account. It makes use of principles of the theory of constraints. This method allows the project team to place buffers on any project schedule path to manage constraints associated with limited resources and project uncertainties. Simply put, rather than calculate the critical path based upon predecessor–successor relationships alone, it also incorporates calculations on resource availability. Once the resource that is most in demand is identified, efforts are made to keep that resource appropriately busy on critical chain activities (those critical both because of the predecessor–successor relationships and because of resource shortages) but not overloaded. Other components of the CCPM system include the following:

- Avoiding multitasking
- Estimating aggressively how quickly each activity can be completed
- Putting a feeding buffer of time directly in front of critical chain activities to ensure they will not be delayed
- Putting the time normally reserved for the uncertainty in each activity at the end of the project as a total project buffer that the project manager can use as needed
- Finishing activities early if possible and passing the work on to the next worker

Proponents of critical chain say it is a major innovation that helps to overcome some of project management's most difficult scheduling and resourcing problems. Detractors say it is another approach that may work in certain circumstances. It requires a great deal of re-education and communication on everyone's part to make it successful, and when resources are reallocated from the buffer to a task in trouble, more work may be created.

A research work on comparing critical path and critical chain explains: "CPM is applicable to cases where there are limited resources and a fixed deliverable. It is also applicable where resources whose volume cannot be quickly increased. Furthermore, inflexible funding level leads to trade-offs. CCPM is applicable to cases where there are unlimited resources and a flexible deliverable. It is also applicable where volume of resources can be increased quickly. Furthermore, the funding level could be highly flexible, and the need for trade-offs is minimal. Clearly, the buffer concept, and lack of emphasis on cost, are departures from the traditional PM and CPM methods."[2]

9.8b Reverse Phase Schedules

Another alternative scheduling method that is sometimes used in the construction industry is called a **reverse phase schedule** or Last Planner System. The reverse phase schedule is developed by the people closest to the work (often either the hands-on workers or the forepersons who directly supervise work) by starting with the final project deliverables and continually asking what needs to be completed before starting work on this deliverable. As each activity is defined, its order is established, and the person proposing it verifies that their company has the workforce to complete the activity as shown in the tentative schedule.

Using this method, the team systematically thinks from the end of the project toward the beginning. This is also a good practice to help ensure that all of the project deliverables and the list of activities are both complete because by working backward, missing deliverables and activities tend to be easier to identify. This approach is similar to developing a deliverable WBS—looking at the project from the client's or end user's perspective.

9.8c Rolling Wave Planning

The idea behind **rolling wave planning** is to plan the first part of the project in as much detail as needed and to plan later phases only at a high level. This allows the project team to focus on the near term without ignoring the longer term. It means the project team needs to plan progressively in more detail as information becomes available. Rolling wave planning is illustrated near the end of Chapter 10 by showing a dummy activity for a later project phase. The extreme of rolling wave planning is Agile.

9.8d Auto/Manual Scheduling

Microsoft Project includes a feature called manual scheduling to enable users to more closely emulate MS Excel. This may be comforting for users who are more familiar with Excel than Project. When people are chartering a project and want to show a few milestones without committing to dates, manual scheduling may be a good starting point. Also, for projects with few predecessor–successor relationships, manual scheduling may sometimes be useful. However, for the majority of projects, the ability of MS Project to plan and track activities based upon logical relationships is useful and suggests manual scheduling is not enough.

9.9 *PMBOK Guide 7e*

Domains:

- Team
- Development Approach & Life Cycle
- Project Work

9.9a Team

The desired outcomes of the Team domain, according to *PMBOK 7e*, are a high-performing team, shared ownership, and "applicable leadership and interpersonal skills demonstrated

by all team members." In other words, a project manager should strive to empower his team members to make decisions and demonstrate leadership when the situation calls for it. This egalitarian approach is compatible with Agile practices and the role of a scrum master rather than an authoritative manager. For this approach to be successful, clarity is needed in terms of who has responsibility, accountability, and authority for various types of decisions. In addition, for team members to feel comfortable stepping up to lead, there must be a safe culture in which people are not afraid to make mistakes or offer unexpected suggestions.

The team needs to reach basic agreements about how they will function and to feel comfortable, freely exchanging information and knowledge.

Best practice suggests that team members are involved in the project as early as possible since they will have increased buy-in to the extent they helped plan the project. There will still be times, however, when team members (such as subject matter experts) are involved in just part of the project and need to be onboarded. It is important to have a process in place for getting these team members up and running as quickly as possible while helping them understand the unique project team culture.

9.9b Development Approach and Life Cycle

The chosen development approach and Life Cycle will guide the resourcing of the project. For example, most adaptive teams are co-located and remain together throughout the Life Cycle of the project. This may include multiple iterations or sprints. There may be times when a subject matter expert (SME) is required, but for the most part, the adaptive team members (7 +/−2) are expected to be able to complete the work themselves.

Predictive or hybrid teams, on the other hand, may not be co-located and may be larger. They may even be virtual and/or working from multiple time zones. This makes creating a team vision and culture more challenging but just as necessary. No matter which type of team is involved, team members should be recognized for their contribution when their work is finished. A good project manager will also spend time getting to know the motivations of their team members so they can help inspire them and further their career development through the project work.

9.9c Project Work

In terms of resourcing, the project work domain is closely related to the development approach and lifestyle domain because the chosen development approach will largely determine when and how work is executed and delivered which, in turn, dictates human resource requirements. *PMBOK 7e* is clear that these domains are interconnected, and this is just one example.

9.10 Agile Project Resourcing

People are resourced differently in plan-driven and Agile projects. We attempt to reduce uncertainty in traditional project management (using a plan-driven approach) with a primary focus on following the plan. In Agile projects, it is a change-driven approach, and uncertainty is embraced. For the most part, project schedule and work are determined based on available resources in Agile projects. Differences in Agile versus plan-driven project resourcing are shown in Exhibit 9.17.

Exhibit 9.17

Comparison of Plan-Driven and Agile Approaches for Project Resourcing

Project Resourcing and Accelerating Questions	Plan-Driven	Agile
Ideally how long is the project team together?	Duration of project	Long-term
What is the more likely limiting schedule factor?	Activities and their logical order and estimated durations	Size and ability of the team
What is needed to get the team going?	Identify potential resources, decide timing, select, and on-board members	Keep the existing team going
How is work divided among team members?	Project manager assigns then finds and resolves overloads	Team decides who does what and supports each other as needed
How is a predictable amount of project work managed?	A worker is assigned to each activity, then overloads are identified and resolved	Teams determine their velocity, then manage their cadence and cycle time
How are schedule compression issues handled?	Reduce scope or critical path, often by fast tracking or crashing	Reduce scope by delivering MVP early and letting the client decide

9.10a Agile Terms Used in Resourcing and Accelerating Projects

Velocity	The forecasted number of story points a team can do in one iteration
Cadence	The rhythm of planning, performing, and evaluating each iteration
Cycle time	The time from when work starts on an item until it is delivered
Swarming	Multiple team members work quickly together to solve a problem
Release decision	Determination that product and support are ready for transition and customer is ready to successfully use the product

In this book, we use many Agile terms and definitions from Anantatmula, V., and T. Kloppenborg, *Be Agile Do Agile* (New York, NY: Business Expert Press: 2021).[3]

The fundamental ideas behind Agile project planning are to use a collaborative approach with the project team and other stakeholders who are heavily involved in planning; to recognize that while it may be difficult to scope the entire project at the outset, stakeholders do want to have a ballpark idea of total cost, schedule, and functionality before approving a project; and to understand that while uncontrolled change is bad, too strenuous a change control system often means valid emergent stakeholder wishes are not met.

Agile projects often continue for a long time and are executed in releases and increments. Thus, project schedules focus on early releases or increments, as compared to plan-driven traditional projects wherein the entire project is planned from start to the end.

The client and project team can collaborate to reduce the impact of the interdependency of activities. Agile project schedules are limited to the amount of work the assigned

resources can handle. The team of workers assigned to an Agile project should remain on the project for at least each iteration, and preferably for the entire duration. An Agile team is a cross-functional team with general expertise that puts them together on a long-term basis. The idea is that the work flows to the team and not the other way around. They develop skills as needed to produce the product needed by the business.

The team uses rolling wave planning to develop detailed resource requirements and specific activities for the early part of the project and less detailed requirements for later project phases. Estimating resource needs is done quite differently on Agile projects. The budget is set based on the human resources needed, and the product is produced at the pace the team can maintain.

Team composition is done at a high level and might include some database experience, some graphic user interface (GUI) experience, and so forth. People are assigned to a long-standing team, and they figure out how to get the work done. The team members on an Agile project decide among themselves who will do each work activity. The ideal team member on an Agile project is described as a generalized specialist, meaning that they can accomplish specific things, but they can also be flexible when needed. Team members pick up the next-highest-priority story when they finish what they have been working on. If they need help, they ask; if they need to learn, they learn.

Resource overloads are not a serious problem in Agile since the team is cross-functional, and the team commits to getting the work done in the iteration. They have the confidence to commit because they monitor how much work they have accomplished in previous iterations and know the **velocity** at which they can progress. They establish a **cadence** to plan, perform, and evaluate each iteration. They learn the **cycle time** from when work on an item starts until it is complete.

Teams self-manage conflicts. The equivalent of crashing is called swarming in AAgile. Agile team members work together (**swarm**) to quickly solve an immediate problem to help the team get back on track. In this way, the planning for and resolving problems is handled by the team and done almost in real time. Team members provide enough confidence that the product owner is able to make a **release decision**-meaning the increment of product is ready to ship.

Compression issues are handled by releasing the minimum viable product (MVP) as quickly as possible to the client and letting the client prioritize the remaining work through the product owner. The team then commits to the amount of work they can do in the next iteration based upon that prioritization. Everyone understands what work will be delivered and when.

9.11 Using MS Project for Resource Allocation

Up to this point in the Suburban Park Homes project tutorials, you have created a file with a project in MS Project, created the WBS for the project, defined the predecessor–successor relationships among the tasks, entered the expected duration for each task, and shown the critical path. This covers the first two ways in which a project schedule may be constrained—namely the logical order of tasks and the expected duration of each. Now it's time to consider a third way in which a project schedule can be constrained—the number of resources available when needed. Using MS Project to understand resource limitations includes five steps.

1. Define resources.
2. Set up a resource calendar (as needed).
3. Assign resources.
4. Identify overallocated resources.
5. Deal with overallocations.

While MS Project is well suited to handle the first three, dealing with overallocations requires the involvement of the project manager.

9.11a Step 1: Defining Resources

For a resource to be available to a project, it must first be described in MS Project's database. A resource may be a single unit, such as a person, or a resource may be a pool of like units, such as five crane trucks. Resources can include people, materials, supplies, facilities, or office spaces—anything necessary for the completion of a task.

To define your project's resources, do the following.

1. Click the **View Tab>>Resource Views Group**> click **Resource Sheet**.
2. In the first blank row, enter the resource name in the **Resource Name** cell.
3. In the **Initials** cell, enter the initials of the resource (if different from the auto-generated).
4. Click the **Max Units** cell and enter the resource's maximum availability.

Max Units defines the availability of a resource for *project* work. Although the default is 100 percent, people resources are rarely 100 percent available (even if they are working full-time on a project), so availability will typically be something less than eight hours if that is the normal working day. For example, a person assigned primarily to one project may be available about six hours per day (or 75 percent of eight hours) for that project. If so, 75 percent would be the Max Units for that resource. Note in Exhibit 9.18 that Bruce is available up to 75 percent of his time for the project, while Jack is only available 25 percent of his time; none of the resources are available 100 percent of the time.

While MS Project offers many fields to define resources, **Resource Name** and **Max Units** are the only fields that require definition (if costs are to be modeled, then the **Std. Rate**, **Ovt. Rate**, **Cost/Use**, and **Accrue At** values must also be defined). Keep in mind that whatever names you assign to resources will be seen throughout your project data. Make sure resource names are relevant to your project team and other key stakeholders who may interact with your MS Project data. Update your Suburban Park Homes project to match Exhibit 9.18.

Exhibit 9.18

Defining Resources

RESOURCE SHEET

	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base
1	Bruce	Work		BF		75%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
2	Jack	Work		JC		25%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
3	Tom	Work		TT		75%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
4	Rinzie	Work		RJ		50%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
5	Judah	Work		JS		50%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
6	Liam	Work		LF		25%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
7	Oliver	Work		OL		50%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard

Source: Microsoft Corporation.

9.11b Step 2: Set Up a Resource Calendar

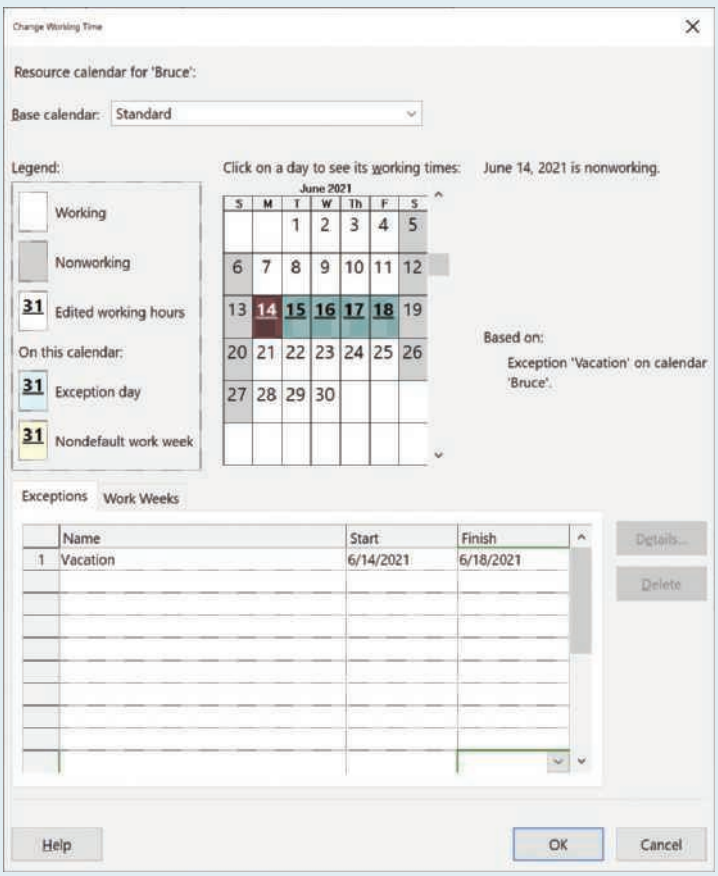
Resource calendars are used to block out vacation days and other *resource-specific* nonworking days. Resource calendars inherit project-wide working day definitions from the project calendar (set up in the Chapter 8 tutorial) when the resource is first defined. Resource calendars are used by MS Project to determine when a resource assignment can be scheduled. If a task has no resource assignment, then the project calendar is used to determine task scheduling. To set nonworking days or hours for a specific resource.

1. Click the **View Tab>>Resource Sheet**.
2. Double-click the row of the resource whose calendar needs revision to activate the Resource Information dialog (see Exhibit 9.19).
3. On the **General Tab**, confirm the correct resource is chosen in "Resource Name" field.
4. Click **Change Working Time**.
5. Make revisions to resource working hours as needed as described in the Chapter 8 tutorial.

Update your Suburban Park Homes project so Bruce's vacation dates match exhibit 9.19.

Exhibit 9.19

Resource Information Dialog Box, Change Working Time Tab



Source: Microsoft Corporation.

9.11c Step 3: Assigning Resources

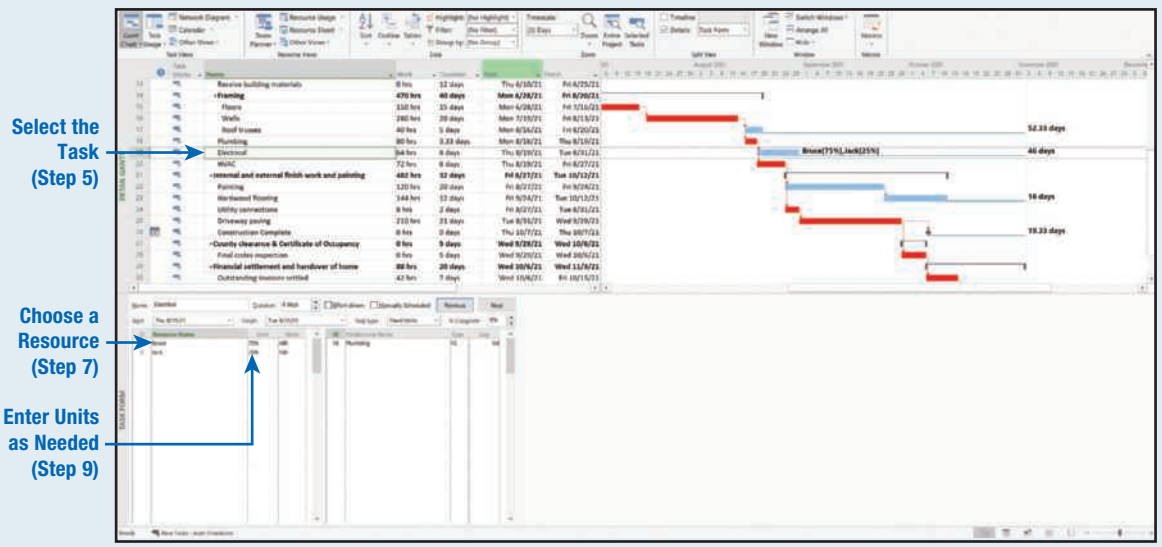
During resource assignment, a project manager allocates one or more resources to an activity. MS Project then generates assignment information based on activity information, resource information, software settings, and any overrides. Assigning a resource to an activity with no existing resource assignments (using default settings) includes the following steps and is illustrated in Exhibit 9.20:

1. Click the **Task Tab>>View Group>>Gantt Chart**.
2. Right-click in the **Start** column header >>**Insert Column**>> type **Work**>> press **Enter** to add the Work column.
3. Click the **View Tab**>>**Split View Group**>> click **Details**>> choose **Task Form** in the drop-down list.
4. Right-click the form in the lower pane and select **Resources and Predecessors**.
5. In the upper pane, click the task row needing a resource assignment.
6. Click the first blank row in the **Resource Name** column in the lower pane's form.
7. Choose the resource name from the drop-down list.
8. Repeat Steps 6 and 7 to add additional resources to the assignment list.
9. Enter a **Units** value if the Max Units value is not correct for any assignment:
   i. If the Max Units entered in the Resource Sheet is correct, you can leave this blank and it will autofill.
10. Click the **OK** button (no assignment is made until the OK button is clicked).
11. Note that Work is calculated and the activity duration value did not change.

When creating resource assignments, keep the following in mind.

Exhibit 9.20

Resource Assignment



Source: Microsoft Corporation.

- **Duration** is the number of time units between the activity start and end (the default display value is in days spanning eight work hours).
- **Units** represents the availability of a resource for work each day.
- **Work** (hours assignment) is calculated by multiplying the Duration value (converted to hours) by the Units value.
- **Task type** determines which of three values (duration, units, and work) changes when one of the other two is modified (choices are Fixed Units, Fixed Duration, and Fixed Work).

(*Note:* For the rest of this tutorial's screenshots, all resources will be assigned to multiple tasks in the Suburban Park Homes project. You can do the same, but your screenshots may not exactly match the ones in the rest of the tutorial).

Basic Assignment Calculation With Fixed Units Selected (Default Settings) When an assignment is made, MS Project uses the Duration and Units values to calculate the number of hours a resource will work on the activity. In the Task Usage View (**View Tab>>Task Views>>Task Usage**), the Work field value in an activity row (e.g., *Electrical*) is the sum of the Work field values for resources assigned to that task. In the Resource Usage view (**View Tab>>Resource Views>>Resource Usage**), the Work field value in a resource row (e.g., *Bruce*) is the sum of the Work field values for tasks assigned to that resource. Here are some basic calculations that MS Project makes with resource assignments:

- **Activity with no prior resource assignments**
  - MS Project uses the Duration and Units values to calculate the assignment work value and sums the assignment work values into the activity Work field.
  - The assignment of a 100 percent available resource (Units=100%) to a two-day-duration activity (eight-hour days) results in 16 hours of resource work across the two-day duration.
    - [(%resource available converted to decimal) × 8(hour workday) × 2(workdays) × 1(number of resources)
      = 16(hours of the resource working on the task)]
  - An assignment of two 75 percent available resources (Units = 75%) results in 24 hours of work assigned across the two-day duration.
    - [.75(% resource available converted to decimal) × 8(hour workday) × 2(workdays) × 2(number of resources)
      = 24(hours of the resource working on the task)]
- **Activity with one or more resources already assigned**
  - When yet another resource(s) is added, MS Project holds the activity Duration value constant and adjusts the activity Work value.
  - The *addition* of a 100 percent available resource (Units = 100%) to a two-day duration activity that already has a 100 percent available resource assigned results in thirty-two hours of activity work across the two-day duration activity, with each resource assigned sixteen hours of assignment work.
- **Removal of resources works in reverse of the above**
  - Removal of the resource from an activity with one resource assigned results in zero task work.
  - Removal of one resource from an activity with two resources assigned results in the activity duration held constant, work calculated for the remaining resource assignment, and the activity work value the same as the assignment value.

Modifying An Assignment After a resource assignment is made, MS Project maintains the relationships among the Duration, Units, and Work values. To see this behavior in action:

1. Ensure the **Task Form View** is activated in the lower pane.
2. Select a task that has resources assigned to it in the upper Gantt chart pane.
3. In the Task Form View options, set the "**Task type**" drop-down to **Fixed Units**.

- If you change the Duration and click OK, MS Project changes the assignment work and task work values.
- If you change the Work and click OK, MS Project changes the duration and assignment work values.
- If you change Units and click OK, MS Project holds the assignment work value constant and changes the task duration.
- When modifying resource assignment, keep the following in mind:
  - If you don't like MS Project adjusting the Duration value as you add and remove resources assignments, an alternative is to switch the "Task type" setting in the Task Form View to **Fixed Work**.
  - Note: If desired, you can make this a ***global change*** in the MS Project for all new projects in two steps:
    - Click **File Tab>>Options>> Schedule>>** change "Default task type" to **Fixed Work**.
  - Change "Scheduling options for this project" to **All New Projects**.
- Since trying different resource assignments on an activity makes it easy to lose the original duration value, you may find saving the original estimated duration value helpful:
- Click the **Task Tab>>Gantt Chart>>** right-click **Duration column heading>> Insert column>>**enter **Duration 1**.
- Right-click the **Duration 1 heading>>Field Settings>>** enter **Estimated Duration** in the Title box to name the column.
- You can now enter the duration of any task you want to play with and not lose the original duration.

9.11d Step 4: Finding Overallocated Resources

Resource overallocation usually occurs when a resource is assigned to two or more activities whose start and finish dates overlap, or if an assignment Units value is greater than the resource's Max Units value. The Gantt chart's "**Indicators**" field (first column with "i" icon) will display a red stick figure if an assigned resource is overallocated.

MS Project can find and understand resource overallocation to help project managers determine solutions; however, most solutions cannot be automatically implemented. For instance, you can level resources to resolve most overallocations by delaying the start of all but one of the conflicting activity assignments by clicking the **Resource Tab>>Level Resource**. While powerful and quick, it may produce an unacceptably lengthened schedule. This automated tool is just one of many solution options that the project manager must evaluate.

Resource Allocation View With slight modification, the Resource Allocation View is very helpful to find and analyze resource overallocation. The Detail Gantt marks the critical path (red) and graphically displays free slack following each activity (how much the activity can be delayed before creating a new, longer critical path). In addition, you also will be able to see the total assignment hours for each resource in the upper pane. To do so, make the following changes:

1. Click the **Task Tab>>View Group>>Gantt Chart** drop-down menu >>click **More Views**.
2. On the **More Views dialog**>> scroll to **Resource Allocation**>> click **Edit**.
3. On the **View Definition dialog**>> click **Details Pane** drop-down >> choose **Detail Gantt**.
4. Click the **Show in menu** checkbox.
5. Click **OK**>> click **Apply**.
6. In the upper pane, right-click the **Work column header**>>**Insert Column**.
7. Enter **Max Units**>> click **Enter**.
8. In the lower pane, right-click the **Leveling Delay column header>>Insert Column**.
9. Enter **Work**>> click **Enter**.
10. In the upper pane, click the empty box to the left of the Indicators icon to select all rows.
11. Click the **View Tab>>Data Group>>Outline**>> click **Hide Subtasks**.

The results of these steps can be seen in Exhibit 9.21.

The Resource Allocation View is a combination view with the Resource Usage view in the upper pane and the Detail Gantt view in the lower pane. The timescale in the upper pane is synchronized with the Gantt graphic in the lower pane, and adjusting the zoom affects both panes. Once you have adjusted settings in the steps above, you can quickly reach this view by clicking the **View Tab>>Resource Views Group>>Resource Usage>>Resource Allocation**.

The Gantt bars in the lower pane represent the duration of the work hours displayed in the upper pane. Selecting a resource in the upper pane's table displays the assignments of that resource in the lower pane. If the resource data in the upper pane's table is red, that resource is overallocated (you will also see a red stick figure in the Indicators column). In Exhibit 9.19, Bruce, Liam, and Oliver are all overallocated.

Exhibit 9.21

Resource Usage and Detailed Gantt Views

Source: Microsoft Corporation.

A straightforward method to analyze overallocated resources in this view is as follows:

1. Set the timescale to the start of the schedule.
2. Slowly scroll the timescale toward the end of the schedule.
3. Analyze each instance of cell values displayed in red for cause and severity.

9.11e Step 4: Dealing with Overallocations

Once overallocations are identified, the project manager has many options. In this tutorial, MS Project is a tool only. It helps identify overallocations, but the project manager is responsible for deciding what to do with them. Remember, each action will have associated risks, and often one change can "break" something down the line, so be sure to protect your critical path. Below are a few choices:

- Replace an overallocated resource with one that has time for the assignment.
- Reduce the Units assignment, extending the activity duration (this could affect the finish date of the project).
- Lessen the scope of one or more activities.
- Ignore the overload if the resource impact is temporary.
- Try **Resource Tab>>Level Group>>Level Resource** or **Level All** and see what happens to your timeline (remember, the Undo command is **Ctrl-Z**).

9.11f Crashing a Critical Path Activity

If your overall project duration needs to be shortened, one way to accomplish it is to "crash" an activity on the critical path. Crashing is simply adding resources to a task to shorten the time it takes to complete it.

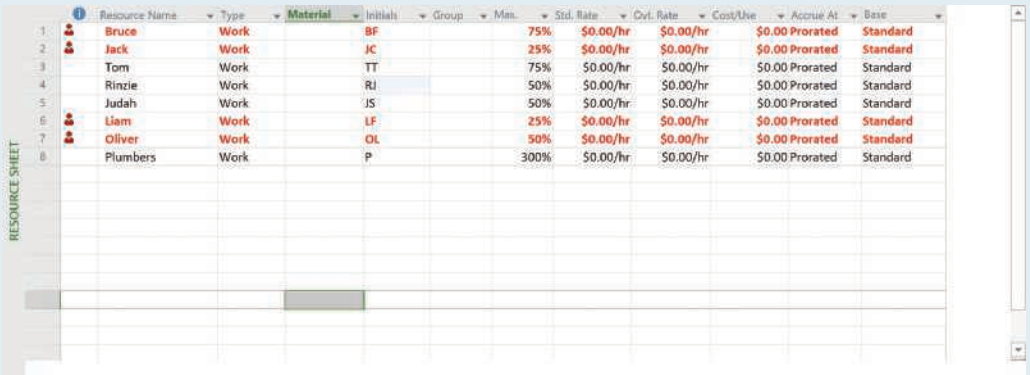
For this example, we will add three Plumbers to our Resource Sheet and then add them to the Plumbing task to crash the activity and shorten the overall project length:

1. Click the **View Tab>>Split View>>** uncheck **Details**.
2. Click the **View Tab>>Resource Sheet**.
3. In the next available row, type "**Plumbers**" in the **Resource Name** column.
4. In the **Initials** cell, enter the initials of the resource (if different from the auto-generated).
5. Click the **Max Units** cell and enter the resource's maximum availability as 300 percent. (This means the project has three plumbers who can work 100 percent of the time on the project.)
6. Your Resource Sheet should now look like Exhibit 9.22.
7. Click the **View Tab>>Task Views>>Gantt Chart**. (Readjust timescale and column views as needed; ensure you can see the Start and Finish columns.)
8. Double-click the **Plumbing** task>> **Resources Tab**.
9. In the first row of the Resource Name column, drop-down menu and choose **Plumbers>>** click **OK**.
10. This assigns one plumber to work on this task (100%).
11. You will notice work hours are added, but neither the critical path nor project's duration has changed.
12. Now assume that the project manager decides the Plumbing task needs to be completed more quickly, and the decision to crash that task is made.
13. Double-click on the **Plumbing** task **>>Resources Tab** again.
14. Change the Units from 100% to 300%. (This will assign three plumbers to the task.)
15. Click **OK**. (See Exhibit 9.21.)

16. You will now see that the critical path Gantt bar has shortened, the duration of the task has shortened, and the overall project finish date has shifted back (because Plumbing was a critical path activity).
17. Good job! You just got the plumbing done sooner!

Exhibit 9.22

Defining Resources

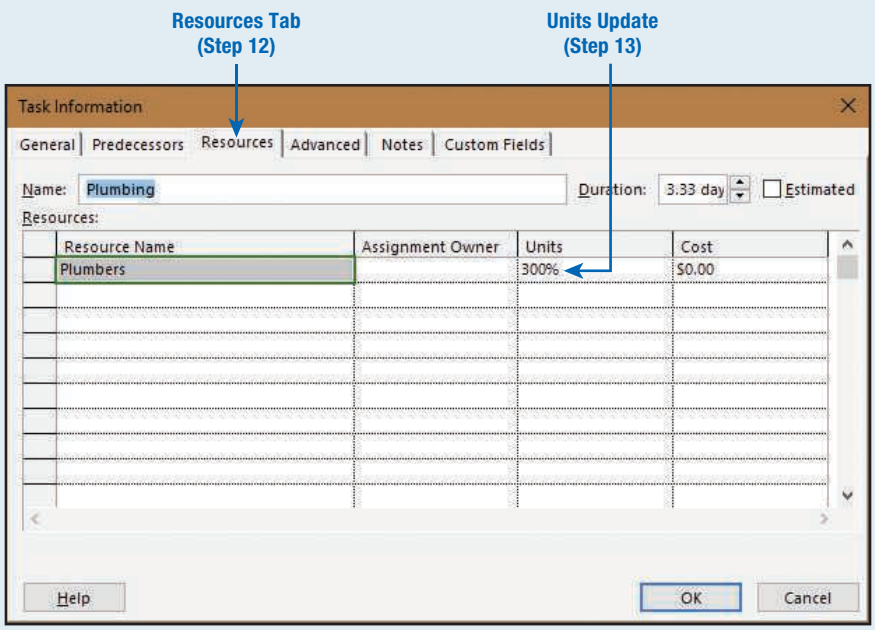


	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base
1	Bruce	Work		BF		75%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
2	Jack	Work		JC		25%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
3	Tom	Work		TT		75%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
4	Rinzie	Work		RJ		50%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
5	Judah	Work		JS		50%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
6	Liam	Work		LF		25%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
7	Oliver	Work		OL		50%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard
8	Plumbers	Work		P		300%	$0.00/hr	$0.00/hr	$0.00	Prorated	Standard

Source: Microsoft Corporation.

Exhibit 9.23

View Definition Dialog Box



Source: Microsoft Corporation.

Remember that you only want to crash tasks on the critical path because they will be the only tasks to shorten the overall project. Also, keep in mind that crashing is simply one option available to the project manager. Sometimes throwing more resources at a task is not the best option. For simplicity's sake, we added more plumbers in this example. However, sometimes adding more human resources can end up increasing the time it takes to complete a task. Not every resource may be as qualified or up to speed as the next, and time-consuming spin-up or training might be required before they can be effective helpers on a task. Also as noted earlier, rarely can a resource be available 100 percent of the time. When an activity is crashed, the project manager still has to worry about overallocation of resources and the consequences of removing resources from one task to put them on another.

Summary

Resourcing projects go hand-in-hand with scheduling (Chapter 8) and budgeting (Chapter 10). To ensure that adequate human and other resources are assigned to a project, first, the project manager needs to look at the listed activities and estimate the resources needed to perform each. After identifying the potential resources, their availability needs to be confirmed. The project manager requires negotiation skills to secure the services of the desired people and resources. Usually, some people assigned to the project are ready to go, while others need training and/or mentoring. Project teams rely on co-located and/or outsourced team members for project execution.

Several tools are useful in identifying and scheduling people and resources. A human resource management plan with role descriptions and a staffing management plan helps the team development plan. Resource assignments are often posted directly on a Gantt chart schedule. RACI charts are matrices that depict work activities on the vertical scale (often in the form of a WBS) and the various people who are involved on the horizontal scale. Work responsibilities are shown by code in the cells. Once workers have been assigned, responsibility histograms can be developed for each worker to determine whether they are overloaded at any point.

The combination of the critical path schedule with resource assignments and the resource histogram allows project planners to determine who is overloaded, at what time, and by what activities. Resource leveling is the method of using this information to reduce the peak demands for workers by postponing some of the non-critical activities within the duration of available slack. Sometimes this solves the problem. If not, some work might be assigned to a different person, the schedule might be delayed, the project scope might be reduced, and/or other methods might be employed. Often, the sponsor will want to be involved in making these decisions.

Once the project schedule is established and resources are assigned, it sometimes appears that the scheduled completion date is not attainable. In these cases, it is common to look for methods of accelerating (or compressing) the project schedule. One frequently used method is crashing, in which a decision is made to pay extra money (often in the form of overtime pay) to speed up certain activities on the critical path. Another frequently used method is fast tracking, whereby activities that are normally conducted in sequence are either overlapped or performed in parallel. Fast tracking can lead to faster schedules. However, the risk is increased because the activity that normally is a successor depends on the output of its predecessor, and if that output is not as expected, the successor activity may need to be reworked.

Several alternative methods of scheduling can be used alone or combined with traditional scheduling and resourcing. These methods include critical chain, reverse phase, rolling wave, Agile, and auto/manual scheduling. Experienced project managers attempt to use the best ideas from several of these alternative approaches.

On Agile projects, the team ideally stays together for long periods of time. This enables team members to learn more so they can plan and commit to the amount of work for each iteration and so they can work together to quickly overcome problems.

Project scheduling software such as Microsoft Project is extremely useful when determining the resources for a project. This software helps pinpoint exactly when each worker is needed, for what activity, and where there are overloads. Despite the power of these scheduling systems, they do not make all of the decisions for a project. The project manager needs to understand the output of the software and be able to ask several what-if questions. Ultimately, the project manager needs to make the decisions—often in conjunction with the sponsor.

Key Terms Consistent with PMI Standards and Guides

estimating activity resources, 326
plan resource management, 326
staffing management plan, 327
responsibility matrix, 328
resource breakdown structure (RBS), 329
responsibility assignment matrix (RAM), 335
RACI chart, 335
resource leveling, 339
fast tracking, 341
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Key Terms Consistent with Agile Practice

Velocity, 351
Cadence, 351
Cycle Time, 351
Swarm, 351
Release Decision, 351

Chapter Review Questions

1. In addition to technical skills, what other skills must a project manager look for to successfully resource a project?
2. Why is it important to involve workers in the planning phase of a project when possible?
3. What does a staffing management plan address?
4. What are the three "r" activities that take place near the end of a project, regarding team members and timing issues?
5. What does RAM stand for, and what is its purpose?
6. What does each column of a RACI chart depict?
7. Why is it necessary to have only one person assigned primary accountability for an activity?
8. What can a project manager use to help determine if workers are overloaded?
9. Whom should the project manager consult when performing resource leveling?
10. What will happen to a project's schedule if an activity on the critical path is delayed? If an activity is not on the critical path?
11. Regarding resource leveling, why are non-critical path activities generally the first to be delayed?
12. What are the two techniques used to compress a project schedule?
13. When crashing a project, what two criteria are considered when deciding which activities to speed up?
14. In addition to the predecessor–successor relationships, what does critical chain project management (CCPM) factor into its scheduling?
15. Who develops the schedule when using Reverse Phase Scheduling?

Discussion Questions

1. Identify three examples of when a project manager uses technical skills and three examples of when they use behavioral skills.
2. Compare a project you've worked on that was limited mostly by activities with another project you've worked on that was limited mostly by resources. Which did you find more challenging? Why?
3. List at least four factors a project manager should consider when identifying individuals to work on a project. Why is each important?
4. Describe a potential timing issue that can occur early in a project and a potential timing issue that can occur at the end of a project. How would you address each of these issues in your project?

5. Describe two ways a project manager can resolve resource overloads. Under what circumstances should each be used?
6. Describe how to perform resource leveling.
7. Give an example of what is given up in a project when it is crashed and when it is fast-tracked and an appropriate time to use each.
8. Cite problems with traditional project scheduling techniques and why some organizations might opt to use critical chain project management.
9. List three common problems that can occur when traditional critical path scheduling is used. How would you address each?
10. As a project manager, how can you ensure that your activity and resource estimates are as accurate as possible?
11. Give an example of a project on which you might expect to see Reverse Phase Scheduling.
12. How are resources scheduled on Agile projects as compared to resource scheduling on traditional projects?
13. Who leads an Agile project team? Might this change throughout the project?
14. What information must you have and what judgment must you exercise to successfully utilize a project planning software like MS Project?

PMP Exam Study Questions

1. Crashing the following activity chains would save time and cost extra money as follows:

   AGJQ—2 days $300
   CDIL—3 days $400

   Which sequence of activities would you, as a project manager, choose to crash?
   a. AGJQ
   b. CDIL
   c. neither AGJQ nor CDIL
   d. depends on which, if either, is on the critical path
2. A _____ addresses when and how project team members will be acquired and how long they will be needed.
   a. resource histogram
   b. staffing management plan
   c. project organization chart
   d. responsibility matrix
3. The process "Estimate Activity Resources" involves identification of the _____ and _____ of resources required for each activity within a work package.
   a. types; quantities
   b. costs; quantities
   c. names; locations
   d. types; costs
4. A schedule in which activities have a firm, fixed order of completion is most likely:
   a. resource-constrained
   b. cost-constrained
   c. scope-constrained
   d. none of the above
5. A "schedule compression technique in which activities or phases normally done in sequence are performed in parallel for at least a portion of their duration" is referred to as _____.
   a. critical path
   b. critical chain
   c. crashing
   d. fast tracking
6. In RACI chart, the single individual who will have to provide an explanation if something goes wrong is indicated with a(n) _____
   a. R—Responsible
   b. A—Accountable
   c. C—Consult
   d. I—Inform
7. The "process of identifying and documenting project roles, responsibilities, required skills, reporting relationships, and creating a staffing management plan" is called _____.
   a. Identify Stakeholders
   b. Create Stakeholder Management Strategy
   c. Plan Resource Management
   d. Acquire Project Team
8. After creating a Staffing Management Plan, the project manager and team might create a chart that provides a visual representation of project resource needs by type of resource and time period (weeks, months, etc.) This chart is called a(n) _____.
   a. project Gantt chart
   b. resource histogram
   c. network diagram
   d. organization chart

9. An iterative planning technique where "the work to be accomplished in the near term is planned in detail, while the work in the future is planned at a higher level" is referred to as _____.
   a. three-point estimating
   b. rolling wave planning
   c. parametric estimating
   d. analogous estimating

10. When the demand for resources is greater than the available supply, the project manager can use a scheduling method that adjusts the start and finish dates of activities to address resource limits or constraints. This technique is called _____.
   a. fast tracking
   b. crashing
   c. resource leveling
   d. critical path method

Exercises

1. A certain project has three activities on its critical path. Activity A's normal completion time is five days. It can be crashed for three days at a cost of $500. Activity B's normal completion time is six days, and it can be crashed to four days at a cost of $50. Activity C's normal completion time is eight days. It can be crashed for three days at a cost of $1,000. Which activity should the project manager crash and by how many days? How much will it cost?
2. Using the data below, create the project schedule using normal times. Determine the order in which you would crash the project one day, two days, and so on until it is in an all-crash mode. Identify how much it would cost for each day you crash the schedule.

Activity	Predecessor	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
A	–	12	200	9	350	
B	A	8	300	8	300	
C	A	9	250	7	450	
D	B	6	400	5	600	
E	B, C	5	150	4	225	
F	C	10	500	9	650	
G	D, E, F	8	400	6	900	

3. Using the data below, create the project schedule using normal times. Determine the order in which you would crash the project one day, two days, and so on until it is in an all-crash mode. Identify how much it would cost for each day you crash the schedule.

Activity	Predecessor	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
A	B	5	200	4	350	
B		8	220	8	220	
C	B	6	250	4	650	
D	A	9	500	5	600	
E	A, C	10	150	9	500	
F	E	10	500	9	650	
G	D, F	8	400	6	900	

4. Using the data below, create the project schedule in MS Project. Be sure to use both the predecessor relationships and the resource assignments. Use a split-screen to show both the Gantt chart with critical path and resource assignments with overloads.

WBS	Activity	Immediate Predecessor	Duration in Weeks	Resource
1	**Operational definition**			
1.1	Research literature		3	Becky
1.2	Identify and define terms	1.1	1	Ann
1.3	Obtain approval of definition	1.2	2	Clive
2	**Target selection**			
2.1	Solicit partners for pilot		2	Ann
2.2	Hold brainstorming meeting	2.1	2	Becky
2.3	Identify characteristics of targets	2.2, 3.1	1	Ann
2.4	Obtain approval of partners	2.3, 1.2, 3.4	1	Clive
3	**Question set**			
3.1	Identify process group members		2	Clive
3.2	Develop question set	2.3	4	Ann
3.3	Prototype and validate question set	3.2	3	Becky
3.4	Add partners	3.1, 2.1	3	Becky
4	**Pilot process**			
4.1	Schedule with target audience	2.4	2	Becky
4.2	Conduct beta test	3.4, 2.4	2	Clive
4.3	Process feedback from target audience	4.2	2	Ann
4.4	Conduct pilot	4.3	2	Clive
4.5	Analyze results	4.4	2	Clive

5. Using the data below, create the project schedule in MS Project. Be sure to use both the predecessor relationships and the resource assignments. Use a split-screen to show both the Gantt chart with critical path and resource assignments with overloads.

	Activity	Immediate Predecessor	Duration in Days	Resource
A	Evaluate freezers		2	Alcides
B	Chart temperatures		6	Joan
C	Review service record		2	Alcides
D	Consult with HVAC engineer	A, B, C	3	Alcides
E	Develop construction plan	D	10	Joan
F	Complete IC assignment	E	2	Alcides
G	Complete ROI analysis	E	5	Joan
H	Conduct regulatory review	E	4	Joan
I	Obtain construction approval	F, G, H	2	Alcides

Integrated Example Projects

Suburban Homes Construction Project

Refer to the project charter from Chapter 3, WBS in Chapter 7, and the project schedule in Chapter 8. The initial scope as identified in the project charter is mentioned below:

Building a single-family, partially custom-designed home as required by Mrs. and Mr. John Thomas on Strath Dr., Alpharetta, Georgia. The single-family home will have the following features:

- 3,200 square-feet home with 4 bedrooms and 2.5 bathrooms
- Flooring—hardwood on the first floor, tiles in the kitchen and bathrooms, carpet in the bedrooms
- Granite kitchen countertops, GE appliances in the kitchen
- 3-car garage and external landscaping
- Ceiling—10′ on the first floor and vaulted 9′ ceilings in bedrooms

After developing the WBS and the project schedule using the CPM method, you were asked to identify resources for all the activities identified in the schedule. To begin, you need to identify all the available resources in-house and resources required externally. One of the promising practices is to develop a resource breakdown structure (RBS). Once the RBS is completely developed, please perform the following tasks.

Tasks to Complete

- Identify resources (people, materials, equipment, etc.) required for each element in the schedule.
- Analyze resource constraints (the same resource may be required for two or more activities at the same time) based on resource availability.
- Develop a responsibility assignment matrix (RAM) and RACI table.
- Develop a resource histogram for the entire project.
- Identify resource overloads and propose resolutions to address them by resource leveling.
- Estimate time required to complete each work element by considering resource constraints.
- If required, calculate the project schedule again. Compute forward pass and backward pass to determine project duration. Determine the critical path for the project.
- If the new project duration exceeds the commitment deadline, develop schedule-compression strategies to complete the project on time.
- Develop a resource calendar.
- As a part of this exercise, update the WBS and project schedule, if required.

Heritage Arboretum Development Project

The team planning and managing the arboretum development project is composed mostly of volunteers but includes some township staff. Several volunteers have related professional experience and credentials such as certified arborist, master gardener, and landscape architect. Almost all of the volunteers have been through a two-year series of classes and assignments conducted by the state forester. Some of the staff have also studied under the state forester and each has experience in some aspect of the needed work.

Questions:

1. How do you think the team members should estimate the amount of work they can accomplish during each iteration?
2. Should the team seek more volunteers? If so, how should they supervise them? Where should they seek additional volunteers? What stories should they have the volunteers work on?

Semester Project Instructions

For your example project, create the following:

1. A Human Resource Management plan, including role descriptions and staffing management plan
2. RACI chart
3. Gantt chart with resource assignments
4. Histogram of demands on each key participant's time
5. Plan for resolving resource overloads

Project Management *in Action*

Practical Challenges and Partial Solutions to Project Resourcing

A graphic (or output from common planning tools) ends up like a spreadsheet or Gantt chart with people's assignments calendarized across time. Sometimes these tools try to consider a % utilization to perform resource leveling. A listing of resources with the projects each is working and a judgment call on whether they can take on more work is the best one can do with a tool. Visuals often highlight problems but do not supply solutions. Remember that most resources are people and not machines that tend to be more predictable. Below are several problems with using tools for project resource management along with a few ideas of how to mitigate some of the impacts of these problems. Having strong professional and trusting relationships with resources and stakeholders alike will provide significant benefits in working through many of the problems and opportunities described below.

Problems:

- Time Horizons
  - Planning horizons are often long and exceed the ability to forecast accurately.
  - A graphic that is based upon assigned tasks and durations that have been leveled often pushes work beyond the desired completion date.
  - Resource (and other plans) that are accurate when developed become immediately out of date as many real-world things happen.
- Quality of plans
  - Information is only as good as the project plans defining the work.
  - Tools create a false sense of precision and accuracy.
  - Estimating and risk planning are not precise.
- Productivity
  - Multitasking is a myth.
  - Context-switching takes time and mental energy.
  - Full-time equivalent (FTE) productivity is more like 70 to 80 percent rather than 100 percent.
- Multi-project issues
  - Tools are used to aggregate across projects.
  - It is hard to schedule a new project unless the current one is finished.
  - Overruns on one project impact other projects.
- Amount and quality of resources
  - One cannot buffer too much against problems, as bench time is not billable.
  - Most organizations have fewer resources than work expected of them.
  - Most organizations do not have the budget to hire more resources.
  - The number of people in the workforce is declining, partly due to retirements and COVID.
  - Suppliers are backlogged and cannot reliably supply workers or materials.
- Disruptions
  - Workers' personal issues disrupt plans.
  - Time is lost on conference calls and work on non-assigned projects.

Partial Solutions

- Time horizons
  - Many work with key stakeholders to understand expectations and influences outside of the defined boundaries of the project. Balance expectations to initial time horizons and communicate with project champions and key stakeholders as soon as possible where there can be disconnects.
  - Typically on plan-driven projects the longer the time horizon, the more risk is involved, especially later in the timeline. Use lower percentages of planning accuracy farther out.
  - Typically on Agile projects, iterative deliverables come early in the time horizon and almost always change the overall outcome of the total project. Work with project champions to understand their expectations, and monitor business changes that could redirect deliverables over time.
  - Know the project resources and have an open and trusting relationship that will yield earlier insight into things that could potentially change their availability to the project.
  - When possible, look at previous projects timelines, learnings, and retrospectives and talk with people who were involved. How did execution compare to original timelines on the other projects? This helps highlight potential timing risk categories unique to that organization.
  - Use shorter time frames to plan and commit.
  - Create realistic estimates on resource times. I have never seen a resource that is 100 percent available. Typically, I use 65 percent for full-time resources.
  - Look to the degree of creativity required on this project. The more repetitive and operational a project is, the more predictable. The higher degree of creativity or innovation required the better iterative approaches are, including managing stakeholder expectations.
  - Engineering and math disciplines typically use higher degrees of precision, which is impractical. It is better to be approximately correct in estimating than precisely inaccurate.
  - Use successive approximation or evaluation in developing and revising plans. Be open about the level of approximation and evaluation in regards to deliverables. *Under promise and over deliver* is most often accepted.
- Productivity
  - Say no when the resource capacity is not available.
- Multi-project issues
  - Assign workers full-time to a single project.
  - Understand the environment and operational culture of the department or group that the project resources come from. Groups that have a very high focus on support and quick business reaction typically have poor track records with project deliverables to anticipated timelines because the urgent help requests always take priority over project deliverables in both predictive and iterative approaches. When in this environment, set clear expectations that deliverables may be delayed based on support demands of the business.
- Amount and quality of resources
  - Ensure your staff is trained with the skills they need.
  - Staff and backfill positions as needed.
  - Many organizations have higher ambitions of what they want to accomplish than the understanding of the resources available to deliver. Some understand their limitations and still expect to produce deliverables with fewer resources. This is where developing a collaborative and cooperative project team is critical. The team that understands there will be long working hours and has a strong culture of collaboration has the greatest chance of success.
  - Frequently remind the team of what the end goal is. Be sure to consider this when developing plans and schedules.

- Using less precise scheduling techniques and more summary graphics of deliverables over time seem to have the greatest acceptance and success.
- When Suppliers are backlogged and cannot reliably supply workers or materials, have open and frequent discussions with them and review their corrective action plan to get back on track. Have alternative suppliers available that could step in. A smaller supplier that is eager for the business may deliver greater results. Sometimes a supplier sensing competitive loss will find creative ways to fulfill their commitments.
- Become an active member of your local professional association and attend their meetings and events. Many times through networking and casual interaction at these events you will find others are having similar quantity and quality of resource issues.

- Disruptions
  - Use sprints and daily stand-ups.
  - Resist political influence.
  - Ensure people are working on what they are supposed to be.

Source: Dan Eslinger, PMP, CSSBB, IT Global Program Manager and Dave Davies, PMP, PgMP, PBA, ACP, CSM, DASSM, MC-HA, PMI-ATP

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Endnotes

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Chapter 10

Budgeting Projects

Chapter Objectives

Core Objectives:

10-1 Define project cost terms and explain how each term is used in estimating project cost.

10-2 Compare and contrast analogous, parametric, and bottom-up methods of estimating cost.

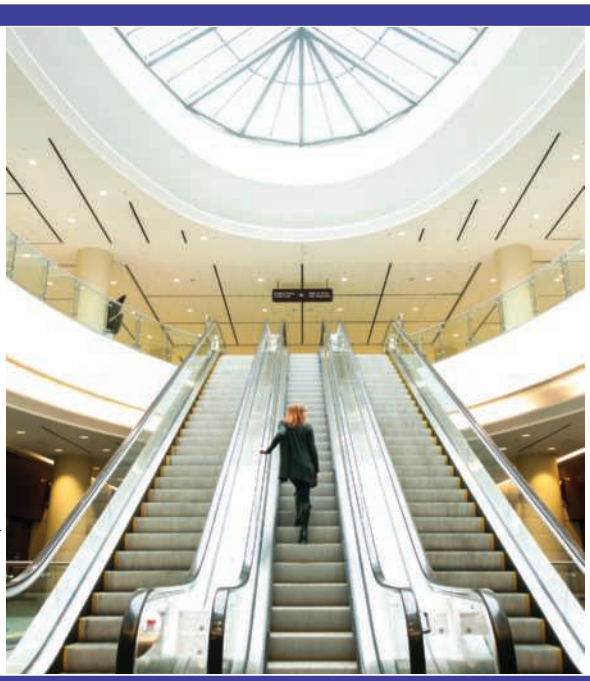
10-3 Describe potential issues in project cost estimating and remedial approaches to deal with each issue.

10-4 Create a time-phased, bottom-up budget for a project.

10-5 Show both summary and bottom-up project budget information with cumulative costs using MS Project.

Agile Objective:

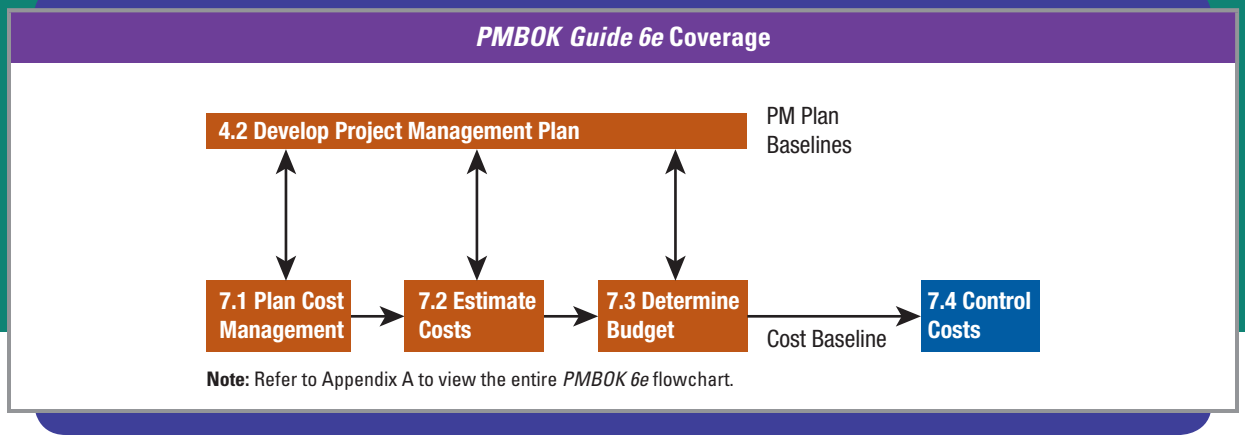
10-6 Describe how to use spikes and the shift left concept to address specific cost uncertainties.



All Canada Photos/Alamy Stock Photo

I sold escalators and elevators for my first job out of business school. As part of my training, before I was sent to the field, I would look over the estimates made by the sales staff. This served to double-check their math, so the company had confidence in their estimates. It also served to teach me many of the little nuances that more experienced estimators used. I had my training manuals, lists of standards, main methods of calculation, and so forth, but learning from others' experiences instead of making all my own mistakes helped.

One of the last parts of my training was to spend eight weeks at the Denver branch to get seasoned a little bit. Construction was booming in Denver during the late 1970s. In fact, some days I needed to bid on more than one job. The first part of putting together a bid was to go to the office where the requests for proposals, plans, specifications, and the like were stored. Then, armed with that information, I would put together an estimate. Finally, the actual bidding took place—usually over the phone. The problem was that creating a detailed estimate



PMBOK Guide 7e
Domains:
- **Planning**
- **Measurement**
- **Uncertainty**

would generally take at least half a day. If that was my only duty (it was not), I would still have had a hard time when multiple jobs were left for bid on the same day. Something had to give.

Every morning around 10 A.M., I met the construction superintendent for coffee. We would discuss each bid that was due. What other job was it like? How was it bigger or smaller than a recently completed job? What features did it include beyond or less than a previous job? Did we make money on that job? We used these questions to compare an upcoming job to other recently completed jobs. We would also ask, "What do we think our competition will bid?" By the end of the conversation, we had determined our strategy for bidding the job. If we won the bid, we would complete a detailed cost estimate to see if we were close.

After my training, I was transferred to Kansas City. Kansas City had less construction than Denver. I had enough time to perform detailed cost estimates before I submitted bids. Therefore, we were more certain that if we got the bid, we would have a good chance of making money.

I worked for the same company in both cities. However, we used two very different methods of estimating cost. Both made sense where they were used. In Denver, if we wanted to bid on every job (and you cannot win the job if you do not bid on it), we needed a fast method. In Kansas City, we had the time to develop detailed cost estimates, and so we took the time. There are many methods of estimating project costs, and each has its place.

—Timothy J. Kloppenborg

10.1 Plan Cost Management

This chapter starts with estimating project costs. Once the overall cost is estimated, the next step is to develop the budget by aggregating the costs and determining the project's cash flow needs. Project managers also need to establish a system to report and control project costs. The final section of the chapter deals with how to use Microsoft Project to aid in cost management activities.

Cost and schedule are closely related. Sometimes, the two move in the same direction. The schedule is maintained by the use of resources, and resources expend parts of the budget. For example, when a schedule calls for materials to be delivered or for workers to perform, money must be available to pay for the materials or workers. Sometimes, they move in opposite directions. For example, if a project needs to be completed earlier than planned, more money probably will need to be found to pay for overtime.

Plan cost management is *the process to determine how to plan, estimate, and control project costs*. Cost planning entails developing a cost management plan for your project. The **cost management plan** *includes forecasting and refining cost estimates of all the project activities throughout the duration of the project*. In other words, the cost management plan is integral to the plan cost management process.

The cost management plan defines the cost baseline, modifies it whenever necessary, and uses it for monitoring and controlling costs. On small projects, this can be as simple as developing accurate estimates, securing the funding, and designing cost reporting procedures to ensure that the money is spent correctly. On large projects, each of these processes can be detail-oriented and much more involved because developing and using accurate cash flow estimates become critical for large projects. A project cost management plan includes descriptions, procedures, and responsibilities for the following:

- Costs included (such as internal and external, contingency, etc.)
- Activity resource estimating
- Cost estimating
- Cost baseline
- Budget determination
- Cost control, including metrics, reporting, and change approvals

A project cost management plan must be consistent and aligned with the methods of the parent organization. In many organizations, project managers are provided with specific guidance on setting up their cost management plan. The plan provides guidelines to the project manager and other stakeholders to serve several purposes such as:

- showing, first and most fundamentally, how to develop and share relevant, accurate, and timely cost information that the project manager, sponsor, and other stakeholders can use to make intelligent and ethical decisions;
- providing feedback, thereby showing how the project's success is linked to the business objectives for which it was undertaken;
- providing information both at a detailed level and at appropriate summary levels, based on needs of the recipients; and
- helping all project stakeholders focus appropriately on schedule and cost performance.[1]

10.2 Estimate Cost

Estimate cost is *the process of developing an approximate and best guess of the monetary value of resources needed to complete all project activities*. Cost estimating is linked closely with scope, schedule, and resource planning and is often performed simultaneously with creating the schedule. For clarity, we cover cost estimating by itself in this chapter. To understand cost implications completely, a project manager needs to understand what the work of the project includes, what schedule demands exist, and what people and other resources can be used. When more of these details are available, such as schedule and resource constraints, the cost estimates can be more precise.

The first principle in dealing with project costs is for the project manager to never lie to themselves. Many times, in dealing with project costs, the project manager will need to negotiate with sponsors, customers, and other stakeholders. If they do not understand what the project costs really are, they are just trading meaningless numbers. That is neither an effective nor an ethical method of establishing and committing to sensible budgets.

The second principle in dealing with project costs is for the project manager to never lie to anyone else. Since sponsors, customers, and other stakeholders can often engage in

hard bargains, it is sometimes tempting to shade the truth to secure the necessary funding. This is wrong on two counts: First, it is ethically wrong and, second, as a practical matter, a project manager's reputation goes a long way for good or for bad. People are more inclined to work with project managers who are viewed as being honest and trustworthy.

To estimate project costs accurately, the project manager must understand the various types of costs, the timing, and accuracy of cost estimates, the different methods that can be employed to estimate costs, and a variety of cost-estimating issues.

10.2a Types of Cost

Costs can be better understood by considering various types of classifications such as those shown in Exhibit 10.1.

Fixed versus Variable Costs Costs can first be classified as either being fixed or variable. **Fixed costs** *are those that remain the same regardless of the size or volume of work*. For example, if you need to buy a computer for your project, the cost is the same regardless of how much you use it. **Variable costs** *are those that vary directly with the volume of use*. For example, if you were building a cement wall, the cost of the cement would vary directly with the size of the wall. To understand the importance of fixed versus variable costs, a project manager ideally structures costs and the impact of changes on those costs. When a project manager understands how big a project is likely to be, they will try to determine how to complete all of the project work at the lowest possible cost. On many projects, there are choices of how to perform certain activities. Some of these choices reflect a high-fixed-cost and low-variable-cost alternative such as buying an expensive machine that can make parts with low variable costs versus a more manual process of inexpensive machines but high labor costs. These choices require both some fixed and some variable costs. Ideally, the cost curve for the expected project volume appears, as shown in Exhibit 10.2. This reflects the lowest possible total cost at the size the project is expected to be. Unfortunately, problems may occur if the volume of the project work is substantially larger or smaller than first expected. If the volume drops a little bit, the total costs may drop very little. If the volume expands a little, the costs may go up significantly. Therefore, when considering fixed and variable cost choices, it is important to understand the project scope.

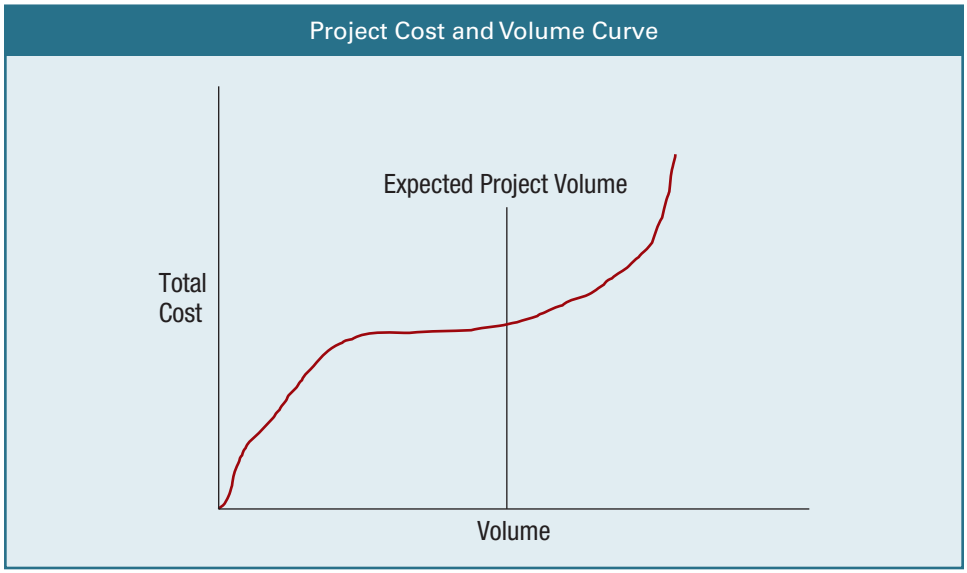
Exhibit 10.1

Comparison of Cost Terms

Fixed	Variable
Direct	Indirect
Recurring	Nonrecurring
Regular	Expedited
Internal	External
Lease	Purchase
Labor	Material
Estimate	Reserve

Source: Adapted from LaScola Needy, Kim, and Kimberly Sarnowski, "Keeping the Lid on Project Costs," in David I. Cleland, ed., *Field Guide to Project Management*, 2nd ed. (Hoboken, NJ: John Wiley & Sons, 2004): 145–147.

Exhibit 10.2



Direct versus Indirect Costs A second classification divides project costs into direct and indirect costs. **Direct costs** *are those that only occur because of the project and are often classified as direct labor or other direct costs*. Direct costs include people (labor) who expend effort to complete project tasks, materials that are consumed for the project, and some other direct costs that may not occur but for the project. For example, direct labor includes workers who are hired specifically to work on the project and who will be either assigned to a new project or released when the project is complete. Other direct costs may include items such as consumable materials, travel, consultants, subcontracts, purchased parts, equipment, and computer time.

Indirect costs *are those that are necessary to keep the organization running but are not associated with any one specific project*. The salaries of the company executives and the cost of company buildings, utilities, insurance, and clerical assistance are examples. These costs are allocated among all the projects and other organizational and internal work that derive benefit from these resources. The methods of allocating these costs have evolved in recent years thanks to activity-based costing, as described in the cost estimating issues section. Exhibit 10.3 shows both direct and indirect costs for a work package.

Recurring versus Nonrecurring Costs The third cost comparison is recurring versus nonrecurring costs. **Recurring costs** *are those that repeat as the project work continues*, such as the cost of writing code or laying bricks. **Nonrecurring costs** *are those that happen only once during a project*, such as developing a design that, once approved, guides the project team. Nonrecurring costs tend to occur more often during project planning and closing, while recurring costs tend to occur more often during project execution.

Regular versus Expedited Costs A fourth cost comparison is regular or expedited. **Regular costs** *are preferred costs and occur when progress can be made by normal work hours and purchasing agreements*. **Expedited costs** *occur when the project must be conducted faster than normal, so overtime for workers and/or extra charges for rapid delivery from suppliers*

Exhibit 10.3

Direct and Indirect Costs in a Work Package

Project: Accounts Payable Refinement	**Work Package: Install Module 1**	
Description:	**Deliverable(s):**	
Install accounts payable refinement application and related hardware.	Installed and functioning accounts payable module.	
Cost Categories	**Quantity**	**Total**
Direct Labor		
Programmer	120 hr @ $ 75/hr	9,000
Systems Analyst	40 hr @ $ 100/hr	4,000
Systems Architect	20 hr @ $ 120/hr	2,400
Other Direct		
Hardware		20,000
Software		8,400
Consultant Services		12,000
Indirect Costs (.6 * DL)		**9,240**
	Total	**65,040**

Source: Kevin P. Grant, University of Texas, San Antonio. Adapted with permission.

are necessary. The comparison of these costs shows why it is vital to understand schedule pressures and resource demands as costs are estimated.

Other Cost Classifications The next several cost comparisons require little explanation. They are helpful to understand both in structuring the cost estimates and as checklists to help remember items that may be forgotten. One comparison is cost internal to the parent organization versus those external to it. Major external cost items such as equipment can be either leased or purchased. Direct cost items are often employees or materials.

Estimate versus reserve costs form the next comparison. The **estimate** is *"a quantified assessment of the likely amount.... It should always include an indication of accuracy."*[2] The **reserve** is *extra money in the project budget to be used if necessary—usually if a risk event occurs*. Reserves are often classified more specifically as a management or contingency reserve. **Management reserve** is *money assigned to the project for unknown possible costs, which is controlled by senior management*. By contrast, **contingency reserve** is *money assigned to the project and allocated for identified risks for which contingent responses are developed*. Contingency reserve is used at the discretion of the project manager.

Just as uncertainty exists when estimating how long an activity will take, there is uncertainty regarding how much an activity will cost. Some activities are easy to estimate with higher levels of accuracy. Other less familiar activities have many uncertainties, and estimating their cost is more like guessing. If one were to estimate conservatively on each uncertain activity, the total estimate for the project would likely be too high to be approved. To overcome this problem, project managers are sometimes encouraged to

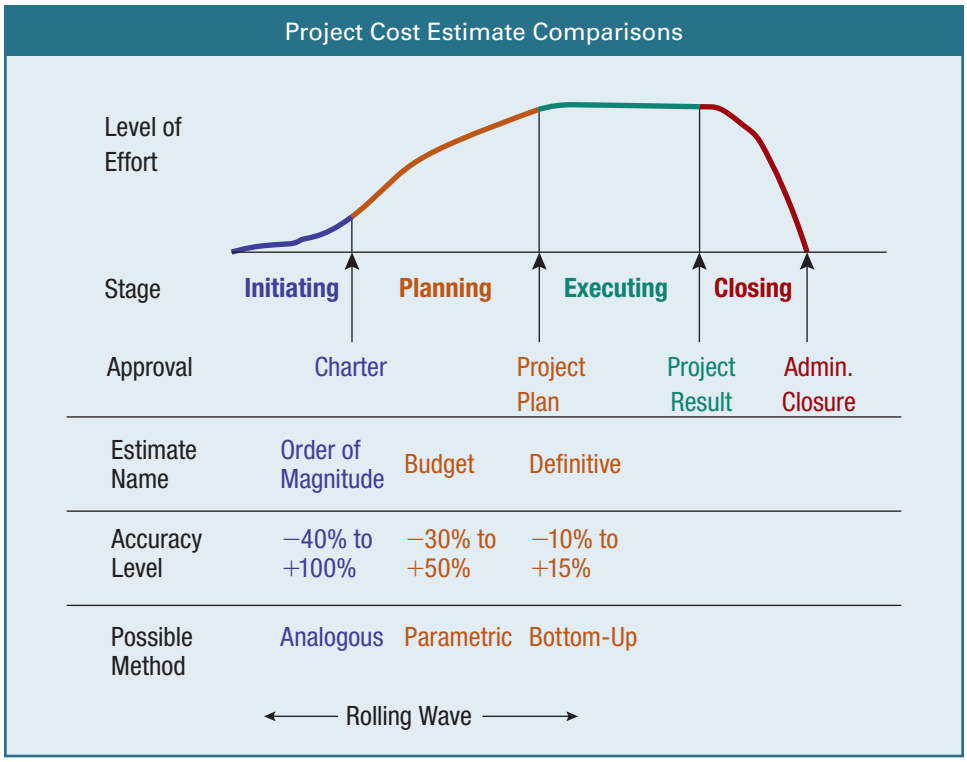
estimate at least a bit more aggressively. That means some activities will run over their estimates, while others will cost less. Project managers frequently add a contingency reserve to cover the activities that run over their aggressive estimates. In any event, one must remember the two principles of ethical estimating discussed earlier in the chapter (do not lie to yourself or others).

10.2b Accuracy and Timing of Cost Estimates

Project managers need to understand when cost estimates should be developed, how accurate they need to be, and how they will be used. During project initiation, many project managers need to develop cost estimates to have their project charters approved. At this point, very little detail is understood regarding the project, so the estimates are only approximate. However, as the scope becomes well defined in the work breakdown structure (WBS), schedules are planned, and specific resources are assigned, the project manager knows much more and can estimate costs associated with each work package more precisely. Many organizations have specific names and guidance for their estimates, and these vary widely. Normally, estimates should be documented, and the level of confidence in the estimate should be described. Exhibit 10.4 shows several points regarding different types of project cost estimates.

Order of Magnitude Estimates Several things should be noted from these comparisons. First, estimates go by several different names. For example, **order of magnitude estimates** that are often used to seek initial charter approval are also sometimes called

Exhibit 10.4



ballpark, conceptual, initial, or *level-one* estimates. These early estimates are often created during the project initiation stage when very little information is available about the project. At this point, a very rough order of magnitude estimate could underestimate the project by as much as 100 percent (i.e., the final cost could be double the initial estimate). And it may be the only possible estimate. There is no way to really know how accurate an estimate is until the project has been completed, but with less detailed knowledge concerning the project in the initiating stage, there is likely to be a larger margin of error. Order of magnitude cost estimates and the parallel high-level views in each of the other planning areas can quickly give enough information to approve the project charter and begin to invest time and money into detailed planning.

A concept of progressive elaboration applies here. Progressive elaboration is improving the accuracy and elaborating the scope plan continuously with more detailed and specific information as the project progresses. Each successive iteration of the planning process would lead to a better and more accurate cost estimate and other project plans.

Budget and Definitive Estimates Once a project plan enters into the more detailed planning stage, it is generally possible to create a more accurate cost estimate. This is the same thought that goes into creating a more detailed project schedule, resource estimates, risk profiles, quality plans, and communications plans. Depending on the complexity and size of their projects and organizational norms, some project managers can proceed directly to definitive cost estimates at this point. Others may still need to look at one or more intermediate levels of detail before they have enough detailed knowledge to create cost estimates with accuracy. At the end of project planning, cost estimates should have a small enough margin of error that they can be used to create a project budget, show cash flow needs, and be used as a basis for controlling the project. Most project organizations prefer an accuracy level of no more than minus 10 or plus 15 percent, and some require considerably better, such as plus or minus 5 percent.

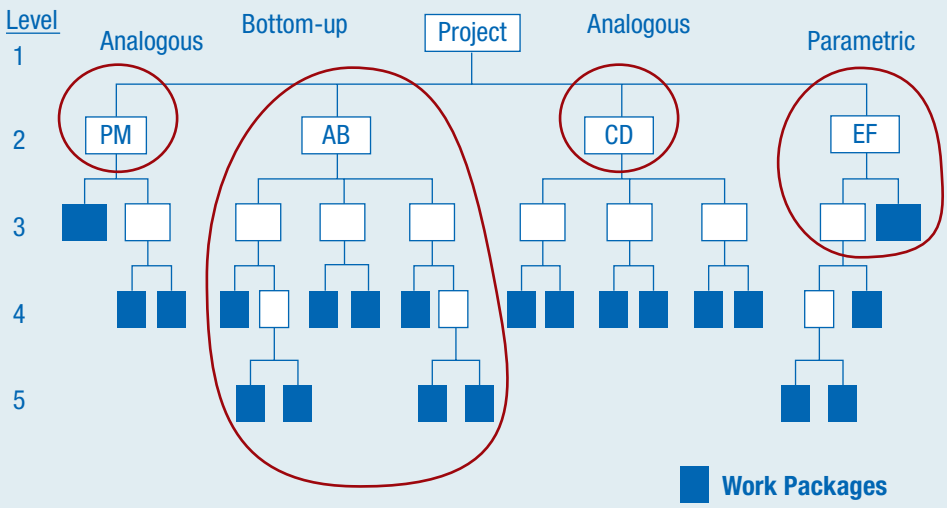
10.2c Methods of Estimating Costs

Many methods can be used for estimating project costs. Most are variations of one of the methods discussed in this section. While these methods can also be used to estimate project scope or duration occasionally, the discussion in this chapter centers on using them to estimate project cost. Exhibit 10.4 indicates that as more details of a project are known as planning progresses, more detailed estimating methods may be used. However, Exhibit 10.5 shows that even at the end of project planning, a project manager may sometimes use a combination of cost estimating methods. If the organization has established accurate analogous and parametric estimating methods and capable estimators, sometimes parts of a project can be estimated by those methods instead of the more detailed (and time-consuming) bottom-up method. The method(s) chosen for cost estimation should account for the extent of complexity, risk, interdependencies, workforce specialization, and site-specific issues of the project.[3]

Analogous Estimating **Analogous estimating** is "a technique for estimating the duration or cost of an activity or project using historical data from a similar activity or project."[4] Analogous estimating was the technique used in Denver in this chapter's opening vignette. To create a bid for a project—in this case, the installation of elevators—a similar project was considered as the starting point. Immediately, questions were asked regarding how this job compared in size and complexity with the previous job.

Exhibit 10.5

WBS Depicting Estimating Methods



Source: Kevin P. Grant, University of Texas, San Antonio. Adapted with permission.

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Several things need to be in place for analogous estimates to be effective. First, the organization needs to have experience in performing similar projects and know the actual costs of each of those projects (not just what they were estimated to cost). Second, the estimator needs to know how and to what extent the proposed project differs from the previous project. Third, the estimator needs to have experience with the methods and processes by which the project will be performed. In the Denver example, sales and construction people jointly discussed how much the project would cost.

Parametric Estimating

Parametric estimating is "an estimating technique in which an algorithm is used to calculate cost or duration based on historical data and project parameters."[5] Parametric estimating can be used to determine the impact of key variables on project costs. A bit more information is needed to complete a parametric cost estimate as compared to an analogous estimate. Exhibit 10.5 shows this graphically by suggesting that another level of detail in the WBS might be used. In the chapter opener example of estimating the cost of elevator installation projects, parametric estimates might involve finding a bit more information regarding the project. For example, one might want to know the height, distance, and speed of the elevator, platform size, trim level, complexity of the controls, and the like. Each of those factors would have an impact on the elevator installation cost. For example, the cost per foot traveled might be calculated (this would cover the cost of providing and installing guide rails, wiring, etc.). Another cost might be associated with speed because faster elevators require bigger motors, more stability, stronger brakes, and so on.

Bottom-Up Estimating

Bottom-up estimating is "a simplified mathematical description of a system or process (used to assist calculations and predictions) that is prepared by starting at the lower, more detailed-level pieces of work; these estimates are then aggregated into total quantity for the component work."[6] For a bottom-up estimate, the WBS needs to be broken down to the most detailed (activity) level, and the specifications and resource requirements must be very clearly identified. In the elevator example, bottom-up estimates were created in Kansas City. Details to be estimated included exactly how many buttons the control panel had, what kind of light fixtures were mounted in the ceiling, what kind of finish was requested, and so on. The cost was estimated for each item. For example, for the process of installing the guide rail, first there was a small amount of time, such as one hour, to set up or get everything in place to do this step. Then, it took a certain fraction of an hour of labor to secure each foot of the rail into position. A material charge was incurred for the guide rails themselves and the fasteners that held them in place. The cost of supervision was charged for the foreperson, who ensured the work was scheduled and performed properly. Finally, overhead costs (indirect costs) were allocated to each dollar of fixed costs.

Bottom-up estimating is the most detailed, time-consuming, and potentially the most accurate way to estimate costs. Many projects use this method eventually to serve as a basis for estimating cash flow needs and for monitoring and controlling the project. One important tenet of bottom-up estimating is to ensure that every item is included and associated and required resources are identified. Obviously, if a portion of the project is left out, that portion is underestimated by 100 percent! A WBS detailing all deliverables (deliverable WBS as discussed in Chapter 7) is best suited for bottom-up estimating. Some organizations first create a bottom-up estimate and then compare it to a top-down view to consider adjusting it if the top-down view yields a much higher number. Exhibit 10.6 summarizes differences in cost estimating methods.

Exhibit 10.6

Cost Estimating Method Comparison

	Analogous	Parametric	Bottom-Up
Amount of Information Required	Least	Middle	Most
Amount of Time Required	Least	Middle	Most
Accuracy Obtained	Lowest	Middle	Highest

10.2d Project Cost Estimating Issues

Regardless of what method is used to estimate project costs, several issues need to be considered. Some of these issues are pertinent to all projects; others pertain only to certain projects. These issues are shown in Exhibit 10.7.

Supporting Detail Supporting detail for project cost estimates includes describing the scope, method used to create the estimate, assumptions, constraints, and range of possible outcomes. The project scope tends to be only loosely defined at the project outset and becomes increasingly well-defined throughout the project planning phase. Each estimate should state exactly what scope it is based on, and version control is critical for this purpose.

The method used might be analogous, parametric, or bottom-up. The name of the method and exactly how the method is used should also be described.

When creating an estimate, many assumptions and constraints are considered. Assumptions should be outlined because two different people coming from two different backgrounds may view a situation differently and assume that two different things will happen. Even if everyone involved with planning a project assumes the same thing, it still may not happen. Assumptions that are not true often cause more work or manifest as risks, causing other problems such as changes in scope, cost, and schedule. As more details are available, a project manager may review assumptions with an eye toward uncovering assumptions that have now proven to be false. When this happens, the project manager can investigate any impact it may have on the project budget (and schedule and scope). Examples of assumptions that may arise when estimating the cost of direct labor might include the following:

- Workers will be paid at the prevailing wage rate of $14 per hour.
- Workers are already familiar in general with the technology being used on the project.

Exhibit 10.7

Issues in Project Cost Estimating

Supporting detail	Activity-based costing
Causes of variation	Life cycle costing
Vendor bid analysis	Time value of money
Value engineering	International currency fluctuations

- Workers will be paid for 40 hr per week whether there is always that much work for them or not.
- Overtime will never be authorized.
- The project schedule can be delayed if the only alternative is to pay overtime.

Constraints are also important since they often dictate the methods available for performing the project work. Examples of constraints include:

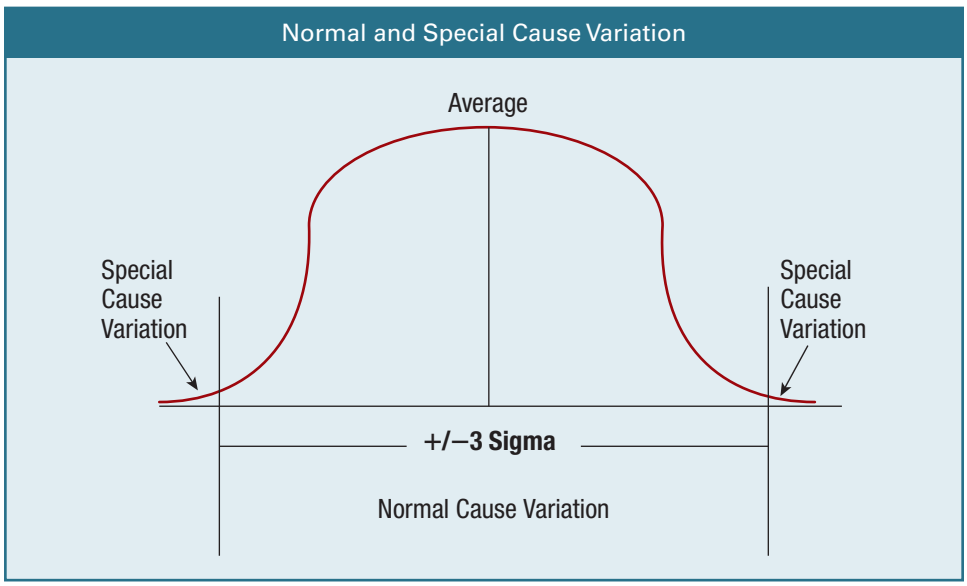
- Only in-house workers will be used.
- No extra space will be provided.
- No extra budget will be allowed.
- The current version of the XYZ software will be incorporated into the design.

The range of possible outcomes should always be stated with a project cost estimate. If the range is not stated, people may lock onto the first number they hear and remember it. If the actual project costs could be 100 percent higher than the order of magnitude estimate, the project manager had better state that accuracy level loud and clear, or they may find themselves continually explaining why they are grossly over budget. In fact, many estimators resist giving an order of magnitude estimate because they fear they will be held to it. A natural tension exists between managers who try to effectively manage their departments by establishing budgets as soon as possible and project managers who try to provide budget estimates as late as possible (once they know more about the project).

Causes of Variation There are many causes for project costs to vary. On routine projects using proven technology, with fewer uncertainties, and an experienced and well-known project team, the causes may be relatively few and easy to categorize. On other projects where some of these factors are not present, more causes of uncertainty in project costs may exist, and some of those may be from unknown sources. Statisticians classify variation as coming from either normal or special causes, as shown in Exhibit 10.8.

Variation occurs in all work processes. The more routine a process is, and the more work driven by machines, the less variation occurs. Projects, however, tend to have novel work and high human interaction, so there are many opportunities for variation.

Exhibit 10.8



Normal variation comes from many small causes that are inherent in a work process. For instance, the variation in the productivity of a programmer writing code could be from phone calls, instant messages, and in-person interruptions that occur each day. Special cause variation, on the other hand, is when something out of the ordinary occurs. For example, a lightning strike could cause such a large power surge that it overwhelms the normal protectors and destroys some of the computers. Most causes of variation are of the normal variety, and improving work methods (as discussed in Chapter 12) can help to reduce this type of variation. Special causes, however, are handled more as risks, as discussed in Chapter 11. Some special causes of cost variations can be externally driven such as inflation, market changes, scarcity of supply and resources, and natural disasters. Both types of variation add to project costs and need to be considered.

Vendor Bid Analysis On some projects, most or all of the cost is internal to the parent organization. On other projects, a substantial portion of the budget goes to securing services and supplies from vendors and external sources. Vendor bid analysis is used to determine whether the price being asked by the vendors appears to be reasonable. If several vendors compete for the work, it is reasonable to believe that the lowest responsible offer is fair. In the absence of competition, however, other methods may be needed to ensure a fair price. On some items, prices are determined in the marketplace and reported in business papers and websites for anyone to refer to. On specialized services and products, one often must negotiate with a vendor. In the absence of any other method, for an expensive item, a project manager may need to develop a sound cost estimate. That is, try to determine how much effort the vendor may need to expend, and then add a fair profit margin to arrive at the price you believe the vendor should charge.

Value Engineering **Value engineering** is a formal and structured approach to reducing cost without decreasing the quality or performance. It is aimed at maintaining or increasing the value or productivity of a work element while minimizing the cost. In other words, it is a ratio of function to the cost associated with the product or service. Value engineering can be a very powerful method of double-checking all of the chosen methods for accomplishing work and the features of the project deliverable. Frequently, stakeholders find that a feature in the specifications costs more than they wish to pay.

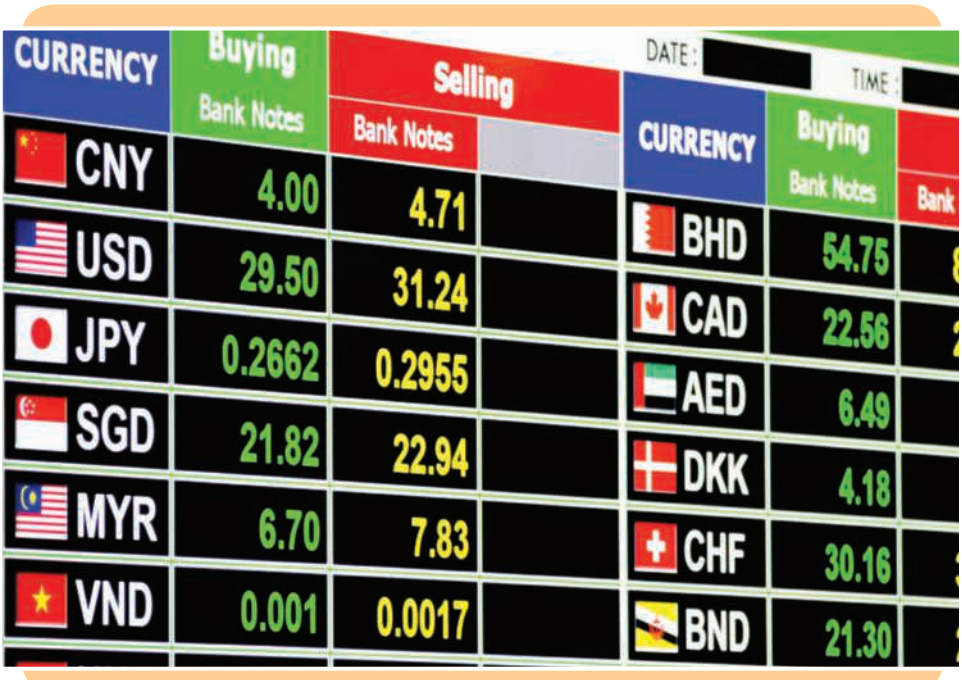
In a project to update an older church, the liturgical committee proposed many controls for special lighting that would be used only on special occasions. The general contractor suggested simplifying the controls, while retaining all the new lights, at a savings of $100,000! While the liturgical committee was disappointed, the church council readily agreed. Value engineering is so common in some industries such as engineering, automotive, and manufacturing that a separate stage is incorporated late in the project planning to ensure that time is spent for this purpose to reduce project cost and/or time and to improve project quality and/or usefulness.

Activity-Based Costing (ABC) Another issue project managers need to understand when estimating costs is what type of accounting system the organization employs. Historically, most companies used functional-based accounting systems. When using these systems, overhead (indirect) costs are assigned to a cost pool, which is often allocated to direct costs based on volume. When direct costs were a large percentage of total costs, this made sense. In more contemporary times, indirect costs form a much larger percentage of total costs, so careful allocation of them is necessary both for selecting the projects that truly will contribute the most profit and for ensuring a focus on controlling the highest costs. ABC is another accounting approach, by which indirect costs are allocated to fixed costs based upon four different types of drivers. The cost drivers are the number of units produced (frequently, the only method used in functional-based accounting), number of

batches run, number of product variations, and amount of facility utilized. ABC requires more involved methods for allocating indirect costs but yields more accurate cost information. By furnishing more specific information on cost drivers, ABC also helps to support process improvement and justify spending money on expensive equipment. Project managers need to understand how costs are allocated in their organization so they can accurately estimate the number of indirect costs (with corresponding amounts) that will be assigned to their projects.

Life Cycle Costing **Life cycle costing** is another concept project managers need to understand when estimating their project costs. Many project selection decisions are made based upon the total costs of both creating the project and of using the result of the project during its useful life. This total cost is called the life cycle cost, in which life cycle denotes the life of the product or deliverable of the project. Many times, trade-off decisions are considered that might involve spending more during the project to create a product that costs less to operate during its useful life. In an age in which environmental concerns are appropriately being considered more heavily, to calculate total life cycle costs, a project manager may also need to consider disposal costs of the product after its useful life is complete. This can entail designing more recyclable parts (even at a higher cost) into the product and adopting sustainable approaches for project execution that would reduce the project cost in the long run.

Time Value of Money and International Currency Fluctuations When considering future costs and revenues, project managers must know how to calculate the time value of money. One dollar today is presumably worth more than one dollar next year. Discounting the value of future revenue and cost streams enables better project decisions. Often, the finance department at a company tells the project manager what rate to use as a discount factor. The rate depends upon the prevailing inflation rate plus the cost of capital. On international projects, it can also depend upon international currency fluctuations.



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10.3 Determine Budget

Once the project costs have been estimated, it is time to establish the project budget. **Determine budget** is "the process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline."[8] To develop the budget, the project manager starts by aggregating all the costs. Once those are totaled, it is time to determine how much money is required for reserve funds. Finally, the project manager must understand cash flow—both in terms of funding and requirements to meet costs for activities on a day-to-day basis.

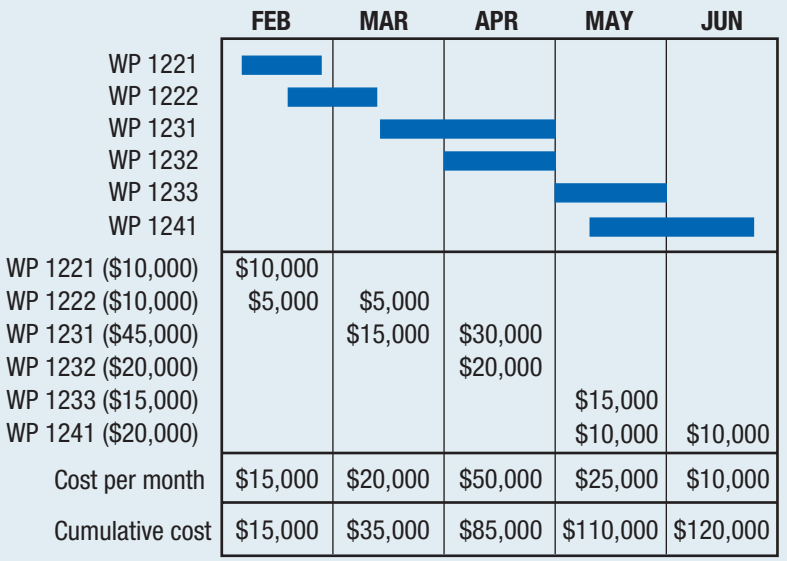
10.3a Aggregating Costs

When the entire project costs, both direct and indirect, have been added up, the result is a **cost baseline,** which is "that part of the project baseline that handles the amount of money the project is predicted to cost and on the other side when that money will be spent. It is an approved budget usually in a time distribution format used to estimate, monitor, and control the overall cost performance of the project."[9]

The work packages of a WBS not only take time and require resources, but they also cost money. The project budget can be aggregated from the work packages. Exhibit 10.9 shows

Exhibit 10.9

Aggregation of Project Budget



	FEB	MAR	APR	MAY	JUN
WP 1221 ($10,000)	$10,000				
WP 1222 ($10,000)	$5,000	$5,000			
WP 1231 ($45,000)		$15,000	$30,000		
WP 1232 ($20,000)			$20,000		
WP 1233 ($15,000)				$15,000	
WP 1241 ($20,000)				$10,000	$10,000
Cost per month	$15,000	$20,000	$50,000	$25,000	$10,000
Cumulative cost	$15,000	$35,000	$85,000	$110,000	$120,000

Source: Kevin P. Grant, University of Texas, San Antonio. Adapted with permission.

how six work packages appear on a Gantt chart with the cost of each work package listed monthly. The total cost for the month is shown and the cumulative cost for the project shown below that. Finally, a graph appears at the bottom that shows the cumulative cost of the project at each point in time. This represents the time-phased project budget. This will be used for control purposes as the project progresses. Note the cumulative cost curve approximates an "S" shape with slow expenditures (and progress) early in the project, rapid in the middle, and gradual late in the project. The S curve is normal for plan-driven projects, as they often require much planning during the early phases of a project and have fewer activities to finish at the end.

10.3b Analyzing Reserve Needs

Another view of project cost variation is to consider how well it is understood and how each type is handled. This is displayed in Exhibit 10.10.

Variation in project costs (and schedules) can be partially explained by the presence of certain events associated with a project. These events are classified as known knowns, known unknowns, or unknown unknowns, depending on the extent to which they are understood and predicted. Known knowns are discovered during the planning and can be estimated directly. An example could be that when a construction crew takes soil samples, they discover that extra pilings are required to stabilize the new building, and they add the cost into the project estimate to cover that expense.

Known unknowns are events discovered during risk identification that may or may not occur. An example could be snowstorms that cause traffic problems for three days at a critical time, preventing workers from getting to their jobs. In the next chapter on risk, methods for calculating costs associated with known unknowns are discussed. They will appear as contingency reserves.

Finally, sometimes things happen that are totally unexpected and can cause an increase in cost and/or schedule. For example, a very dependable supplier goes out of business due to the sudden death of the owner. These unknown unknowns (commonly called *unk unks*) also need to be covered in the project budget. The money used to cover them is frequently called management reserve and is usually authorized by company executives.

The amount placed into contingency reserve is calculated during risk analysis and is often in the range of 5 to 10 percent of the total project.[10] The amount placed into management reserve is determined by how much uncertainty management feels exists in the project. Typical ranges are from 5 percent of project costs for well understood, routine projects to 30 percent or more of project costs for poorly understood, unusual projects. These costs are not to be used to overcome poor estimating or project execution.

Once the cost baseline is determined along with both contingency and management reserves, it is time to determine if sufficient funds are available. On many potential

Exhibit 10.10

Estimating Costs of Project Variation

How Variation Is Understood	Known Knowns	Known Unknowns	Unknown Unknowns
How It Is Discovered	Scope definition Create WBS	Risk identification	Situation occurs
Stage When It Is Usually Uncovered	Initiating or planning	Initiating or planning	Executing
Method of Estimating Costs	Estimate directly	Contingency reserves	Management reserves

projects, a funding limit exists. The project sponsor for internal projects and the customer for external projects need to be very clear if the necessary funds exceed the limit of what is available. If enough funds are not available, this is the time to look hard at all the estimates, schedule, and scope to determine what changes need to be made before the project management plan is accepted. It does no good for anyone to deliberately start a project with insufficient funds.

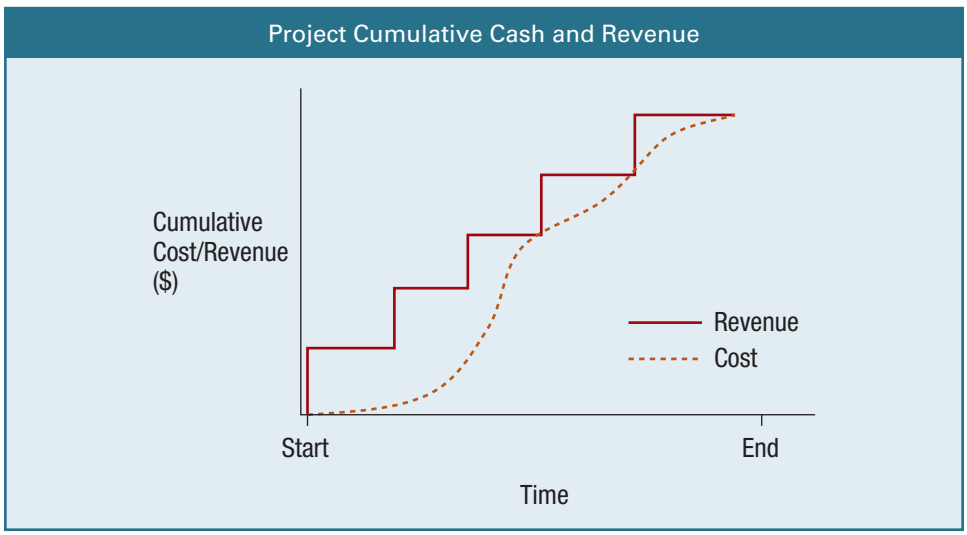
10.3c Determining Cash Flow

Projects require cash to make progress with the work. Suppliers and workers need to be paid in a timely fashion. A common difficulty is that the project's customer may not pay for the work until it is completed—often months after project bills were supposed to be paid. Therefore, the timing of cash inflow and outflow for a project is just as important as the amount of money required.

Just as the demands on individual workers can be applied to individual activities in the project schedule to determine where overloads may occur, expenses can be applied to individual activities in the schedule to see when cash is needed. Revenue can also be tracked to interim deliverables in the project schedule to show when revenue can be expected. Even if a project is internal to a company, understanding the timing of cash availability is important. While workers may work every day and suppliers may deliver frequently, cash may be supplied through organizational budgets only periodically. A project manager must ensure that the cumulative amount of cash coming into the project either from internal budgeting or from customer payments meets or exceeds the demands for paying cash out. This cash flow is shown in Exhibit 10.11 where incoming cash is in large increments, yet outgoing cash is almost continuous. The cumulative revenue at project completion minus the cumulative cost at project completion equals the profit (or surplus) generated by the project.

Project costs and consequent determination of budget are influenced by costs that are not planned well, unanticipated changes, and factors that are ignored knowingly or unknowingly during the planning. These factors would influence the budget planning

Exhibit 10.11



for an individual project. However, in a multi-project environment, multi-year capital project portfolio planning is usually developed for determining the budget on a long-term basis. The purpose is to use the available capital judiciously among various projects in the pipeline to optimize strategic value and reduce risk. Budget optimization is an important aspect of budget planning in projects.

10.4 Establishing Cost Control

The approved project budget with contingency reserves (and any amount of management reserve that has already been approved) serves as a baseline for project control. The budget shows both how much progress is expected and how much funding is required at each point in time. These are used for establishing project control. **Control cost** is the process of monitoring the project costs and managing changes to the cost baseline. Cost control is discussed in Chapter 14.

When establishing cost control, a typical measuring point is a milestone. Major milestones are often identified in the milestone schedule initially in the project charter, and additional milestones may be identified while developing the project schedule. Project managers can use the cash flow projections to determine how much funding they expect to need to reach each milestone. This can then be used for determining how well the project is progressing. The sponsor and project manager often jointly determine how many milestones to use. They would like to have enough milestones to keep track of progress, but too many milestones can become an administrative burden. Microsoft Project and other software can be used to automate the cost reporting.

10.5 *PMBOK Guide 7e*

Planning

Measurement

Uncertainty

10.5a Planning

Budgeting may be performed mostly upfront on predictive projects or in an iterative or incremental approach on adaptive projects. Planning includes creating estimates for work effort and costs associated with people and physical resources. Early estimates may change based upon circumstances and better information. Estimates may vary by range, accuracy, precision, and confidence, with all improving as the project progresses and better information is available.

Estimates that go into budgets can be presented as deterministic (single point) or probabilistic (ranges). Agreed-upon estimates are aggregated into a cost budget which will become the baseline for a predictive project. The budget should include contingency reserves to respond to risk events as they happen and management reserves that may be controlled by the sponsor to cover unforeseen events. Budgets also need to include funds for crashing or fast tracking a project if needed.

Part of budgeting includes determining metrics, baselines, and thresholds so the project team can capture information and show stakeholders that the project is proceeding according to budget or make needed adjustments if it is not.

10.5b Measurement

Timely and accurate information enables the project team and stakeholders to make good decisions. Measurements are valuable not so much for their own sake, but for the conversations and decisions they enable. Leading indicators can predict changes or trends and may help to keep the project from exceeding its budget. Lagging indicators reflect past performance.

Effective metrics can deal with quality, schedule, or resources, since each may impact the project cost. Effective metrics should be SMART—specific, meaningful, achievable, relevant, and timely. Business value metrics can include cost-benefit ratio, planned benefits compared to actual benefits, return on investment (ROI), and net present value (NPV). These should be used at project selection and chartering but should continue to be considered when budgeting the project. Metrics should have thresholds beyond which corrective action is taken.

10.5c Uncertainty

Project teams should consider economic factors such as volatility in prices, availability of resources, ability to borrow funds, and inflation/deflation as they construct their budget. Some approaches to dealing with uncertainty are to prepare for multiple outcomes or build resilience to potential sudden changes, and these may require extra funds (contingency or management reserve) in the budget. Teams may use experiments or prototypes to address and understand ambiguity, and funds required for them are usually included in the project budget. Some approaches to dealing with risk such as transferring it to another party through insurance or other means and implementing mitigation efforts in advance of a possible risk event cost money and need to be considered in the project budget.

10.6 Budgeting Agile Projects

The project budgeting process in Agile environments differs from traditional project selection methods discussed thus far in this chapter, as shown in Exhibit 10.12.

Exhibit 10.12

Comparison of Plan-Driven and Agile Approaches for Project Budgeting

Project Budgeting Questions	Plan-Driven	Agile
At what point is an order of magnitude estimate created?	In chartering	In creating the project vision
At what point are budget and definitive estimates created?	Before baselining	Repeatedly for each release and iteration
How are overall project cost uncertainties handled?	Reserves	Plan for team size by time box
How are cost uncertainties for specific project components handled?	Value Engineering	Spikes, Shift Left, and Definition of Ready
What primarily controls the project budget?	Baseline	Salary of team members

10.6a Agile Terms

Spike	Short, time-boxed effort to test the concept or reduce risk
Shift left	Perform as much testing and risk reduction early to gain feedback as soon as possible so needed changes can be started quickly

In this book, we use many Agile terms and definitions from Anantatmula, V., and T. Kloppenborg, *Be Agile Do Agile* (New York, NY: Business Expert Press, 2021).[11]

In Chapter 1, we stated that contemporary project management is integrative, iterative, and collaborative. Nowhere is that truer than in estimating agile projects. Agile project estimating is integrative in that scope, cost and schedule are highly interrelated. For any given iteration, the cost and schedule are set by the length of the iteration and the size of the project team. The schedule will vary depending on how much work the team can accomplish.

Agile project estimating is iterative in that at the start only an order of magnitude estimate is created for the entire project at the same time the product owner is establishing the project vision. Agile project participants know that decisions should be made at the last responsible moment when the most information is available. Therefore, when planning a release, a somewhat more detailed estimate, sometimes called a budgetary estimate, can be developed as the number of iterations can be at least tentatively determined and the team size is set. Some organizations plan for fiscal quarters instead of or in addition to releases. These intermediate-level plans are also based upon the expected number of workers on each team and number of teams. Finally, for each iteration, teams commit in detail to what they will create, and the team size is firmly set. These are definitive estimates.

Agile project estimating is collaborative in that while the product owner prioritizes work, the team clarifies their understanding of each user story by ensuring each meets the definition of ready—that is, the team understands each story well enough to estimate the work needed to create it. The team plays planning poker as described in Chapter 8 to estimate the effort for each story and to commit to each. Agile project estimating is also collaborative in that the team and product owner agree to sometimes work a **spike** if needed. That is, they work exclusively on verifying a specific approach will work to lessen risk and give more confidence in estimates. Further, they adjust their thinking by **shifting left** so they test as early as practical in the project anything that will ultimately need to be tested. This reduces risk, improves quality, and improves the accuracy of estimates. Teams demonstrate their work results and decision-makers (sometimes the product owner and sometimes either a committee or a higher-level executive) consider whether the value the team has produced is enough and if the highest priority for the project or even for the organization is to continue the same work or assign the team to new work.

10.7 Using MS Project for Project Budgets

MS Project supports both bottom-up and summary level cost modeling. Bottom-up cost modeling is primarily based on the cost of each resource assignment to WBS tasks. Assignment costs can be seen in the related task's Cost field (when shown) in the Gantt chart and other views. Task costs are summarized at the parent WBS levels (summary tasks).

Summary costs allow the project manager to make a "summary level" estimate of the cost of the project. Often when the complete details of later stages of the project are not known, placeholder or "dummy" tasks are added to the schedule and costs are estimated. Using summary cost estimates, a projected duration and cost estimate of the entire project can be provided to project stakeholders.

The following examples will continue to use the Suburban Park Homes project from previous chapters' examples.

10.7a Developing a Bottom-Up Project Budget Estimate

To develop a bottom-up project budget estimate, a project manager needs to understand the assignment and task costs for each task of the project. MS Project allows the user to view costs from different perspectives to better understand where costs are coming from and which major tasks are cost drivers for the project. We will now look at assignment and task costs in more detail.

Assignment Costs The following data are used to compute each assignment's cost value:

- **Assignment work hours** (calculated when the work assignment is made)
- **Resource standard rate**
- **Resource overtime rate** (only if modeling overtime)

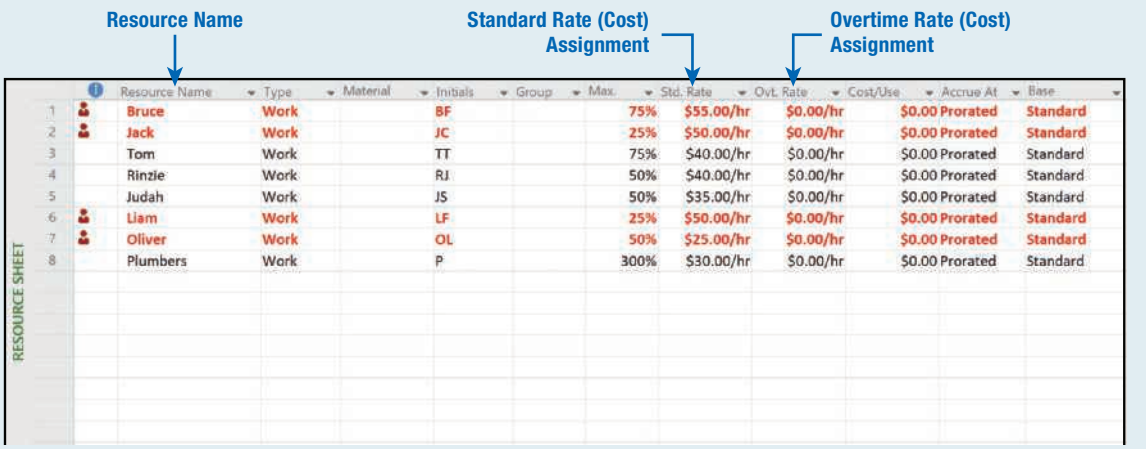
An assignment cost value is the total number of assignment hours multiplied by the standard rate (cost) of that resource (e.g., $50 an hour). Each resource has a standard rate; some may have an overtime rate as well. Cost rates can be assigned when defining the resource in the Resource Sheet (**View Tab**>>**Resources Sheet**), as described in Chapter 9, or assigned later when costs are known. Exhibit 10.13 shows the Resource Sheet with standard rates assigned to the project resources.

Task Costs The task cost value is the sum of all *assignment* cost values, plus any task's fixed cost value (e.g., a building permit). Exhibit 10.14 displays the **Task Usage View** in the top pane (with the **Cost** column inserted) and the **Task Form View** in the lower pane. To generate this view:

1. Click the **Task Tab**>>**View Group**>> click **Task Usage**.
2. Click the **View Tab**>>**Split View Group**>> click **Details**>> choose **Task Form**.

Exhibit 10.13

Assign Cost Rates

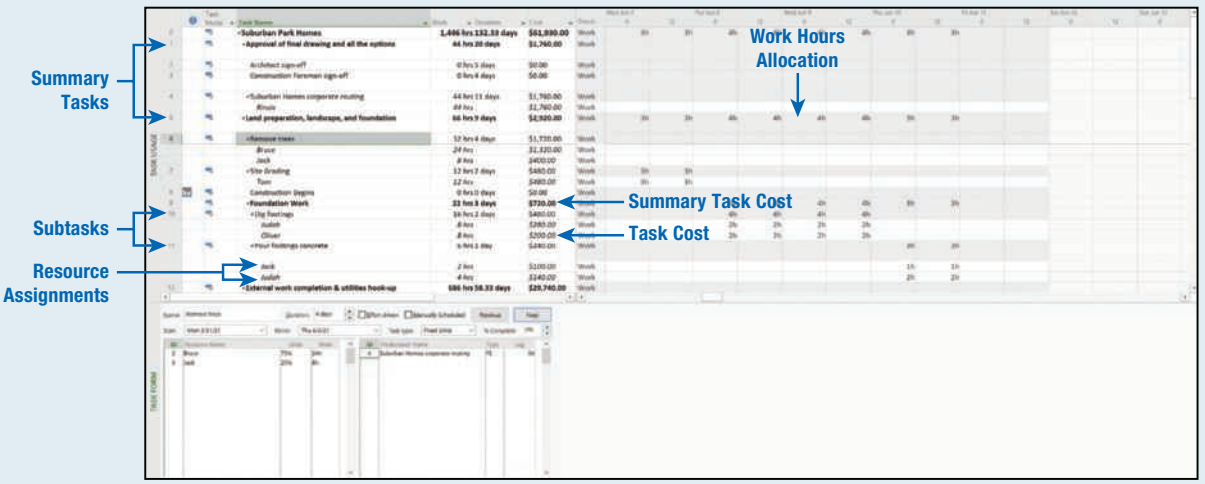


	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base
1	Bruce	Work		BF		75%	$55.00/hr	$0.00/hr	$0.00	Prorated	Standard
2	Jack	Work		JC		25%	$50.00/hr	$0.00/hr	$0.00	Prorated	Standard
3	Tom	Work		TT		75%	$40.00/hr	$0.00/hr	$0.00	Prorated	Standard
4	Rinzie	Work		RJ		50%	$40.00/hr	$0.00/hr	$0.00	Prorated	Standard
5	Judah	Work		JS		50%	$35.00/hr	$0.00/hr	$0.00	Prorated	Standard
6	Liam	Work		LF		25%	$50.00/hr	$0.00/hr	$0.00	Prorated	Standard
7	Oliver	Work		OL		50%	$25.00/hr	$0.00/hr	$0.00	Prorated	Standard
8	Plumbers	Work		P		300%	$30.00/hr	$0.00/hr	$0.00	Prorated	Standard

Source: Microsoft Corporation.

Exhibit 10.14

Task Usage View with Resource Work Form



Source: Microsoft Corporation.

3. Right-click in the form in the lower pane and choose "**Work**."
4. In the upper pane, right-click the **Start** column header >>**Insert Column**>> type "**Cost**".
5. Your screen should now look like Exhibit 10.14 (with adjustment of view dividers).

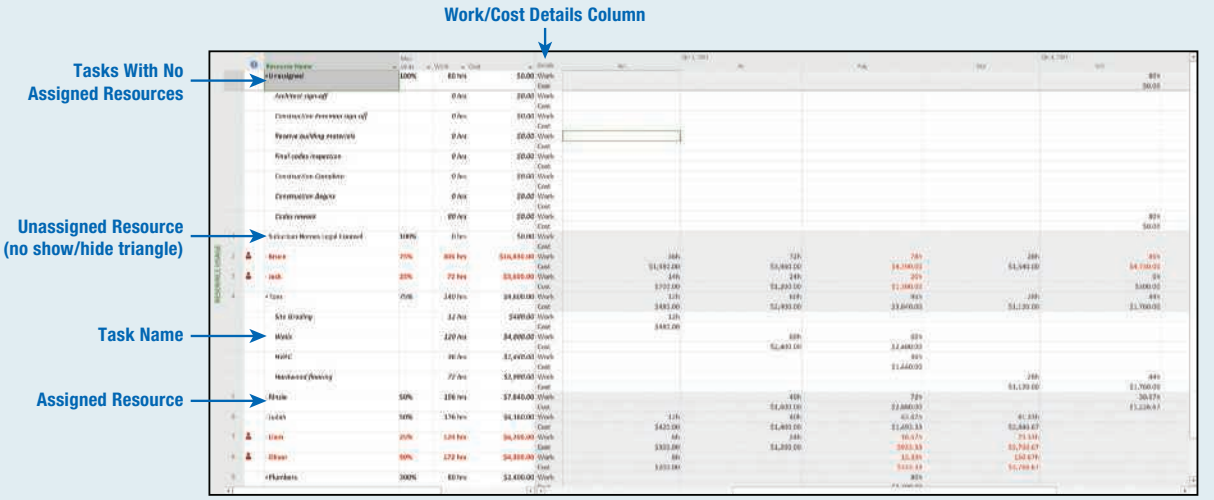
In Exhibit 10.14, rows 1, 5, 9, and 12 are summary tasks; rows 2, 3, 4, 6, 7, 8, 10, and 11 are subtasks. The unnumbered rows are resource assignments. Two resources are assigned to the task "Remove Trees" (Row 6). Bruce is assigned to work 24 hours on the task, and Jack is assigned eight hours. Reviewing the Resource Sheet reveals their standard cost rates are $55 and $50 per hour, respectively. Their individual costs to the task are calculated in the cost column cells at $1,320 and $400. Since they are the only two resources assigned to the task "Remove Trees," summing the two values provides the total cost of the task. Therefore, the task of removing the trees from the lot will cost the project $1,720 as calculated [(24 × $ 55) + (8 × $ 50) = $ 1,720], and shown in the summary row's Cost column cell. The assignment Units and Work values for the "Remove Trees" task are shown in the Task Form View in the lower pane.

View Costs from a Different Perspective The preceding discussion has been from the view of the WBS, or task perspective. Cost data may also be viewed from a resource perspective using the **Resource Usage View**. In this view, assignment costs are summarized at the resource level (as seen in Exhibit 10.15). To activate this view:

1. Click the **View Tab**>>**Split View**>> uncheck **Details**.
2. Click the **View Tab**>>**Resource Views Group**>>**Resource Usage**.
3. Insert a **Cost** column in the left pane (if one is not already showing).
4. In the right pane, right-click >> choose **Cost**.
   a. **Work** is the default view in the Details column; this adds **Cost** to Details.

Exhibit 10.15

Resource Usage View



Source: Microsoft Corporation.

In Exhibit 10.15, the most indented rows are tasks. The "Unassigned" set represents tasks with no assigned resources. If a resource has no show/hide control, then it has not been assigned.

10.7b Develop Summary Project Budget

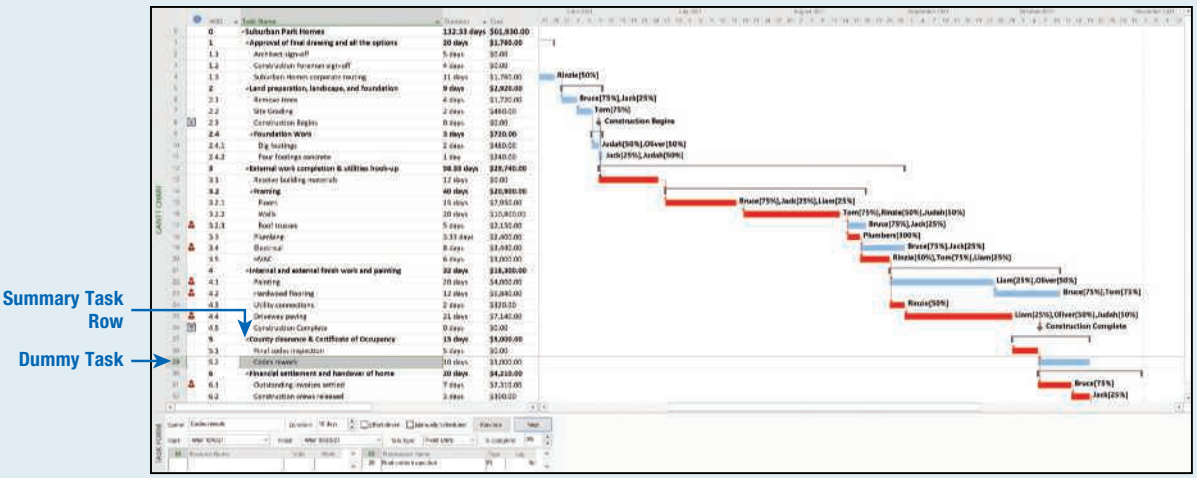
Once duration and costs have been determined for project tasks, a simple summation of all summary row durations and costs gives the project manager an overall estimate of the project's total duration and cost. However, as discussed earlier, details of later project phases may not be completely identified in earlier stages of the project. In other words, there may be tasks later in the project whose details cannot be known early in the project.

Regardless of project unknowns, stakeholders will want ongoing estimates of the completion date and cost of the project. One way the project manager can manage these unknowns and still provide estimates is to add "dummy tasks" under any summary task where there is not enough information to plan in detail. A dummy task is simply a placeholder for future project work. When creating a dummy task, the project manager estimates both the duration and cost of the task. This estimate becomes part of the overall project summary cost and duration estimate. As details of later project phases emerge, dummy tasks can be replaced with actual task data. Each update further sharpens overall project duration and cost estimates.

A dummy task example can be seen in Exhibit 10.16. The "County Clearance & Certificate of Occupancy" summary row has the dummy task "Codes rework" added. Since the project manager cannot know if rework on the house will be necessary due to a failed codes inspection (the inspection will happen after the project is almost completed), codes rework makes for a useful dummy task. No resources are assigned to the task yet, but cost and duration estimate is assigned, allowing the project manager to factor this task into project estimates. Dummy tasks should not be carelessly added to the project since they affect project timelines and cost estimates. With experience and good

Exhibit 10.16

Dummy Activity for Late Phase



Source: Microsoft Corporation.

planning, the project manager can judiciously add dummy tasks that will serve both the project and the stakeholders.

Agile projects commonly use dummy tasks to represent the work for future project iterations that have not yet been defined. Since the number of workers is often known and the length of the iteration is known, the amount of cost can usually be established. However, the exact task activities are only determined during iteration planning.

Summary

The cost management plan outlines how to structure and control project costs. On a small project, it can be very simple. On a large, complex project, it may need more structure. It guides the project manager during the project.

Cost estimating can be challenging because some activities may have a great deal of variation. Many methods are available to assist in cost estimating. Use a simple method if it will suffice, and use more rigorous methods, if necessary. Generally, as project planning identifies more specifics, more detailed and accurate cost estimates can be made.

Cost budgeting includes aggregating individual costs, analyzing needs for cost reserves where uncertainty exists, and determining cash inflow and outflow. Establishing cost controls includes establishing cost reporting systems. MS Project can assist in developing either bottom-up project budgets or summary project budgets.

Key Terms Consistent with PMI Standards and Guides

plan cost management, 372
cost management plan, 372
estimate cost, 372
fixed costs, 373
variable costs, 373
direct costs, 374
indirect costs, 374
recurring costs, 374
nonrecurring costs, 374
regular costs, 374

expedited costs, 374
estimate, 375
reserve, 375
management reserve, 375
contingency reserve, 375
order of magnitude estimates, 376
analogous estimating, 377
parametric estimating, 379
bottom-up estimating, 379
value engineering, 382
life cycle costing, 383
determine budget, 384
cost baseline, 384
control cost, 387

Key Terms Consistent with Agile Practice

Spike, 389
Shifting Left, 389

Chapter Review Questions

1. What type of cost does not depend on the size of a project?
2. During which phase of a project do recurring costs typically occur?
3. What are some examples of expedited costs?
4. What is the purpose of an order of magnitude cost estimate?
5. Under which conditions can analogous estimating be effective?
6. Which method of estimating can produce the most accurate estimate: parametric or bottom-up?
7. What are some examples of supporting detail pertaining to cost estimates?
8. What does the Agile term "shift left" mean?
9. What can be used to determine whether a vendor's bid is reasonable?
10. Define value engineering.
11. What is the "time value of money," and why is it relevant to project management?
12. For a routine project, what is a typical percentage of total project costs that should be placed into contingency reserves? For an unusual project?
13. What is used to compare actual project spending with planned expenditures to determine if corrective action is needed?
14. What three types of data does Microsoft Project use to compute each assignment's cost value?
15. Explain the importance of creating a cost management plan.
16. Why is it important for project managers to understand the fixed and variable costs of a project?
17. Describe the difference between direct and indirect project costs.
18. During which phase(s) of a project do nonrecurring costs typically occur? Give an example of a nonrecurring cost.
19. The project manager at a software company predicts their project's costs based on previous projects they have worked on that were similar. (They take into account the differences between their current and previous projects, as well.) What type of cost estimating are they using?
20. Why is it important for assumptions to be listed in the cost estimate?
21. What is the difference between deterministic and probabilistic estimates?
22. What is an Agile "spike," and when would it be used?

Discussion Questions

1. A rockslide closes down a major highway on your delivery route and leads to unforeseen costs. Does the extra money needed come from contingency reserves, management reserves, or elsewhere? Why?
2. You are the project manager in charge of the construction of a new school building. Give one possible example each of a known known, known unknown, and unknown unknown you might encounter.
3. Using the same project described in question 2, what are a few examples of milestones at which you might measure cost control?

4. Using the same project described in questions 2 and 3, which method(s) of estimating cost would you use to establish a baseline budget? Why?
5. Give an example of how a project manager could run into problems with cash flow, even when they are within budget on the overall project.
6. Describe a few normal causes and special causes of variation on a project you have worked on. How did you address these variations?
7. What is the purpose of dummy tasks, and on what types of projects would you use them for budgeting purposes?
8. The order of magnitude budget estimate you created during chartering is deemed by your sponsor to cost far more than your organization is willing to spend on your project. What are your options as a project manager?
9. Give an example of a leading indicator and a lagging indicator from a project or type of project you are familiar with.
10. Why is it important for the metrics we use to have thresholds associated with them?
11. In what circumstances might a project manager use "dummy" tasks?

PMP Exam Study Questions

1. The "process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs" is referred to as:
   a. determine budget
   b. estimate costs
   c. plan cost management
   d. control costs
2. Activity cost estimates, the basis of estimates, and other supporting detail are outputs of which process?
   a. determine budget
   b. estimate costs
   c. plan cost management
   d. control costs
3. As the project progresses from initiation through planning and executing, and additional detail is gathered, the range of values for the project cost estimate will:
   a. broaden
   b. stay the same
   c. narrow
   d. be replaced with a single number
4. Determine budget is "the process of aggregating the estimated costs of individual activities or work packages to establish an authorized time-phased project budget or cost baseline." This is used for _____ projects.
   a. Agile
   b. Plan-driven
   c. Iterative
   d. both Agile and plan-driven
5. A(n) _____ is used to compare actual project spending with planned expenditures over time to determine if corrective action is needed.
   a. cost baseline
   b. funding limit reconciliation
   c. reserve analysis
   d. activity resource estimate
6. Jason, a project manager, is working with his team to estimate the total cost of developing a web-based CRM system. After reviewing the planned scope of work with Jason, his sponsor suggests that Jason use the budget from a previous, similar project as the basis for his project budget. The estimating process that Jason's sponsor is using is called _____.
   a. three-point estimating
   b. parametric estimating
   c. analogous estimating
   d. single-point estimating
7. One of the principal benefits of creating a bottom-up estimate during planning is that the estimate:
   a. can be created quickly
   b. is very accurate
   c. matches the high-level estimate in the project charter
   d. will not change once the project is in flight
8. The amount of project budget reserved for unforeseen project work that addresses the "unknown unknowns" that can affect a project is the _____.
   a. project buffer
   b. funding limit
   c. contingency reserve
   d. management reserve

9. Ellen is estimating how much it will cost to recarpet the executive conference room. After selecting the grade and pattern of carpet, Ellen multiplies the carpet price per square yard times the number of square yards in the conference room to derive the total price of the material. This estimating method is called _____.
   a. expert judgment
   b. analogous estimating
   c. parametric estimating
   d. three-point estimating
10. The budget within the cost baseline that is allocated for identified risks, for which mitigating responses are developed, is called the _____.
   a. contingency reserve
   b. management reserve
   c. control account
   d. activity cost estimate

Exercises

1. A baker has a contract to bake three dozen chocolate chip cookies for a customer's party. Create a bottom-up estimate that includes both items needed for the project and the cost. According to your estimate, how much should the baker charge for the cookies?

2. Using the data below, create a time-phased budget for the project. Show how much the daily and cumulative costs for the project are, just as the monthly and cumulative costs are shown in Exhibit 10.9.

	Activity	Immediate Predecessor	Duration in Days	Resource	Hourly Cost	Work Hours per Day
A	Evaluate freezers		2	Alcides	$45	6
B	Chart temperatures		6	Joan	$50	4
C	Review service record		2	Alcides		
D	Consult with HVAC engineer	A, B, C	3	Alcides		
E	Develop construction plan	D	10	Joan		
F	Complete IC assignment	E	2	Alcides		
G	Complete ROI analysis	E	5	Joan		
H	Conduct regulatory review	E	4	Joan		
I	Obtain construction approval	F, G, H	2	Alcides		

3. Using the data below, create a time-phased budget for the project. Show how much the daily and cumulative costs for the project are, just as the monthly and cumulative costs are shown in Exhibit 10.9.

WBS	Activity	Immediate Predecessor	Duration in Weeks	Resource	Hourly Cost	Hours per Week
1	Operational definition					
1.1	Research literature		3	Becky	$35	30
1.2	Identify and define terms	1.1	1	Ann	$60	30
1.3	Obtain approval of definition	1.2	2	Clive	$50	20
2	Target Selection					
2.1	Solicit partners for pilot		2	Ann		

WBS	Activity	Immediate Predecessor	Duration in Weeks	Resource	Hourly Cost	Hours per Week
2.2	Hold brainstorming meeting	2.1	2	Becky		
2.3	Identify characteristics of targets	2.2, 3.1	1	Ann		
2.4	Obtain approval of partners	2.3, 1.2, 3.4	1	Clive		
3	Question set					
3.1	Identify process group members		2	Clive		
3.2	Develop question set	2.3	4	Ann		
3.3	Prototype and validate question set	3.2	3	Becky		
3.4	Add partners	3.1, 2.1	3	Becky		
4	Pilot process					
4.1	Schedule with target audience	2.4	2	Becky		
4.2	Conduct beta test	3.4, 2.4	2	Clive		
4.3	Process feedback from target audience	4.2	2	Ann		
4.4	Conduct pilot	4.3	2	Clive		
4.5	Analyze results	4.4	2	Clive		

Integrated Example Projects

Suburban Homes Construction Project

You developed the WBS of multiple levels, including work packages, at the lowest level based on the initial project requirements below, which were further elaborated. Also, you were asked to identify all the available resources in-house and resources required externally in Chapter 9 for this case study. If not developed, it is important now to develop a resource breakdown structure (RBS) to estimate the total budget of the project.

Building a single-family, partially custom-designed home as required by Mrs. and Mr. John Thomas on Strath Dr., Alpharetta, Georgia. The single-family home will have the following features:

- 3,200 square-feet home with 4 bedrooms and 2.5 bathrooms
- Flooring—hardwood on the first floor, tiles in the kitchen and bathrooms, carpet in the bedrooms
- Granite kitchen countertops, GE appliances in the kitchen
- 3-car garage and external landscaping
- Ceiling—10′ on the first floor and vaulted 9′ ceilings in the bedrooms
- 7-year warranty for structure and 2-year warranty for finishing components

Using the WBS and RBS, you were asked to develop a bottom-up cost estimate. This approach will require you to identify resources required for each lowest-level WBS activity. Once resources are identified, you will estimate the effort required for each resource. The cost estimate is derived from the resource effort required.

This approach tends to be more stable because, when estimating, errors have a chance to balance out. However, it requires more preparation effort than top-down estimates. In essence, the estimate is based on a more detailed understanding of the project

Tasks to Complete

- The resource expenditure of each lowest-level WBS activity is estimated.
- Resource effort (duration and cost) in monetary terms is estimated for all the resources.
- Costs for all the activities under the same WBS element at the next higher level are rolled up.
- This process is continued for all the WBS elements to determine the overall project estimate.

Heritage Arboretum Development Project

The budget for this project was not formalized. It includes partial funding from several departments and some in-kind donations of trees and work. The various departments that have an interest in the project and may provide some funding include:

- Building and Grounds Maintenance since they provide mowing, trimming, mulching, etc.
- Event Coordination since they rent the facility and improving the grounds makes it more desirable.
- Planning and Zoning since they oversee the Tree Committee which selects and plants trees.
- Public Works since part of the site is greenspace and they oversee greenspace.

The initial budget included funds for Trustee tree planting, trimming, mulching, watering, hazardous tree cutting, deer guards, Gator bags for water, and signs.

As progress was made and more detail was understood it became apparent that more funding would be needed. It was decided that signs would have QR codes (and cost a bit more than simple signs). More extensive deer protection was needed as deer proved to be aggressive, better and more consistent mulching was needed for beauty and better tree growth, and minor funding for outreach meetings with science teachers and representatives from other arboreta.

Also, as progress was made and more detail was understood, other decisions also needed to be made. For example, a free method of setting up the website was used to show the location of each tree, a picture of each, and a description. However, in the future, more information might be added which could necessitate the use of a paid website. Another decision is various individuals on the Tree Committee and various vendors who are sympathetic to the cause of a new arboretum, wish to donate trees and woody shrubs. Decisions first needed to be made on a case-by-case basis of which to accept and then a more general approach to selection needed to be developed. Yet another decision that needs to be made is how to determine which service from volunteers to accept and to supervise. For instance, the certified arborists on the Tree Committee are willing to help with trimming that the maintenance contractors do not perform. There are many invasive plants in the wooded area of greenspace that could be removed, but there are also desirable plants there that should be left alone.

Questions:

1. How can the budgeting process be improved?
2. How would you suggest structuring the approach to deciding which donations to accept?
3. How do you recommend deciding which offers of donated service to accept and how would you supervise that?

Semester Project Instructions

Create a time-phased budget for your example project using bottom-up estimating. To the extent that your sponsor supplies rates for workers, use those. Use approximate rates for ones you cannot get. Ask your sponsor how they treat indirect costs. Be sure to include direct labor costs for yourself and your teammates. Budget your costs at the starting salary you expect to receive when you graduate (or your current salary, if you are employed). Divide your annual salary by 2,080 hours and add 20 percent for fringe. State all assumptions and constraints you have used when creating your budget. State how confident you are in your estimates and what would make you more confident. Give examples of known knowns and known unknowns on your project. Tell how you have budgeted for both of them, as well as how you have budgeted for unknown unknowns.

Project Management *in Action*

The Value of Budget Optimization

At a major Midwestern electric utility, budgeting for the ongoing capital expansion of the electric power system represents a process at the core of the organization's strategy and operations. During extensive annual planning efforts, a three-year capital project portfolio is developed for implementation and budgeted. The budgeting process is used to ensure available capital is carefully scrutinized by management and applied judiciously to those projects providing the greatest strategic value on a schedule minimizing overall risk. Maintaining the forecasted budget and completing projects as planned ensures the integrity of the electrical system and the financial strength of the business.

The budgeting process itself is actually conducted year-round as Planners, Engineers, Project Managers, and Financial experts endeavor to balance multiple competing objectives into a rational, achievable, and ongoing capital spending plan. There is little margin for error. Annual spend for major capital projects is typically over $250 million representing approximately 500 projects to be completed across a five-state area. Under-budgeting means that projects potentially critical to the reliability of the electrical network may not be completed. Over-budgeting could result in investment dollars not yielding returns and reducing earnings.

As with any enterprise, the electric utility capital budget is restricted by annual spend targets necessary to maintain prudent financial ratios. In the case of capital spending, one key element involves maintaining a targeted Debt to Equity Ratio. For this reason, judgments need to be made about the cost versus the value of projects considered for investment and the risks associated with potentially postponing projects to maintain favorable financial ratios.

To enable this entire process to work continuously and effectively, the utility adopted a project portfolio optimization process to create, analyze and refine the budget for the project portfolio. This process involves executive management in creating a strategic value and risk scoring methodology that is applied during the planning phase for each project. The method assigns a value and risk score based on each project's forecasted impact in five critical strategic areas—Financial, Reliability, Customer, Regulatory, and System Operations. A computer-based mathematical algorithm is used to optimize all possible spend portfolios to maximize value and minimize risk at specified budget levels. Within hours, the utility can analyze multiple optimized budget scenarios at various annual spend levels involving thousands of projects and nearly one billion dollars of investment.

This methodology has several key benefits for the electric utility that can be applied to any organization attempting to make budgeting decisions for complex project portfolios.

- **Budget Strategy Well Understood and Communicated Through the Organization**—The process starts with an annual review by the executive management of the strategy categories to which value and risk assessments will be applied. These categories and relative importance weightings can be adjusted to match the organization's current strategic emphasis. These categories and their relative weightings are published, communicated, and used throughout the organization
- **Budget Optimized for Strategic Objectives**—The scores of value and risk for each project are applied to the strategy categories and optimized to provide maximum value and minimum risk for the capital spend available. Computer software allows instant scenario changes and "what if" options to be analyzed. The outcome provides management with consistent and well-understood decision-making information.
- **Ensures Consistent Organizational Strategy**—Projects are submitted for budget consideration in the capital portfolio from throughout the utility's five-state operating area. There is a diverse array of business and financial reasons for each project to be evaluated. The use of a single enterprise-wide tool allows all projects to be analyzed on an equal basis providing assurance that organizational strategy is universally applied.
- **Understanding Risk Thresholds and Tolerance**—Postponing projects to conserve capital brings with it certain risks. The budget optimization process provides detailed risk analysis information

on all deferred projects. Widespread communication of these risks and expert analysis of the consequences and probability allow management to make calculated and carefully considered decisions. Importantly, management gains recognition of its own risk tolerance and risk threshold levels as a result.

- **Expanded Planning Horizon and Purchasing Power**—The most significant result of the budget optimization process is the certainty to which the implementation (the project execution phase) of the budget plan can be approached. The high levels of upfront management scrutiny leave little doubt about executive support for the plan going forward. This enables the planning horizon to be significantly expanded into future years and brings with it an enormous level of labor and material purchasing power in the market.
- **Accounting for Project Dynamics**—Although the three-year budget plan is updated annually, there are still elements of uncertainty associated with implementation of a large project portfolio. These changes might be items such as significant shifts in public policy or regulations, fundamental changes to the business model, unexpected weather events, etc. These midstream shifts can be dealt with readily, if needed, by changing project scoring criteria, re-optimizing the project mix, and re-evaluating the resulting information for options going forward.

Source: Paul Kling, PE, PMP, Director Pike Engineering, LLC.

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Chapter 11

Project Uncertainty Planning

Chapter Objectives

Core Objectives:

11-1 Describe the processes of identifying risks, analyzing risks, and developing response plans for identified risks.

11-2 Identify and classify risks for a project and populate a risk register.

11-3 Describe various risk assessment techniques and state when each technique is appropriate to use.

11-4 Prioritize each risk on a project using an appropriate assessment technique and develop and defend at least one strategy for each of the high-priority risks.

11-5 Compare and contrast the various strategies for dealing with risks.

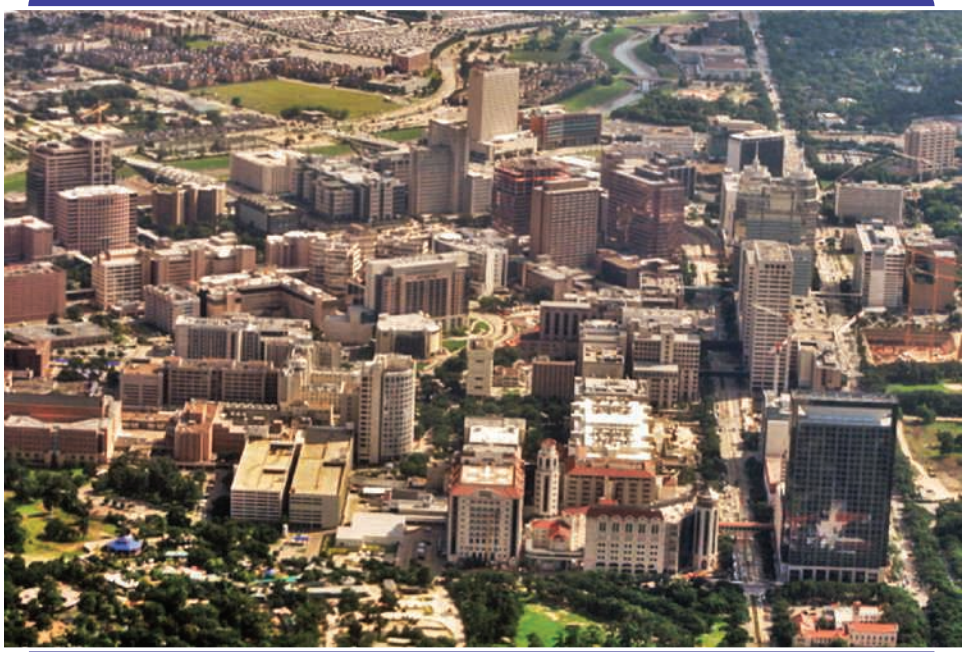
11-6 Select and utilize an appropriate quantitative risk analysis tool if qualitative risk analysis is not sufficient.

11-7 Determine the propensity of a key decision-maker to accept risk and use that knowledge to strategize about which risks to accept.

Agile Objectives:

11-8 Explain how risk is generally reduced or mitigated using Agile methods.

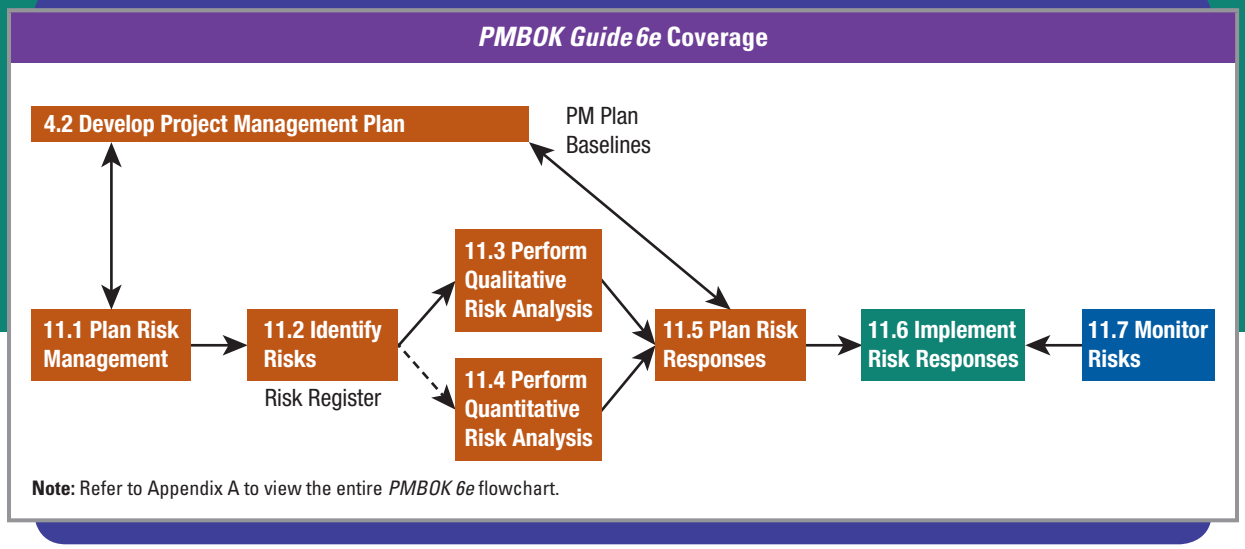
11-9 Plan and conduct a risk-based spike to prove your approach to your product owner.



Historic Images/Alamy Stock Photo

The Texas Medical Center (TMC) is composed of forty-nine not-for-profit institutions that are dedicated to the highest standards of patient care, research, and education. These institutions include thirteen renowned hospitals and two specialty institutions, two medical schools, four nursing schools, and schools of dentistry, public health, pharmacy, and virtually all health-related careers. People come from all walks of life and from all over the world to have access to the best healthcare anywhere. Member institutions specialize in every imaginable aspect of healthcare, including care for children and cancer patients, heart care, organ transplantation, terminal illness, mental health, and wellness and prevention.

Currently, multiple major construction projects are underway. Collectively, these major projects will add facilities that will be staffed by up to 27,000 additional employees. When complete, TMC will have 40 million square feet of occupied space. If you consider downtown business space, by itself it forms the seventh-largest downtown business district in the United States.



PMBOK Guide 7e
Domains:
- Stakeholders
- Team
- Development approach
- Planning
- Delivery
- Measurement
- Uncertainty

With hurricane season approaching, TMC held a conference for over one hundred contractors to review how to prepare for a potential hurricane. Contractors must have a plan in place detailing how they are going to secure their construction sites and keep materials from becoming airborne missiles in the event of a hurricane. Conference attendees were given a handout describing TMC's hurricane guidelines. These guidelines call for storm preparations to be completed 24 hours before tropical storm winds are predicted to hit land. Examples of storm preparations include dismantling scaffolds and privacy screens, securing giant cranes, emptying and weighting down dumpsters, photographing all buildings and assets, and unblocking all streets for emergency access.

While project managers cannot prevent hurricanes, through careful risk planning, actions can be taken to greatly mitigate the impact.

—Rhonda Wendler, Texas Medical Center News

Imagine you are asked to plan for risks on two different projects. One is a major construction project at TMC with hurricane season approaching. The other is planning a small fundraising event for charity. Would you handle the risks on these two projects the same way? Would you invest the same level of time and energy into planning these two projects? The answers are yes and no. Yes, you would approach the risks in the same way. But you would not spend the same amount of time planning for risk on both projects. You would spend considerably more time and money on risk management planning for the major construction project that is vulnerable to a hurricane than for the small fundraiser project. Just as in other types of project planning, there is an approach to planning for risks that all projects follow; however, the depth of planning depends greatly on the potential project risks and consequences if some of these risks are not managed. In other words, a smart project manager gladly spends $100 in risk planning to save $1,000 in expected consequences but does not gladly spend $1,000 to save $100.

The purpose of risk management is to reduce the overall project risk to a level that is acceptable to the project sponsor and other key stakeholders. The methods that project managers use in risk management start with identifying as many risks as possible. Once the risks are identified, each risk is analyzed in terms of its likelihood of occurrence (probability) and impact on project goals (such as duration, cost, or quality) if it occurs.

Using this qualitative analysis, the project team can focus their attention on the most critical risks. Analysis always consists of a qualitative or judgmental approach for all the identified risks and sometimes also includes a quantitative approach for the most critical risks.

In the final risk management process, the project team decides how to respond to each potential risk. Once the complete risk management planning has initially been accomplished, the response plans are incorporated into the overall project management plan. Changes may need to be made to the schedule, budget, scope, or communication plans to account for certain risks. These risk management planning processes are covered in this chapter. Risk management also includes monitoring and controlling the risks according to plan. These are covered, along with ongoing risk planning, in Chapter 14: Determining Project Progress and Results.

11.1 Plan Risk Management

Plan risk management describes how the risk management processes are implemented and how they fit with other project management processes.[1] A future event is considered a project risk if it threatens the successful accomplishment of a project goal or more. Obviously, a project manager must first understand the project's objectives to plan for project risks. As project objectives are generally aimed at project success, a project manager develops this understanding initially by realizing what project success in general is and then by understanding the specific priorities of the most important project stakeholders, as discussed in Chapter 6. Exhibit 11.1 summarizes current project success research results.

The first set of general project success measures is meeting various agreements associated with a project. This includes meeting the project requirements while not going over the cost and schedule agreements. The second set of project success measures focuses on the project's customers, specifically addressing questions such as the following: *Did the project results or outcomes meet the customers' needs? Did the customers use the project result? Did it enhance the customers' satisfaction?* The third set deals with the future of the performing organization, the one that manages the project. The specific measures vary, but essentially, they focus on whether the project helped the performing organization. The **performing organization** is an enterprise whose employees have direct involvement in

Exhibit 11.1

Project Success Measures

- **Meeting Agreements**
  Cost, schedule, and specifications met (including performance and quality)
- **Customer's Success**
  Needs met, deliverables used, customer satisfied
- **Performing Organization's Success**
  Market share, new products, new technology
- **Project Team's Success**
  Loyalty, development, satisfaction, reward, recognition

Source: Kloppenborg, Timothy J., Debbie Tesch, and Broderick King, "21st Century Project Success Measures: Evolution, Interpretation, and Direction," *Proceedings, Project Management Institute Research and Education Conference*, Limerick, Ireland (July 2012).

executing and completing the project. Typical project success measures for the performing organization include an increase in market share, developing new markets or new products and/or technologies, and commercial success of the project output. The final set of project success measures deals with the project team, for example: *Did they become better and more dedicated employees?Did they meet professional and personal aspirations and personal development goals?*

As an example, the specific priorities of the project's most important stakeholders can be summarized in a table such as Exhibit 11.2. In general, the unspoken expectations from the project sponsor are to complete the project sooner and below the budget while delivering the agreed-upon scope and meeting/exceeding the quality. A project manager and the project team need to understand not only what the project plans call for but also what area(s) the most important key stakeholders would like to improve and what area(s) they are willing to sacrifice to enable those improvements. For example, consider a project that calls for building a four-bedroom house of 2,800 square feet. Perhaps the homeowner (the most important stakeholder) prefers to keep the size at 2,800 square feet and insists on the normal quality (no leaks, square walls, etc.), but would like to improve on the cost (pay less money). To improve on the cost objective, one of the other objectives probably needs to be sacrificed. Perhaps the homeowner would be willing to move in a month late if the savings were $5,000 or sacrifice a cosmetic feature in the garage.

Once the project team understands the project success measures and priorities, attention is turned to understanding the project risks that could impede one or more of these success factors. All projects have some risk, and the more unique a project is, the more risk there will be. The uniqueness of a project is usually associated with uncertainties and unknowns, which contribute to project risks. It is impossible to remove all sources of risk. It is undesirable to even try to remove all risks because that means the organization is not trying anything new. Without risk, there is no gain or progress.

A **project risk** is anything that may impact the project team's ability to achieve the general project success measures and the specific project stakeholders' priorities—together, referred to as project objectives. This impact can be something that poses **threats**, which are risks that would adversely impact one or more project objectives. On the other hand, any uncertainty that has a positive impact on one or more project objectives is known as an **opportunity**.

Exhibit 11.2

Specific Project Stakeholder Priorities

	Improve	Keep	
Scope		X	
Quality		X	
Time			≤ 1 month to save $5,000
Cost	Want to save		
Contribution to Organization		X	
Contribution to Society		X	

Source: Adapted from Kloppenborg, Timothy J. and Joseph A. Petrick, *Managing Project Quality* (Vienna, VA: Management Concepts, Inc., 2002): 46.

Exhibit 11.3

Risk Management Plan Guidance for an IT Consulting Company

Risk management includes guidance on how to perform three risk management activities:

1. Decide what level of risk premium to charge for the project. The team must rate factors such as project size, complexity, technology, and type. The combined ratings dictate that a risk premium of zero, ten, or twenty percent be added to the estimated project cost or, for very risky projects, that executive approval is mandated.
2. Mitigate risk external to the firm through contract clauses and risk internal to the firm through agreements.
3. Manage the risk very carefully through specifically designed weekly conference call meetings and reports.

Source: Rachana Thariani, PMP.

Wise project managers strive to develop a **risk management plan**, an important plan that is integral to the comprehensive project management plan. It describes how risks are identified, prioritized, and monitored for changing priorities, and how prioritized risk management activities will be planned and performed. Usually, a risk management plan develops a mitigation strategy for all the prioritized risks before these risk events occur. By documenting risk information proactively, a project manager can eliminate or reduce the impact of some threats and capitalize on some opportunities. The risk management plan is also useful for communicating with the various project stakeholders during the project execution and for later analysis to determine what worked well and may be good practice to use on future projects, as well as what went poorly and should be avoided on future projects.

Some risk management plans include all the topics in this chapter. Others are smaller, based on the project type and size. For example, a risk management plan template for an IT consulting company is shown in Exhibit 11.3.

11.1a Roles and Responsibilities

It is a good practice to encourage wide participation in risk management activities. One reason is that everyone brings a different perspective, and the more perspectives that are considered, the more likely it is that important risks will be uncovered early. Another good reason is that people often resist when they are told what to do but work with great enthusiasm if they participated in the planning. The surest way to get the various project stakeholders to buy into a risk management approach is to involve them in risk management planning right from the beginning. Potential critics can be turned into allies if their concerns are included.

The risk management plan should define who is responsible for each risk management activity. On small projects, often the project manager or a core team member is responsible for most risk activities. On larger projects, the plan can be more elaborate, and subject matter experts may be involved at many stages of the project.

11.1b Categories and Definitions

Most projects have many types of possible risks. Therefore, it is helpful to look at risks systematically to consider as many risks and types of risk as possible. One way to look at risk is by considering when it occurs in the project life cycle. For example:

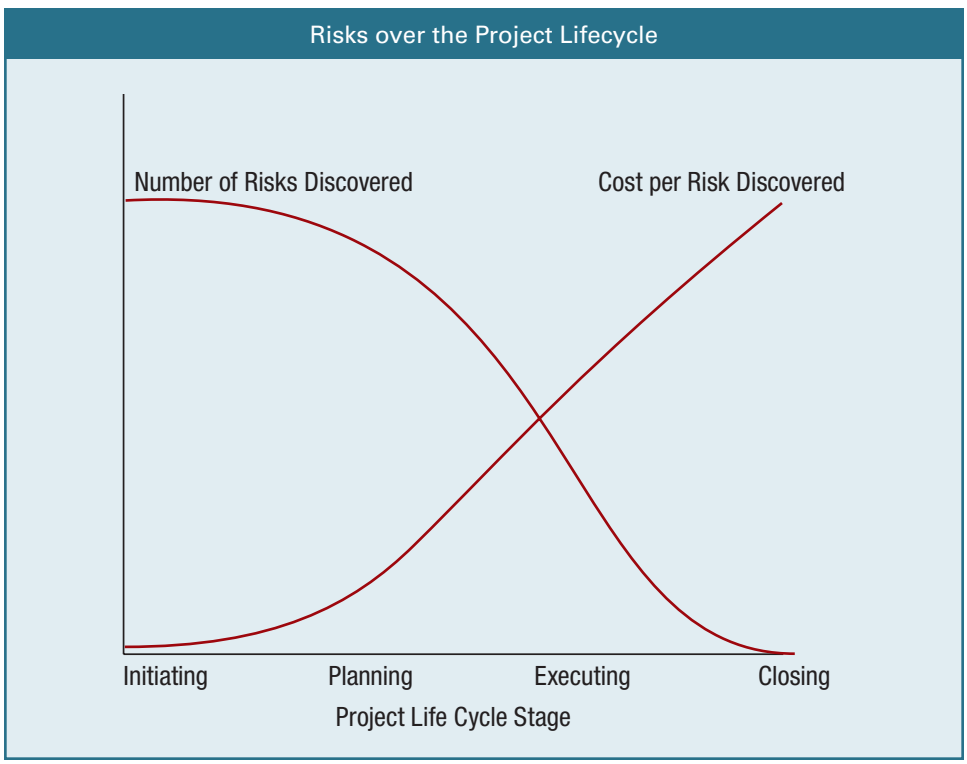
- Certain types of risks, such as a customer not agreeing on the price, may occur during project initiation.

- Others, such as not finding a capable supplier, may occur during project planning.
- Risks, such as delivery difficulties from a supplier, may occur during project execution.
- Omission of some of the essential activities in the WBS may also be realized during the project execution.
- Some risks, such as the project deliverable not actually working properly, may even appear near the project conclusion.
- Assumptions made during the project plan may prove incorrect, and they can become threats during the project execution.
- Duration and cost estimates of some of the WBS elements could prove to be wrong and become risks during the project execution.

The number and costs of project risks over a project life cycle are graphed in Exhibit 11.4. More project risks are typically uncovered early in the life of a project. However, the cost per risk discovered early is often less since there will be an opportunity and time to make changes to the project plan. Risks discovered late in a project lifecycle can prove to be very expensive. Experienced project managers work hard to uncover risks as early in the project as feasible. Usually, some risks are uncovered when chartering the project. On small or simple projects, this may be the biggest risk identification push, but on other projects, a great deal of time and effort may also be expended during project planning.

In addition to being categorized by when they might occur in a project, risks can also be categorized by what project objective they may impact, such as cost, schedule, scope, and/or quality. Risks can also be classified as external to the performing organization or internal to it, or by whether they are operational or strategic. Many organizations have developed lists of risks for certain types of projects they routinely perform. In addition, researchers have

Exhibit 11.4



created general lists of risk factors for certain types of projects. For example, recent research has shown the sources for the largest risks on megaprojects include:

1. Design
2. Legal and political
3. Contractual
4. Construction
5. Operation and maintenance
6. Labor
7. Customer/user/society
8. Financial
9. Force majeure (an unforeseen event that prevents a contract from being fulfilled)[2]

Another recent study found that green retrofit projects classify their biggest risks as coming from eight areas:

1. Post-retrofit tenants' cooperation
2. Regulatory
3. Industry
4. Financial
5. Pre-retrofit tenant's cooperation
6. Varying concerns from different stakeholders
7. Material supply and availability
8. Quality[3]

For a few further examples, Exhibit 11.5 shows the biggest fourteen risks on the Panama Canal expansion (which might be similar to those of other major construction projects). Exhibit 11.6 shows major risk categories for international projects generally, and Exhibit 11.7 shows common risks for information systems projects. Any of these categorizations can be shown as a **risk breakdown structure**, which presents a hierarchical organization of risks based on categories such as operational, strategic, finance, external, and project management. A Risk Breakdown Structure is similar to a WBS or a resource breakdown structure (RBS) in its hierarchical representation. It can be presented in graphic or table format (Exhibit 11.8).

Exhibit 11.5

The Fourteen Most Important Risks in Panama Canal Expansion

Changes in design and quantities	Extreme bad weather
General inflation	Inadequate claims administration
Ineffective contracting process	Inefficient planning
Insufficient revenues	Lack of controls
Lack of skilled and local labor	Local labor strikes
Material, equipment, and labor cost	Organizational risks
Owner-driven changes	Referendum delays

Source: Alarcon, Luis F., et al., "Risk Planning and Management for the Panama Canal Expansion Program," *Journal of Construction Engineering and Management* (October 2011): 762–770.

Exhibit 11.6

Top Risks in Each Factor for International Projects

Resources	Regulations	Crisis	Insurance	Science/Health	Digital
• Inflation/price instability • Commodity price shocks • Supply chain disruptions • Natural resource shortages • Environmental changes • Talent/skill shortage	• Different and changing regulations • Interstate relations failure • Collapse of multilateral institutions • Erosion of social cohesion • Political power transitions	• Economic crisis • Debt crisis • Asset bubble burst • Collapse or lack of social security systems • Terrorist strikes • State collapse • Youth disillusionment	• Differences in risk appetite or aversion • Insurance market challenges • Collapse of an important industry • Safety issues	• Backlash against science • Infectious disease • Vaccine challenges	• Failure of technology governance • IT infrastructure breakdown • Increased cyberthreats • Digital power concentration • Digital inequality • Private information compromised

Source: Adapted from Four Globalization Risks Impacting International Projects, Visualized: A Global Risk Assessment of 2021 and Beyond, Global Risks Perception Initiative—2021 Report, Five Top 2021 Trends Posing Risks to Construction Industry and Steffey, Robert W., and Vittal S. Anantatmula, "International Projects Proposal Analysis: Risk Assessment Using Radial Maps," *Project Management Journal* (April 2011): 62–70.

Exhibit 11.7

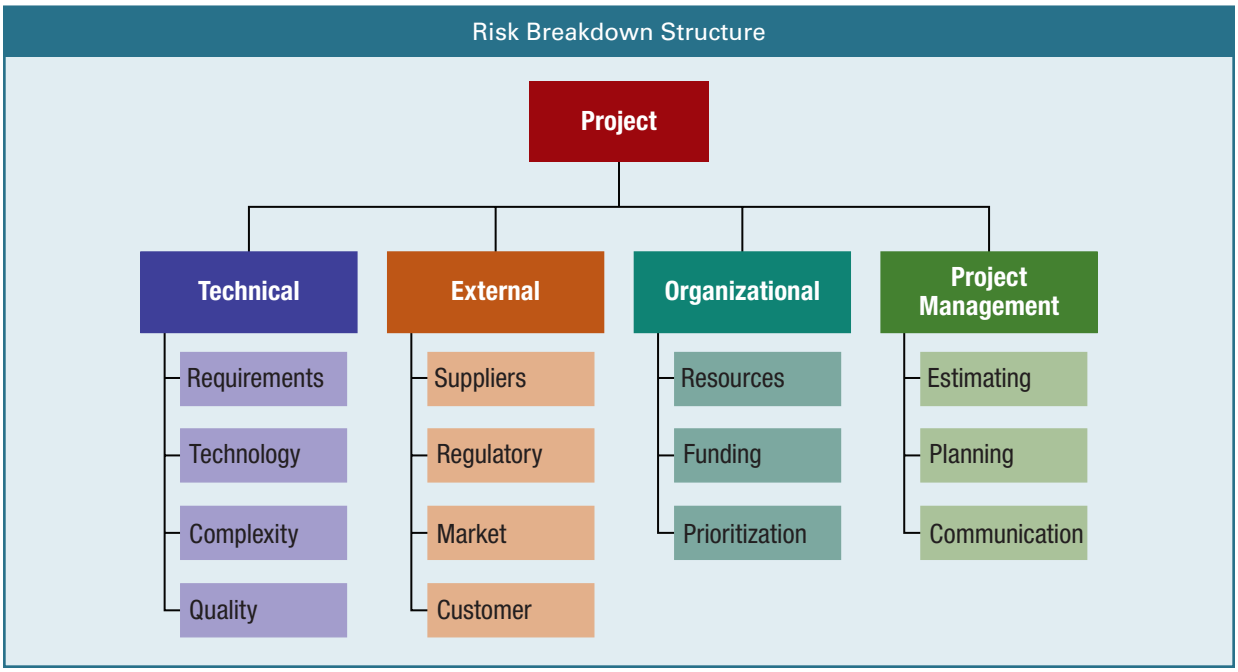
Top Risks in Each Factor for Software Projects

Execution Management	User Coordination
Configuration management system	User evaluation of progress
Formality of status reports	User understanding of complexity
Specification approval process	Care in user manual preparation
Post-project audits	Coordination with user
Regularity of technical reviews	Informal communication channels
Human Resource Management	**Project Planning**
Flexibility of working hours	Frequency of software reuse
Individual performance incentives	Planning tools used
Technical assistance availability	Minimum cost software design
Recognition for extra work	Removal of unnecessary requirements
Enforced attendance system	Individual accountability

Source: Thomas, Sam, and M. Bhasi, "A Structural Model for Software Project Risk Management," *Journal of Management* (March 2011): 71–84.

Yet another method to classify project risk is by what is known and what is not known about each risk. Something that is a ***known-known*** can be planned and managed with certainty; therefore, it is not a risk. An example is that cement will harden. The next level is ***known-unknowns***, which are risks that can be identified as risk but the likelihood and

Exhibit 11.8



impact of them are not known. In other words, a ***known-unknown*** may or may not happen. These risks should be identified, and an analysis (qualitative for sure and quantitative if required and helpful) must be made to identify a mitigation strategy before a contingency reserve is established to pay for them. An example of a long construction project is that bad weather will probably happen at some points, but no one knows exactly when or how bad it will be. The final level is for the true uncertainties. These are called ***unknown-unknowns*** (or *unk unks* by people who must deal with them). Since they cannot even be envisioned, it is hard to know how much reserve time and money are needed to cover them. They are usually covered by a management reserve, and the amount of this reserve is often negotiated based upon the confidence level the project manager and key stakeholders have regarding how well they understand the project. An example could be a 100-year flood that covers a construction site that everyone thought was on high enough ground to stay dry—an event so rare it is expected to happen only once a century. The tsunami that devastated a part of Japan in March 2011 was completely unexpected and an unknown-unknown risk that many projects in that region did not anticipate.

Savvy organizations are now often encouraging their project managers to reduce the number of *unk unks* by exploring unforeseen events so they can be *known-unknowns*. They learn more by a combination of design approaches such as analyzing scenarios, using checklists, considering weak signals that might have been previously ignored, and mining big data. They also use behavioral approaches such as frequent and effective communication and creating incentives for discovery.[4]

11.2 Identify Risks

Once the risk management planning is in place, it is time to begin identifying specific risks. Project managers are ultimately responsible for identifying all risks, but often they rely upon subject matter experts to take a lead in identifying certain technical risks.

11.2a Information Gathering

A large part of the risk identification process is gathering information. The categories shown in Exhibits 11.5, 11.6, 11.7, and 11.8 and/or project stages can be a good starting point in this information gathering. The project manager either needs to act as a facilitator or get another person to serve as a facilitator for information gathering. This is essentially a brainstorming session, wherein the question "What could go wrong?" is repeatedly asked of everyone present for every activity identified in the WBS. It is helpful to use Post-it Notes and write one risk per note to prepare for further handling the risks during risk analysis.

Classic rules for brainstorming are used. For starters, every idea is treated as a useful idea. The risks will be assessed next. Even if a suggested risk does not prove to be important, it is preferable to keep it on the list. Also, sometimes a risk that is obviously not important—or is even humorous—may cause another person to think of an additional risk they would not have considered otherwise.

While it is helpful to have as many stakeholders together as possible to "piggyback" on each other's ideas, with the information technology available today, much of the same interaction can be achieved with global or virtual teams; it just takes more careful planning. Variations, combinations, and extensions of possible risks can help a project team to identify additional risks.

Several other techniques are also used in risk identification. The project team members may choose to interview stakeholders or use a structured survey questionnaire, specifically when a project is big, complex, and has many uncertainties. In certain cases, **SWOT analysis**, which is a detailed analysis of the project's and project management's strengths, weaknesses, opportunities, and threats, might be used. Remember, risks can be both threats to overcome and opportunities to exploit. Yet another method of identifying risks is the **Delphi technique**, an information-gathering technique used as a way to reach a consensus among experts on a subject, with the experts participating anonymously to avoid groupthink and prejudice. Responses are summarized and recirculated for further comments and improvements. Finally, a team can use a structured review to identify risks either in person or remotely.

11.2b Reviews

A project manager and team can review a variety of project documents to uncover possible risks. Exhibit 11.9 lists some of the documents a project manager may use and typical questions they would ask for each. Project teams can often identify risks from each type of review shown in the exhibit. Of these, documented assumptions and the WBS are especially important sources for identifying risks. Every wrong assumption becomes a project risk. We initially develop a list of assumptions and constraints in the project charter. However, the list needs to be updated during the project planning phase and must be critically examined during the risk management planning to assess if all these assumptions are correct. Likewise, each work package in the WBS must be examined to identify risks associated with it. It is important to maintain a balance between the extent of the reviews and the amount of useful information for identifying risks. As with the brainstorming mentioned previously, it is better to identify any possible risks and later determine that some of them are not major, rather than to *not* identify what *does* turn out to be a big risk.

11.2c Understanding Relationships

Project managers can also seek to identify risks by learning the cause-and-effect relationships of risk events. One useful technique is a flow chart that shows how people, money, data, or materials flow from one person or location to another. This is essentially what the

Exhibit 11.9

Project Risk Reviews

Type of Review	Question
Charter	Is there clarity and common understanding in each section? Are the sections consistent with each other?
Stakeholder register	What could upset any of them?
Communication plan	Where could poor communications cause trouble (or threaten project goals)?
Assumptions	Can you verify that each assumption is correct?
Constraints	How does each constraint make the project more difficult?
WBS	What risks can you find for each WBS item? What can go wrong with each WBS work element?
Schedule	What milestones and other handoff points might be troublesome?
Resource demands	At what points are certain people overloaded?
Touchpoints	What difficulties may arise when some project work is handed off from one person to another?
Literature	What problems and opportunities have been published concerning similar projects?
Previous projects	What projects and opportunities have similar projects in your own organization experienced? Can we gain some insights from the lessons learned database?
Peers	Can your peers identify any additional risks?
Senior management	Can senior management identify any additional risks?

team does when it reviews the project schedule, provided it looks at the arrows that show which activities must precede others. By studying the flows, a person can consider which "handoffs" (when one person or team passes deliverables to another) might be risky.

A second method of understanding risk relationships is to ask why a certain risk event may happen. This can be accomplished through **root cause analysis**, which is an analytical technique to ascertain the fundamental or causal reason or reasons that affect one or more variances, defects, or risks. A simple approach to root cause analysis is to simply consider each risk one at a time and ask, "Why might this happen?" At this point, since many potential risks have probably been identified, project teams do not spend a large amount of time on any single risk. If necessary, the project team can perform a more detailed root cause analysis of the few risks that have been designated as major risks during risk analysis.

One more type of relationship project managers like to understand is a **trigger condition** or a situation that has been identified in advance that prompts us to invoke a risk strategy or risk action. A trigger can be specific to an individual risk like a key supplier stops responding to a request or commitment, which may jeopardize their delivery of materials.

11.2d Risk Register

The primary output of risk identification is the risk register. When complete, the **risk register** is "a repository in which outputs of risk management processes are recorded."[5] At this point (the end of risk identification), the risk register includes only the risk categories, identified risks, potential causes, and potential responses. The other items are developed during the remainder of risk planning. An example of a partial risk register is shown in Exhibit 11.10.

Exhibit 11.10

Partial Risk Register

Risk Description (Event)	Impact	Category	Probability	Impact	Score	Mitigation Strategy-Resolution
Incomplete requirements were identified in the RFP and Exhibits (see Risk 7).	Greater possibility of gaps in functionality. Greater possibility of missing State-specific functionality. Greater possibility of "Scope Creep." Greater possibility of delay in finalizing requirements. Greater possibility of rework in subsequent phases.	Business Requirements	5	4s	20	MAXIMUS will begin conducting the detailed BA sessions 09/20/2012. Additional requirements will be gathered in those sessions and documented in subsequent versions of the Requirements Validation Documentation. A schedule of future Business Architecture and Technical sessions is being developed. State will provide closure and decisions regarding requirements and system scope.
Since there are various vendor products (IBM/Curam, Connecture), each with its own rules engines, it is not clear which rules engine takes precedence.	Potential duplication of rules or conflicting rules that lead to different outcomes.	Technology	3	4	12	Engage point will explain how to mitigate this risk. (See Risk Response Plan for resolution.)
Difficulty integrating to state's end-to-end infrastructure.	Potential difficulty integrating new technology into existing infrastructure.	Technology	4	4	16	Work with the state to define infrastructure requirements and ensure that the necessary information is being provided to the MN-IT staff.
Going through a hierarchical reporting structure will impact real-time decision making.	Potential bottlenecks in document reviews and decision making may affect task completion according to the project schedule.	Communications	4	4	16	Identifying a point-of-contact for each functional area from vendor and state to eliminate bottlenecks.
State functional POCs may have competing priorities that will hinder their ability to respond promptly.	Secondary risk—related to Risk 6.	Communications	4	4	16	Identify multiple points-of-contact for each functional area from vendor and state to eliminate bottlenecks.
Delays in procurement process may negatively impact the project schedule.	Inability to acquire resources promptly may negatively impact-related activities in the project schedule.	Procurement	2	5	10	Add lead time as early as possible. Evaluate procurement requirements during the change order process. Make sure commerce procurement staff are engaged in the PO development process.

Source: http://mn.gov/hix/images/BC9-l-ITAttachmentN.pdf, accessed April 26, 2013.

The risk register is a living document. As soon as a risk is identified, it is added to the risk register. More information regarding a risk can be added when it is discovered. It is normal to identify risks during all the phases of the project. As risks are addressed, they can be removed from the risk register because they no longer are of the same level of concern. On smaller projects, a spreadsheet works fine for a risk register. On larger, more complex projects, some organizations use databases.

11.3 Risk Analysis

Every project team must consider risks diligently. If a project team is serious about risk identification, they will uncover quite a few risks. Next, the team will analyze and decide which risks are major and need to be managed carefully, as opposed to minor risks that can be handled more casually. The project team should determine how well they understand each risk and whether they have the necessary reliable data. Ultimately, they must be able to report the major risks to decision-makers.

11.3a Perform Qualitative Risk Analysis

Perform qualitative risk analysis evaluates the importance of each risk to categorize and then prioritize risks to develop further actions. All project teams should perform this analysis. If the project team understands enough about the risks at this point, it can proceed directly to risk response planning for the major risks. If not, they use quantitative techniques for prioritized risks to develop a better understanding based on the risk factor. The risk factor of a risk is the product of probability and consequence or impact. Risks with higher risk factors are considered for quantitative analysis.

Differentiating Between Major and Minor Risks Project teams use two primary questions in qualitative risk analysis: How likely is this risk to happen? If it does happen, how big will the impact be? This was shown in Exhibit 3.7. A somewhat more involved example is shown in Exhibit 11.10. Note that for each dimension—probability and impact—in Exhibit 11.11, a scale of 1 to 5 is used with descriptions. The scale used does not matter, as long as it is applied consistently and is easy for everyone to understand. Note also the dark line. This line separates the major and catastrophic risks that need either further analysis and/or specific contingency plans from minor and moderate risks that can

Exhibit 11.11

Qualitative Risk Assessment

Probability	Impact				
	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost certain (>90% chance)	High	High	Extreme	Extreme	Extreme
Likely (50%–90%)	Moderate	High	High	Extreme	Extreme
Moderate (10%–50%)	Low	Moderate	High	Extreme	Extreme
Unlikely (3%–10%)	Low	Low	Moderate	High	Extreme
Rare (<3%)	Low	Low	Moderate	High	High

just be listed and informally monitored. Without making such a distinction, project teams may be tempted to either ignore all risks or make contingency plans for all risks. Ignoring all risks is not desirable because it almost guarantees that the project will have problems. On the other hand, making contingency plans for even minor risks is a terrible waste of time and draws focus away from the critical risks.

Some people choose to make a finer distinction in their risk analysis by coding the biggest risks red, moderate ones yellow, and smaller ones green like traffic signal lights. This may be a good practice on bigger and more complex projects. Regardless, it is important to have specific plans for big risks while not overreacting to small ones.

Project teams must ask, regarding each risk: When it is likely to occur in the project lifecycle? This can be useful because those risks that are likely to occur earlier often need to be assigned a higher priority. Teams may also inquire how easy it is to notice and correctly interpret the trigger condition. Risks with triggers that are difficult to notice or interpret often are assigned a higher priority.

Cause-and-Effect Relationships One additional type of qualitative risk analysis is to determine cause-and-effect relationships. This is part of root cause analysis, which was described in the previous section on understanding relationships. While effects are often more visible, it is easier to change the effect by changing the underlying cause. For example, assume that a construction worker is not laying stones evenly for a patio (the effect). Perhaps the easiest way to ensure that future stones are placed evenly is to understand

Peter Skinner/Science Source

why the worker is having this problem. The cause may turn out to be inconsistent stone size, incorrectly prepared ground, the cement for holding the stones having bigger gravel than normal, or an improperly functioning leveling tool. Once the causes are understood, they can serve proactively as trigger conditions to identify that a risk event may be about to happen. This knowledge is useful when developing responses to risks.

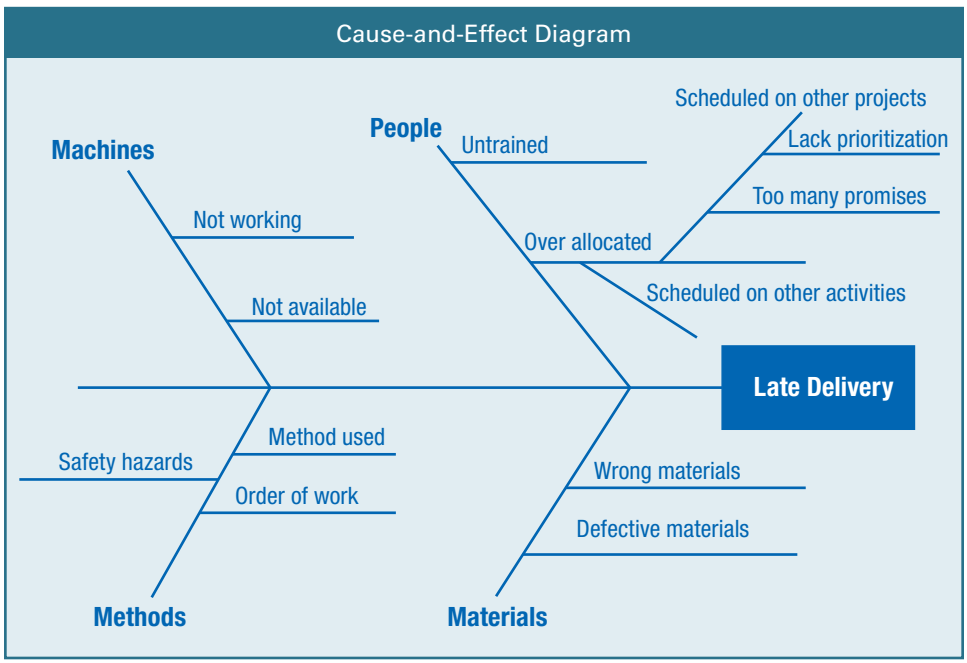
Cause-and-Effect Diagram A tool that is useful in this analysis is the cause-and-effect diagram. Many project teams use this diagram to identify possible causes for a risk event. An example is shown in Exhibit 11.12.

The cause-and-effect diagram is also known as the fishbone diagram because it looks like the skeleton of a dead fish. To construct the cause-and-effect diagram, the project team first lists the risk as the effect in a box at the head of the fish. In this example, it is late delivery. The more specifically the risk is stated, the more likely the team can uncover its real causes. The next step is to name the big bones. In this case, there are four big bones named *people, machines, methods,* and *materials.* There can be any number of big bones, and they can be named based on major causes contributing to the effect. Team members are then encouraged to keep asking the question "Why?" For example: Why could *people* be a cause? Two reasons are shown: they are not trained properly or they are overallocated. Often, a team proposes many possible reasons. The team continues to break down the reasons—that is, asking "why" until it no longer makes sense to ask why. Cause-and-effect or fishbone diagrams frequently contain more details than what is shown in Exhibit 11.12. Once the team no longer can think of possible causes, they need to determine which of the many possible causes are true or very likely. Selecting a few very likely causes and then testing them can help address the effect (or risk).

11.3b Perform Quantitative Risk Analysis

Perform quantitative risk analysis is the process of developing insight using a detailed numerical estimate of the overall impact of the risk on project objectives. While all projects

Exhibit 11.12



use qualitative risk analysis, quantitative risk analysis is used only when necessary and only on selected risks. Bigger, more complex, riskier, and more expensive projects often can benefit from the additional rigor of these more structured techniques. Quantitative risk analysis is often used when it is critical to predict with confidence the probability of completing a project on time, on budget, and with the agreed-upon scope and/or quality. Some of the more frequently used quantitative techniques follow:

- **Decision tree analysis**: A graphic tool depicting alternative choices as branches, multiple options for each alternative, and evaluating potential outcomes in terms of uncertainty and monetary value. Potential outcomes are often determined using the expected monetary value (EMV) method.
- **Expected monetary value (EMV) analysis**: A statistical technique to calculate the present value of future outcomes to choose the best alternative. It is generally used for engineering economics and cost-benefit analysis.
- **Failure mode and effect analysis (FMEA)**: **Failure mode** means the ways, or modes, in which something might fail. Failures are any errors or defects, which can be potential or actual. **Effects analysis** refers to studying the consequences of those failures. FMEA documents current knowledge and actions about the risks of failures and can be used for continuous improvement.[6]
- **Sensitivity analysis**: A quantitative what-if risk analysis technique that presents comparative analyses of various desirable outcomes with respect to a financial measure or uncertainty. It can be used to determine which risks have the most impact on the project outcomes or goals.

  Tornado diagrams are often used to represent this analysis. A **tornado diagram** is a special type of bar chart and data where project goals are listed vertically and risk uncertainties are depicted horizontally as probability. The order of presenting the categories is that that the largest bar appears on the top and the smallest bar appears at the bottom.
- **Simulation**: A technique that mimics real situations using uncertainties and assessing their impact on project objectives. In the context of projects, the Monte Carlo simulation tool is used to develop probability distribution of risks and their impact on project goals such as cost and time.

Criteria to help select a suitable quantitative risk technique or methodology should do the following:

- Use explicit knowledge of the project team members.
- Allow quick response.
- Help determine project cost and schedule contingency.
- Foster clear communication.
- Be easy to learn and use.

11.3c Risk Register Updates

The probability of each risk occurring and the impact, if it does happen, are added to the register for each risk. The priority for each risk is also listed. Some organizations use a "Top 10" list to call attention to the highest-priority risks. In addition, some organizations choose risks that are likely to happen soon for the higher priority list. Some organizations pay attention to risks that are difficult to detect—that is, risks with obscure trigger conditions. Any of these means of calling attention to certain risks are also listed in the risk register. If the project team performed any quantitative risk analysis, the results are also documented in the risk register.

11.4 Plan Risk Responses

Once risks have been identified and analyzed, the project team decides how they will handle each risk. The **plan risk** response process determines effective response actions that are appropriate for prioritized individual risks and for the overall risk of a project. This is often a creative time for project teams as they decide how they will respond to each major risk. Sometimes a team develops multiple strategies for a single risk because they do not believe one strategy will reduce the threat or exploit the opportunity as much as the stakeholders would like. The team may decide that it is not worth the effort to eliminate a threat completely. In those cases, the goal is to reduce the threat to a level that the sponsor and other stakeholders deem acceptable.

11.4a Strategies for Responding to Risks

Because so many possible strategies can be developed for dealing with project risks, it helps to classify the strategies. Common risk strategies are shown in Exhibit 11.13.

Exhibit 11.13

Common Project Risk Strategies

Strategy	Type of Risk	Examples
Avoid	Threat	1. Change project plan and/or scope 2. Improve project communications 3. Decide not to perform project
Transfer	Threat	1. Insurance 2. Fixed-price contract 3. Hire expert
Mitigate	Threat	1. Lower probability and/or impact of threat 2. Build in redundancy 3. Use more reliable methods
Accept	Threat and opportunity	1. Deal with it if and when it happens 2. Establish triggers and update frequently 3. Establish time and/or cost contingencies
Research	Threat and opportunity	1. Get more and/or better information 2. Verify assumptions 3. Use prototype
Exploit	Opportunity	1. Assign talented resources to project 2. Give more emphasis to project
Share	Opportunity	1. Allocate partial ownership to third party 2. Form a joint venture
Enhance	Opportunity	1. Increase probability and/or positive impact 2. Identify and maximize key drivers 3. Add more resources

Source: Adapted from Project Management Institute, *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* (Newtown Square, PA: Project Management Institute, 2008): 261–263; Royer, Paul S., *Project Risk Management: A Proactive Approach* (Vienna, VA: Management Concepts, Inc., 2002): 35; and Verzuh, Eric, *The Fast Forward MBA in Project Management*, 2nd ed. (Hoboken, NJ: John Wiley & Sons, 2005): 100–103.

Disability Images/Science Source

Avoid Risk Many people prefer to avoid a risk if possible, and often, that is the best strategy. Sometimes, a project plan can be altered to avoid a risk by deleting the risky section or work element. For example, if the local police tell the organizers of a parade that traffic patterns on one section of their route are very difficult to control, perhaps they may alter the route. Project risk response strategy decisions often must be made with a thorough understanding of the key stakeholders' priorities of cost, schedule, scope, and quality. In this example, if no powerful stakeholder had a strong interest in the exact route, the change might be easily made. However, project managers need to understand that every decision they make regarding risk response strategies may impact something else.

Another avoidance strategy is to ensure communications are good, especially concerning risky issues. Many risks can be more easily addressed with prompt and accurate information. The ultimate avoidance strategy is to not perform the project at all. This choice is sometimes made when the risks posed by the project are deemed unacceptably large compared to the potential benefits. Before a decision is made not to perform a project at all, normally each of the other strategies is considered. One example of people-related risk avoidance practices from an experienced European project manager is shown in Exhibit 11.14.

Transfer Risk Sometimes, a decision is made to transfer a part of or an entire project risk to another organization. One common means to do so is through insurance. Project insurance works like any other type of insurance: a premium is paid to another organization, which will assume a level of risk. Higher premiums need to be paid for more risk to be assumed (think of lower deductibles). Therefore, using insurance as a risk transfer strategy is a two-part decision: Do we transfer risk, and, if so, how much risk do we transfer? The answer generally is "enough so the overall risk is acceptable to key stakeholders."

A second transfer strategy deals with the type of contract used. An owner wishing to transfer risk to a developer will want to use a fixed-price contract. The developer who accepts the risk would insist on a higher price to cover their uncertainty. A fixed-price

Exhibit 11.14

People-related Risk Avoidance Practices

In 50 years based in the UK but having worked on hundreds of projects all around the world, I have found the greatest project risk is untrustworthy participants. This leads to important project management rules:

1. Choose your suppliers on past proven performance rather than price.
2. Make personal contact with the most senior person in a supplier organization who is responsible for your project and regularly review progress.
3. Reserve as much of every Friday necessary to check with suppliers to ensure they are fully prepared for the following week.
4. Don't make informal, verbal, arrangements for events that are important to your project.
5. Be aware of your project's subcontractor chain which may be of higher risk than your prime subcontractor.
6. When possible, employ (small/medium) expert contractors that are managed by their owners.

Source: Tony Martyr, Author of *Why Projects Fail: Nine Laws for Success.*

contract can be used when the scope is well defined. A developer who prefers that risk stays with the owner would prefer a cost-plus contract under which they are compensated for their cost plus a certain amount of profit. The owner, in turn, would prefer to drive for a low cost in such an arrangement because they are assuming the risk. This risk transfer strategy of using contracts is employed when the scope cannot be defined completely. Other types of contracts can be used when both parties agree to share the project risk.

A third risk transfer strategy is to hire an expert to perform the risk and to hold that person accountable. None of the transfer strategies eliminate risk; they just transfer the risk and let someone else assume and manage it.

Mitigate Risk Mitigation strategies are those in which an effort is made to lower risk. In general, this means either reducing the probability of a risk event happening and/or reducing the impact if it does happen. For example, a major risk could be that a key resource may not be available. To reduce the probability of that happening, perhaps the person could be hired well in advance and then not be assigned to work on any other projects. To reduce the impact if this person were not available, perhaps the project team would like to use the second mitigation strategy of building redundancy. They could train another team member to do the work of the key resource. Redundancy is a way of life in systems projects. Captive power generation plants often build redundancy to the tune of 100% additional capacity to ensure an uninterrupted power supply. Another example is building a redundant system when developing an aircraft to increase reliability and safety. However, we must be judicious in selecting redundancy because the weight of the aircraft would increase and could become cost prohibitive. In such cases, a third mitigation strategy is often utilized: use more reliable methods. If the primary way of performing a key activity is highly reliable, there is less need for other mitigation strategies.

Accept Risk A fourth risk response strategy is to accept the risk. This is often used for risks that are deemed to be minor. The project team deals with them if and when they happen. If the risks are deemed to be minor, most of them are not likely to happen, and when they do, most will not cause major disruptions. However, some risks can have a significant impact on the project if left untended. Therefore, project teams often define a trigger condition for some of these accepted risks. The trigger condition marks the dividing point where, instead of just monitoring the risk, the team starts to deal with it.

For fruit and vegetable growers in California, the trigger condition may be a weather report predicting cold temperatures. Armed with that knowledge, the growers enact

strategies to protect their crops to the extent possible. The growers are willing to accept the risk of cold weather occasionally because they make enough money at other times to compensate for the loss. If they are likely to experience more cold weather, they may choose not to grow sensitive crops during the cold season. One other acceptance strategy is to put contingencies of time and/or money into the project plan to cover the risks that transpire.

Each of these acceptance strategies can also be used to take advantage of opportunities. All the strategies—establishing trigger conditions to notify the team when an opportunity is present, dealing with it as it happens, and having a little extra time and money to alter the project plans to reap the potential benefits—make sense. An example of these three strategies applied to an opportunity could be when a company develops a new style of hat, a celebrity wears it on TV, and then the demand takes off. By using more money to advertise to unexpected customers, the company may generate many additional sales.

Research Risk In certain instances, the best way to handle a risk is to learn more about it. The first research strategy, therefore, is to secure better and/or more information so the project team understands what they are dealing with. Projects often are conducted in a rapidly changing environment in which decisions need to be made quickly, often based upon imperfect and incomplete information. It is unusual to gather and verify all the information desired, and we may not be able to do so; however, at times it is useful to gather as much information as possible.

Another research strategy is to verify assumptions that have been made. Assumptions that prove to be false become risks. Yet another research strategy is to perform the project on a small scale first to see if it works. This can include developing a prototype, test marketing a new product, running new software in one department first, and so on. Project teams can often learn a great deal from trying their ideas on a small scale first. These research strategies work well for both reducing threats and capitalizing on opportunities.

Exploit Opportunity One strategy that is aimed exclusively at opportunities is exploitation. A project manager may identify trigger conditions that, if reached, will allow them to go to their sponsor to request that the project be assigned a higher priority. If the organization wants to exploit opportunities, they can assign more or better resources to the project, remove barriers, and give it more visibility in management reviews.

Share Opportunity One additional exploitation strategy deals with the results of the project. Perhaps the project team can develop a new product or service so revolutionary that the parent organization is not capable of fully exploiting it. In a case like this, the parent organization may spin off a nimble subsidiary, form a joint venture with another firm, or sell the rights.

Enhance Opportunity Essentially, a project team wants to either maximize the probability that an opportunity will occur and/or maximize the benefit if it does. The project manager wants to identify key drivers of these positive impacts and develop strategies to capitalize upon them. Certainly, adding more or better resources is one way to enhance opportunities.

11.4b Risk Register Updates

The project manager ensures that the risk register is updated with the results of the response planning. For each risk, the response strategy is noted. It also means that a single person is assigned as the "owner" of each risk, and that person is responsible for understanding the trigger and for implementing the strategy. Finally, any changes that need to be made to the project schedule, budget, resource assignments, and communications plan should be included.

11.5 *PMBOK Guide 7e*

- Stakeholders
- Team
- Development approach
- Planning
- Delivery
- Measurement
- Uncertainty

11.5a Stakeholders

Stakeholder analysis provides useful information about their interests, concerns, and needs. If not met, these elements could become risk factors for a project. A project team must work collaboratively with stakeholders to elicit their requirements and expectations, then attempt to resolve issues and concerns while developing the risk plan. Stakeholder interactions, interests, and influences are dynamic in nature and vary throughout the project life cycle; if not monitored, these could manifest as risks. Further, periodic communication with the stakeholders is highly desirable, with a focus on new developments and changes in the risk management plan.

11.5b Team

Every team member must be involved in developing a comprehensive list of risks with associated impact and probability of occurrence. Identifying risks is easier and a more realistic list of risks can be identified when team members possess experience with similar past projects and are knowledgeable about the risks associated with those projects. Team members assume a leadership role in monitoring risks during the project execution phase. They take proactive steps to notify the project team about such risks and consequences associated with them. A collaborative effort with stakeholders is desirable in developing and managing the risk plan.

11.5c Development Approach

Risk management will differ based on the development approach chosen. When requirements are identified with a greater level of confidence and with less uncertainty, a predictive development approach is employed. The development of a risk register and risk management plan is often based on scope planning and the WBS. Cost and schedule risks can be minimized with a collaborative team effort of developing these plans. In an adaptive approach, however, uncertainty and ambiguity are often associated with defining requirements. Therefore, risk associated with the project scope may be higher. Risk is minimized by iterative and incremental planning wherein the scope of a sprint is minimized and focused on; a prioritized business value is considered as a story and is executed in a sprint.

11.5d Planning

Project deliverables, organization requirements, market requirements, and legal or regulatory restrictions all contribute to project planning, and associated risks must be assessed. In a predictive planning approach, it is possible to develop a detailed WBS and forecast possible risks associated with each and every WBS work package. In an adaptive approach,

high-level themes or epics are used to develop features that are further decomposed into stories. In the process, the scope is narrowed down to what is feasible and adds the most business value. It is executed in a sprint. This narrowly defined scope reduces the inherent risk associated with the scope. Cost and schedule risks are minimized as all the available resources are dedicated to this sprint.

11.5e Delivery and Measurement

Completion of requirements can be asserted and measured using acceptance criteria, technical performance measures, and definition of done. However, if requirements are not complete or are ambiguous, then the delivery and measurement will be in jeopardy. If uncertainty in defining requirements is minimized, a predictive approach and consequent detailed development of scope will help us in identifying, monitoring, and managing risks. If uncertainty and volatility are present in requirements, the scope is narrowed down using an adaptive approach so that acceptance criteria, measures, and definition of done can be determined.

11.5f Uncertainty

Risks are bound to occur when uncertainty exists in defining requirements, and the presence of risk adds to the uncertainty. Further, ambiguity, volatility, and complexity are some of the factors that, if present, will increase risks associated with the project.

11.6 Agile Projects

Agile projects are similar to other projects regarding developing early risk planning, assessment, and response planning at a high level. However, more detailed and timely risk management occurs in planning each subsequent iteration, in daily stand-up meetings, and in retrospectives at the end of each iteration. Exhibit 11.15 compares plan-driven versus Agile projects on several risk-related questions.

Exhibit 11.15

Comparison of Plan-Driven and Agile Approaches for Project Uncertainty Planning

Project Uncertainty Planning Questions	Plan-Driven	Agile
When are risks identified?	Early if possible, but throughout project	Early if possible, but throughout project
What types of risk analysis are used?	Always qualitative, sometimes quantitative	Always qualitative, sometimes quantitative
What risk response strategies are used?	Avoid, transfer, mitigate, accept, research, exploit, share, enhance	Avoid, transfer, mitigate, accept, research, exploit, share, enhance
What is the project trying to create and how is it delivered?	Outputs by meeting agreements	Outcomes by close coordination with stakeholders
When are risks handled?	Whenever needed	Early by using a risk-based spike and whenever needed
What risks are based upon resources?	Commitments are not honored	There are not enough resources to commit
Where do many lessons learned originate?	Previous projects workers were on	From the long-lived project team

11.6a Agile Terms

Continuously identify risks	Specific effort to use feedback and engage team to identify risks
Premortum	Brainstorming description of what could go wrong
Assume variability	Preserve options to provide flexibility because of unknowns
Handoffs	Whenever work is turned over some tacit knowledge is lost
Risk-based spike	Short time-boxed work to address a specific risk

In this book, we use many Agile terms and definitions from Anantatmula V. and Kloppenborg T. (2021). *Be Agile Do Agile*. Business Expert Press: New York, NY.[7]

Risks and other uncertainties are **continuously identified** as early as possible on all types of projects. Agile project teams often use an additional technique called a **premortum**. In the premortum, before the project begins, they pretend they are looking back at it after it failed and ask why did it fail. This allows team members to speculate about causes or potential failure and to make sure they adjust their plans to avoid what they think could lead to failure.

There are many ways in which risk management on Agile projects is similar to plan-driven projects. Both identify risk as soon as possible and keep an eye out throughout the project for additional risks or the materialization of previously identified risk events. Both always use qualitative analysis (judgment) and both use quantitative analysis if needed. Both use many of the same risk response strategies.

Risk can be reduced in several ways using Agile projects. For one, the emphasis on solving the client's problem rather than merely satisfying the contractual requirement encourages the team to confer often, even daily with the product owner. These continual, candid conversations often uncover problems and determine solutions quickly. Agile teams **assume variability** and plan with the flexibility to make necessary adjustments. **Handoffs** (where one person or team passes information or product to another) are potential failure points. The close communication in Agile projects helps to ensure smooth handoffs. Further, one hallmark of Agile projects is that the team provides something of value at the end of each short iteration. The team demonstrates how that increment of product works. This practice of repeated demonstrations identifies problems quickly so they can be solved before they get bigger.

Teams and their product owners often agree early in a project to perform a **risk-based spike**. That is a short period when the only thing the team works on is a large identified risk that could upset the entire project. If the team cannot solve this risk, the product owner may decide to use a different approach to the project or even cancel the project outright. This is far superior to finding out late in a project that there is an insumountable problem.

Many projects of all types have limits on the resources assigned. When resources are insufficient on plan-driven projects, sometimes the team is unable to fulfill commitments. On Agile projects, the team with too few resources will simply not commit to more work than they can do. That often means when a project requires too many resources, the work is delayed, but the delays are clearly communicated in advance and product owners can make early decisions in response.

Many risks can be predicted by using lessons from previous projects. This is true for any type of project. Plan-driven project team members may collectively have experiences on a variety of projects from which they can bring lessons learned. The project team on Agile projects has often stayed together from one project to another. As such, they may not have as varied of background, but they also likely have more established and open working relationships with each other which may enable them to more freely share and understand lessons learned.

Summary

All projects have some risks. More unique projects have more uncertainties and unknowns and, therefore, more risks. A project manager needs to use an appropriate level of detail in risk planning—enough to plan for major risks, yet not so much that a great deal of time is spent on minor risks.

Risk management planning starts with understanding what constitutes success for the upcoming project. This may require understanding the trade-off decisions that key stakeholders are willing to make among the project scope, cost, time, and quality. Risk management planning is part of the overall project management plan and may be performed concurrently with other project planning components.

Identifying risks includes gathering information on potential risks. This can be accomplished by having the project core team and selected subject matter experts brainstorm all possible risks. Many times, a core team can review documents such as the project charter, WBS, communication plan, or schedule to help identify risks. The core project team can look beyond project documents for external risks using reviews of literature and consulting with external experts. Once risks have been identified, the core team creates the risk register with each risk categorized. Sometimes, a team also lists potential causes for each risk and potential responses.

The next major activity is to analyze the risks. At a minimum, this involves determining which risks are major—at least from the standpoints of how likely each risk event is to occur and how big of an impact it will have if it does occur. Sometimes, more sophisticated analysis is performed to identify the root causes of risks, to identify the trigger conditions that signify the risk event is about to happen or to consider more complex relationships among risks. Quantitative techniques are sometimes used to determine which risks are major in terms of probability to occur and potential to impact project goals.

Risk response planning involves determining in advance how to respond to each major risk. Minor risks are handled by simply being aware of their potential and dealing with them if they occur. Eight types of risk response strategies that can be applied to major risks are avoid, transfer, mitigate, accept, research, exploit, share, and enhance. A project manager may decide to use multiple strategies on a large and critical risk. Armed with proper risk planning, a project manager can confidently begin even a risky project.

Key Terms Consistent with PMI Standards and Guides

plan risk management, 404
performing organization, 404
project risk, 405
threats, 405
opportunity, 405
risk management plan, 406
risk breakdown structure, 408
SWOT analysis, 411
Delphi technique, 411
root cause analysis, 412
trigger condition, 412
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decision tree analysis, 417
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Key Terms Consistent with Agile Practice

Continuously identified, 424
Premortum, 424
Assume variability, 424
Handoffs, 424
Risk-based spike, 424

Chapter Review Questions

1. A potentially negative uncertainty is known as a(n) _____, while a positive uncertainty is known as a(n) _____.
2. Who should be involved in identifying potential risks for the project?
3. List and describe the four different categories of project success measures.
4. During which stage of a project are most risks typically uncovered?
5. Relative to the project's life cycle, when is the cost per risk discovered typically highest for plan-driven projects? Is this different on Agile projects?
6. What does a SWOT analysis examine?
7. What is a root cause analysis?
8. Name three different ways to categorize project risks.
9. A key supplier for your project has not been returning your calls or responding to your e-mails. This is an example of a(n) _____, which indicates that a risk is likely to occur.
10. What two main criteria are used when evaluating risks during qualitative risk analysis?
11. Should every risk, no matter how major or minor, have a contingency plan created to address it? Why or why not?
12. Are both qualitative and quantitative risk analyses used on all projects? Why or why not?
13. What is an example of transferring risk?
14. Describe the various types of information that are often contained in the risk register. Why is each included?
15. In the risk register, why should only one person be assigned "owner" of a risk?
16. Which three risk strategies are used specifically for dealing with opportunities?

Discussion Questions

1. Give one example each of a known known, known unknown, and unknown unknown you have encountered on previous projects.
2. Describe trade-offs that may need to be made among project stakeholders' priorities. How would you address these trade-offs as a project manager?
3. List three methods that can be used for categorizing project risks. For a fundraising project, give examples of risk using each categorizing method.
4. To help identify risks, what are some questions a project manager could ask when reviewing the project charter and WBS?
5. You are hosting a large dinner party. What are two possible risks you would encounter? Identify at least one trigger condition for each.
6. What is the difference between a major risk and a minor risk? How do you determine which risks are major versus minor?
7. List and describe at least three common quantitative risk analysis techniques. Under what circumstances would you find each one useful?
8. Name the eight common risk responses that are used and describe how you might use two or three of them together on a project.
9. You are the project manager of a construction project for a large organization and will be relying mostly on independent contractors to execute the project work. Which type of contract would you prefer to use to procure their services? Why?
10. Give an example of a risk you have chosen to accept on a previous project. How did you decide to accept it? In retrospect, was that the right decision to make?
11. How do the development approach and project lifecycle you choose affect the way you plan for uncertainties?

PMP Exam Study Questions

1. A SWOT analysis is an information-gathering tool that helps increase the range of identified risks by examining strengths, weaknesses, _____, and threats to a project.
   a. opportunities
   b. options
   c. origins
   d. organizations
2. The _____ is a living document in which the results of risk analysis and risk response planning are recorded.
   a. root cause analysis
   b. risk register
   c. risk management plan
   d. cause-and-effect diagram
3. While all projects use _____ risk analysis, _____ risk analysis is used only when it is needed and there is sufficient data to develop appropriate models.
   a. quantitative, qualitative
   b. quantitative, opportunity
   c. opportunity, qualitative
   d. qualitative, quantitative
4. An Agile meeting at which risk may be discussed could be any of the following EXCEPT:
   a. premortum
   b. stand-up
   c. risk-based spike
   d. retrospective
5. Avoid risk, mitigate risk, accept risk, and _____ are all strategies for responding to negative risks, also known as threats.
   a. enhance risk
   b. prevent risk
   c. transfer risk
   d. share risk
6. An analytical technique used to determine the basic underlying source of a variance, a defect, or a risk is called _____.
   a. qualitative risk analysis
   b. Monte Carlo analysis
   c. SWOT analysis
   d. root cause analysis
7. The Risk Management Plan describes the methodology, roles and responsibilities, budgeting, timing, and risk categories for potential causes of risk. These risk categories can be structured into a hierarchical representation called a(n):
   a. organizational breakdown structure (OBS)
   b. risk breakdown structure (RBS)
   c. work breakdown structure (WBS)
   d. threats breakdown structure (TBS)
8. Risks that have been identified and may or may not happen are referred to as known unknowns, and a _____ should be established to cover them if they are triggered.
   a. contingency reserve
   b. management reserve
   c. funding reserve
   d. risk buffer
9. _____ is a quantitative risk analysis modeling technique used to help determine which risks have the most powerful impact on the project. Using a tool such as a tornado diagram, it "examines the extent to which the uncertainty of each project element affects the objective being studied when all other uncertain elements are held at their baseline values."
   a. Fishbone diagram
   b. Monte Carlo technique
   c. Expected monetary value analysis
   d. Sensitivity analysis
10. Expected monetary value (EMV) is commonly used within this type of analysis:
    a. root cause
    b. decision tree
    c. Monte Carlo
    d. cost/benefit

Exercises

1. For a project in which you are planning a campus event with a well-known speaker, identify and quantify risks and develop contingency plans for the major risks.
2. For the same campus event project, perform a literature review to identify risks.
3. Engage another student team to perform a peer review of project risks for your project. In turn, you perform a peer review for theirs.
4. For one of the risks identified in Exercises 1 through 3 above, construct a cause-and-effect diagram to determine possible root causes. Determine which of the possible root causes are probable. Describe how you would test each probable root cause to determine if it really is a root cause.
5. For the risks identified in Exercises 1 through 3 above, identify trigger conditions that indicate each risk may be about to happen.

6. Brainstorm and group at least twelve risk factors (as shown in Exhibits 11.5, 11.6, and 11.7) for risks in one of the following types of projects:
   - Research and development projects
   - Organizational change projects
   - Quality improvement projects

Integrated Example Projects

Suburban Homes Construction Project

Refer to the project WBS from Chapter 7. You developed the WBS of multiple levels, including work packages at the lowest level based on the initial project requirements below, which were further elaborated.

Building a single-family, partially custom-designed home as required by Mrs. and Mr. John Thomas on Strath Dr., Alpharetta, Georgia. The single-family home will have the following features:

- 3,200 square-feet home with 4 bedrooms and 2.5 bathrooms
- Flooring—hardwood on the first floor, tiles in the kitchen and bathrooms, carpet in the bedrooms
- Granite kitchen countertops, GE appliances in the kitchen
- 3-car garage and external landscaping
- Ceiling—10' on the first floor and vaulted 9' ceilings in the bedrooms

High-level Assumptions and Constraints

- The list of options is limited and the cost of the house would vary based on the options selected.
- The client must choose one from among the models offered.
- 7-year warranty for structure and 2-year warranty for finishing components

After the WBS was developed, it is necessary to identify risks associated with the project and include prioritized risks in revising cost and schedule estimates. For this purpose, you were asked to develop a comprehensive risk management plan.

Tasks to Complete

- Identify all the risks. To do so, you will use a WBS and ask yourself, "What can go wrong with this work package?" for each work package identified at the lowest level of the WBS. Also, you can identify more risks by challenging all the assumptions listed in your project plan.
- Develop a risk register as discussed throughout the chapter.
- Develop a risk breakdown structure.
- Perform a qualitative assessment to prioritize risks.
- Develop risk response strategies for the top ten risks in the prioritized list of risks.
- Choose a critical risk and develop a greater understanding of the risk using quantitative risk assessment.

Heritage Arboretum Development Project

Questions for students to answer first for the project overall and then for each iteration in turn at a smaller scale are the following:

1. Brainstorm all of the risks you can imagine. Use a premortum. Create a definition of done.
2. Assess the risks to determine which you believe are big.
3. Create response plans for the big risks, including who owns each and what the triggers are that indicate they may happen soon.
4. Which two of these risks do you feel are showstoppers? How would you plan a risk-based spike for one of these big risks? Perform a premortum on the other big risk you identified.

Semester Project Instructions

Create a risk register for your example project. Categorize each risk, list potential causes, and list potential responses for each cause, as shown in Exhibit 11.9.

Describe what each project success measure (from Exhibit 11.1) looks like on your example project. Identify at least three risks to each success measure,

determine which are major risks, and for each major risk, develop one or more contingency plans. Identify whether the contingency plan is an avoidance plan (reducing the probability of the risk event), a mitigation plan (reducing the impact of the event), or both.

Facilitate a discussion with the sponsor and other key stakeholders of your project. Have them determine the relative importance of their priorities and document them, as shown in Exhibit 11.2.

Perform a risk review for your example project. Use at least three types of review, as shown in Exhibit 11.8. Which of these types gave you the most useful information? Why?

Project Management *in Action*

Risk Management on a Satellite Development Project

Introduction

Proactive risk management is definitely one of the key advantages in implementing and using standardized project management practices today. We always have the balancing act of managing the triple constraints of cost, time, and scope, and on top of that, we need to effectively assure project quality and that we have enough resources to do the job. In this age, we are continuously asked to optimize our performance and "be more efficient"; often, this is because we simply have too much work and not enough people to do it. So, in practice, we work with risks every day—from the risk of not spending enough time planning to the risk of not having enough supplies, or even the risk of not running a thorough enough risk management program.

Some time ago, I worked on a satellite development project that involved a lot of research technologies. There were many unknowns, with variables in the manufacture of components, integration of systems, working with subcontractors, tests, and other areas that made the project full of risk. Additionally, we were on a tight timeline for production and had only limited budget reserves available to handle cost overruns. Thus, we needed a practical way to manage and deal with the risks of the project. By systematically working with the risks of the project, we were better able to prepare responses to the risks if and when they occurred.

Planning

For our project, it was essential to have an integrated system and mechanism for risk management. Thus, at the outset of the project, during the planning phase, we developed our risk management plan and established with the team the process for dealing with not only risk but also any subsequent changes that could occur with the project as a result of the risk. This was done during a daylong clinic where we exclusively worked on developing this risk plan, as we knew our project was high risk and we wanted to make sure we could work with the plan. We developed criteria for evaluating probabilities of occurrence and impact for the risk and also for prioritizing risks. Furthermore, we researched and compared our methods to industry standards for risk management such as those from SEI®.[8]

Execution

Once we had a solid approach for risk management in this project, we then went forward with the processes of identifying our project risks, analyzing the risks, developing potential responses for the risks, and deciding upon the next steps for the risks. Our approach to all this was an integrated one, using a risk management database tool we developed as its cornerstone. This tool allowed for anyone in the project team to view the risks, enter new risks, and provide input for potential risk responses. An example of a similar type of tool is shown in Exhibit 11.16, where each risk is logged as a record in the database. The database allowed the team to have a single repository for recording and logging all the risks for the project, which was critically important because the risks in satellite development were constantly changing.

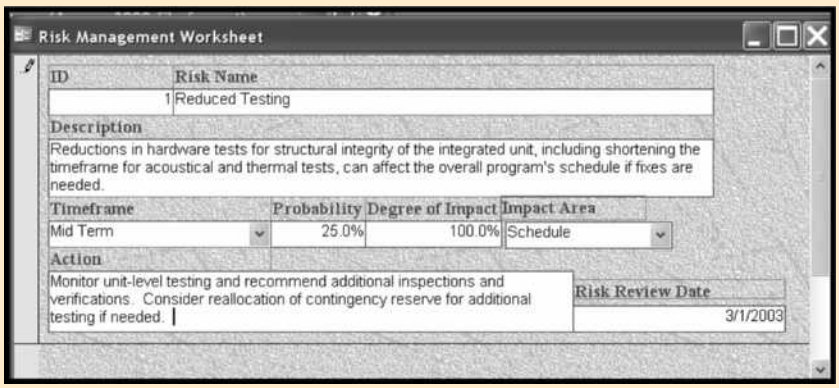
Every other month, the project team would hold a risk management review, in which each risk would be discussed and any decisions on actions would be made. Typically, we would meet and review the risks logged in the database in this group setting, and the risk's assigned owner would talk about the background of the risk, things that occurred since the risk was

first logged (or since the last risk review), and what they felt the next steps needed to be. Project team members brought up other areas of the project that might have been impacted by the risk or new risks that resulted from the occurrence of the risk or provided potential ideas for deferring, transferring, mitigating, or accepting the risk. The team also determined whether the risk decision needed to be elevated.

Another reason we held risk management reviews was to make sure that the team was up to date with the overall project's risks. Based on the criteria we defined in developing the risk management plan, the database tool provided us with a prioritized report of all the project's risks. That risk report was used by the group to make decisions about the project and look at mitigation strategies for the project as a whole. The risk management review provided us with an avenue through which we could work together to resolve the high-priority risks of the project. Often, the high-priority risks were related to overall project drivers, and it was essential to be as proactive as possible in managing those risks. Moreover, by examining and analyzing the project risks in this manner, potential risks for other related projects, in this case, other satellite development projects, were also identified.

Exhibit 11.16

Risk Management Worksheet



Source: Microsoft Corporation.

The level of risk management necessary for a project can vary greatly. On the satellite development project, it was necessary to have a comprehensive program to address risk because there were many unknowns. We performed all our duties with the notion of understanding risk, and thus the risk management program addressed both the daily needs of logging and updating risks and the long-term strategic needs of understanding risk implications. However, for a smaller or more well-defined project, having such a detailed level of risk management may be unwieldy and difficult to manage. The key is finding the appropriate level for the project at hand.

Source: Lydia Lavigne, PMP, Ball Aerospace Co. Reprinted with permission.

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Chapter 12

Project Quality Planning and Project Kickoff

Chapter Objectives

Core Objectives:

12-1 Define each core concept of quality in projects and explain its significance in planning and managing projects.

12-2 Explain what may be included in a project quality management plan.

12-3 Describe the major contributions to contemporary project quality of the quality gurus and TQM, ISO, and Six Sigma.

12-4 Baseline your complete project plan in Microsoft Project.

12-5 Compile a complete project management plan, including all parts covered in the last several chapters.

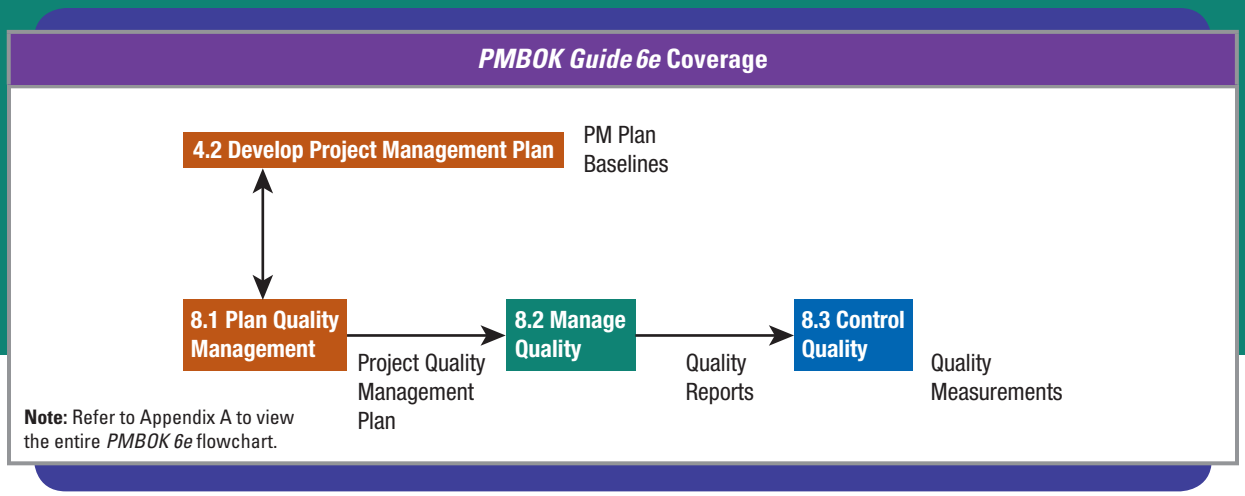
12-6 Kick off a project with effective pre-meeting preparation, a kickoff meeting, and documentation.

Agile objectives:

12-7 Describe how Agile methods help to improve the quality of project products, processes, communications, and people.

Duncan Andison/Shutterstock.com

Founded in 1947, General Tool Company is a Cincinnati-based contract manufacturer of highly engineered defense and aerospace hardware. GTC's Fortune 500 customers include Lockheed Martin, General Electric, General Dynamics, Raytheon, Boeing, and others. Performing to the exacting standards of such a demanding clientele is an entry barrier that few contract manufacturers can overcome. A failure to provide objective quality evidence of sound and auditable project, risk, and quality planning systems can (and usually does) exclude prospective subcontractors from the bid and proposal process. For example, most major manufacturers of flight safety hardware are required to adhere to AS 9100c, which incorporates the well-known ISO 9001:2000 quality management system standards. In short, for GTC, proper quality planning is more than good project management—it is a matter of survival!



PMBOK Guide 7e

- **Stakeholders**
- **Team**
- **Work**
- **Delivery**
- **Measurement**
- **Uncertainty**

Chapter Output

- **Project quality management plan**

Quality and Risk

As if manufacturing highly complex, tight-tolerance aerospace and defense hardware was not challenging enough, the majority of related contracts transfer risk to the subcontractor through firm-fixed-price arrangements. Under such arrangements, the subcontractor agrees to manufacture hardware of desired quality at an agreed-upon fixed price, assuming all risks associated with schedule and cost overruns (unless otherwise specified through an approved change order process).

In such an environment, it is imperative for the subcontractor to understand all quality and technical performance requirements and management disciplines ***prior to beginning the manufacturing process***. Within GTC's quality planning system, vendor selection requires special investigation to ensure the following criteria can be met.

- The vendor is on the GTC "Approved Vendor" list.
- The vendor is capable of providing the service in the required timeframe and has available capacity to meet the demand.
- The vendor can meet all the procedural requirements and provide the required certifications for traceability and part pedigree.

Failing to "flow-down" all quality requirements at the start of a project can create significant, if not irreversible, challenges to part delivery. This makes the quality planning process especially important to companies operating within the firm-fixed-price environments, like GTC.

Few knowledge areas are more important than project quality management; and this is especially true when the safety of aviation and defense personnel are involved.

—Brad Brezinski, Jim Stewart, Korey Bischoff, and Mark Butorac of General Tool Corporation

Perhaps the best way to understand the contemporary approach to project management is to learn how project quality management is developed. Many people have influenced the modern approaches to quality, and their contributions have largely been meshed together to give project managers a full understanding of project quality demands, processes, and tools. With this understanding, project managers are ready to perform project quality management—all the necessary work to ensure that project deliverables satisfy their

intended purpose. This chapter includes the first part of project quality management, namely **plan quality management**, which is "the process of identifying quality requirements and/or standards for the project and its deliverables and documenting how the project will demonstrate compliance with quality requirements and/or standards."[1] The remaining parts of quality management are covered in Chapter 14.

This is the final chapter dealing with project planning. Quality planning is often performed simultaneously with other aspects of project planning. In certain ways, quality of the project deliverable is integrated with scope planning as requirements are translated into specifications with clearly defined qualitative and quantitative parameters and measures based on standards and industry practices.

Once the various aspects of planning are complete, the project manager leads the team in sorting out any inconsistencies. The team then takes the completed project plan to the sponsor and other stakeholders for approval. Once the plan is accepted, it is communicated widely, and the project execution formally begins. Completing and approving the overall project management plan in this manner demonstrates how contemporary project management is integrative, iterative, and collaborative.

12.1 Development of Contemporary Quality Concepts

The contemporary approach to quality management has evolved first from the teachings of several quality "gurus" from the 1950s through the 1980s and then through various quality frameworks and management concepts popularized during the last 25 years.

12.1a Quality Gurus

Arguably the most influential thought leader in quality was W. Edwards Deming. One concise way to summarize his ideas is his four-part Profound Knowledge System, shown in Exhibit 12.1. Deming started as a statistician and initially preached that understanding variation was essential to improving quality. By the time he had fully developed this system, he also stated that it is important to understand how organizations operate as systems, that managers need insight in order to accurately predict the future, and that leaders need to understand individual motivations.

Exhibit 12.1

Deming's Profound Knowledge System

Systems	Interactions occur among parts of a system, and parts cannot be managed in isolation.
Variation	Managers need to understand common and special causes of variation and then work to reduce both.
Knowledge	Managers need to learn from the past and understand cause-and-effect relationships to predict future behavior.
Psychology	Leaders need to understand what motivates each individual and how different people and groups interact.

Source: Adapted from James R. Evans and William M. Lindsay, *The Management and Control of Quality*, 8th ed. (Mason, OH: Cengage Learning South-Western, 2011): 94–99.

Joseph Juran, who was a contemporary of Deming, also wrote and lectured prolifically for decades. Juran is perhaps best known for his Quality Trilogy of quality planning, quality control, and quality improvement, as shown in Exhibit 12.2. The *PMBOK Guide* coverage of quality largely mirrors Juran's approach.

Many other pioneers in quality, particularly Japanese and American, have added to the body of quality concepts and tools. Several of the most influential thought leaders and their contributions that apply specifically to project quality are shown in Exhibit 12.3.

Much of the work of these pioneers and many others has been incorporated into three popular frameworks that many organizations use to define and organize their quality

Exhibit 12.2

Juran's Quality Trilogy

Quality Planning	Identify all customers and their needs, develop requirements based upon those needs, and develop the methods to satisfy those requirements.
Quality Control	Determine what to control, establish measurement systems, establish standards, compare performance to standards, and act on differences.
Quality Improvement	Select and support improvement projects, prove causes, select and implement solutions, and maintain control of improved processes.

Source: Adapted from James R. Evans and William M. Lindsay, *The Management and Control of Quality*, 8th ed. (Mason, OH: Cengage Learning South-Western, 2011): 104–106.

Exhibit 12.3

Plan-Driven Project Roles

Thought Leader	Additional Key Project Quality Contributions
Clifton	High-quality organizations encourage individuals to develop their strengths.
Crosby	Quality is meeting requirements, not exceeding them. The burden of quality falls on those who do the work. Quality costs least when work is done correctly the first time. Quality improves more by preventing defects rather than fixing them.
Harrington	Business processes can be improved using a systematic method.
Ishikawa	Quality outputs start with understanding customers and their desires. Work to identify and remove root causes, not just symptoms. All workers at all levels must engage to improve quality. Most quality problems can be solved by using simple tools.
Senge	Team learning is necessary to improve quality.
Shiba	Societal networking accelerates quality improvement. When continual improvement is not enough, a breakthrough is needed.
Taguchi	Reducing variation saves money. Project deliverables will be better with a focus on improving methods.
Zeithaml	Services pose different challenges from manufacturing when improving quality.

initiatives. These frameworks are Total Quality Management (TQM), the International Organization for Standardization (ISO), and Six Sigma.

12.1b Total Quality Management/Malcolm Baldrige

In the United States, government, business, consulting, and academic specialists in quality worked together to develop a common means of describing TQM. This description forms the key areas of the Malcolm Baldrige Performance Excellence Award, as shown in Exhibit 12.4.

12.1c ISO 9001:2015

While the Baldrige Award is a framework developed in the United States, ISO represents a framework developed in Europe. The International Organization for Standardization (ISO) has developed many technical standards since 1947. ISO 9001 is the quality management standard, and the 2015 designation is the latest revision of the standard. When the ISO 9000 family of standards first appeared, they focused largely on documenting work processes. However, over the years, the standards have evolved, and the current seven principles are shown in Exhibit 12.5. Notice that they contain many of the same ideas as the current Baldrige Award values.

12.1d Lean Six Sigma

Lean evolved from lean manufacturing ideas of eliminating as much waste as possible from work processes. *Sigma* stands for *standard deviation*—a statistical term for the amount of variation in data. Six Sigma quality literally means quality problems are measured in parts per million opportunities. Many projects have few routine activities and many unusual and nonroutine activities, so the rigor of the statistics in Six Sigma is not always applicable. However, the ideas behind Six Sigma provide a meaningful framework for project quality.

Exhibit 12.4

Malcom Baldrige Performance Excellence Award Core Values

Core Value	Brief Interpretation of Core Value
Systems perspective	Manage organization as unified whole
Visionary leadership	Demonstrate clear values and set high expectations
Customer focused excellence	Consider all characteristics that contribute to customer success
Valuing people	Value workforce and all stakeholders
Agility and resilience	Able to anticipate, prepare for, and recover from disruptions
Organizational learning	Continuously improve, and significantly change, leading to new goals
Focus on success and innovation	Drive change in your products, services, and operations to create value
Management by fact	Measure and analyze performance to support decision making
Societal contribution	Be role models for well-being of your communities
Ethics and transparency	Stress ethical behavior and transparency in all interactions
Delivering value and results	Balance finance and process results, customer and worker satisfaction

Source: Adapted from: https://www.nist.gov/baldrige/core-values-and-concepts. Baldrige Performance Excellence Program Core Values and Concepts. Accessed October 25, 2021.

Exhibit 12.5

ISO Quality Management Principles

Principle	Brief Description of Principle
Customer focus	Meet customer requirements and exceed customer expectations
Leadership	Establish unity of purpose and create conditions for people to succeed
Engagement of people	Competent, empowered, and engaged people create and deliver value
Process approach	Understand and manage processes to produce desired results
Improvement	Successful organizations consistently focus on improvement
Evidence-based decision making	Decisions based on analysis and evaluation produce desired results
Relationship management	Manage relationships with all interested parties including suppliers

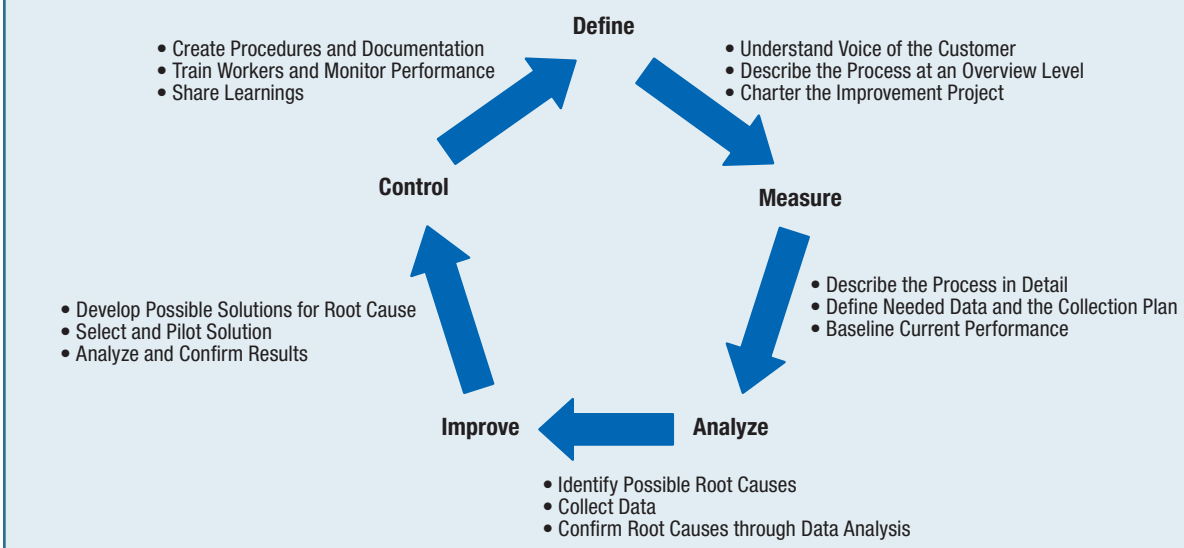
Source: Adapted from: https://www.iso.org/publication/PUB100080.html. ISO Quality Management Principles. Accessed October 25, 2021.

Six Sigma has been a popular approach to quality, as Motorola, General Electric, and many other companies have promoted its application and usage. General Electric, in particular, expanded the focus of Six Sigma to include many service processes that people had previously said were too difficult to measure.

Six Sigma uses a disciplined process called the define, measure, analyze, improve, and control (DMAIC) process to plan and manage improvement projects. The DMAIC methodology is a 15-step process broken up into 5 project phases: define, measure, analyze, improve, and control, as shown in Exhibit 12.6. The DMAIC process is illustrated to show

Exhibit 12.6

The DMAIC Methodology



Source: Timothy J. Kloppenborg and Laurence J. Laning, *Strategic Leadership of Portfolio and Project Management* (New York: Business Expert Press, 2012), 122.

objectives within each of the five key stages. It is shown as a continuous, circular flow because DMAIC is typically used as a method of implementing continuous improvement and thus can be practiced repeatedly. Lean Six Sigma uses DMAIC and waste elimination together to improve performance.

12.2 Core Project Quality Concepts

Each of the quality gurus and frameworks provides input into the contemporary understanding of project quality. When defining quality, several perspectives should be considered, including:

- Product—the presence of desired attributes
- Value—the ratio of benefits to price
- Manufacturing—consistency in goods and services
- Customers—ability to satisfy given needs and expectations[2]

We condense these ideas, as stated in Chapter 1, into a simple definition of **project quality**: "the characteristics of a product or service that bear on its ability to satisfy stated or implied needs." Remembering that customer satisfaction is the most important goal on most projects, this emphasis on satisfying needs is critical to project success. However, to fully understand both the meaning of this definition and how to achieve it, one needs to understand the four contemporary core project quality concepts that have evolved from the sources above:

1. Stakeholder satisfaction
2. Process management
3. Fact-based management
4. Empowered performance

12.2a Stakeholder Satisfaction

Stakeholder satisfaction consists of identifying all stakeholders and understanding the stakeholders' ultimate quality goals using a structured process to determine relevant quality standards. External stakeholders may include customers, suppliers, the public, and other groups. Internal stakeholders may include shareholders and workers at all levels and all functions within the organization, including the project team members.

Developing Quality Standards Based upon Stakeholder Requirements The decision process for developing relevant quality standards on a project consists of the following steps:

1. Identify all stakeholders.
2. Prioritize among the stakeholders.
3. Understand the prioritized stakeholders' requirements.
4. Develop standards to ensure the requirements are met.
5. Make trade-off decisions.

Some stakeholders actively participate in the process of developing quality standards. Therefore, they make judgments about the quality of a process based on what they see. Thus, the quality both of project work processes and of deliverables is monitored and judged. When making trade-off decisions, the project manager often facilitates the process, and the stakeholders actually make the decisions. Stakeholders frequently need to be reminded that the relative importance of cost, schedule, scope, and quality can be very helpful in determining sensible standards. Often, quality costs money and requires more time. Sacrificing quality may save money and time, but the stakeholder satisfaction could be in jeopardy.

Stakeholder Satisfaction Sayings When satisfying stakeholders, it is helpful to remember a few sayings. One is the old carpenters' advice of "measure twice, cut once." This careful planning tends to yield less variation, less cost, and faster delivery—all of which satisfy stakeholders. Another saying is "meet requirements, but exceed expectations." Contractually, a project must meet the agreed-upon specifications, but if stakeholders see excellent work processes and experience clear communication, their expectations will be exceeded, and they will be even happier. This point regarding meeting requirements while exceeding expectations comes from two sources. Good project management practice is to meet requirements without spending extra money or time. Good quality practice is to not only satisfy but also to delight customers. The third saying is "a smart project manager develops capable customers." That means the customer is able to use the project deliverables to do their job better. This often results in opportunities for additional revenue streams by partnering, training, and supporting the customer.

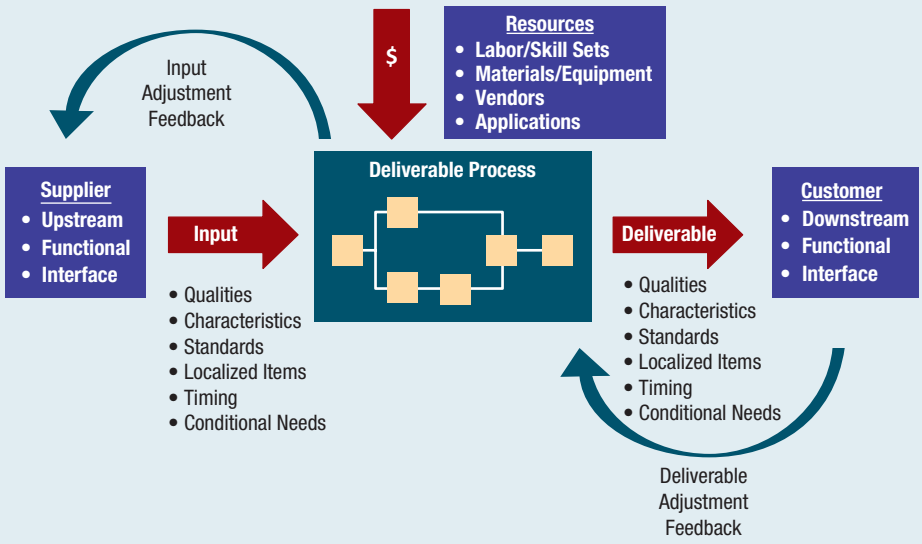
12.2b Process Management

A **process** is "a sequence of linked activities that is intended to achieve some result, such as producing a good or service for a customer."[3] To effectively manage project processes, project managers need to understand, control, and improve them.

Process Understanding with a SIPOC Model The first part of understanding a project is to demonstrate that all work flows from suppliers, through the project, to customers. A useful way to envision this is a tool called a supplier-input-process-output-customer (SIPOC) model, as shown in Exhibit 12.7.

Exhibit 12.7

PDE Deliverable Analysis Functional Model



Source: Paul Kling, PMP.

In Exhibit 12.7, the process boundaries are clearly defined. This prevents future scope creep from occurring by eliminating previous or later steps in the process. The SIPOC above also begins to identify key stakeholders who both provide inputs into the process (suppliers) and receive benefits from the process (customers) and shows feedback loops that provide useful information.

One way to interpret the SIPOC is to think backward from the project's customers. As described previously in the stakeholder satisfaction section, it is helpful for a project manager to identify all the customers for their project and their desired outputs. Since that is usually a far-reaching list, prioritization decisions need to be made. At that point, the project manager can work with the project core team to define the work processes necessary to create those outputs. Then they can identify the inputs to accomplish those activities and determine who will supply them.

Once the supplier-customer view is understood, it is time to determine whether the process is capable of creating the project deliverables. This discussion should be initiated when the project charter is developed. When people discuss the milestone schedule, risks, and constraints, they should raise any serious doubts they have. On some small projects, that may be enough to determine if the proposed methods of creating the project deliverables will work. On others, more detailed analysis of schedule, resources, and risks may yield further insight.

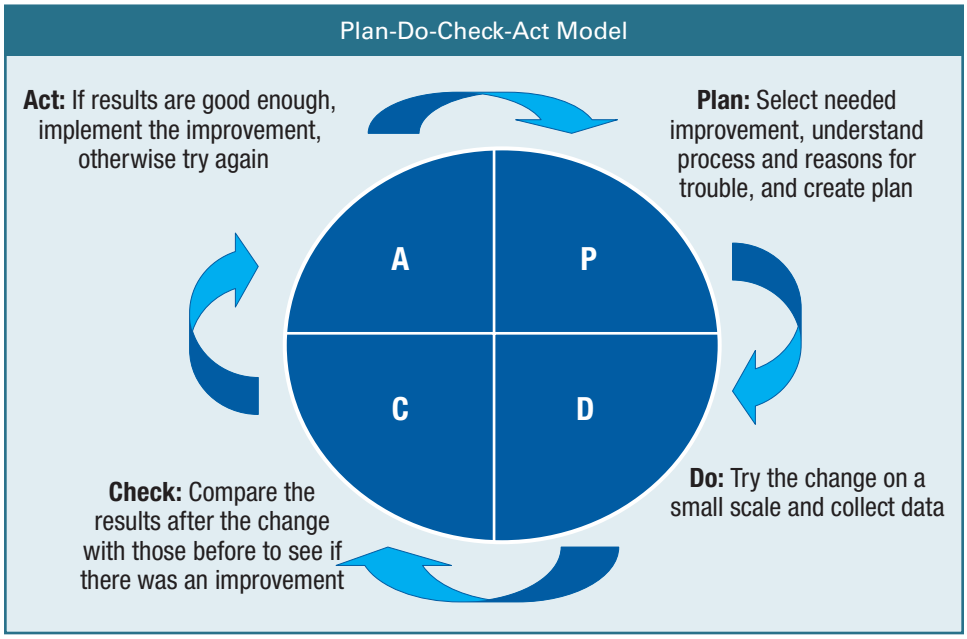
Experienced project managers understand that it is far better to design quality into their processes than to find problems only upon inspection. In the first place, it costs more to make junk and then remake to obtain good outputs. Second, having to rework anything aggravates schedule pressure that already exists on many projects. Finally, even the best inspectors do not find every mistake, so a few mistakes or defects are likely to exist when project outcomes are delivered to customers.

Process Control The second aspect of process management is process control. **Control** is "the activity of ensuring conformance to the requirements and taking corrective action when necessary to correct problems and maintain stable performance."[4] The purpose of process control is to have confidence that outputs are predictable. Process control is covered in Chapter 14. If the outputs are not predictable—or if they are predictable but not satisfactory—then a project manager needs to use the third aspect of process management: process improvement.

Process Improvement with a PDCA Model Processes can be improved either in a continuous or a breakthrough fashion. All project core team members and subject matter experts (SMEs) should be thinking of little ways they can improve throughout the project. Slow, steady, and minor improvements ultimately improve processes. However, sometimes substantial improvement is necessary, and a breakthrough is in order. Regardless of the size of improvement desired, many models exist to guide the effort. Improvement models such as DMAIC are usually based upon the plan-do-check-act (PDCA) improvement cycle, as displayed in Exhibit 12.8.

When project managers are considering process improvements, they often involve suppliers and/or customers in a partnering arrangement. Often, they need to forecast changes in their work environment, technology, or customer desires. Organizations that take a balanced view of long-term improvement and short-term results create a culture in which project process improvement can thrive. Organizations that focus almost exclusively on short-term results make it hard for project managers to devote energy toward process improvement.

Exhibit 12.8



Akimov Igor/Shutterstock.com

12.2c Fact-Based Management

One challenge many project managers face is making decisions based upon facts. Making decisions using facts sounds like an obvious thing to do, yet it is difficult because:

- Opinions get in the way.
- It is hard to know what data is required.
- Projects often operate with so much time pressure that decisions need to be made quickly.

Four aspects of fact-based management are understanding variation, deciding what to measure, working correctly with data, and using the resulting information appropriately.

Understanding Variation Project decision makers need to understand the difference between two types of variation. A common cause is variation that is a result of the product design and the method of making it and is exhibited by a random pattern within predictable limits. On the other hand, a special cause is variation that comes from external sources that are not inherent in the process and can be quite unpredictable.

It is important to determine whether a variation in a project is within the range of what can be expected for that particular work activity or deliverable (common cause) or whether something unusual is happening (special cause). If the variation is due to a common cause, but the results are still not acceptable, some change needs to be made to the system—how the work is accomplished. However, if the change is due to a particular cause, focus on that particular cause and not the entire system for improvement. Many quality proponents estimate that often variations are due to common causes, yet project managers are quick to try to find a person or issue to blame (special cause). The problem is often compounded when a cause is really part of the system, yet individuals are blamed. The problem does not go away, and people become fearful. Management by facts requires an understanding that variation can be due to either common or special causes, a determination to discover which type, and the resolve to act appropriately upon that discovery.

Determining What to Measure A project manager wants to avoid two extremes; the extreme of not measuring anything since they are in a hurry or there is not enough time, and the extreme of measuring too many things. As project managers become more experienced, they develop an understanding of how many data points are useful and when they need to move into action regardless of the data they have.

A **quality metric** is a measurement meant to ensure that customers receive acceptable products or deliverables.[5] Measures may include project attributes such as on-time or on-budget performance, product specifications, or attributes such as defect frequency.

In a good project charter, a milestone schedule with acceptance criteria for each milestone can provide useful measures. Project teams often can seek useful measures when they study lessons learned from previous projects. Many lessons state either what worked well and should be repeated on future projects or what worked poorly and should be avoided on future projects. Both of these aspects can provide ideas for useful measures of quality. The project manager and sponsor should agree on what measures will be taken, when they will be taken, and under what circumstances. While many sponsors can be quite busy, the more specific this agreement becomes, the more useful the data collected are likely to be.

Working Correctly with Data A third aspect of management by facts is how the identified data are collected, handled, and stored. **Data** is information in an unorganized form representing conditions, ideas, or objects. Generally, people closest to the situation are best for collecting data. Efforts should be made to ensure that the data are complete, without errors, and timely. Many project teams either use templates from their organization or create their

own forms for collecting data. When more than one person is involved, consistency must be ensured. Once the data are collected, they should be analyzed. A great deal can be learned by using simple tools to look for patterns and trends in data. On larger, more complex projects and sophisticated Six Sigma projects, more detailed statistical analysis is often used. The analysis should transform the raw data into information for decision making.

Using the Resulting Information Appropriately The final aspect of making fact-based decisions is how the information is used. **Information** is "knowledge gained through study, communication, research, instruction, etc.; factual data"[6]: that is (1) accurate and timely, (2) specific and organized for a purpose, (3) presented within a context that gives meaning and relevance, and (4) can lead to an increase in understanding and decrease in uncertainty. Project communications plans often spell out how the information is disseminated. The best project culture encourages facts and transparency in communication—even when it is inconvenient. People are encouraged to use information to challenge opinions and decisions. Making decisions based upon facts often requires courage. It also requires judgment because challenges that are factual are helpful; yet, if the challenges become personal and are not fact-based, they can be destructive and demotivating.

12.2d Fact-Based Project Management Example

A rapidly growing, fast, casual restaurant chain was experiencing growing pains that were manifest in delays for restaurant openings. SWOT analysis revealed several broad issues that were threats to opening the restaurants on time, but the issues needed to be quantified for improvement. The company had been keeping records on the time required to open a restaurant after breaking ground. Exhibit 12.9 shows that 80 percent of the restaurants opened within 160 days or fewer, but some of the others took much longer. At $5,000

Exhibit 12.9

Days from Breaking Ground to Opening

Days	Frequency	Cumulative %
60	0	0%
80	1	1%
100	8	10%
120	26	41%
140	23	67%
160	11	80%
180	8	90%
200	5	95%
220	2	98%
240	1	99%
260	1	100%
280	0	100%
More	0	100%
Total	86	

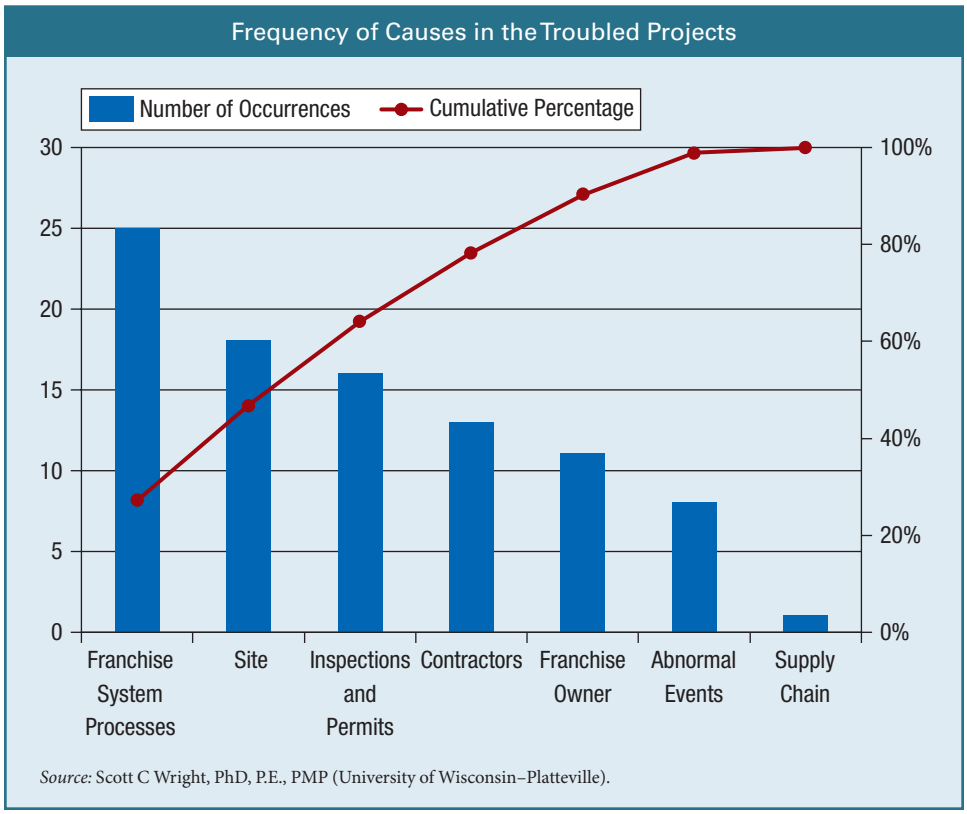
lost revenue per day for the franchisee and a 4 percent loss for the franchisor, it was in the interest of all stakeholders to dissect the facts and determine the causes for delayed openings. With the anticipation of expanding to an additional 500 restaurants in the next two to three years, every improvement of one day would result in a $0.5 M increase to revenue, assuming the same 20 percent of the troubled projects were lagging the average for the 80 percent of excellent or healthy performing projects. The corporate franchising organization needed to determine the root cause of the delays.

Exhibit 12.10 is a Pareto chart showing the frequency of causes in the troubled projects. Seven causes for delays were identified for the troubled projects. The top 4 causes were found in 80 percent of the troubled projects. This led to a focus on improving projects by better managing the risks associated with each cause or by making changes to management processes that were negatively impacting the project's time objective. Based on root cause information, a risk breakdown structure was used to categorize threats causing delays and develop appropriate responses to avoid or mitigate the risks for future openings.

12.2e Empowered Performance

The fourth and final core project quality concept is empowered performance. The goal of empowered performance is to have capable and willing workers at every level and every function within a company. Corporate leaders set the stage for this by developing the organizational culture. Project sponsors and managers, in turn, develop the project culture. Remember from Chapter 4 that organizational culture includes the formal and

Exhibit 12.10



Source: Scott C Wright, PhD, P.E., PMP (University of Wisconsin–Platteville).

informal practices utilized, along with the values shared by members of an organization. Part of an empowered performance culture is setting an expectation for managers to encourage their associates to take appropriate risks and to treat risk events as learning opportunities rather than opportunities to dole out punishment. Part of it is training and equipping workers so they are willing to take risks. Part is getting managers to let go of some decision-making authority and delegate decisions to people at lower levels in the organization. Yet another aspect of empowered performance is helping to develop specialists who can aid anyone in the organization. For example, a person trained as a Black Belt in a Six Sigma organization can become an expert in guiding process improvement projects, or an internal coach/mentor in an organization that is adopting Agile can observe the team and provide suggestions.

Recognize Individuality One essential understanding in creating capable and willing workers is to recognize everyone's individuality and diversity. Leaders at all levels must promote inclusiveness and recognize that diversity is not only to be accepted, but it is also very helpful as projects develop.

Capitalize on Individual Strengths Outstanding project managers not only want to recruit people with unique skills and develop a strong project team, but they also want to capitalize on each person's strengths. Every team member feels validated when they use their unique skills and gets an opportunity to improve them. When a person feels their boss understands them and works to create opportunities for them to do both what they most want to do and what they have the potential to be best at doing, they are motivated to perform at the highest level.

Emphasize Individual Responsibilities Empowered performance requires that people understand and accept their responsibilities. Much of the responsibility falls upon the project manager and core team. However, SMEs are responsible for their individual activities. Functional managers, who are the technical supervisors of the SMEs, are responsible for work methods in their functional areas. Sponsors share a high-level responsibility for project completion with project managers. Customer representatives are responsible for understanding the impact of their directives to a project manager. Ultimately, everyone must understand what they need to do, realize how it fits in the bigger picture, and then commit to both completing their work correctly and accepting the consequences of their decisions.

Use Appropriate Collaboration Finally, appropriate collaboration is a key to developing empowered performance. This is true both within and beyond the organizational boundaries. Cross-functional teams perform a great deal of project work and are most effective when individual, team, and organizational learning flourishes. One effective method of encouraging this learning in projects is to develop lessons learned during the project execution, at the completion of project milestones, and at project closure. These lessons then need to be shared openly with other project teams. Collaboration and learning accelerate when people share information outside their parent organization. Of course, some things such as information that provides a competitive advantage cannot be shared, but a surprising number of things *can* be shared. When the recipients of those lessons reciprocate, the first team learns something new. This type of external sharing can take place through conferences, company exchanges, or other means. An example of a unique project challenge that required empowered performance to be successful is the vintage aircraft-shipping project in Exhibit 12.11.

Exhibit 12.11

Vintage Aircraft Shipping Project

Global Shipping Company (GSC) was approached by an individual who was interested in selling and shipping an antique $1 million 1942 Staggered-Wing Beech aircraft from Cincinnati to a buyer in Australia. Since the aircraft was fragile, a plan needed to be developed for moving it as economically as possible while avoiding damage.

One challenge was handling the entire project in-house using only the company's staff, equipment, and resources, and the other was devising a custom solution for moving this unusual piece of cargo.

GSC has an organizational culture that encourages cross-training, collaboration among departments, risk-taking, and designing creative approaches to problem solving while minimizing cost. Because of the size and fragility of the aircraft, a strategy was devised to dismantle it and ship via containerized ocean freight. The project was broken down into five distinct segments: pickup, dismantling, packing, loading, and shipping.

To pick up the entire aircraft, the equipment, permits, and escorts had to be arranged to get the aircraft intact from the airport and move it to the warehouse down a major street on the back of a flatbed truck. In order to fit in a standard ocean container, the aircraft had to be dismantled—under the supervision of the FAA—and documented to meet FAA regulations. To avoid damage, each piece had to be individually packaged. Different types of cloth and foam had to be tested and selected in order to prevent scratching the aircraft. Due to the height restrictions, the warehouse personnel had to design and build a custom gurney to allow the body of the plane to be wheeled into the container and secured. Once packaged, the individual pieces were then loaded, blocked, and braced into the container to prevent damage while in transit; then the aircraft was shipped. The dismantling, documentation, and packing process was designed in a way that the new owner of the aircraft could replicate it in order to move the plane for air shows and events.

© Danny McKee

The project's success was achieved by having the courage to take on the project in the first place, the ability to use the company's resources creatively and efficiently, and the ability to adapt when unexpected events occurred. The result was a project that was successfully completed, meeting all FAA standards, exceeding stakeholder expectations, and developing a shipping process that can be replicated.

Source: Danny McKee, Global Shipping Company.

12.2f Summary of Core Concepts

A summary of project quality core concepts is shown in Exhibit 12.12.

Exhibit 12.12

Summary of Project Quality Core Concepts

Concept	Specific Guidance
Stakeholder Satisfaction	Identify all internal and external stakeholders. Prioritize among the stakeholders. Understand the prioritized stakeholders' requirements. Develop standards to ensure the requirements are met. Make trade-off decisions. Realize stakeholders will judge quality both of work processes and deliverables. Measure twice, cut once. (Plan and check the plan.) Meet requirements but exceed expectations. Develop capable customers.

Concept	Specific Guidance
Process Improvement	Learn about process with the supplier-input-process-output-customer model. Realize designing a quality process is far better than merely trying to find mistakes. Ensure project processes are capable and flexible. Control project processes to make them predictable. Improve project processes using a model based upon the plan-do-check-act concept.
Fact-Based Management	Understand the difference between common and special causes of variation. Select a few key well-defined items to measure. Carefully collect data and use appropriate analysis techniques to create useful information. Encourage truthful, transparent, and challenging communication when making decisions.
Empowered Performance	Develop capable and willing workers at every level and every function. Develop a risk-taking project culture. Understand each person is an individual. To the extent possible, let everyone do what they will enjoy doing and what their strengths support. Ensure everyone understands and accepts their responsibilities. Share lessons learned and other information as widely as possible.

12.3 Plan Quality Management

The **quality management plan** specifies the acceptable level of quality, typically defined by the customer, and provides a detailed account of how the project will meet this level of quality with its deliverables and work processes. A logical place to start is by understanding what a quality policy is and how it governs the actions of a project manager and team. The remainder of this section discusses the components of a project quality management plan and process improvement plan.

12.3a Quality Policy

The top management of an organization normally writes a concise statement to guide their company's quality efforts. This policy reflects top management's principles of achieving quality and the benefits they hope to achieve with good quality practices and products. Project managers normally first consider using the quality policy of their parent company—if it is a good fit. If not, or if the project is a partnership between organizations, the project manager may need to combine and/or supplement the quality policies. However, the project's quality policy should never violate the intent of the quality policies of either the parent company or of a major customer.

Studies of 25 organizational quality policies in 2013, 2017, and 2021 found that they vary widely. Some are fewer than 30 words, while others are over 100 words. The content and style can be quite different. The frequency of terms that interest project managers is shown in Exhibit 12.13.

Several interesting patterns can easily be found. First, the most frequent term is *customer*, which corresponds with the core concept of stakeholder satisfaction. The second most frequent term is *improvement/innovation*, which corresponds with process improvement. High inclusion of improvement suggests that processes are drivers in delivering

Exhibit 12.13

Evolution of Terms in Quality Policies though 2013, 2017, and 2021

Term	Percent of Policies in 2013	Percent of Policies in 2017	Percent of Policies in 2021
Customer	92	80	92
Improvement/Innovation	84	80	84
Employee Engagement	44	60	80
Satisfy Requirements/Meet Standards or Laws	68	72	60
Best/Excellent/High Quality/ Exceed Requirements	44	44	56
Suppliers/Collaboration	16	24	48

quality products and services. Two terms that appear in considerably more quality policies now that previously are *employee engagement* and *suppliers/collaboration*. These correspond with empowered performance and recognize projects need both employees and suppliers to be engaged. Many include *satisfying requirements*, but not as many in the first two surveys included *exceeding requirements*. By 2021, just about as many seek to *exceed* as *satisfy requirements*.

Remember, many of these policies are very short and only include a few key thoughts. They are meant to set direction, not plan in detail.

12.3b Quality Management Plan Contents

In addition to the quality policy and quality management processes, most project quality management plans describe which quality standards the project will use and how the project team will implement them. The quality management plan may include a description of the quality baseline by which the project will be judged, along with methods for quality assurance and control.

The quality management plan is a portion of the overall project management plan. On many small, simple projects, the quality planning is performed concurrently with other planning, and the quality plan is seamlessly incorporated into the project plan. On some large, complex, or unusual projects, the quality planning is handled separately, and the plan, while a portion of the overall project plan, appears as an additional plan document.

A project quality management plan should describe how to identify some or all of the following:

- Quality objectives
- Key project deliverables
- Processes to be reviewed for meeting and maintaining desired quality levels
- Quality standards
- Quality control and assurance activities
- Quality roles and responsibilities
- Quality tools
- Plan for reporting quality control and assurance problems[7]

12.3c Quality Baseline

At the point of developing the quality baseline, the project work should be clearly defined in a scope statement and/or with a work breakdown structure. Appropriate quality standards are selected for the materials and other inputs, work activities, documentation, and project deliverables. These standards might be industry norms, customer-specific standards, or government regulations. The project manager is ultimately responsible for selecting appropriate standards and developing additional standards that may be needed. However, project managers normally take their cues from functional managers and SMEs for many standards dealing with methods and from customers on standards dealing with documentation and deliverables.

The quality baseline reflects the agreed-upon quality objectives. It may include metrics that define exactly what will be measured, how each will be measured, and the target value of each.

12.3d Process Improvement Plan

A **process improvement plan** is a component plan of the comprehensive project management plan. The process improvement plan documents the steps for analyzing processes with a focus on improving them. The plan includes process boundaries, process configuration, process metrics, and targets for improved performance. Process improvement was discussed in 12-2b in the process management core concept.

12.4 Manage Quality

Manage quality is the process of using the quality plan and policy to perform tasks that will most likely lead to creating project outputs to customers' satisfaction. A key part of managing quality is the forward-looking quality assurance. **Perform quality assurance** is a practice, primarily concerned with overall process improvements to ensure that every deliverable produced is error free.[8]

Quality assurance ensures that proper methods and standards are used. It consists of a broad set of proactive management activities designed to give key stakeholders confidence that sensible methods and capable people are working on the project. This hopefully yields good project deliverables along with documentation. Quality assurance is one way to simultaneously improve quality and manage stakeholder relations.

Perhaps quality assurance is best understood by considering two of its primary methods: the quality audit and process analysis. A **quality audit** enable us to review and evaluate the project activities and identify those which should be improved versus those that meet the quality standards. Quality audit objectives aim to improve acceptance of the product, identify areas of improvement, and reduce the overall cost of quality. A quality audit is also used to determine what methods are being used and whether they are effective. For audits to be effective, people need to be convinced that the real purpose is to improve work methods and not to punish individuals.

Quality audits sometimes show the need to request changes. These requests may include recommendations for:

- **Preventive actions**—"steps taken when the project is trending away from the planned scope, schedule, cost, or quality requirements. Preventive actions are proactive in nature, based on a variance and trend analysis."[9] Preventive actions are taken to ensure future performance is acceptable.

- **Corrective actions**—"steps taken when the project has deviated from the planned scope, schedule, cost, or quality requirements. Corrective actions are reactive in nature and are intended to bring the project's performance back into alignment with the agreed-upon project baselines."[10]
- **Defect repair**—steps required to take when a product or deliverable does not meet the specified quality requirements. Not all defects can be repaired, so judgment is required to decide if the output is repairable or if it needs to be scrapped and a new output will be created.

Process analysis is "a step-by-step breakdown of the phases of a process, used to determine the inputs, outputs, and operations that take place during each phase. A process analysis can be used to improve understanding of how the process operates, and to determine potential targets for process improvement through eliminating waste and increasing efficiency."[11] It can follow an improvement model such as the DMAIC method shown in Exhibit 12.6 or the PDCA model shown in Exhibit 12.8. Process improvement is used to improve both quality and productivity. It can be of a continuous nature, in which many incremental improvements are made over time, or of a breakthrough nature, in which a substantial change is planned and implemented at once.

Processes can be measured for both efficiency and effectiveness. Efficiency is the ratio of outputs to inputs. A more efficient process uses fewer inputs to create the same number of outputs. This could equate to fewer work hours or less money spent to create the same project deliverable. Effectiveness is the extent to which a process is creating the desired deliverables. A more effective process is one that creates higher-quality deliverables and better pleases the stakeholders. Effectiveness can also be seen as employing people with the right skills (no less, no more) and producing the right results (not inferior, not superior). Process improvement can deal with both efficiency and effectiveness and is akin to the concept of value engineering for products and services.

There are many avenues for improving project processes. One is to interpret the results of quality control measurements with an eye toward process improvement. Feedback from customers, suppliers, work associates, and other stakeholders can often lead to suggestions for improving processes. These suggestions might pinpoint opportunities to improve both the inputs into a process and the actions within the process.

Another useful method of process improvement is benchmarking. Benchmarking is a structured consideration of how another organization performs a process with an eye toward determining how to improve one's own performance. It is not directly copying the methods. Benchmarking consists of 10 steps:

1. Determine a process that needs dramatic improvement.
2. Identify another organization that performs that process very well.
3. Make a deal with that organization to learn from them (they might require payment or the sharing of one of the observer's best practices with them).
4. Determine what needs to be observed and what questions need to be asked.
5. Make a site visit to observe and question the other organization.
6. Decide which observed methods will help the organization.
7. Adapt the methods to fit the organization's culture and situation.
8. Try the new methods on a small scale.
9. Evaluate the results.
10. If the methods are good enough, adopt them.

Quality assurance is a continuous process in each iteration and provides incremental progress toward higher product or service quality for the customer.

12.5 Control Quality

Control quality is "the activities … used to verify that deliverables are of acceptable quality and that they are complete and correct. Examples of quality control activities include inspection, deliverable peer reviews, and the testing process."[12] This detailed set of reactive technical activities verifies whether specific project deliverables meet their quality standards. The purposes of quality control on projects are to reduce the number of defects and inefficiencies, as well as to improve the project process and outputs. Quality control consists of the following:

- Monitoring the project to ensure that everything is proceeding according to plan
- Identifying when things are different enough from the plan to warrant preventive or corrective actions
- Repairing defects
- Determining and eliminating root causes of problems
- Providing specific measurements for quality assurance
- Providing recommendations for corrective and preventive actions
- Implementing approved changes as directed by the project's integrated change control system.

Monitor the Project Quality Project managers use quality control focus on project inputs, processes, and outputs. When considering inputs, a project manager wants to ensure that the assigned people can do their work. They also work with suppliers to ensure that materials, information, and other inputs meet the required specifications and perform satisfactorily. When considering the project processes, the manager wants to minimize rework because it wastes time, effort, and money, which are in short supply on most projects. Rework also often has negative impacts on both worker morale and stakeholder relations because it is very discouraging to make and/or receive an inferior product, even if it is fixed eventually. When considering outputs, a project manager may first use internal inspection to ensure the performance of deliverables before they are sent to the customer. External inspection may also be required to convince the customer that the deliverables are developed to meet the desired performance.

While the specifics vary greatly from project to project, there are some useful general lessons regarding the timing and types of project inspections, including the following:

- Conduct an inspection before a critical or expensive process to make sure the inputs are good before spending a large amount of money or time on them.
- Process stages in which one worker hands off work to another worker are good times for both the workers to conduct inspections.
- Milestones identified in the project charter provide good inspection points.
- As practiced in software development, think of an inspection in terms of units (individual components), integration (how components work together), and the system (how the deliverable performs).

Quality Control Terms Many terms with specific meanings are used in project quality control. Exhibit 12.14 shows pairs of terms that are sometimes confused, and the differences between each pair are described in the following paragraphs. While few projects repeat processes enough times to formally use statistical quality control, the concepts are still quite useful in making good decisions.

- **Prevention versus Inspection** Prevention is keeping errors out of a process, while inspection is trying to find errors after they occur to correct these errors before they reach the customer. Preventing a problem in the first place is preferred over inspecting it to find a problem. Prevention is the cheaper alternative. Inspection does not guarantee that a problem is detected. Inspection should be practiced, but every effort should be made to prevent problems from happening in the first place.
- **Sample versus Population** Sample and population are the factors considered for determining the scope of inspection. A population is all of the possible items in a set, such as all the students in a class. It is often costly, difficult, or even impossible to inspect an entire population of units produced. Instead, a random sample or subset is inspected. Three students, picked randomly, would be a sample. The key is to use a big enough sample to be representative of the population, but a small enough sample that it is cost and time effective.
- **Attribute versus Variable** Quality is measured either as an attribute or a variable. An attribute can be described either as yes or no—either it is good enough, or it is not. A variable is a quantitative data point assessed by measuring physical characteristics. Either one may be chosen. For example, if one of the goals of a project was to teach all the people in a client's company, an attribute for each employee might be, "Did that person pass the test?" A variable might be, "How many questions did each employee score correctly?" Attributes are usually quicker (and cheaper) to observe but may not yield as much detailed information. Project managers make a trade-off between information and cost in deciding whether they will count or measure.
- **Precision versus Accuracy** A process is precise when the outputs are consistently similar, such as shooting three shots at a target that all land in a cluster near each other. A process is accurate when, on the average, it produces what the customer wants. Ideally, a process is both precise and accurate.

Exhibit 12.14

Pairs of Project Quality Control Terms

Term:	Sometimes Confused with:
Prevention	Inspection
Sample	Population
Attribute	Variable
Precision	Accuracy
Tolerance	Control limit
Capable	In control
Special cause	Common cause
Preventive action	Corrective action

- **Tolerance versus Control Limit** A tolerance limit is what the customer will accept and is sometimes called the voice of the customer. For example, if the customer wants a 1-inch bolt, perhaps they are willing to accept bolts ranging from a lower tolerance limit of 0.99 inches to an upper tolerance limit of 1.01 inches. A control limit reflects what the process can consistently deliver when things are behaving normally and is sometimes called the voice of the process. The upper and lower control limits are often statistically calculated to be three standard deviations above or below the process average.
- **Capable versus In Control** A process is determined to be in control when the outputs are all within the statistically calculated control limits. A process is considered capable when control limits are within the customer's tolerance limits, so that customers can remain consistently satisfied with project performance. Project managers try to ensure that their processes are both in control and capable of consistently delivering acceptable quality.
- **Special versus Common Cause** Special causes are statistically unlikely events that usually mean something is different from normal. Common causes are normal or random variations that are considered part of operating the system at its current capability. Special causes are identified by individual points outside the control limits or by unusual patterns within the limits. Common causes need systematic change for improvement—perhaps new methods or better training or tools that would allow workers to produce excellent quality more consistently. Special causes, on the other hand, require specific interventions that include identifying the root causes and making changes so those same root causes do not happen again.
- **Preventive versus Corrective Action** Preventive action is a proactive approach of making a change because a problem may occur otherwise. Corrective action is a reactive approach of making a change to fix a problem that has occurred.

12.6 Cost of Quality

Even with good inspectors, deliverables with some mistakes or defects will reach customers if poor quality exists in project processes. **Cost of quality** is a sum of the cost of conformance of quality and cost of nonconformance of quality. Quality decisions should be based on costs associated with all the factors listed in Exhibit 12.15.

Exhibit 12.15

Costs of Quality

Cost of Conformance	Cost of Nonconformance
• Planning	• Scrap
• Training	• Rework and repair
• Process control and validation	• Additional material
• Product design validation	• Inventory
• Test and evaluation	• Warranty repairs and service
• Quality audits	• Compliant handling
• Maintenance and calibration	• Liability judgments
• Inspection	• Product recalls
• Field testing	• Field service
	• Expediting

12.7 Develop Project Management Plan

Chapters 5 through 11 have all dealt with aspects of project planning. On small and simple projects, the various portions of this planning may already be combined to a large extent. On larger, more complex projects, specific methods are often used to plan the various project aspects separately, such as cost, schedule, resources, communications, risk, and quality. If they have not been planned together, they need to be compiled into a unified, comprehensive project management plan. Conflicts need to be resolved. A configuration management system needs to be selected or developed. The project manager should apply a sanity test to all project plans (sanity test is explained in 12.7c). There is often a formal project kickoff of some sort, and after everything is agreed to, the scope, schedule, budget, and so forth are baselined. The baseline becomes part of the project management plan, and it is used to monitor and control the project.

12.7a Resolve Conflicts

Sometimes, when all parts of the plan come together, it becomes obvious that the overall plan is impractical. If this occurs, the key stakeholders may need to determine their priorities and trade-offs. For example:

- What do they really want and need most from the project?
- Are all of the quality standards truly mandatory, or can one of them be relaxed a bit?
- Is the imposed deadline really critical, or, considering the impact it poses for costs and risks, can it be relaxed a bit?
- Is the budget a true maximum, or can it be adjusted to secure the desired features?

These questions and others like them have probably been asked all along, but now they take on added urgency because once the project plan is approved, it may be more difficult to make these changes.

12.7b Establish Configuration Management

Project planning can be hard work. Once the plan is in place, it still takes a lot of hard work to control the project. One last part of planning is to create a configuration management system to aid project control. A **configuration management system** has four parts:

1. Process for identifying and uniquely naming items that need to be controlled
2. Activity of managing the project deliverables and documentation
3. Recording and reporting of all changes
4. Verification of the correctness of all deliverables and their components.[12]

12.7c Apply Sanity Tests to All Project Plans

A common saying is appropriate to consider here: "can't see the forest for the trees." This means that sometimes a person is so concerned with details that they forget the big picture. During the initial stage of a project (initiating), the primary deliverable the team creates is a project charter. The charter is a high-level view of a project, so seeing the big picture is easy. During the more detailed planning stage, however, the team looks in great detail at scope, schedule, resources, cost, communications, risks, and quality. Now they need to step back a bit and ask if all these elements work well together. The project manager and core team should apply a sanity test to their project plans by asking one another questions to ensure that the comprehensive project plan makes sense. Some of these questions could be as follows:

- Does the critical path look reasonable?
- Do the milestones look achievable?
- Are some resources overallocated?
- Does everyone understand what they are supposed to do?
- Do we really understand our customers?
- Are the customers' desires likely to change?
- How well do we understand the standards we will be judged against?
- Are the methods for completing our work really sensible?
- Are we confident we can gather and analyze the data we need to control the plan?

If the answer to any of these questions is no, re-visiting components of the project management plan will be necessary before establishing a baseline.

12.8 Kickoff Project

Project kickoff meetings are conducted for many reasons. First, everyone should express their legitimate needs and desires and should strive to understand the desires of all the other stakeholders. If the leader charged with accomplishing the project does not have the full authority to direct all the project work activities, they need to use their influence to get everyone excited about the project, to feel pride in their participation, to believe they share in the risks and rewards the project offers, and to be motivated to self-manage as much as possible. Many people may have helped with some parts of the project planning. This is their chance to see how all the parts fit together. Since many projects fail because of "touchpoints" at which point one person hands off work to another, it is critical for all parties to understand these potential trouble spots. Kickoff meetings are also helpful in convincing all the project stakeholders that the project leaders (sponsor, project manager, and core team) will be good stewards of the customer's and the parent organization's assets. Answering any remaining questions and overcoming lingering concerns help to accomplish this. Finally, all interested parties (outside customers, top management, functional managers, frontline workers, and any others) should be eager to commit to the project and get on with the work!

Monkey Business Images/Shutterstock.com

12.8a Preconditions to Meeting Success

Several preconditions must be met for project kickoff meetings to be successful:

- The sponsor and project manager need to set clear direction during the planning.
- The core team needs to commit to the project first—it is hard for them to convince others if they do not believe in it themselves.
- Everyone should contribute to setting up an atmosphere of trust and relationship building.
- Project leaders need to practice active listening to uncover potential problems.
- As many people as possible should be included in parts of the planning to enhance chances that they will buy into the resulting project plan.
- A communication plan that uniquely addresses the project at hand must be discussed and approved.

12.8b Meeting Activities

The formality of a kickoff meeting can vary considerably depending on the size and type of project. Typical activities that might be included in the kickoff meeting are the following:

- The sponsor and project manager describing the importance of the project
- The customer(s) describing their acceptance standards, sense of urgency, and budget concerns
- The project manager outlining the project goals
- The project manager and the core team describing work expectations
- The project manager unfolding the project plan and its current status (if work has commenced)
- The core team explaining the communications, risk, and quality plans
- Everyone asking questions and making suggestions
- The project manager authorizing appropriate changes to the project plan
- Everyone concurring with the overall plan and to their individual action items.

The above list of activities for the kickoff meeting is suggestive, and you may have to delete or add activities based on the specific needs of the project. On small, simple projects, presenting the charter and signing can take the place of a kickoff meeting. However, on many projects, the team needs to perform much more detailed planning after the charter is signed. Project kickoff meetings are vital for communications and commitment on these projects. Exhibit 12.16 is an example of how the information systems and technology division of a major healthcare company kicks off a project.

Exhibit 12.16

IS&T Project Launch Assessment Agenda

Purpose: The Project Manager is to illustrate to an executive audience the chartered IS&T project's readiness to successfully launch. Upon conclusion of the Project Manager's presentation, the executive audience will determine and document the actions required for the project to launch.

Prerequisite: The Project Manager is required to complete the Project Deliverable Review and receive documented approval from the Project Deliverable Review Board in order to proceed to the Project Launch Assessment.

Standard Participants

- Core Group (CG) (CIO and IS&T Director) PMO Manager
- Project Manager
- Functional Manager
- Quality Consult
- Security Consult (Optional)
- Test Coordinator
- Sponsor

Required Documents: The Project Manager is required to present the PLA materials online. If a paper copy is needed, it should be printed double-sided.

- Project Charter PMO Risk Forms
- Project Financial Worksheet
- Master Test Plan
- Progress Report—PDR

Project Launch Assessment Agenda: The Project Manager is required to present all of the listed deliverables in the provided order, focusing on specifically the identified components and content specified.

1. Project Charter—Discuss Business Need, Purpose, Logical Scope: In-Scope, Out-of-Scope, and Assumptions.
2. Master Test Plan—Discuss Sections 1.3—Test Levels, Objectives, and Deliverables; 3—Test Timeline and Key Events; and 5—Define System Characteristics, Relative Importance, and Subsystems.
3. Privacy and Security—Discuss the Security and HIPAA Template for PMO Projects.
4. Risk Forms—Discuss all populated and scored forms created to date.
5. Project Financial Worksheet—Discuss populated spreadsheet.
6. Progress Report (PDR)—Speak to the current status of all actions provided for each deliverable.

Source: Nancy D'Quila, PMP.

12.9 Baseline and Communicate Project Management Plan

Once the project plan is complete and accepted by the stakeholders, the plan is baselined. A baseline is the complete, approved plan. Many project plans are developed iteratively as more information comes to light. A project plan is considered to be in draft form until enough information is available for the key stakeholders to commit to all of the details and baseline the plan. At that point, it becomes official, and any changes in the future need to be formally approved and documented.

This is a time of great excitement because this marks the transition between planning and executing the project. In reality, on many projects, some activities that are on the critical path or nearly critical paths are started before the official project kickoff. Planning also continues in the form of re-planning to adjust to changing circumstances. However, the majority of planning is done, and the majority of executing is just starting.

The project management plan needs to be communicated in accordance with the communications plan requirements. Hopefully, many of the key stakeholders can attend the kickoff meeting. Regardless of who is present, proper communication needs to be sent to all stakeholders.

12.10 *PMBOK Guide 7e*

- Stakeholders
- Team
- Work
- Delivery
- Measurement
- Uncertainty

12.10a Stakeholders

One dimension of quality is stakeholder satisfaction. To ensure that satisfaction, the project team should develop a collaborative and productive working relationship with stakeholders. Teams draw out stakeholder needs, desires, requirements, and acceptance criteria. The team continues to use close and transparent two-way communications with stakeholders to manage expectations, resolve issues, and make decisions.

12.10b Team

Engaged and effective (high performing) project teams deliver the best quality. Project managers and other leaders can use servant leadership to understand and address the needs and development of team members. High-performing project teams use open communication, shared understanding of project purpose, shared ownership of project performance, trust, collaboration, adaptability, resilience, empowerment, and recognition. Effective project leaders establish and maintain the project vision, use critical thinking, and strive to understand and improve the motivation of their team members.

12.10c Work

Quality must be built into the project and project deliverables to meet requirement measures and acceptance criteria. These project deliverables are created using work processes. Processes should be reviewed to ensure they are efficient and effective. Project managers need to balance competing constraints and the workload of their teams to consistently create deliverables that will deliver the desired quality and value. Project teams should develop and share knowledge to improve both current and future projects.

12.10d Delivery

Delivery quality focuses on value as determined by required performance levels. This value may be delivered incrementally in adaptive projects and more likely at the end of predictive projects. Project teams strive to maintain and improve the quality of their processes and products. They ideally deliver the full scope that enables users to accomplish their objectives and fulfills each of the multiple quality dimensions such as performing as intended, meeting specifications, being reliable, coping effectively with unforeseen situations, and being efficient and sustainable. Quality costs include prevention, appraisal, internal failure, and external failure.

12.10e Measurement

Project teams and their stakeholders want a reliable understanding of project progress, actionable data for decision making means to keep performance acceptable and to

ultimately deliver outcomes that generate business value. Effective metrics enable these. Some are leading indicators that predict trends and changes and can help to reduce variances. Lagging indicators are also used to measure deliverables and reflect past performance. Metrics directly related to quality include defects, performance measures, work in progress, and stakeholder satisfaction. Each metric should include the desired baseline and the threshold beyond which corrective action is taken.

12.10f Uncertainty

Project quality can be adversely impacted by uncertainty, ambiguity, complexity, and volatility. To respond to uncertainty—gather information, prepare for multiple outcomes, investigate alternative designs, and build-in resilience. To deal with conceptual ambiguity use clear definitions, and for situational ambiguity use progressive elaboration, experiments, and prototypes. Deal with complexity by decoupling, simulating, viewing from diverse perspectives, balancing data used, iterating, engaging, and building in redundancy. Deal with volatility by analyzing alternatives and using reserves.

12.11 Agile Projects

Exhibit 12.17 shows ways in which plan-driven and Agile projects approach quality in some ways in a similar fashion and in other ways in different fashions.

Exhibit 12.17

Comparison of Plan-Driven and Agile Approaches for Project Quality Planning and Project KickOff

Project Quality Planning and Project KickOff Questions	Plan-Driven	Agile
What framework is used for broad quality guidance?	Malcom Baldrige and/or ISO	Malcom Baldrige and/or ISO
What core project quality concepts are used as guidance?	Stakeholder satisfaction, process management, fact-based management, and empowered performance	Stakeholder satisfaction, process management, fact-based management, and empowered performance
What organizational level guidance is used?	Parent organization's quality policy and industry quality standards	Parent organization's quality policy and industry quality standards
When and how frequently is quality inspected?	Varies	Early and often
When and how are requirements changed?	Seldom, through change control and contracts	Frequently, through refactoring and continuous integration
When and how is the project kicked off?	After significant planning, with kickoff meeting baselining project	Early, after chartering, with team identifying personas, creating a backlog, and planning the first release

12.11a Agile Terms

Build quality in	Workflow is reduced and waste increased if mistakes are made
Continuous improvement	Pursue perfection by enlisting all in never-ending effort to get better
Make process explicit	Ensure everyone understands how a process works
Value stream mapping	Visual flowchart identifying value and nonvalue activities
Inspection	Everyone examines, trying to improve product, process, and people
Testing	Evaluating to ensure that the deliverable meets requirements, which serves as an important feedback mechanism
Test-driven development	The practice of writing tests to be used before writing code
Test plan	Determine how you will verify work is acceptable before performing
Unit test	Ensuring small function or classes work properly
Integration test	Ensuring new functionality works immediately in existing system
Acceptance test	Verifying for customer entire system works correctly
Continuous integration	The practice of immediately ensuring each bit works in the system
Refactoring	Simplifying and cleaning a product to make it stable and maintainable

In this book, we use many Agile terms and definitions from Anantatmula, V., and T. Kloppenborg, *Be Agile Do Agile* (New York, NY: Business Expert Press: 2021).[13]

The Agile approach to project management is consistent with the modern approach to quality in general. The first three rows of Exhibit 12.7 point to this consistency. Many organizations follow the USA Malcom Baldrige and/or the European Union ISO approaches to overall quality. The core project quality concepts of stakeholder satisfaction, process management, fact-based management, and empowered performance all fit nicely with good project management practice—whether plan-driven or Agile. One final similarity is most projects will adhere to the quality policies of their parent and client organizations.

Despite these similarities, there are major differences. Most of these ideas that follow regarding quality on Agile projects can be used to improve quality on plan-driven projects. The most fundamental idea is to **build quality in**, since poor quality requires finding the

mistakes and slows everything down. Agile emphasizes the **continuous improvement** of people, process, communications, and product. This never-ending drive to get better helps satisfy stakeholders' desires for better, faster, cheaper, and more flexible. A key tenet of the Agile approach to quality is to **make processes explicit** so that all people involved—both team and stakeholders—can understand how work is being done and strive for consistency and improvement. Agile teams often use **value stream mapping** to understand from a customer's viewpoint what work contributes to the value and what work does not. A goal is to eliminate or at least reduce the amount of time spent working on things the customers do not value.

Agile places great emphasis on **inspection** and **testing**. Since all team members are co-responsible for the products they are creating, everyone inspects. In Chapter 10, we introduced the concept of shifting left, which means testing as soon as possible to find mistakes when they are small and easily fixed. This thinking includes **test-driven development** and creating a **test plan** which means deciding how you are going to test something before you do the work. This is consistent with agreeing on the definition of done from each story in advance before you commence work on it. Small portions of deliverables can be tested individually as **unit tests**. Any small problem identified can be quickly fixed without it impacting a larger portion of the system. Whole systems are tested as **integration tests**. Finally, customers conduct **acceptance tests** to determine if they will accept the project deliverables based on how they perform.

Two additional Agile tools are used to improve and ensure quality. Development teams use **continuous integration** to immediately ensure each deliverable they create will work with the rest of the system that is being created or updated. Thus, integration tests are conducted frequently as additional product is produced. **Refactoring** is the deliberate work of asking if any of the deliverables already turned over to the customer and in current use need improving. This cleaning up and simplifying work helps the customer use the project deliverables better—helping to promote stakeholder delight.

On Agile projects, planning is conducted at a high level for the entire project or release at the outset and at a detailed level just before the start of each iteration. Therefore, you might envision conducting the equivalent of a small kickoff meeting and plan for each iteration or release rather than a large one for the entire project.

12.12 Using MS Project for Project Baselines

MS Project can be used as a tool to automate and communicate many facets of a project. A key job of the project manager is monitoring and controlling the project. MS Project can assist the project manager in this effort by creating a project baseline to measure against as the project is executed. Before a baseline is created with MS Project, the project manager needs to verify that the following items have been incorporated in the planning (you'll probably note some of these are omitted in our running Suburban Park Homes tutorial):

- Quality assurance and quality control activities are included.
- Risk response plan activities (or duration compensation) are included.
- Performance posting activities are included.
- All "hard" date constraints are incorporated.
- A realistic start date has been chosen.
- Organizational holidays and resource vacations are entered.
- Resource allocations are realistic, and overloads are addressed.
- Management and contingency reserves are in the schedule.
- Time and cost trade-offs are applied to the schedule.

12.12a Baseline the Project Plan

Once the project plan has been completed as above and agreed on by the key stakeholders, it is important to "lock in" the plan, or baseline it. Baselining is important so the project manager can track and measure how well actual project performance matches the original plan (the baseline). Tracking and measuring these variances is one way the project manager monitors and controls the project.

Up to this point, the project manager has inputted start, finish, and duration data into MS Project, along with resources, their costs, and assignments. These values, together with project quality and scope targets, are what the stakeholders agreed to, approved, and expect as key measures of project success. Collectively, these values and targets, along with the risk and communications plans, form the project management plan.

However, once work begins on the project (execution), the *actual* value of the inputs will begin to vary from the *planned* value for most, if not all, of these inputs (unless the project is executed *exactly to plan,* which is unlikely). When the baseline is created, MS Project makes a project plan snapshot of all planned input values (i.e., duration, start, stop, resources). With this snapshot, MS Project begins to track the variance between baseline and actual values as the project is executed. The project manager can use MS Project to compare the baseline with actual schedule, work, and cost variance values and display these graphically and in tables. This comparison can be used to know where the project is doing well, and where it may need help. Baseline variance can also help predict future impacts to time and cost targets. With these bits of information, project managers can take action to get the project back on track where needed and reduce or eliminate undesirable future impacts to the project.

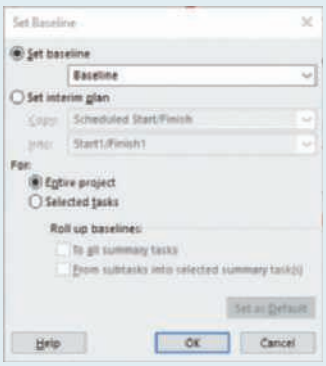
12.12b Create the First Time Baseline

Once key stakeholders agree to the project plan, the baseline is created by:

1. Click the **Project Tab>>Schedule Group**>>click **Set Baseline**>>click **Set Baseline….**
2. The defaults should be accepted as shown in Exhibit 12.18, click **OK**.

Exhibit 12.18

Set First Time Baseline



Source: Microsoft Corporation.

12.12c Subsequent Baselines

For any number of reasons, it may not be useful to continue to manage to the present baseline. Reasons to change the baseline might include changes to the project scope, project delay, or unavailability of planned resources (among a host of other reasons). If a change is approved, the changed tasks must be re-baselined, as well as the WBS parents of the new or changed tasks (Step 3 below):

1. Select the changed or added activities, milestones, and WBS elements.
2. Click the **Project Tab>>Schedule Group**>>click **Set Baseline**>>click **Set Baseline…**
3. Ensure the original baseline is selected in the drop-down menu under "**Set baseline**".
4. Click **Selected tasks**>>check **To all summary tasks**.
5. Click **OK**.

Instead of re-baselining as above, you may wish to create an entirely new baseline. MS Project supports up to 11 baselines. Some project managers like to save a baseline for each iteration of planning to compare different values, while others like creating a new baseline as each phase or milestone of a project is reached. Steps for creating additional baselines match those of creating the original baseline, only the drop-down menu under "**Set baseline**" needs to be changed to **Baseline 1** (or Baseline 2, 3, 4, etc., whichever number of baseline the project happens to be on).

12.12d Viewing Baselines and Variances

The Gantt Chart view can be formatted to show "baseline bars," which provide a graphical view of differences between the planned and actual schedule of each task. To display baseline bars in the Gantt view:

1. Click the **View Tab>>Task Views>>Gantt Chart**.
2. Click the **Format Tab>>Bar Styles Group>>Baseline**>>click the **Baseline you want to view**.

A good way to view the difference between a task's baseline value versus its actual value is side by side. This is easily accomplished in MS Project using the Variance table:

1. Click the **View Tab>>Task Views>>click Other Views>>Task Sheet**.
2. In the **Data Group>>Tables>>Variance**.

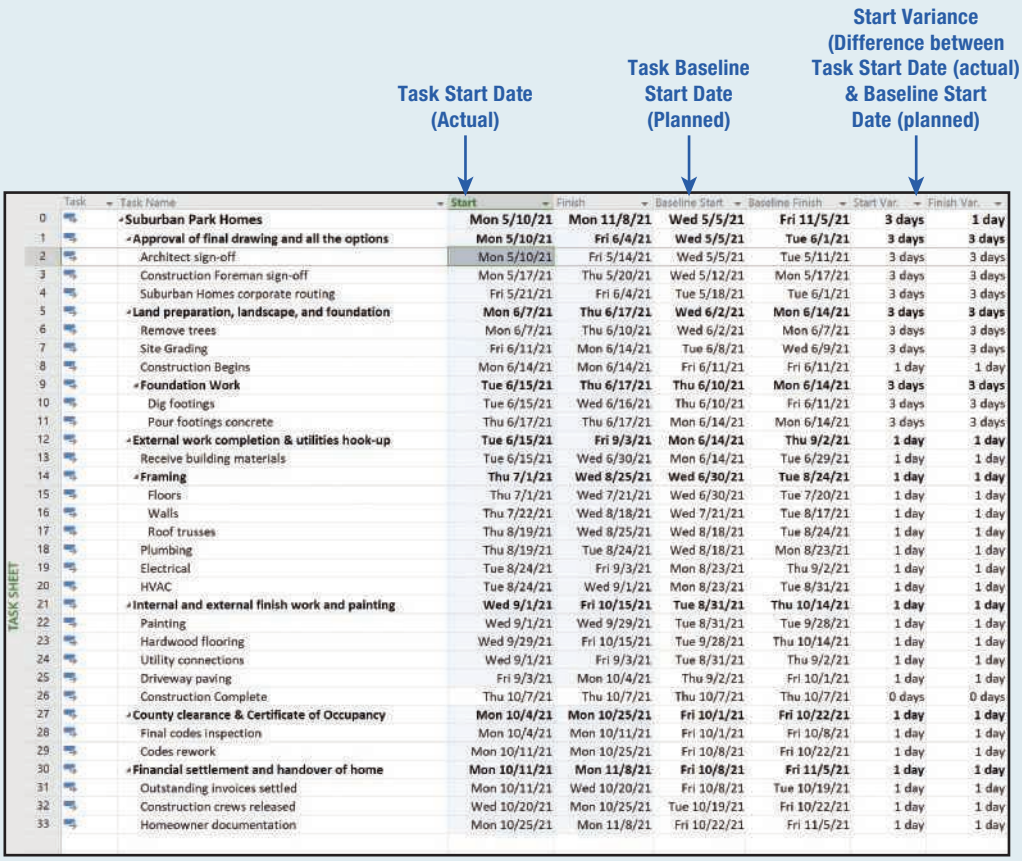
The variance table appears and shows you several columns as in Exhibit 12.19. Once the project has entered the execution phase, many of your start and finish dates will likely be different from what was originally planned (baselined). The variance table shows you the Start and Finish dates (the actual dates you executed on) and the baselined Start and Finish dates (the dates you planned to execute on). It also shows you the Start and Finish variance (the difference between the planned and the actual date).

As you can see in Exhibit 12.19, a date change in the project has been made to the task "Architect sign-off." The original plan was for this task to start on Monday 12/4/17 (the Baseline Start). However, the actual start was on Wednesday 12/6/17 as seen in the Start column. This change shows up in the Start and Finish Variance columns as a two-day variance. If you go back to the Gantt view (**View Tab>>Task Views>>Gantt Chart**), you will notice that the baseline bars have been revealed more prominently as the taskbars have shifted to the right.

As other project tasks shift, variances will ripple down through the project and give the project manager an idea of how the schedule will shift on the project. This is just another tool the project manager can use to examine critical path activities and plan to crash or make other adjustments to the schedule as necessary.

Exhibit 12.19

Project Task Variances



TASK SHEET

	Task	Task Name	Start	Finish	Baseline Start	Baseline Finish	Start Var.	Finish Var.
0		**Suburban Park Homes**	**Mon 5/10/21**	**Mon 11/8/21**	**Wed 5/5/21**	**Fri 11/5/21**	**3 days**	**1 day**
1		**Approval of final drawing and all the options**	**Mon 5/10/21**	**Fri 6/4/21**	**Wed 5/5/21**	**Tue 6/1/21**	**3 days**	**3 days**
2		Architect sign-off	Mon 5/10/21	Fri 5/14/21	Wed 5/5/21	Tue 5/11/21	3 days	3 days
3		Construction Foreman sign-off	Mon 5/17/21	Thu 5/20/21	Wed 5/12/21	Mon 5/17/21	3 days	3 days
4		Suburban Homes corporate routing	Fri 5/21/21	Fri 6/4/21	Tue 5/18/21	Tue 6/1/21	3 days	3 days
5		**Land preparation, landscape, and foundation**	**Mon 6/7/21**	**Thu 6/17/21**	**Wed 6/2/21**	**Mon 6/14/21**	**3 days**	**3 days**
6		Remove trees	Mon 6/7/21	Thu 6/10/21	Wed 6/2/21	Mon 6/7/21	3 days	3 days
7		Site Grading	Fri 6/11/21	Mon 6/14/21	Tue 6/8/21	Wed 6/9/21	3 days	3 days
8		Construction Begins	Mon 6/14/21	Mon 6/14/21	Fri 6/11/21	Fri 6/11/21	1 day	1 day
9		**Foundation Work**	**Tue 6/15/21**	**Thu 6/17/21**	**Thu 6/10/21**	**Mon 6/14/21**	**3 days**	**3 days**
10		Dig footings	Tue 6/15/21	Wed 6/16/21	Thu 6/10/21	Fri 6/11/21	3 days	3 days
11		Pour footings concrete	Thu 6/17/21	Thu 6/17/21	Mon 6/14/21	Mon 6/14/21	3 days	3 days
12		**External work completion & utilities hook-up**	**Tue 6/15/21**	**Fri 9/3/21**	**Mon 6/14/21**	**Thu 9/2/21**	**1 day**	**1 day**
13		Receive building materials	Tue 6/15/21	Wed 6/30/21	Mon 6/14/21	Tue 6/29/21	1 day	1 day
14		**Framing**	**Thu 7/1/21**	**Wed 8/25/21**	**Wed 6/30/21**	**Tue 8/24/21**	**1 day**	**1 day**
15		Floors	Thu 7/1/21	Wed 7/21/21	Wed 6/30/21	Tue 7/20/21	1 day	1 day
16		Walls	Thu 7/22/21	Wed 8/18/21	Wed 7/21/21	Tue 8/17/21	1 day	1 day
17		Roof trusses	Thu 8/19/21	Wed 8/25/21	Wed 8/18/21	Tue 8/24/21	1 day	1 day
18		Plumbing	Thu 8/19/21	Tue 8/24/21	Wed 8/18/21	Mon 8/23/21	1 day	1 day
19		Electrical	Tue 8/24/21	Fri 9/3/21	Mon 8/23/21	Thu 9/2/21	1 day	1 day
20		HVAC	Tue 8/24/21	Wed 9/1/21	Mon 8/23/21	Tue 8/31/21	1 day	1 day
21		**Internal and external finish work and painting**	**Wed 9/1/21**	**Fri 10/15/21**	**Tue 8/31/21**	**Thu 10/14/21**	**1 day**	**1 day**
22		Painting	Wed 9/1/21	Wed 9/29/21	Tue 8/31/21	Tue 9/28/21	1 day	1 day
23		Hardwood flooring	Wed 9/29/21	Fri 10/15/21	Tue 9/28/21	Thu 10/14/21	1 day	1 day
24		Utility connections	Wed 9/1/21	Fri 9/3/21	Tue 8/31/21	Thu 9/2/21	1 day	1 day
25		Driveway paving	Fri 9/3/21	Mon 10/4/21	Thu 9/2/21	Fri 10/1/21	1 day	1 day
26		Construction Complete	Thu 10/7/21	Thu 10/7/21	Thu 10/7/21	Thu 10/7/21	0 days	0 days
27		**County clearance & Certificate of Occupancy**	**Mon 10/4/21**	**Mon 10/25/21**	**Fri 10/1/21**	**Fri 10/22/21**	**1 day**	**1 day**
28		Final codes inspection	Mon 10/4/21	Mon 10/11/21	Fri 10/1/21	Fri 10/8/21	1 day	1 day
29		Codes rework	Mon 10/11/21	Mon 10/25/21	Fri 10/8/21	Fri 10/22/21	1 day	1 day
30		**Financial settlement and handover of home**	**Mon 10/11/21**	**Mon 11/8/21**	**Fri 10/8/21**	**Fri 11/5/21**	**1 day**	**1 day**
31		Outstanding invoices settled	Mon 10/11/21	Wed 10/20/21	Fri 10/8/21	Tue 10/19/21	1 day	1 day
32		Construction crews released	Wed 10/20/21	Mon 10/25/21	Tue 10/19/21	Fri 10/22/21	1 day	1 day
33		Homeowner documentation	Mon 10/25/21	Mon 11/8/21	Fri 10/22/21	Fri 11/5/21	1 day	1 day

Summary

Deming, Juran, and many other people have contributed to the modern approaches to quality. The Malcolm Baldrige Award, ISO certification, and Six Sigma each present a framework with many good points. The contemporary approach to project quality draws upon all of these sources.

The first concept in contemporary project quality management is stakeholder satisfaction. It is critical to understand project stakeholders, prioritize their needs, manage toward those needs, keep the relationships strong, and always strive to ensure that the customer is capable of using the project deliverables. The second concept is process management. This includes understanding both continual and breakthrough forms of improvement, seeking the root cause of problems, and using an appropriate model such as DMAIC to guide improvement efforts. The third concept is fact-based management. This entails understanding variation, making good decisions regarding what to measure, capturing and analyzing data correctly, and using the information in an open and honest decision-making manner. The final concept is empowered performance. Project managers want to have capable and willing workers throughout their project and should treat each person as an individual, ensure people accept responsibility, and strive to get more done through collaboration.

When project managers perform quality management planning, the first thing they need to do is either adopt the quality policy of their parent organization or supplement it. The policy should broadly guide their efforts. The quality plan should include the quality baseline defining performance expectations. It should also include instructions for how quality assurance and quality control will be handled.

Many quality tools have been developed over the years, and quite a few of them work well on projects. Many of these tools can be used in project management activities.

Once the quality management plan and all the other subsidiary plans have been developed, it is time to iron out any inconsistencies among the various plans that comprise the project management plan. The overall project management plan needs to make sense. Quality, cost, schedule, human resources, risk, and communications may have been planned somewhat independently on a large project, and now is the time to make sure they all work well together.

The project core team usually asks themselves several questions concerning the practicality of the overall plan and then holds a kickoff meeting with all of the project stakeholders. Hopefully, the outcome of the meeting is commitment and excitement all around. Now, the project officially moves into execution. While some of the project activities may already be under way (or even complete), the approval of the project plan signals the change from primarily planning to primarily execution. Ongoing planning and re-planning still occur, but managing the performance of project activities and communicating with various stakeholders consume much of the project manager's time from this point forward.

Key Terms Consistent with PMI Standards and Guides

plan quality management, 434
project quality, 438
stakeholder satisfaction, 438
process, 439
control, 440
four aspects of fact-based management, 442
quality metric, 442
data, 442
information, 443
quality management plan, 447
process improvement plan, 449
manage quality, 449
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Key Terms Consistent with Agile Practice

Build quality in, 460
Continuous improvement, 461
Make processes explicit, 461
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Inspection, 461
Testing, 461
Test-driven development, 461
Test plan, 461
Unit tests, 461
Integration tests, 461
Acceptance tests, 461
Continuous integration, 461
Refactoring, 461

Chapter Review Questions

1. What is the name of the process that identifies which quality standards are relevant to the project and how to comply with them?
2. Who was the influential thought leader in the area of quality who created the Profound Knowledge System?
3. Who is best known for creating the Quality Trilogy?
4. What does the acronym TQM stand for? How does it apply to project management?
5. What does the name *Six Sigma* refer to?
6. Define the term *project quality* in your own words.
7. Give some examples of external stakeholders.
8. What are the four core project quality concepts?

9. What are three main reasons it is better to design quality into a process than to find problems upon inspection?
10. Identify and describe the steps of the PDAC model.
11. What is the difference between common and special causes of variation?
12. Define quality assurance and the primary methods that can be used to achieve it.
13. Define quality control and the primary methods that can be used to achieve it.
14. What activities are typically included in a project kickoff meeting?
15. What marks the transition between the planning and executing project phases?
16. How do lessons learned fit into quality planning?
17. When and how is value delivered on a predictive project? On an Agile project?
18. What is the difference between a leading indicator and a lagging indicator? Give an example of each.
19. What is the purpose of identifying a threshold for project metrics?

Discussion Questions

1. What did Deming mean when he said that organizations operate as systems? Give examples.
2. Identify similarities and differences among TQM, ISO, and Six Sigma. What strengths and weaknesses are inherent in each of these approaches?
3. Rank the seven quality management areas of ISO from most to least important. What rationale is your list based upon?
4. Describe the process of achieving stakeholder satisfaction. How would you address a situation in which two stakeholders have mutually exclusive goals for the project?
5. Give examples of how a single company might use continuous process improvement and/or breakthrough process improvement.
6. Give some examples of common and special cause variation that you have witnessed. Which of these causes of variation can be addressed through continuous improvement?
7. Discuss the four areas of fact-based decision making. In your opinion, what is the greatest obstacle to using fact-based decision making?
8. Discuss the costs of conformance versus nonconformance and how they both factor into the overall cost of quality. What percent of your budget would you put toward conformance-related tasks compared to nonconformance-related tasks? Why?
9. In your own experience, have you seen companies integrate quality within their project planning processes? If so, when and how have they done so? If not, do you think it would have been more beneficial to address quality in one area of the overall project plan or continuously throughout the plan?
10. How does the idea of servant leadership relate to project quality?
11. How might a project leader's understanding of the team members' individual motivations affect the project's overall quality?
12. What is the difference between an efficient process and an effective process? How can we improve efficiency and effectiveness, respectively?

PMP Exam Study Questions

1. An important input to the Plan Quality Management process is requirements documentation. This is because:
   a. the organization will have a uniform set of specific quality requirements that every project must adhere to.
   b. requirements include the schedule and cost information that must be balanced against quality needs for the project.
   c. requirements documentation captures the stakeholder expectations that the project should meet.
   d. the sponsor's directives for the project's level of quality are expressed in the requirements.
2. Which of the following is part of a Configuration Management System?
   a. process for identifying and uniquely naming items that need to be controlled
   b. recording and reporting all changes

c. verifying the correctness of all deliverables and components of them
d. all of the above

3. What cycle is the basis for Six Sigma quality planning and improvement?
   a. DMAIC
   b. PDCA
   c. DOE
   d. TQM
4. All of these are components of a work flow diagram called the SIPOC model *except*:
   a. customer
   b. process
   c. input
   d. support
5. Total Quality Costs are comprised of the costs of all of the following EXCEPT:
   a. prevention
   b. appraisal
   c. management
   d. external Failure
6. During quality management planning, the project manager and team determine what will be measured during the Control Quality process. Project or product attributes such as on-time performance, defect frequency, and costs versus budget are known as _____.
   a. quality metrics
   b. quality thresholds
   c. quality tolerances
   d. quality boundaries
7. Preventive action _____.
   a. is primarily addressed in the Control Quality process
   b. realigns the performance of the project work with the project management plan
   c. seeks to ensure the future performance of the project work is aligned with the project management plan
   d. modifies a nonconforming product or product subcomponent
8. According to the *PMBOK*, which of the following is *not* a quality management process?
   a. Plan Quality Management
   b. Monitor Quality
   c. Perform Quality Assurance
   d. Control Quality
9. Once the project management plan is complete and accepted by the stakeholders, the approved plan is _____.
   a. reviewed
   b. baselined
   c. followed
   d. documented
10. Who came up with the four-part Profound Knowledge System?
    a. Deming
    b. Juran
    c. Maslow
    d. Ford

Exercises

1. Create a SIPOC for an everyday activity (i.e., paying bills, parallel parking, or making cookies).
2. Identify key quality project plan steps that you feel should be included within a typical overall project plan. Be sure to include quality items throughout the project plan life cycle.
3. Create a SIPOC model for a project in which your university is modernizing its student center to include space for on-campus, student-run businesses. Be sure to include all relevant stakeholder groups. Describe how you would use this information to design quality into your project.
4. Improve a work process using either the DMAIC or the PDCA model to guide your actions. What project quality tools did you use, and why did you select each?
5. Identify the quality policy for a local company. Speculate how the policy focuses the efforts on a project in that company. Find a project manager at that company and ask their opinion of the quality policy's impact.

Integrated Example Projects

Suburban Homes Construction Project

Suburban Homes realized that its ambitious plan of expanding its business to several Southern States in the United States is possible if it is known for its high-quality homes that meet local, state, and federal standards as well as exceed industrial standards for quality.

Even though Suburban Homes did not initially place a strong emphasis on quality but rather focused on meeting industrial standards, the company has realized that it must exceed all the quality standards to expand its business successfully. Although Adam Smith worked for several years in the construction industry, he is not specifically trained in quality management, and he is not well versed with quality management tools and techniques. He is actively seeking help internally and externally.

In the previous chapters, you have developed a scope plan (WBS), schedule network, cost estimation along RBS, and risk assessments for the project described. Now, the quality management plan needs to be added to make the project plan comprehensive.

Adam's primary task is to develop a quality management plan. Further, he realized that employee turnover and the expansion of the business in the southern states has led to Suburban Homes developing a centralized quality management team. You are hired as a consultant to develop a comprehensive quality management plan.

Tasks to Complete

- Assess quality expectations of a typical home buyer who is the primary stakeholder and other key stakeholders to develop a plan for stakeholder satisfaction.
- Identify relevant standards of quality.
- Develop quality measures for monitoring project performance.
- Develop a quality management plan as described in this chapter.
- Perform a qualitative assessment to prioritize risks.
- Develop a quality policy.
- Develop a process improvement plan.
- Define a quality assurance approach.

Heritage Arboretum Development Project

Two aspects of quality policy guide the arboretum development project. One is the Township's Greenspace Policy and the other is Arbnet's arboretum certification requirements. While Level One arboretum requirements place certain demands upon the arboretum, Level Two requirements are more aspirational as the Heritage Center Arboretum may choose to apply for level two status at some future date. Levels three and four do not apply as the minimum number of species for each is 500 and our site is far too small to consider that. These policies can be found below.

https://andersontownshipoh.gov/Portals/andersontownship/Documents/Committees/Greenspace/Use_Maintenance_Policy.pdf

http://www.arbnet.org/arboretum-accreditation-program

The Arboretum team annually assesses the size and condition of each tree and woody bush in our inventory. These are not every single plant, but specifically the one of each species that is identified by a sign. We track how each grows.

Questions:

1. What actions do you suggest to improve the people, process, communication, and product of this project?
2. Create a definition of done for one deliverable on each of the three main components of project scope: the physical facility of the arboretum, the online presence, and the partnering and programming.
3. From a stakeholder perspective, what activities can the development team do to add value to the Arboretum?

Semester Project Instructions

Talk with your sponsor to determine if the organization for which you are planning your example project has a quality policy. If it does, determine whether you will adopt it as is or ask to augment it. Tell why you wish to either accept or modify it.

With your sponsor, determine the quality baseline for your project. What standards will you use?

Perform a stakeholder analysis. After completing the technique, are there any stakeholders that you didn't think of before? Are there any who are opponents? What actions could you take to try to change those who are opponents into enthusiasts?

Create a SIPOC for your project. What did you learn that surprised you? How will your project plan be different because of what you learned?

Create an agenda for a kickoff meeting for your project. Conduct the kickoff meeting and capture minutes for it. Tell what went as you expected and what went differently from what you expected.

Baseline your project management plan with the activity baseline start, activity baseline finish, activity baseline duration, activity baseline cost, and activity baseline work shown in MS Project. Also show in your project management plan the agreed-upon quality and scope targets, risk, and communications plans.

Pick one work process related to your example project. Use the DMAIC model to improve the process. Perform the *define* and *measure* steps. Tell what you learned. Identify what project quality tools you expect to use on the remaining steps and tell why you will use them.

Project Management *in Action*

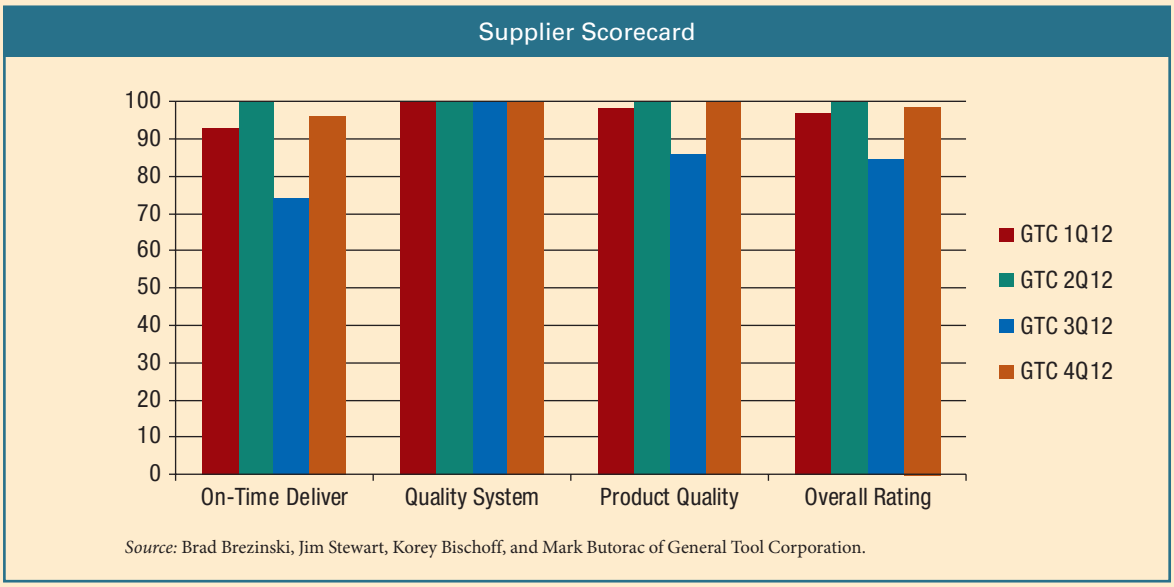
Quality Planning at GTC

Every customer-facing project performed by General Tool Company (GTC) has an associated Quality Plan Requirements (QPR) document. The QPR is an output of the technical review process and is performed by the Quality Engineer (QE) during the preliminary planning stages of the project. The QPR is derived from various source documents, including the Purchase Order Agreement, Statement of Work, technical publications, customer flow-down requirements, and drawing notes. Familiarity with the customer's quality system requirements is an essential element of the review process. It is not uncommon for a customer to mistakenly leave out critical quality requirements when issuing a purchase order or request-for-proposal. However, by being familiar with the customer's quality systems and manufacturing needs, GTC can work with the customer to correct any deficiencies prior to beginning the manufacturing process.

Through the QPR process, the QE may (and often does) uncover project risks previously unknown to the team. Such risks may impact cost, schedule, scope, or any combination thereof. At a minimum, identified risk must be investigated by the project manager so as to ensure there are no changes to the scope of work as originally proposed. While many tools exist to identify and address quality-related risks (DMIAC, Ishikawa Diagram, 5 Whys, etc.), GTC utilizes the Quality Improvement Action Plan for planning and in-process management of project risks.

Of course, not all risks are uncovered during the planning phase. Unsuspecting performance issues can arise at any point during the project's lifecycle and must be dealt with appropriately to ensure cost, schedule, and performance objectives are met. In the example on the following pages, GTC identified, by way of the supplier scorecard in Exhibit 12.20, delivery issues associated with a particular aerospace project. The scorecard led the project team down the continuous improvement path, in an effort to bolster the supplier rating. The relationship between the supplier scorecard and the Quality Improvement Action Plan is clearly indicated (as well as the marked improvement in the subsequent quarter).

Exhibit 12.20



Source: Brad Brezinski, Jim Stewart, Korey Bischoff, and Mark Butorac of General Tool Corporation.

By working closely with the customer and the QE, the project manager ensures that the project's quality and technical requirements are properly identified and integrated into the project plan. In addition, the QPR process provides an opportunity to validate the team's underlying assumptions from the bid process. Any incongruences can be addressed before the manufacturing process begins, thus giving the project the best opportunity for a successful outcome. Further, it is often during the quality planning process that the customer comes to realize the significant costs associated with heightened quality and technical requirements. In a firm-fixed-price environment, this is the best time for the subcontractor to negotiate any associated cost impact, as the risk is squarely on the shoulders of the subcontractor once the purchase order agreement is accepted.

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Part 4

Performing Projects

Organize | Lead | Plan | **Perform**

Performing a project includes leading, managing, and controlling all of the various knowledge areas described in *PMBOK Guide 6e,* using the principles described in *PMBOK Guide 7e* simultaneously so as to ensure progress is being made and results will be delivered. Chapter 13 deals with procurement, including all work with suppliers and partners in the supply chain. Chapter 14 includes the ongoing work concerning scope, schedule, cost, quality, communications, risks, and stakeholders. Chapter 15 wraps up the project, showing how to successfully close a project and reap the benefits.

Chapter 13

Project Procurement and Partnering

Chapter Objectives

Core Objectives:

13-1 Describe how to plan, conduct, control, and close project procurements.

13-2 Describe the various formats for supply contracts and when each type is appropriate.

13-3 Determine activities, supplies, or services to be purchased in a project situation.

13-4 Create bid documents for the purchase of a service or supply for a project.

13-5 Determine the criteria to select a seller, then decide and justify the type of contract to be used.

13-6 Describe effective approaches to and advantages of project partnering.

Agile Objectives:

13-7 Describe four main types of contract clauses used in Agile and the benefits of each.

13-8 Explain the Agile approach to project partnering and collaboration.

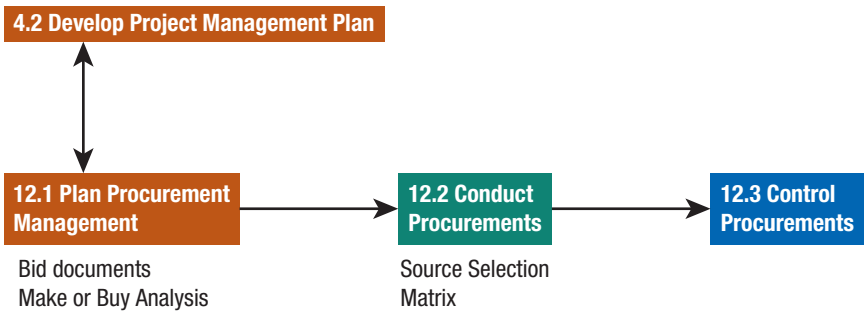
Robert Evans/Alamy Stock Photo

How does a company work successfully in a supply chain with much larger and much smaller companies, ensuring fair treatment and protection to all parties, when the technology is new and market size can grow explosively? Here is one firm's story through a series of projects and partnerships that is currently known as T°Cool.

As an independent inventor, IP owner, and entrepreneur, the greatest challenge is how to muster the required organizational support, critical capital, and project management input while staying agile and responsive to developing conditions. Project management adds crucial skills you need to generate cooperation from your resources without implicit or granted hierarchal authority.

This story was born when I encountered a challenge on a landscaping project. The solution to a previous project became a significant independent project called Super Absorbent Polymer Turf (SAPTURF). The problem is that synthetic turf systems generate extreme heat of 50 to 60° above the ambient temperature on the surface, which is unpleasant and even dangerous. As an individual, I developed and patented a polymer that solves this problem in many situations.

PMBOK Guide 6e Coverage



Note: Refer to Appendix A to view the entire *PMBOK 6e* flowchart.

PMBOK Guide 7e
Domains:
- **Stakeholders**
- **Planning**
- **Work**
- **Measurement**

I ended up choosing a firm in the synthetic turf industry as a long-term partner and licensee. I chose Shaw Industries, a Berkshire Hathaway company. Shaw Industries operates three synthetic turf divisions. Shaw's experience as the largest flooring manufacturer in the United States and its financial stability as a Berkshire Hathaway company were additional reasons I selected them as a long-term partner. I also developed confidence that they would respect both my knowledge and my intellectual property.

I entered into a long-term license agreement with Shaw Industries and they trademarked my technology "HydroChill." HydroChill is now commercialized worldwide. HydroChill projects have been executed in the categories of large-scale athletic fields, parks, roof gardens, and residential lawns throughout the world.

The exclusive relationship with our original licensee, Shaw Industries, was a great commercial incubator for our Synthetic Turf Cooling technology. At the same time, it became clear that Tatro's vision for growth and an open market approach to commercialization was more aggressive than Shaw's vision. In hindsight, this is not surprising as Shaw Industries is a multibillion-dollar business based on a variety of flooring products and technologies with a critical mass in carpet and hard surfaces.

We had made the prudent decision to include an "exclusivity" conversion clause in our license agreement with Shaw. This allowed us in 2017 to convert Shaw to a non-exclusive license. Effectively this allows us to manage what had become dual visions for the commercialization for our technology, instead of a singular or exclusive vision. Once the conversion clause was activated, Shaw would continue to license our technology and sell it under the tradename HydroChill.

We immediately got to work establishing a new trademark which became and remains T°Cool. In order to rapidly deploy T°Cool manufacturing and distribution capabilities, we negotiated supply, tolling, and warehousing deals with a major raw material and manufacturing resource.

The founder's son, Jacob Tetrault, was also recruited to develop a T°Cool marketing, sales, and distribution program. Jacob was faced with the daunting challenge of reaching important potential customers in a very fragmented synthetic industry, especially in the landscape category. He immediately built a marketing strategy and campaign with social media as the main engine. The social media platform proved to have tremendous penetration, flexibility, and agility in adapting to a non-centralized industry.

© Chris Tetrault, owner and founder of T°Cool

We developed a pre-payment program with our rapidly growing roster of new T°Cool. Prepayment was rewarded with financial incentives based on tiered pricing. This allowed us to collect payment upfront and leverage our capital. In turn, we secured price concessions with our suppliers based on our rapid payment.

Combining social media both pre- and post-sale along with "payment upfront" fulfillment program has proven to be very powerful in generating revenue. This approach has allowed us to reach thousands of small companies in the quickly growing synthetic turf industry. While building critical momentum, it also avoids having any one customer with undue leverage.

Even more important is the ability to gather immediate feedback from a multitude of customers in real time to enable quick and meaningful adaptation to ever-changing market conditions.

Lessons we learned include:

- To facilitate future contract term execution in a changing business environment, build in a clause to allow you to convert current resources to non-exclusivity. This should be accomplished in a fair and balanced way toward all stakeholders.
- Expedite purchase orders through an invoice process to improve cash flow. Reward customer partners with preferred pricing for quick payment. Award all partners for participating in a flexible system.
- Create a contract clause based on various market conditions including a "force majeure" to allow for adjustments to be made to a contract without the contract falling apart.

13.1 Introduction to Project Procurement

Can you provide a project example that is fully completed by the project organization itself, without using any products or services from outside suppliers? Most likely, the answer is no. As the opening case illustrates, in-house personnel complete almost no serious projects from scratch anymore. In fact, outsourcing some project tasks has been a well-established practice in various industries for a long time. In many cases, companies have to rely on external suppliers or partners for acquiring many of the unique resources they need. In this

chapter, we consider the interorganizational purchasing-related issues (hereafter referred to as procurement management) in the context of projects and project management.

Supply Chain Management includes a set of approaches to integrate suppliers, manufacturers, warehouses, and stores efficiently and effectively such that the process of procurement, production, and distribution of products and services are distributed in the right quantity, to the correct location, and on time with an overall goal to minimize overall cost in meeting requirements.

Procurement management includes supply chain and requires a project team to collaborate with all key suppliers and contractors to determine optimal logistics strategies defined to meet the needs and expectations of user requirements and performance expectations.

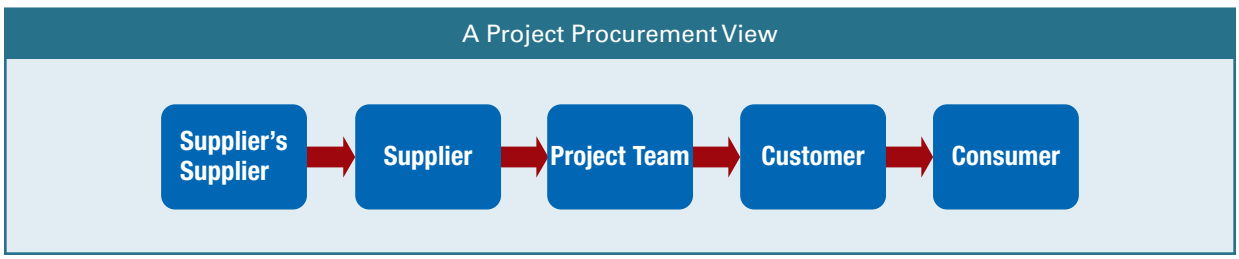
A procurement supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. In project management, this request can be made by the project team in order to acquire some specific product, service, or resource such as people required for completing various stages of the project. The customer can also make the request. As a result, procurement requires managerial processes that span functional areas within individual organizations and link trading partners and customers across organizations.

In recent years, the topic of procurement management has evolved into a systematic approach for managing all material, services, money, and information flows across all partners. With its broader coverage and profound impact, project procurement management has become a challenge to many firms to manage. Because the ultimate goal of serving project customers hinges on the systematic and coordinated performance of all partners (suppliers, transporters, etc.), procurement management becomes a critical project management activity. However, many organizations traditionally have been concerned with purchasing and procurement, where the goal was to obtain necessary goods and services at the lowest possible price. In this chapter, we cover not only traditional procurement and contractual management topics but also supplier partnership and collaboration issues.

We define project procurement management as a system's approach to managing all the flows of physical products, information, and funds from suppliers and producers, through resellers or intermediaries, and finally through the project organization for creating customer satisfaction. A sample project supply chain is shown in Exhibit 13.1.

The traditional purchasing perspective is only concerned with the relationship between the project team and its supplier(s)—those who supply the project organization directly. At its most extensive, procurement management involves strategic and operational issues concerned with all organizational partners involved in projects. Doubtless, all supply chain parties need to work together to complete the project faster, better, and/or cheaper. They all need to remember that the key project stakeholders determine the trade-offs among cost, scope, and schedule for better results in achieving project outcomes.

Exhibit 13.1



In traditional project procurement management literature, *purchasing, supply chain management,* and *procurement* are usually used interchangeably to refer to the integration of related functions to purchase or acquire the needed materials and services for the project team. Thus, procurement management is concerned with more than the standard steps in the purchasing process, such as recognizing needs, translating needs into commercially equivalent descriptions, and searching for suppliers. Further responsibilities of a project procurement may also include receiving, inspection, storage, inbound and outbound transportation, and disposal. Project procurement management can also be extended to cover various stages of the supply chain for providing the necessary goods or services (e.g., the supplier's supplier). It is helpful to think in terms of the following:

- **Owner**—the "person or entity that owns the product of the project and to whom that product will be handed over at the time of its completion"[1]
- **General contractor**—a person or agency that "does not specialize in one kind of work; often used to refer to the primary contractor who employs specialty subcontractors"[2]
- **Subcontractor**—a "contractor who is holding a contract with a prime contractor (also referred to as a first-tier subcontractor) or is holding a contract with a subcontractor to the prime contractor (i.e., lower-tier subcontractor)"[3]

Though procurement management and project management are traditionally separate business areas, we find that integrating them can significantly enhance the effectiveness of project management. The last section of the chapter covers how to improve project procurement performance.

13.1a Project Procurement Components

In particular, this chapter focuses on the following project procurement management components:

- **Make-or-buy decisions**—These are the acts of choosing between manufacturing a product or developing a service in-house or purchasing it from an external supplier.[4]
- Contract types—We introduce contact types and compare their advantages and disadvantages in case a buy decision is warranted.
- Collaboration and cooperation—As different firms take care of their own interests, it is essential to coordinate their project activities to ensure the deliverables are produced as scheduled. The project at hand should become the common goal of all the parties concerned.
- System integration—This concerns the trade-offs among project goals such as time, cost, and scope (including quality).

13.1b Project Procurement Factors

Generally, procurement management is more important to projects in which a large portion of the work is subcontracted and more collaboration is needed. Other factors include the following:

- The value of the outsourced products or services relative to the total value of the project
- The timing of the work being purchased
- The capability of the project team
- The role of the outsourced work in the entire project
- The number of suppliers required

- The structure of the procurement supply chain (the number of stages in the supply chain and the nature of the inter-company relationship)

As noted earlier, it is becoming common for projects to have a significant part of their value come from various external suppliers. It is also increasingly common for some organizations to exist only as coordinators of activities, without having their own capability of producing and offering the project deliverables. It is a norm that not only large businesses but also small business outsource project tasks. In fact, small firms tend to rely more on external resources, as they may not have in-house capability for executing certain project activities or they may not have the working capital to own and employ resources.

13.1c Project Procurement Decisions

Some of the major project a procurement management decisions involve:

- Distribution network configuration
- Inventory control in a supply chain
- Logistics
- Supply contracts
- Distribution strategies
- Supply chain integration and strategic partnering
- Outsourcing and procurement strategies
- Product design
- Information technology and decision-support systems
- Matching internal inadequacies with external expertise

In practice, these decisions often involve quantitative analysis. All of these decisions can play an important role in managing a complex project. The implication is that project managers must be aware of these methodologies to ensure project completion in a timely and cost-effective way.

13.1d Project Procurement Processes

Project procurement management includes the following three processes.

1. Plan procurement management
2. Conduct procurements
3. Control procurements

13.2 Plan Project Procurement

Plan procurement management is determining how project procurement decisions, approach, and dealing with sellers will be accomplished and documented. It identifies those project needs that can be met by acquiring products or services from outside suppliers, determines what to purchase or acquire, and finalizes when and how to do so. On some projects, a portion of the services or materials may be sourced from another company; on other projects, the bulk or even all of the work may be performed by an external company. A client organization needs to plan for purchasing and acquisition, whether it is for part or all of a project. The needs of the parent organization should be considered as well as those of the project when deciding how to acquire necessary items because it may be better for the parent organization to buy an item rather than to rent it for the current project and then rent it again for a future project.

To effectively plan for purchasing and acquisition of materials and services, a project team typically finishes identifying customer requirements and planning most of the project in order to understand what the true project needs are. At a minimum, the project team requires knowing the project scope, which was defined in Chapter 1 as the entirety of what will and will not be done to meet the specified requirements. Once the requirements are identified, a project manager should be able to determine whether or not to buy and, if the decision is to buy, what to buy and how much to buy.

13.2a Outputs of Project Procurement Planning

One primary output of this planning is a **procurement management plan**, which is the portion of the project management plan that describes how a project team will acquire goods and services they choose to purchase. The procurement management plan can include guidance for types of contracts to be used, risk management issues, and how to select potential suppliers. This plan guides the client company's efforts through all activities dealing with the acquisition of all the necessary materials, other resources, and services to complete the project. Another major output is the **procurement statement of work**, which documents the portion of work to be purchased, described in enough detail so potential suppliers can decide if they feel they are capable of and interested in providing it. This document should ensure that both the contractor and the client organizations clearly understand the work that is being requested; for example, the document should provide information such as specifications, quantity, quality standards, performance data, work requirements, schedules, inspections, and other needs.

13.2b Make-or-Buy Decisions

Project procurement can be considered from the buyer–seller interface perspective. Depending on the application areas, the seller can be called a supplier, supplier's supplier, or contractor. Depending on the buyer's position in the project acquisition cycle, the buyer can be called an owner, a customer, a service requestor, or a purchaser. The seller can be viewed during the contract life cycle first as a bidder and then as the contracted supplier or vendor.

For any products or services needed in a project, during the purchase planning phase, the project team determines which project needs can best be met by purchasing or acquiring products and services from an outside provider and which project needs can be accomplished by the project team. Buying from an outside supplier to meet project needs is a well-established practice. For example, many firms outsource information technology requirements, accounting work, legal functions, logistics, and so on.

Reasons to Buy or Sell The make-or-buy decision is not trivial. It involves intricate issues such as a project organization's competitive analysis and demand analysis. The project team also needs to evaluate the advantages and disadvantages of outsourcing from the viewpoint of time, cost, and performance control. The analysis should include both direct and indirect costs so that the final decision is based on equal comparisons. The project team evaluates alternative suppliers and provides current, accurate, and complete data that are relevant to making the right decision. Exhibit 13.2 lists a variety of considerations for make-or-buy decisions.

Most firms begin conducting a strategic outsourcing analysis by identifying their major strengths and then building on them. A firm's competitive advantage is often defined as lower cost, product differentiation (better quality), and/or responsiveness (fast delivery).

Exhibit 13.2

Reasons to Make or Buy

Reasons to Make	Reasons to Buy
1. Lower production cost	1. Frees project team to deal with other important activities
2. More control over quality and time	2. Ability to utilize specialized suppliers
3. Lack of suitable suppliers	3. Flexibility in procurement
4. Obtain a customized item	4. Inadequate managerial or technical resources
5. Utilize project team's expertise and time	5. Inadequate capacity
6. Protect proprietary design or knowledge	6. Small volume requirements
	7. Ability to procure work elements that are complex or high-tech

To project teams, these have different levels of importance, depending on the wishes of the customer and the progress the project is making at the moment. Project time-cost analysis often helps generate insights about making efficient procurement decisions. For example, a noncritical activity may be outsourced with a focus on minimizing cost but not necessarily receiving the fastest delivery. However, during different stages of a project, a noncritical task can become a critical task, which raises the importance of timing and shifts priorities. Factors like this can hold quite different implications for a make-or-buy decision in different phases of project execution.

While make-or-buy investigations usually begin with a cost analysis, various qualitative factors frequently portend more far-reaching consequences than does the cost analysis. A thorough investigation is clearly complicated by the dynamics and uncertainties of various project activities.

Outsourcing Issues While outsourcing has gained in popularity, there are potential issues related to outsourcing. Some of these are relatively important with regard to the goal of projects:

- Loss of time control for completing project activities
- Lack of cost control for outsourced activities
- Gradual loss of special skills for doing some specific activities
- Loss of project focus and a potential conflict of interest
- Ineffective management as a result of complicated business interactions
- Loss of confidentiality and double outsourcing when a third party is used
- Sharing of proprietary knowledge that impacts competitive advantage

The concepts and techniques of project procurement management are of strategic importance because of these potential issues related to outsourcing. Purchasing can contribute to the achievement of benefits such as higher product quality, shorter lead times, and lower costs. Project procurement strategies can change often and differ from corporate procurement strategies because of constraints, availability of critical resources, and specific project requirements that change dynamically. After making the make-or-buy decision, the project team proceeds to the next step of project outsourcing for selecting the right supplier and negotiating the contract.

The outputs of procurement planning also include documents and criteria for selecting a supplier, if a buy decision has been made. When multiple suppliers are available, selection standards such as total cost of ownership and risk also need to be developed.

When a buy decision is made, the client company is attempting to create a situation in which prospective contractor companies have the capability and motivation to provide useful and complete proposals that are easy to evaluate in order to determine which one best suits the client company's needs. The client company typically uses **procurement documents**, which are documents that define the requirements and contractual relationship between suppliers and customers of services and products used on a project.

Project procurement personnel need to understand the differences between types of requests so they use the correct one.

- **Request for Information (RFI)** is "a proposal requested from a potential seller or a service provider to determine what products and services are potentially available in the marketplace to meet a buyer's needs and to know the capability of a seller in terms of offerings and strengths of the seller."[5] An RFI is used to learn about the potential sellers and/or the products or services.
- **Request for Quotation (RFQ)** is a type of procurement document "used when discussions with bidders are not required (mainly when the specifications of a product or service are already known) and when price is the main or only factor in selecting the successful bidder."[6] An RFQ is used to compare prices from various vendors of standard items.
- **Request for Proposal (RFP)** is a type of procurement document used at "an early stage in a procurement process issuing an invitation for suppliers, often through a bidding process, to submit a proposal on a specific commodity or service."[7] An RFP is often used to compare different approaches for nonstandard items.

The client company creates evaluation criteria to define how they will evaluate and rank the proposals. Armed with these documents, the client company is now prepared to conduct the procurement.

13.3 Conduct Project Procurements

The second project procurement management process is to **conduct procurements**, which includes receiving seller responses, selecting a seller, and awarding a contract. Client firms need to decide which potential contractor organizations are selected to solicit and then make sure those organizations know about the project under consideration. Sometimes, firms develop a qualified sellers list and only allow listed firms to submit a proposal on the upcoming project. Other times, they advertise widely in hopes of attracting new contractors. In either event, a formal request is normally sent out with hopes that competent firms will compete for the right to perform on the project.

One Singapore company describes its project procurement process in Exhibit 13.3. The first part of the procurement process encompasses gathering of market intelligence, developing a procurement strategy, and developing a contract.

The *intelligence-gathering* phase includes defining the scope for the procurement, analyzing the needs of the end user, and articulating the upstream and downstream market forces. It is important to question whether the procurer has leverage or is beholden to the tight supply situation. A *strategy* is then developed and some parts are shared with "partner vendors" so that there is a clear understanding of the needs, available supply, and the satisfaction criteria of procurement. After understanding the total

Exhibit 13.3

Procurer, Prospects, and the Project Manager

Intelligence	Strategy	Contracting
Scope	Statement	Legal
Needs	Analyses	Technical
Market forces	Alternatives	Commercial
	Mandates	

Source: Raji Sivaraman, M.S., PMI-ACP, PMP.

cost of procurement, the procurer needs to be armed with the best alternatives. The culmination of the strategy phase is to obtain clear mandates to negotiate. A *contract* is then developed. The contract should articulate clearly, without contradictory clauses, the legal aspects, technical requirements, and commercial terms.

These developments are the result of continuous dialogue between the procurer and prospective suppliers.

13.3a Sources for Potential Suppliers

Based on the nature of what is being requested in early procurement stages, the project team usually starts the selection process by establishing a robust list of potential suppliers. The following information sources are frequently used to identify these potential suppliers:

- Supplier websites
- Supplier information files
- Supplier catalogs
- Trade journals
- Phone directories
- Sales personnel
- Trade shows
- Professional organizations and conferences
- Electronic search engines
- Published information by local, state, and federal governments

13.3b Approaches Used When Evaluating Prospective Suppliers

Once potential contractors submit bids or proposals, the client company applies previously defined selection criteria to select one or more sellers who are qualified to perform the work and are acceptable as sellers. On some projects in which the services or materials are routine and common, the selection decision is made mostly or entirely on price. On other projects, the client chooses the contractor on the basis of life cycle cost—that is, the cost associated with the purchase of the item and the cost for maintaining it for its entire useful life. On still other projects, price is one of multiple considerations. With more complex projects, the client company may very well decide that one company is more capable than another on technical, managerial, financial, or experiential grounds. The evaluation criteria developed during the plan procurement process should guide this decision.

For example, a research study in the Middle East involving a range of public sector contracting agencies revealed that when a client selects a design-build contractor (one who supervises both the design and construction for a project with many other companies involved), several tangible and intangible selection factors are considered, as shown in Exhibit 13.4. In essence, the selection of a design-build contractor is chiefly guided by clients' business needs, functional requirements, and expectations of the outcome of the design-build process. Clients look for a sound business partner who is capable of and committed to delivering the design-build promise of producing better projects faster and at a reduced cost. The design-build contractor selection process is indeed twofold: one is process-related, focusing on project outcomes, and the other is organization-related, focusing on the actual abilities and qualities of the design-build contractor's organization.

After developing a comprehensive list of potential suppliers, the project team will evaluate each prospective supplier individually. The approaches and analyses can include the following:

- Supplier surveys that provide sufficient knowledge of the supplier to make a decision to include or exclude the firm from further consideration
- Financial condition analysis that reveals whether a supplier is clearly incapable of performing the work satisfactorily due to financial conditions

Exhibit 13.4

Factors to Consider When Selecting a Design-Build Contractor

Component A: Process-related design-build contractor selection factors:

Priority	Factor	Definition
I	Shorten Duration	To reduce the overall project delivery time as compared to other project delivery methods
II	Reduce Cost	To reduce the overall project delivery cost as compared to other project delivery methods
III	Reduce Claims	To eliminate claims raised by contractors due to design errors or shortcomings
IV	Establish Cost	To fix project budget early on, long before completing detailed designs and specifications
V	Establish Schedule	To fix schedule of project benefits long before completing detailed designs and specifications
VI	Innovation	To benefit from the innovation opportunity created by designers and builders' interaction
VII	Reduce Coordination	To reduce client risk and effort of coordinating between contractors and designers

Component B: Organization-related design-build contractor selection factors:

Technical	Managerial	Financial	Experiential
Know-how	Brand	Financial strength	Design-build similar projects
Expertise	Culture	Marketability	
Plant/equipment	Trust/integrity	Stability	Diversity
Specialism	Methodology	Audit reports	Resources
Design capacity	Organization	Turnover	Reputation

Source: Adapted from Dr. Sherif Hashem, *The Power of Design-Build: A Guide to Effective Design-Build Project Delivery Using the SAFEDB-Methodology* (Business Expert Press: USA, August 2014).

- Third-party evaluators such as Dun and Bradstreet that can be hired for obtaining relevant information
- Facility visits to allow the project team to obtain firsthand information concerning the adequacy of the firm's technological capabilities, manufacturing or distribution capabilities, and managerial orientation
- Quality ability analysis that examines the potential supplier's quality capability
- Delivery ability analysis that estimates the supplier's capability to deliver the required product or services on time; backup solutions can also be considered

The analyses listed above should not necessarily be limited to potential first-tier suppliers. In some cases when second- or even third-tier suppliers are involved, the project team needs to evaluate these suppliers as well. This proactive screening process usually generates a handful of potential suppliers with good standing. If the organization has a list of current qualified sellers, it can form the basis for new projects.

13.3c Supplier Selection

After one or more potential suppliers have passed the evaluation process, the selection process must begin. The project team now invites potential suppliers to submit bids or proposals. Procurement documents are used to solicit proposals from various vendors. The most common procurement document is the request for proposal (RFP). The RFP can be a foundation for the future working relationship between the buyer and the supplier. In fact, the proposal prepared by the vendor often becomes a part of the final contract, as an addendum or exhibit, between the supplier and the vendor. A request for proposal usually includes the following items:

- Purchasing overview
- Basic supplier requirements
- Technical requirements

Jeffrey Isaac Greenberg 20+/Alamy Stock Photo

- Managerial requirements
- Pricing information
- Appendices

The basic supplier selection decision is a classic decision tree problem. This is a choice between alternatives under uncertainty. The outcome is concerned with both price and performance, including delivery time. Does the decision-maker wish to trade a higher price against supply assurance under all circumstances? The difficulty in quantifying all consequences reinforces the need for sound judgment in key decisions.

Evaluation criteria are used to rate proposals and other supplier characteristics. The criteria can be objective or subjective, and they are often provided in the RFP. Typically, the most important evaluation criterion is price. Other important criteria include the vendor's technical capability, reputation, and so on. Exhibit 13.5 shows factors in addition to price that can be used in assessing suppliers.

The project team selects one or more sellers who are both qualified and acceptable as sellers. Many tools and techniques, including the following, can be used in the seller selection decision process:

- Weighting system
- Independent estimates
- Screening system
- Seller rating system
- Expert judgment
- Proposal evaluation techniques

The goal of selecting suppliers is to award a contract. A **contract** is "a mutually binding legal relationship obligating the seller to furnish supplies or services and the buyer to provide consideration for them."[8] A contract establishes a legal relationship between parties, and it is subject to remedy in the court system. The project organization can be a seller in dealing with the project owner or customer and a buyer in a more prevalent procurement setting. In many project management scenarios, the project manager must be aware of how a wide range of contracts are developed and executed. A procurement contract is awarded to each selected seller. The contract can be in the form of a simple purchase order or a

Exhibit 13.5

Factors Used to Assess Potential Suppliers

Potential suppliers should provide evidence they do or can:

- Treat all stakeholders with fairness and ethics
- Live by similar values and business objectives as you do
- Anticipate and meet the needs of our customers
- Quickly react to and satisfy our changing needs
- Create quality outputs and adhere to quality standards such as ISO
- Have a consistent track record of successful performance
- Will provide solutions with low total cost of ownership
- Are financially viable for the long term
- Advocate for inclusion, trust, respect and mutual commitment with their workforce

Adapted from https://www.mindtools.com/pages/article/10-cs.htm

complex document detailing generic and specific conditions of the contract. The major components in a contract document generally include the following:

- Statement of work
- Schedule baseline
- Period of performance
- Roles and responsibility
- Pricing
- Payment terms
- Place of delivery
- Limitation of liability
- Incentives
- Penalties

13.4 Contract Types

Different types of contracts can be used as tools in planning acquisitions specified in the make-or-buy decision. Contracts differ by type with regard to how the risk is distributed and how the project is performed. The seven most common types of project procurement contracts are shown in Exhibit 13.6.

13.4a Fixed-Price Contracts

A **fixed-price contract** is an agreement that binds the seller to perform the agreed-upon work for the agreed-upon money. The contract may also include an agreed-upon date for completion. The most common types of fixed-price contracts are firm-fixed-price (FFP), fixed-price-incentive-fee (FPIFD), and fixed-price-economic-price-adjustment (FP-EPA).

Exhibit 13.6

Types of Contracts

Contract Type	Cost Risk Absorbed By	Appropriate When
Firm-fixed-price	Seller	Costs are well known
Fixed-price-incentive-fee	Mostly seller	Costs are well known and buyer wants to maximize some performance aspects
Fixed-price-economic-price-adjustment	Both	Project may be of long duration, and inflation and commodity prices may fluctuate
Cost-plus-incentive-fee	Mostly buyer	Costs are not well known, and buyer wants to maximize some performance aspects
Cost-plus-award-fee	Mostly buyer	Both parties agree most of the award fee is based upon buyer's opinion of seller performance on stated criteria
Cost-plus-fixed-fee	Buyer	Costs not well known
Time and material	Buyer	Cost rates known, volumes are unknown

Firm-Fixed-Price (FFP) Contract The **firm-fixed-price contract** is a contract in which the seller has to complete the job for the agreed-upon amount of money regardless of the actual cost incurred. Any cost increase due to adverse performance or inflation or other market conditions is the responsibility of the seller, who is obligated to complete the effort. A simple form of a firm-fixed-price contract is a procurement order for a specified item to be delivered by a certain date for a specified price, such as a truckload of mulch delivered on the job site at 3110 Elm Street on May 15 for $300.

Fixed-Price-Incentive-Fee (FPIF) Contract The **fixed-price-incentive-fee contract** is a contract in which the price is fixed as defined by the contract, but the seller can earn an additional amount as incentive if the seller meets defined project metrics. An example is a contract for rebuilding a bridge for a fixed price of $1,250,000 with an incentive of an extra $3,000 for every day it is complete before the scheduled date of September 15. The buyer would like to have use of the bridge sooner, and the seller would like to earn a higher fee, so both have an incentive to finish the project early. Performance incentives can also include bonuses for better quality, more features, or anything else that the buyer wishes to maximize and is willing to pay for.

Fixed-Price-Economic-Price-Adjustment (FP-EPA) Contract The **fixed-price-economic-price-adjustment contract** is a fixed-price contract with a clause to protect the seller from conditions such as inflation or commodity cost increases. For example, a contract states the contractor will receive $400,000 to supply all of the gravel for a project, but the price may be adjusted based upon market price for gravel at the dates when it is delivered.

Fixed-price contracts provide low risk for the buyer, since the buyer does not pay more than the fixed price regardless of how much the project actually costs the seller. Consequently, a seller bidding on a fixed-price project must develop accurate and complete cost estimates and include sufficient contingency costs. Certainly, overpricing should be avoided, as a competing contractor with a lower price might be selected. In case the seller does not have a clear understanding about the project scope, another type of contract should be considered as an alternative.

Cost-reimbursable contracts, unlike fixed-price contracts, provide lower risk for the seller and higher risk for the buyer. They are generally more appropriate when it is difficult to estimate the project cost.

13.4b Cost-Reimbursable Contracts

Cost-reimbursable contract is a type of contract in which the seller is reimbursed for the actual approved costs of completed work, plus a fee typically representing profit. The three variations of commonly used cost-reimbursement contracts are cost-plus-fixed-fee, cost-plus-award-fee, and cost-plus-incentive-fee.

Cost-Plus-Fixed-Fee (CPFF) Contract The **cost-plus-fixed-fee contract** is a type of contract in which the buyer reimburses the seller for all of the seller's allowable costs plus a fixed amount of profit (fee). An example is a research project in which all scientist hours spent on the project are paid along with a fee of $5,000 regardless of how many hours the scientist spent.

Cost-Plus-Award-Fee (CPAF) Contract The **cost-plus-award-fee contract** is a type of contract that involves payments to the seller for all allowed costs incurred for

completed work, plus an award fee based on satisfying certain subjective performance objectives. An example is a development contract that pays the contractor $3,000,000 plus puts in escrow an award fee pool of $210,000, and an executive in the customer's organization has sole discretion regarding how much of the award fee pool is given based upon customer satisfaction criteria or the contractor meeting certain subjective performance objectives.

Cost-Plus-Incentive-Fee (CPIF) Contract The **cost-plus-incentive-fee contract** is a type of contract in which the buyer reimburses the seller for the seller's allowable costs and pays the seller a fee if it meets defined performance criteria. These criteria can be for schedule, cost, and/or performance. An example of a schedule criterion is a contract for constructing a college dormitory that calls for completion by August 15 so it is ready for occupation in the fall semester. A cost criteria example is the buyer of a small house negotiating a total project cost of $150,000. A performance criteria example is when an auto company enters a contract with a supplier to develop a battery that can get 55 miles per gallon in a 3,000-pound hybrid car. In each of these cases, the contract can call for the seller to receive a bonus if it does better than the agreed-upon target and/or a penalty if it does worse. Both the buyer and the seller can benefit if performance criteria are met.

13.4c Time and Material (T&M) Contracts

Time and material contracts are hybrid contracts containing aspects of both cost-reimbursement and fixed-price contracts, and they are generally used when the scope is unclear and the deliverable is created using either effort (labor hours) and/or amounts of materials. In this type of contract, the unit rate for each hour of labor or pound of material is set in the contract, as it is practiced in a fixed-price contract. However, the amount of work is not set, so the value of the contract can increases like a cost-reimbursement contract. The seller simply charges for the effort to develop the product or service in the contract. This can be problematic if the time scheduled for production is greatly underestimated. This type of contract is used when the scope of the project work is ambiguous.

In choosing the right type of contract, the nature of the outsourced project activity influences the decision. The requirements that a buyer imposes on a seller, along with other planning considerations such as the level of market competition and degree of risk, also determine which type of contract is used. The following items are frequently considered when selecting the right type of contract:

- Overall degree of cost and schedule risk
- Clarity about the scope of work
- Type and complexity of requirements
- Extent of price competition
- Cost and price analysis
- Urgency of the requirements
- Performance period
- Contractor's responsibility
- Contractor's accounting system
- Extent of subcontracting
- Contractor's financial track record

One of the important factors to consider is the degree of risk for the seller and the buyer that each type of contract presents. Each of the contract types has risk attached to it. When considering different contracts, it must be clear who assumes the most risk—the

buyer or the seller. Under normal conditions, the greatest risk to the buyer is when the cost-plus-fixed-fee contract is chosen. The contract with the greatest risk to the seller is the firm-fixed-price contract. Generally, the buyer and seller negotiate details of the contract risks and benefits that both parties can accept.

One risk management technique that is rapidly becoming popular for insuring large projects is the use of wrap-ups. A wrap-up, or owner-controlled insurance program (OCIP), is a single insurance policy providing coverage for all project participants, including the owner and all contractors and subcontractors. An OCIP can potentially reduce an owner's total project cost by 1 to 2 percent compared to traditional fragmented programs. Its major advantages include broader coverage, volume discounts, and reduced claims due to comprehensive loss-control programs. The type and complexity of the agreements may also necessitate assistance from legal specialists, buyers, and contracting experts.

13.5 Control Project Procurements

Control procurements include managing relationships between sellers and customers, monitoring contract performance, and making changes and corrections if needed. Both buyers and sellers administer contracts to make sure that the obligations set forth in the contract are met and to make sure neither party has any legal liability. Both must perform according to the contract terms. The seller creates performance reports, and the buyer reviews these reports to ensure that the performance of the seller satisfies the obligations of the contract.

13.6 Improving Project Procurement

Project procurement can be improved by resolving procurement conflict, adopting lean procurement methods, and by improving communication among all of the parties involved.

13.6a Conflict During Project Procurement

Project procurements can be improved by identifying the source of conflicts and then by resolving those conflicts.

Sources of Conflict During Project Procurement In the procurement and purchasing environment, conflicts are inevitable. For example, many people envision the purchasing process as a type of zero-sum game, meaning what one party loses is what the other party gains. (The most common type of conflict is this: lower price means cost reduction for the buyer, but it also means revenue loss to the seller.) In fact, many types of conflicts of interest arise among different organizations. For example, delays in construction are common and expensive, and litigation related to design and construction is rising.

Obvious conflicts of interest predispose owners and contractors to be suspicious of one another's motives and actions. Suspicion and mistrust prevent effective problem solving throughout the process. In taking care of each party's own interests, mistakes and problems are often hidden. When conflicts emerge, they often create costly delays as well as questionable responses simply because the information transferred may be distorted many times before it reaches the decision maker. The consequences, however, are avoidable from the beginning.

Resolving Project Procurement Conflicts One approach to resolving conflict is to use project partnering as an effective way to engage both the project owner and contractors.

Ann Kosolapova/Shutterstock.com

Project partnering naturally developed as people began to realize that the traditional win/lose adversarial relationship between owner and contractor often degenerates into a costly lose/lose situation for all the parties involved. The systematic project acquisition management view goes beyond this traditional view to increase the baseline of trust and collaboration.

13.6b Lean Project Procurement

Lean procurement refers primarily to a manufacturing context and implementation of just-in-time (JIT) tools and techniques to ensure every step in the supply process adds value while various costs are kept at the minimum level. By reducing ordering cost (for placing orders, e.g., the fixed part of the shipping cost), project organizations can use JIT for eliminating waste in ordering and reducing time and cost, which eventually results in timely completion of projects and customer satisfaction. Firms are discovering that when they emphasize lean to an extreme, sometimes they increase the risk of supply chain delays, so judgment is recommended in determining how lean to go.

Doubtlessly, integrating procurement management into project management helps project managers create win/win situations for all parties involved in the project supply chain as they become more efficient and effective. The specific supply chain techniques can help project managers make better trade-offs between project costs and time to create better customer satisfaction.

13.6c Improving Communication in Project Procurement

Information is also key to the success of project procurement because it enables management to make decisions over a broad scope that crosses both functions and firms. For instance, information sharing in many cases can allow the project supply chain to shorten the delivery time and, at the same time, offer better-quality products or services

to meet the dynamic demand of a project. Information must have the following characteristics to be useful when making supply chain decisions:

- Accurate
- Accessible in a timely manner
- Of the right kind

Information is a key ingredient not just at each stage of the project supply chain but also within each phase of supply chain decision making. This is where IT comes into play. IT consists of the hardware, software, and people throughout a project supply chain that gather, analyze, and execute procurement actions based on information. In today's business world, IT-based information management is crucial to the performance of project supply chains simply because it provides the basis of decision making, which has profound impacts for every aspect of project management.

13.7 Project Partnering

Organizations are constantly in need of outsourcing or contracting significant segments of project work to other organizations. The trend for the future suggests that more and more projects will involve working with people from different organizations in a partnering relationship. **Partnering** is "a long-term relationship between an owner and a contractor in which the contractor acts as a part of the owner's organization for certain functions."[9] We consider strategic project partnering, mutual goals shared by project partners, effective practices in project partnering, and securing commitment to project partnerships.

13.7a Strategic Project Partnering

Research finds that through strategic partnering, organizations are more likely to access advanced technology, share risks, and improve project-based performance and relative competitiveness. This section extends the previous discussion of project procurement and contracting by focusing specifically on issues surrounding working with different suppliers to complete a project. The term *partnering* is used to describe this process. Partnering is a method for transforming contractual arrangements into a cohesive, collaborative project team with a single set of goals and established procedures for resolving disputes in a timely and cost-efficient manner. The single set of goals takes care of the customer requirements and the entire project instead of each individual organization. Exhibit 13.7 presents an excellent example of project partnering and collaboration in the international airport industry.

Five key elements for effective project partnerships are shown in Exhibit 13.8.

13.7b Mutual Goals in Project Partnerships

Some common goals warrant a more supportive relationship. For example, both the buyer and seller would like to complete the project on time and safely. Both parties would prefer to avoid costly and time-consuming litigation. On the other hand, once the specified project can be finished on a faster and less-expensive basis, either party is in a better position of getting better operational rewards. Some of the many advantages for establishing a project partnership are shown in Exhibit 13.9.

For example, Procter & Gamble (P&G) started using the web to share information and streamline purchasing a few years ago. Ford used 900 virtual workspaces to design cars and hold meetings. In one project, Ford used digital conference rooms from eRoom to manage

Exhibit 13.7

Jorge Chavez International Airport, Lima, Peru

The location of Lima in the center of the west coast of South America presents an extended area of attraction, making the airport into a natural international hub. The proximity of Jorge Chavez International Airport (JCIA) to Port Callao, the principal port of Peru, offers the possibility of developing a sea/air plan in favor of external commerce.

Lima Airport Partners

Fraport-Bechtel-Cosapi Consortium won the international public tender for building and running the JCIA. With an equity contribution of $30 million, the consortium founded Lima Airport Partners (LAP). The three consortium partners each have impressive track records. Fraport AG operates the Frankfurt Airport, considered one of the largest in continental Europe. Fraport also provides other airport services such as handling and other commercial services. Fraport participates in more than 50 projects around the world. Bechtel is a private construction company founded in 1898. It has participated in more than 1,000 projects in 67 countries, of which 80 have been airport projects. Cosapi is a local construction company founded in 1960 with projects in South America. Currently, LAP's shareholders are Fraport AG, the International Finance Corporation (IFC), and the Fund for Investment in Infrastructure, Utilities, and Natural Resources, managed by AC Capitales SAFI S.A.

LAP's objectives are to improve both facilities and operation of JCIA. The improved facilities will be transferred to the State of Peru after 30 years.

Source: Patricia Quiroz, Professor of Pontificia Universidad Catolica del Peru.

Exhibit 13.8

Five Key Elements of Successful Partnerships

Open Communication	Each party keeps other informed
Accessibility	Access to the right team members when needed
Flexibility	Discuss what can go wrong and be willing to change
Mutual Benefit	Each party helps the other succeed
Measurable Results	Always measure the value to each partner

Source: Five Qualities of Successful Partnerships, https://www.cvent.com/en/blog/events/5-qualities-successful-partnership. accessed November 23, 2021.

Exhibit 13.9

Advantages of Project Partnerships

When two organizations partner for their projects, both parties often find they gain these advantages:

- Creative, fast, and practical development and implementation
- Easier approvals due to shared interests
- Better time and cost estimates as partner understands you
- Problems get solved and features deployed faster
- Early risk identification as both parties share perspectives
- Multidisciplinary, highly motivated and talented team
- Transparent, proactive, and appreciative communication
- Increased openness to question and challenge
- More dependable stream of work

Adapted from https://hpi.de/en/school-of-design-thinking/project-partners/benefits.html Benefits of a project partnership, accessed October 26, 2021; and https://info.iointegration.com/blog/8-upsides-to-long-term-relationship-with-partner-in-creative-operations

the formation of the auto industry e-marketplace Covisint. Lawyers from law firms and three automakers shared virtual rooms to haggle over contracts.

13.7c Effective Project Partnering Approaches

Many differences exist between the way traditional project procurement unfolds and the way contemporary project procurement takes place in a partnering mode. Exhibit 13.10 lists some of the requirements of effective project partnering.

Many large Japanese manufacturers have found a middle ground between purchasing from a few suppliers and vertical integration. These manufacturers are often financial supporters of suppliers through ownership or loans. The supplier then becomes part of a company coalition known as a *keiretsu*. Members of the *keiretsu* are assured long-term relationships and are therefore expected to function as partners, providing technical expertise and stable quality production to the manufacturer. Members of the *keiretsu* can also have suppliers farther down the chain, making second- and even third-tier suppliers part of the coalition. Most partners value their membership and work hard to do their part. In the rare instance in which a partner consistently takes advantage of the situation, the partner is eventually dropped.

Organizations can use different purchasing modes for purchasing specific items when dealing with large projects. For example, one major Chinese petroleum company used five purchasing models for multiple projects, which include purchasing mechanisms for strategic materials, full competitive products, limited resource products, nonstandard products, and existing long-term collaboration suppliers. Third-party inspection companies were hired to conduct on-site assessment and quality approval for the incoming materials of multiple projects at the same time. The integrated on-site warehousing management system streamlined the management process, reduced unnecessary inventory to almost zero, and minimized the total investment of the projects.

Exhibit 13.10

Effective Project Partnering Approaches

Organization-wide willingness to:

- Use long-term perspective
- Share power with partner
- Trust partner
- Adapt to partner
- Go beyond contractual obligations

Mutual commitment to:

- Quality
- Continuous improvement
- Clearly understand partner
- Ongoing relationship with partner

Effective methods:

- Openly share information
- Develop contractual relationships
- Develop interpersonal relationships
- Resolve conflict

13.7d Securing Commitment to Partnering

When developing a project supply chain partnership, a project manager may want to consider contractors with a mutual interest and expertise in partnerships. At the beginning, the owner needs to get the commitment of the top management of all firms involved. All the benefits of the partnership and how the partnership would work must be described in detail. Team building is an effective approach for involving all the key players from different firms. Separate training sessions and workshops are offered to promote a collaborative spirit. One of the major goals of the team-building sessions is to establish a "we" as opposed to an "us and them" attitude among the different participants. A second goal of the sessions is to establish a mechanism in advance designed to ensure that this collaborative spirit will withstand the problems and setbacks that will invariably occur on the project. Some of the most significant mechanisms are as follows:

- Problem resolution—Solving problems at the lowest level of organizations and having an agreed-upon escalation procedure
- Continuous improvement—Endless process of waste elimination and cost reduction
- Joint assessment—Reviewing the partnering process jointly
- Persistent leadership—Displaying a collaborative response consistently

More project organizations are pursuing partnering relationships with each other. Project partnering represents a proactive way for managing many challenges associated with working with different organizations. The process usually starts with some agreed-upon procedures and provisions to deal with potential problems and issues before they become real. One way is to design a contract with specific incentives and penalties. On the other hand, partnering is not just about relationship contracting.

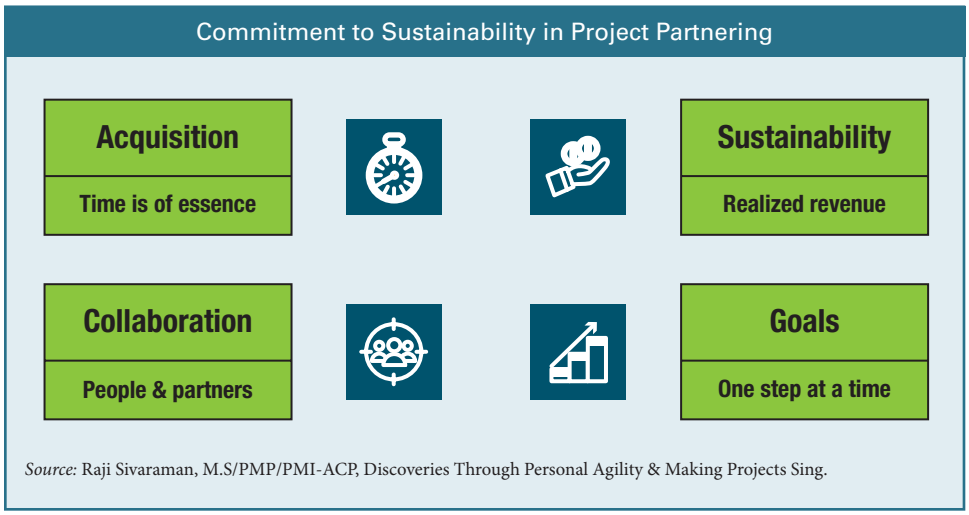
For example, although many companies may wish to develop company-wide policies and procedures for inter-firm conflict resolution, this method is less effective since each project and each company is different. The partnering approach has to be dynamic to unite a wide variety of suppliers and contractors for some common goals that everyone cares about. Although the project purchasing relationship has been moved from short-term arrangements based on contracts to long-term relationships based on trust, this change is by no means universally applicable.

Partnering fosters a strong desire to contain costs when changes are necessary and leads to a team approach in resolving any financial and time consequences. In the next section, we discuss the integrated project procurement management approach.

Partnering seeks to recast relations between actors in projects by promoting the use of collaborative, more open relationships. The integrated procurement perspective further shifts traditional channel arrangements from loosely linked groups of independent businesses, that buy and sell products or services to each other, toward a managerially coordinated initiative to increase collaboration, customer satisfaction, overall efficiency, continuous improvement, and competitiveness. For example, in the construction industry, the construction procurement management consists of all the construction partners such as client, designer, general contractor, subcontractor, supplier, and consultant. In fact, the procurement management itself represents a concept of systematic coordination of relevant business activities within the supply chain and beyond.

Effective, sustainable project partnerships require a structured charter to convert sustainable goals into workable management goals. Moreover, partnerships by nature, are shaped by various changing environments, and the stakeholders may alter or may have to adjust their views during the lifespan of the partnerships. Thus, sustainability commitment is essential, requiring a thorough governance of governance, in other words, *meta governance*. In short, sustainability thrives when collaboration includes problem solving with divergent and critical thinking and sometimes spontaneity. This commitment is shown in Exhibit 13.11.

Exhibit 13.11



Source: Raji Sivaraman, M.S/PMP/PMI-ACP, Discoveries Through Personal Agility & Making Projects Sing.

13.8 *PMBOK Guide 7e*

- Stakeholders
- Planning
- Work
- Measurement

13.8a Stakeholders

Stakeholders can be upstream as suppliers and downstream as customers. Project teams should strive to partner and collaborate with both. This involves managing expectations, resolving issues, and negotiating.

13.8b Planning

Project teams conduct procurement planning early in the project life to set expectations and to conduct make-or-buy analysis. This decision will depend on many factors such as availability of internal resources, expertise, and risks associated with the work. Sometimes time constraints and the urgency of completing the project deliverable will also influence the make-or-buy decision.

13.8c Work

Project teams develop bid documents such as statements of work (SOW), terms and conditions, requests for information, requests for proposal, and requests for quote. The project team conducts bidder conferences with prospective suppliers prior to bid preparation to address concerns and to provide clarifications. Teams will select a vendor based on some combination of price, experience, delivery time, and quality. Depending on the situation, negotiations may happen before closing the bidding process.

13.8d Measurement

Project teams need to be assured that their suppliers are on track with their project performance. They will use deliverable metrics that show the results being delivered. Once the contract work is complete, it should be closed administratively.

13.9 Procurement and Partnering on Agile Projects

As in some other chapters, some procurement and partnering practices are similar in Agile and predictive projects, but some are different. Exhibit 13.12 shows some of these similarities and differences.

Exhibit 13.12

Comparison of Plan-Driven and Agile Approaches for Project Procurement and Partnering

Project Procurement and Partnering Questions	Plan-Driven	Agile
How are make or buy decisions made?	Reasons for both make or buy are considered	Reasons for both make or buy are considered
How are suppliers treated?	Fairly as vendors	Fairly as partners
How are clients treated?	Fairly as customers	Fairly as partners
What factors are used in selecting suppliers?	Technical, managerial, financial, experiential	Primarily alignment with project vision, but also technical, managerial, financial, and experiential
What is emphasized in procurement agreements?	Cost, schedule, scope, and contract incentives	Value chain, transparency, flexibility, and collaboration
What types of contracts are typically used?	Fixed price (FFP, FPIF, and FPEPA), Cost plus (CPIF, CPAF, CPFF), and time and material	Change for free, fixed price increment, graduated fixed price, and money for nothing

13.9a Agile Terms

Value chain	All activities performed by project team or partners that help produce solution
Change for free	Agreement allowing customer to substitute future work packages
Fixed-price increments	Agreement to pay set amount for current increment of work
Graduated fixed price	Agreement by which a contractor makes more if completed early
Money for nothing	Agreement to pay contractor portion if future work is terminated

In this book, we use many Agile terms and definitions from Anantatmula, V., and T. Kloppenborg, *Be Agile Do Agile* (New York, NY: Business Expert Press, 2021).[10]

Leaders of all projects regardless of type need to decide what products and services they will make themselves or purchase. Once those decisions are made, Agile projects emphasize some things differently than predictive projects do. For instance, Agile projects place a strong emphasis on creating win-win relationships with suppliers and customers up and down their value chain. Thus, the tendency is to drive a deal that sustains partnering rather than the most favorable deal if that were to be detrimental to one of the partner organizations.

Responsible leaders on any project consider technical, managerial, financial, and experiential factors when selecing suppliers. Leaders on Agile projects consider one other factor to be at least as important as any of those: namely alignment with the project vision. Does the potential supplier clearly understand and enthusiastically support the vision of solving the ultimate customer's issues or are they just interested in getting the job?

The emphasis on structuring contracts is quite different for Agile projects. Contracts for predictive projects emphasize cost, schedule, scope, and contractual incentives. Agile contracts emphasize the value chain, transparency, flexibility, and collaboration. Any of the classic variations of fixed price and cost-sharing contracts can be used. However, several other types of contracts, or at least clauses added to a more standard contract are often used, as shown in Exhibit 13.13.

These contracts promote flexibility so that if the buyer decides it is in their best interest to do different work or cancel the project entirely, neither party suffers. The project team performing the work knows that if the project is cancelled, they will receive a previously determined amount of funds which will keep them paid while they transition to different work.

Exhibit 13.13

Types of Agile Project Contracts

Contract Type	Brief Description
Change for Free	If the Product Owner (PO) attends every meeting when requested, then the PO can pivot at the end of an increment and ask the team to do different work
Money for Nothing	If the PO attends every meeting when requested, the PO can decide at the end of an increment to cancel remaining work and project team gets previously agreed percentage of what they would have otherwise earned
Graduated Fixed Price	If team completes work sooner than expected, they get a higher hourly rate for their work, but if they are slower, they get a lower hourly rate
Fixed Price Work Packages	Contract work is priced in chunks and the buyer chooses which chunks to buy and only pays for them

Summary

More and more organizations are seeking cooperative relationships with each other to compete in today's demanding marketplace. Project procurement management represents a set of proactive responses to many challenges created by people from different organizations working together on projects. By identifying the project needs and wants, project organizations start with assessing the need to outsource part of the project work. Contracting is commonly used to specify and manage supplier–buyer relationships. Purchasing details such as scope, deliverables, and quality expectations are legally enforced in the contract. As such, project teams take great care in defining and selecting a specific and attainable contract to meet customer delivery expectations and internal profitability goals. However, project procurement management is not just about contracting. Partnering and coordinating purchasing across all supplier stages allow a firm to maximize economies of scale in purchasing and also to reduce transaction costs. Agile projects often include unique contract clauses to fairly incentivize the seller to support the client's need for flexibility. Partnerships are often deeper and emphasized more strongly on Agile projects.

Key Terms Consistent with PMI Standards and Guides

owner, 478
general contractor, 478
subcontractor, 478
make-or-buy decisions, 478
plan procurement management, 479
procurement management plan, 480
procurement statement of work, 480
procurement documents, 482
request for information (RFI), 482
request for quotation (RFQ), 482
request for proposal (RFP), 482
conduct procurements, 482
contract, 486
fixed-price contract, 487
firm-fixed-price contract, 488
fixed-price-incentive-fee contract, 488
fixed-price-economic-price-adjustment contract, 488
cost-reimbursable contract, 488
cost-plus-fixed-fee contract, 488
cost-plus-award-fee contract, 488
cost-plus-incentive-fee contract, 489
time and material contracts, 489
control procurements, 490
partnering, 492

Key Terms Consistent with Agile Practice

Value chain, 497
Change for free, 497
Fixed-price increments, 497
Graduated fixed price, 497
Money for nothing, 497

Chapter Review Questions

1. Do small businesses often outsource project work? Why or why not?
2. Name the three processes that make up project procurement management.
3. In supply chain management, what are some other names for the seller? What are some other names for the buyer?
4. List three functional areas that are frequently outsourced by business organizations.
5. What is the difference between a request for quotation (RFQ) and a request for proposal (RFP)?
6. After an organization has developed a list of potential suppliers, how should the organization evaluate each supplier individually?
7. What are four potential information sources that organizations can use to identify potential sellers?
8. Describe two methods that can be used to evaluate potential suppliers.

9. What items are generally included in a request for proposal?
10. In a fixed-price contract, who assumes the greatest level of risk?
11. What type of contract(s) is good to use if it is necessary for both parties to share the risk?
12. In what type of contract does the buyer assume the greatest level of risk?
13. What is the name of a single insurance policy that is used to provide coverage for all project participants?
14. What is meant by *lean procurement* and how does it relate to project management?
15. _____ is a method for transforming contractual arrangements into a cohesive, collaborative project team with a single set of goals and established procedures for resolving disputes.
16. What do the contract terms *Change for Free* and *Money for Nothing* mean?

Discussion Questions

1. What does the project team need prior to planning procurements?
2. List three reasons an organization might choose to make a product or service in-house and three reasons why an organization might choose to buy or outsource the work.
3. Should activities on the critical path be outsourced? Why or why not?
4. Which of the three competitive advantages do you think companies are most willing to outsource for? List any examples you can think of.
5. Your company is hoping to outsource some of its work constructing a new development of condominiums. What would you use as selection criteria to narrow down your list of potential sellers?
6. You decide to board your dog at the vet's office while you are on vacation and sign papers saying you will pay $25 per day plus $15 for a bath every third day. What type of contract have you entered into?
7. What is the difference between Graduated Fixed Price and Fixed Price Work Package contracts? Give an example of when you might use each on an Agile project.
8. Describe three differences between a partnering relationship and a traditional seller–buyer arrangement.
9. What are some potential issues related to outsourcing? How could you mitigate these issues?
10. You are the project manager in charge of renovating a large apartment building, and your team has decided to outsource the installation of a new septic system. Do you put out an RFQ or RFP to interested contractors? Why?
11. How would you determine if a potential partnership aligns with your project vision?

PMP Exam Study Questions

1. The Project Procurement Knowledge Area includes all of the following processes *except*:
   a. plan procurement management
   b. conduct procurements
   c. close procurements
   d. control procurements
2. In making a decision about whether or not to outsource part of a project, one must evaluate the effect it would have on _____.
   a. time
   b. cost
   c. performance control
   d. all of the above
3. One output of the Plan Procurement Management process is the _____, a document that describes the item to be procured "in sufficient detail to allow prospective sellers to determine if they are capable of providing the products, services, or results."
   a. request for proposal
   b. procurement statement of work
   c. scope statement
   d. procurement management plan
4. Which of the following contracts is riskiest for a buyer?
   a. time and material
   b. cost reimbursable
   c. firm-fixed-price
   d. fixed-price-economic-price-adjustment

5. A _____ analysis is a technique that results in a decision about whether particular work can best be accomplished by the project team or should be purchased from external sources.
   a. make-or-buy
   b. SWOT
   c. sensitivity
   d. vendor
6. Which contract type puts the most risk on the seller?
   a. time and material
   b. cost reimbursable
   c. firm-fixed-price
   d. fixed-price-economic-price-adjustment
7. Which of the following contracts is NOT commonly used with Agile projects?
   a. time and material
   b. money for nothing
   c. graduated fixed price
   d. change for free
8. The type of procurement document that might be used to request prices for standard products or services is called a(n) _____.
   a. request for proposal (RFP)
   b. request for information (RFI)
   c. invitation for negotiation (IFN)
   d. request for quotation (RFQ)
9. During which of the following processes is evaluation criteria developed, in order to evaluate potential sellers?
   a. plan procurement
   b. conduct procurement
   c. control procurement
   d. plan communication management
10. Procurement performance reviews, contract change control system, payment systems, and performance reporting are all tools and techniques for which procurement process?
    a. plan procurement management
    b. conduct procurements
    c. close project
    d. control procurements

Exercises

Find a story in your local newspaper about a project that is about to start. For that project, answer each of the following questions and justify your answers:

1. Using the ideas in Exhibit 13.2, speculate on what activities, supplies, or services could be contracted out.
2. Create a request for information for one portion of the project work that could be contracted out.
3. Using ideas from Exhibits 13.4 and 13.5, determine criteria you would use to select sellers for the portion of contract work under consideration.
4. Determine what type of contract you would use for this work and explain why.
5. Describe the extent to which any partnering makes sense for this project. What are the challenges and benefits to this partnering? What would prevent any further partnering?

Integrated Example Projects

Suburban Homes Construction Project

A well-known aspect of the construction industry is that it is a fragmented industry with a large share of working people engaged with it. Due to its nature of operations and fluctuations in demand, the construction industry thrives on hiring contractors and subcontractors on an as-needed basis. Likewise, one can find multiple sources of suppliers nationwide for all the hardware items such as windows, doors, drywall, doorknobs, and HVAC equipment. Suburban Homes, as an organization, realizes the importance of long-term partnership with various suppliers and contractors and the many benefits of such a partnership. Suburban Homes is planning to revisit their existing partnerships with various suppliers and contractors because competition is rising and profit margins are declining. Suburban Homes is looking

for partners and suppliers to improve profits and increase customer satisfaction. Suburban Homes developed a set of criteria to select partners for construction work and supply of materials:

- Collaboration
- Reliability
- Value engineering (higher quality at a competitive price)
- Performance
- Trust
- Transparency in commercial deals and communication

With its ambitious plan of expanding its business to several southern states and its vision to deliver high-quality construction that adheres to local, state, and federal standards as well as exceed industrial standards for quality, Suburban Homes is willing to identify, negotiate, and partner with competent and reliable suppliers and contractors. Adam Smith entrusted you with the task to develop a procurement and supply chain management plan. For this purpose, you were asked to do the following tasks:

Tasks to Complete

- Assess the current market situation.
- Identify prospective partners for supply of materials and construction work.
- Select an appropriate type of contract for each supplier (it may not be same for each).
- Assess risks associated with each contract.
- Develop contract terms and conditions.
- Perform qualitative assessment to prioritize risks.
- Develop a procurement policy.

Heritage Arboretum Development Project

The Heritage Center has two primary project procurement and partnering questions to answer:

1. What products and services should this project make and what should they buy? Why?
2. What types of organizations should this project collaborate with? Why?

Semester Project Instructions

Using the ideas in Exhibit 13.2, determine what activities, supplies, or services needed on your example project could be contracted out. Create a request for information for one portion of the project work that could be contracted out. Using ideas from Exhibits 13.4 and 13.5, determine criteria you would use to select sellers for the portion of contract work under consideration. Determine what type of contract you would use for this work and tell why. Describe the extent to which you are partnering on your example project. Describe the extent to which any other person or group may be partnering on the project. What are the challenges and benefits to any partnering that is occurring? What is preventing any further partnering?

Project Management *in Action*

Partnering & Collaboration

Minibus taxis are the most popular mode of transport in urban areas for the majority of South Africa's population, and the South African taxi industry plays an important role in the economy. Taxis account for 65 percent of the total public transport in the country, amounting to approximately 15 million commuter trips per day. Despite their importance to the economy, the taxi industry does not receive any government subsidies and only benefits from 1 percent of the money allocated by the government to public transport.

This story takes place in the Western Cape, one of South Africa's provinces.

On March 27, 2020, South Africa was placed into a COVID-19 lockdown. The lockdown placed heavy restrictions on public transport, including severely

limiting operating hours and passenger-carrying capabilities. While this did not affect government-subsidized public transport services so severely in terms of their ability to stay afloat financially, it placed an unprecedented financial burden on the taxi industry, which is fully dependent on passenger fare income to stay afloat. The South African National Taxi Council (SANTACO), the governing body of minibus taxis in the country and the province, faced a challenge in that the vast majority of its members had their income slashed out of no fault of their own.

At the same time, health workers performing critical life-saving work at hospitals, and relying on public transport to get home after their shift in the evening, were left stranded due to the curfew hours limiting public transport from operating at night. The Western Cape Dept of Health (DoH) faced a transport crisis for their staff, and the Department of Transport and Public Works (DTPW) was approached to assist. SANTACO, with its well-established networks and experienced fleet of drivers and operators, was well placed to fill this transport need. This was the start of the Red Dot Taxi project.

Negotiations between government and the taxi industry usually take several years. Because of the urgency of the COVID-19 situation, there was time pressure to roll out the program as soon as possible. Luckily, in this situation both parties were highly motivated by the benefits the system would bring to them. It was a classic win-win situation. While there were challenges and the process had its moments of heatedness, the negotiations were completed in record time and the system went live in little over two months since its inception.

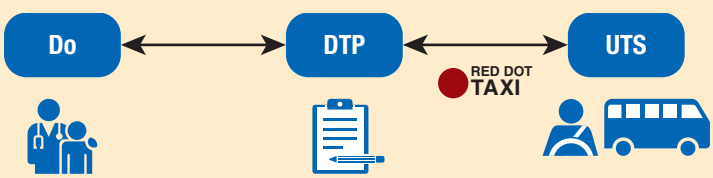
The partnership between DTPW and SANTACO was unique, as was the formal relationship formed between the entities. While DTPW is a government entity with clear contracting and procurement requirements as would be expected, SANTACO and the taxi industry brought unique characteristics that would need to inform the relationship. Some unique factors were:

- The taxi industry settles the vast majority of its payment obligations and receipts on a cash basis and not via formal agreements, both in day-to-day operations as well as at the leadership level.
- The taxi industry is an informal industry, and SANTACO itself works more like a cooperative. There was initially no formal legal entity that could be contracted with. SANTACO had to formalize into a registered company with shareholders and directors. Government assisted with this process, and the company that was formed was called Umanyano Travel Services (UTS). This was an industry first, and a massive step toward formalisation of the industry, which could bring further benefits along the line through participation in future opportunities.

The project was a three-way partnership and collaboration, with DTPW playing the central coordination role. In essence, the elements of the partnership were as follows:

- DoH enters into an agreement with DTPW to supply essential hospital-to-home transport to its staff. Health workers book a spot the night before a ride is required, and they are picked up at the hospital in the evening and dropped off at home.
- DTPW contracts with UTS to deliver the transport service.
- DTPW and UTS see to the day-to-day operations of the program together. Administrative aspects of dispatch are done by the DTPW team, and UTS is responsible for managing their drivers, including salary payments. However, because UTS is so familiar with the operations in the areas the vehicles would drive to, they often assisted with planning in this regard.
- All vehicles were housed at a central staging facility for the duration of the contract, and participants were not allowed to use the vehicles for public transport passenger services.
- DTPW would be responsible for sanitizing of vehicles and their safekeeping at the staging facility.

The partnership synergistically brought together the best aspects of both parties into the process. It was a massive learning curve for all parties involved, but



the learnings were able to be applied in future projects and working together by the same entities. Some of the most powerful learnings were:

- **Breaking down silos**: The service has helped cultivate a partnership and good working relationship between the DoH and DTPW, a key to the success of the service. Two government departments worked extremely closely together, breaking down siloed barriers.
- **Collaboration is key**: Government needs to walk hand in hand with the industry, providing ongoing support, to effectively build capacity to deliver a professional service. The industry is very well organized with clear governance structures in place. These are helpful for getting things done quickly through strong networks. The collaborative working together of UTS and DTPW strengthened the service.
- **Leveraging strengths helps build a strong relationship**: DTPW's planning and operational experience combined with UTS knowledge of routes assisted the operation's smooth running, especially in instances where passengers lived in informal settlements not shown on maps or with planning efficient routes.

Red Dot really laid the foundation for government to work effectively with the taxi industry. The service has already provided a range of other COVID-related transport services, including transport to quarantine and isolation facilities and to vaccination sites. In fact, it worked so well that a minibus taxi incentive pilot is currently being undertaken called Blue Dot. Blue Dot is also a partnership between UTS and DTPW, and aims to reward improved driving behavior and service quality, and discourages illegal operations and conflict. This will go a long way in making minibus taxis a public transport mode of choice for commuters in the province.

Source: Rogeema Kenny, PMP, Engagement Manager, Pegasys and Deidre Ribbonaar, Chief Director – Transport Operations, Western Cape DTPW.

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Chapter 14

Determining Project Progress and Results

Chapter Objectives

Core Objectives:

14-1 Develop and demonstrate use of a change control system.
14-2 Demonstrate how to monitor and control project risks with various resolution strategies.
14-3 Create and present a project progress report.
14-4 Describe the importance of formal project progress reporting and communications.
14-5 Demonstrate negotiating skills.
14-6 Manage conflicts throughout the project execution.
14-7 Describe project quality control tools, including how and when to use each.
14-8 Calculate current project schedule and budget progress, and predict future progress, using Earned Value Analysis.
14-9 Document project progress using MS Project.

Agile Objectives:

14-10 Create an Agile iteration plan.
14-11 Conduct Agile stand-up meetings and document meeting minutes.
14-12 Demonstrate use of Kanban boards.
14-13 Capture and share lessons learned (retrospectives).

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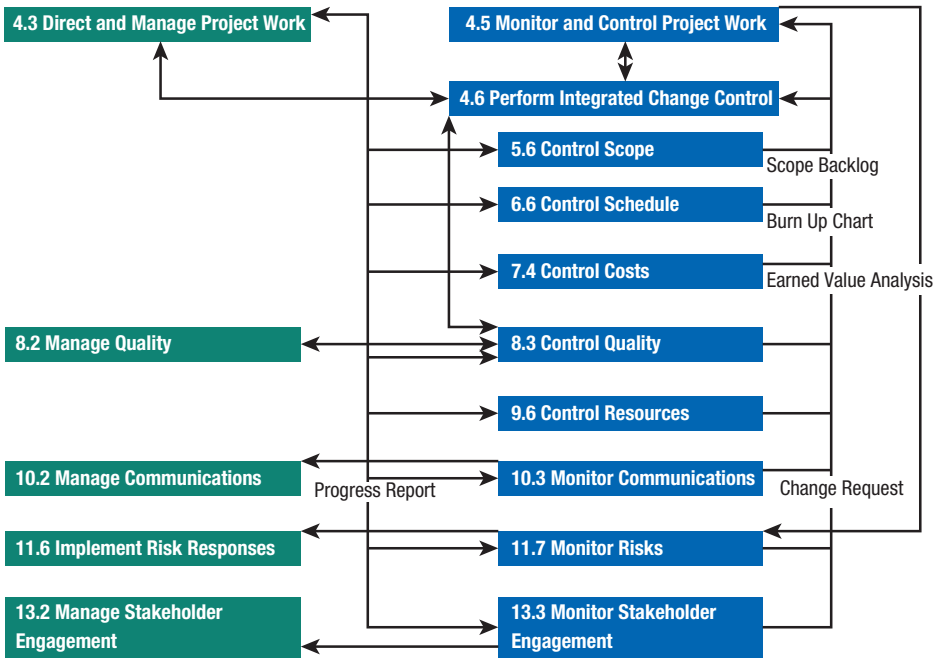
The fundamental reason for determining project progress and results comes down to one thing: *presenting actionable, decision-making information to project leaders to ensure that the project is on course to meet its objectives.*

A major U.S. electric utility company is continuously faced with the daunting task of managing over 1,200 simultaneous projects in all phases of planning, execution, and completion over a geographic area consisting of 5 states. These projects are supported by over 40 departments within the utility company and hundreds of external contractors and equipment suppliers. Over 85 percent of these projects take place over multiple years. There are over 15,000 activities tracked for active projects every month. Today, many of these projects are related to Smart-Grid efforts to fundamentally change the way the electric utility system delivers power to homes, schools, and businesses.

This utility regularly sets the standard for its industry each year by completing over 90 percent of its projects on time and utilizing its annual project budget within just a few percentage points. How is this accomplished?

PMBOK Guide 6e Coverage



Note: Refer to Appendix A to view the entire *PMBOK 6e* flowchart.

PMBOK Guide 7e

Domains:

- **Stakeholders**
- **Team**
- **Development approach**
- **Planning**
- **Delivery**
- **Measurement**

By identifying and collecting just the right amount of financial, scheduling, resource, and risk management data, and by focusing intently on turning raw data into actionable information for the groups leading and supporting the projects, the utility's project controls staff can continuously find and highlight the information that requires leadership attention and project team action.

As projects are managed, the focus on individual projects decreases and management of the entire group of projects as a portfolio increases and becomes paramount. The actionable information presented highlights significant issues for individual projects, but more important, forecasts trends over the entire portfolio and extended spans of time, helping turn earned-value statistics and analysis into meaningful strategies.

Presenting valuable decision-making data to the multiple resource and leadership groups required to support a project provides the critical linkage between the feedback of raw data and the ability to successfully control a single project or an entire multiyear portfolio. Project data collection and management present the opportunity to simultaneously manage an organization's "profit, people, and planet" objectives in an optimal way.

As you move forward with this chapter and your own projects, consider the use and impact of the project information that needs to be collected and disbursed. What are the key factors for your project—financial, environmental, resource management, scheduling, risk identification, stakeholder management, or others? Who needs the project progress data, and exactly what do they need to know to make good decisions and successfully achieve organizational objectives?

Identifying, collecting, managing, and presenting data that allow you to control critical aspects of your projects are fundamental elements of project success.

—Paul Kling, Director—project management and controls, Power Delivery Engineering, Duke Energy

The word *determine* in the context of "determine project progress and results" has multiple meanings. While each offers a slightly different perspective, collectively, they help a project manager understand what they need to do to ensure that their project is progressing adequately and will yield the intended results in the end. *Determine* can be interpreted as:

1. Giving direction to or deciding the course of
2. Influencing action
3. Limiting in scope
4. Reaching a decision
5. Concluding

Ultimately, *determining* is integral to making decisions. Project managers, in the course of planning, give strategic and actionable direction to a project.

Many projects also require replanning or revising the project plan due to any number of causes. Project managers sometimes can influence only how work is accomplished (when people do not report to them), but other times they may be able to regulate or demand the project work be accomplished at a certain time or in a specific manner. To be successful in influencing and regulating project work, the project manager needs to consider the stakeholder priorities and communications needs, as discovered in Chapter 6, and use those to design the monitoring and control mechanisms described in this chapter. Many stakeholders on projects attempt to persuade the project manager and team to deliver more scope, but one important role of the project manager is to jealously guard the agreed-upon scope. Throughout a project, decisions will be made. In such instances, the project manager can do one of the following:

- Personally make these decisions
- Be part of a group that makes decisions
- Delegate decisions to others
- Facilitate the process by which each decision is made

Often, project managers follow up to ensure that decisions are made and then carried out. Finally, the project manager is responsible for making sure that the project is completed satisfactorily.

14.1 Project Balanced Scorecard Approach

To successfully accomplish all five aspects of project determination (direct, regulate, limit, decide, and conclude) in managing project progress, a project manager can think in terms of a balanced scorecard approach. The concept behind a balanced scorecard is that an organization needs to be evaluated from the perspectives of customer, internal business, financial, and growth and innovation. If one considers a project as a temporary organization, the same perspectives make sense when monitoring and controlling a project. Exhibit 14.1 shows a project balanced scorecard approach to project determination.

When a project manager seeks to monitor and control a project, they must consider different critical aspects that are often interrelated and, thus, impact each other. For example, a proposed change in project plan or execution approach may impact the scope, quality,

Exhibit 14.1

Balanced Scorecard Approach to Project Determination

Internal Project	Customer	Financial
Direct and manage project work	Manage quality	Control resources
Monitor and control project work	Control quality	Control schedule
Perform integrated change control	Control scope	Control costs
Implement risk responses		
Monitor risks		
Manage communication		
Monitor communication		

Source: Adapted from Kevin Devine, Timothy J. Kloppenborg, and Priscilla O'Clock, "Project Measurement and Success: A Balanced Scorecard Approach," *Journal of Healthcare Finance* 36 (4) (2010): 38–50.

schedule, and/or cost. However, to understand project control, one must consider each aspect individually before assessing the impact on all other factors. This chapter begins with the project manager controlling internal project issues. The next major section of this chapter deals with the customer-related issues of quality and scope. The final sections deal with the financial issues of resources, schedule, and cost. The project manager can use a number of tools to manage schedule overloads and conflicts and to reprioritize the work. Earned value and project scheduling software such as MS Project can prove to be useful to manage these issues.

14.2 Internal Project Issues

While all aspects of a project are important and interrelated, when determining progress and results, a logical starting place is with the project work that needs to be accomplished. Closely related are the risks and conflicts that may impede the work and adequate communication. Collectively, these form the project's internal issues. These issues can be envisioned as the project's nerve center. Problems in any of them travel to all other project areas just as nerves carry information throughout a body. When dealing with this project nerve center, project managers direct and manage project work; monitor and control the project work; perform integrated change control; implement risk responses and monitor project risks; resolve conflicts; and manage and monitor communications.

14.2a Direct and Manage Project Work

Directing and managing project work is performing the work as defined in various components of the project management plan, including approved changes, with an intent to accomplish project objectives. When project managers authorize project work, they should empower others to the extent possible, yet control them to the extent necessary. It should be clear who is allowed to authorize each portion of work to commence. The project management plan identifies work to be accomplished, but the project manager or their appointee must tell someone when it is time to perform the work based on the

project schedule baseline. Often, spending limits are intertwined with work authorization (e.g., "*Please perform this activity and do not spend more than $X on it. Report back to me for approval if you need to spend more.*").

The work to be performed can come from one of several sources. The primary source is the work package level of the work breakdown structure. However, approved corrective actions, preventive actions, unexpected constraints, and defect repairs may also trigger work to be authorized.

When directing project work, trade-offs are often present both between projects and work within the project itself. Organizations often manage many projects at the same time and accomplish a variety of other work as well. Some work is of higher priority than other work. A project manager needs to understand where their work fits in the priority list. If their project is relatively low in priority, they may have trouble getting people and resources to perform the project-related activities as per the planned schedule. In a case like that, the project manager and sponsor should have open and transparent communications so the sponsor can either help the project manager secure the resources needed or understand that the project could be delayed.

Projects often are resource-constrained or time-constrained. In resource-constrained projects, the project is limited by budget constraints. In this case, the project schedule gets extended. When a project is time-constrained or its completion date is nonnegotiable, organizations may have to expend more resources to complete the project, and project cost is likely to exceed the planned cost. In both resource- and time-constrained projects, project scope is often not compromised. However, one should remember that the project manager should have some leeway with one of the three constraints. If all three constraints (cost, time, and scope) are fixed, it is unlikely that the project manager and the team will be successful in completing the project within time, on budget, and with the promised scope and acceptable quality.

As the project progresses, are there changing priorities that impact project importance? Remember, any proposed change to the project scope, quality, schedule, or budget needs to be processed through the integrated change control system described later in this chapter.

Projects are undertaken with scope goals and with constraints on cost, schedule, and quality. Exhibit 14.2 gives an example of Tatro, Inc., dealing with project trade-offs.

Well-developed project charters, effective stakeholder management, and clear communications help the project manager make sensible trade-off decisions. Sometimes, an owner representative works closely with the project manager to make these decisions. Skills an owner representative can use when working closely with a project manager to make these trade-off decisions effectively are shown in Exhibit 14.3.

Exhibit 14.2

Project Trade-Off Decisions at Tatro, Inc.

Tatro, Inc., is a company that describes itself as a designer, builder, and caretaker of fine landscaping. It has both commercial and private (homeowner) clients. Landscaping projects for private homes often cost well over $100,000. Homeowners who contract for landscaping projects of this magnitude are people who will not change their mind once they decide they want something special. These clients tend to focus closely on the process of a project. They wish to have polite, skilled workers with no interruptions. The reason they wish to have the project completed is to create a "wow factor." Therefore, they will rarely compromise at all on either scope or quality, but they will often compromise on the necessary cost and schedule.

Source: Chris Tetrault, president, Tatro, Inc. Reprinted with permission.

Exhibit 14.3

Useful Owner Representative Skills in Project Trade-Off Decision Making

Partnership	Building trust Improving relations Collaborating Creating alliances Assuring quality
Management	Planning Managing change Aligning resources
Leadership	Communicating Team building
Technical	Project management Knowledge of criteria

Source: Adapted from Denis R. Petersen, and E. Lile Murphree, Jr., "The Impact of Owner Representatives in a Design-Build Construction Environment," *Project Management Journal* 35 (3) (September 2004): 35–36.

Skills required for the project manager and the team are discussed in Chapter 5, and they play a critical role in project execution, as well as monitoring and controlling activities.

14.2b Monitor and Control Project Work

Monitoring and controlling project work includes a series of activities such as identifying work packages for tracking, reviewing, and documenting the progress to ensure that the project execution is aimed to meet performance objectives as defined in the project plan. The term **monitor** refers to reviewing the progress and capturing project performance data with reference to the project plan; developing performance measures; and communicating performance information. **Control** means assessing actual performance obtained from monitoring a work element and comparing it with planned performance, determining variances, analyzing trends to identify and implement process improvements, evaluating possible alternatives, and finally, recommending appropriate corrective action as needed.

A **variance** is a measurable departure from a planned baseline or expected value. Variance is often measured in quantitative terms, but qualitative measures cannot be ruled out. Variance measurement in monitoring and controlling activities necessitates a project manager to keep an eye on those project activities that can indicate how well the project performance is progressing. This prepares them to act if necessary to get the project back on track. The most difficult part of monitoring and controlling is figuring out what metrics to keep, what to measure, and how to report the results to various decision-makers as necessary.

Monitoring and controlling are not activities that are done only once. Monitoring and controlling activities occur along with project execution. As such, monitoring and controlling are a continuous, overarching part of an entire project's life cycle, from project

initiation through project closing. Since the purpose of monitoring and controlling project work is to take appropriate corrective action, these activities need to be timely. In fact, the reverse of an old adage is in order. Instead of shooting the messenger when there is bad news, reward the messenger if the message is delivered quickly enough to bring the project back into control and at low cost.

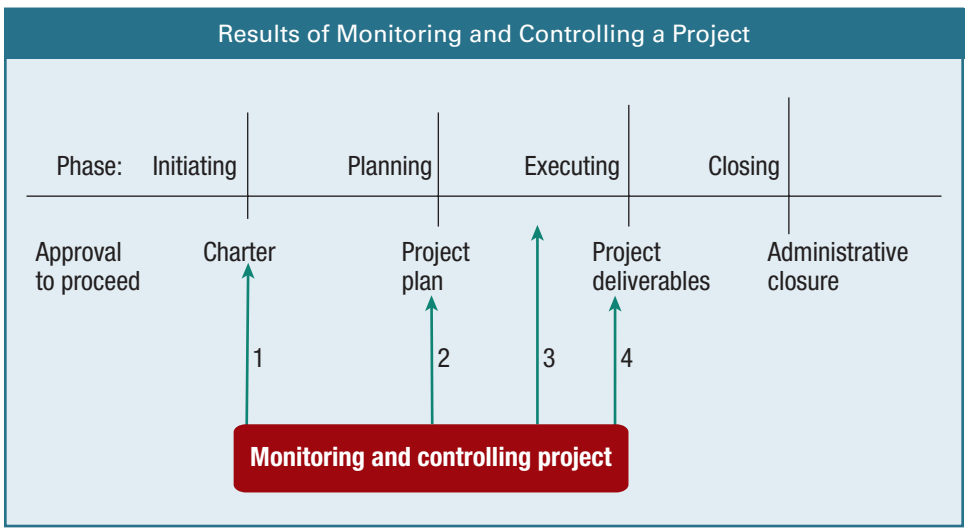
To the extent possible, letting people self-manage their work increases their enthusiasm, motivation, and commitment. In other words, make them responsible and accountable by empowering people and delegating the work. That said, the project manager is ultimately accountable for all of the project results and needs to develop a sense for how much control is necessary, given the work and the person performing it.

Types of Project Control While this section deals with monitoring and controlling project work, the remainder of this chapter deals with monitoring and controlling each of the other project management knowledge areas. Two types of control are used extensively on projects, and both compare actual performance against the project plan. One type is steering control, in which the work is compared to the plan on a continual basis to see if progress is equal to, better than, or worse than the project plan. Adjustments can be made as often as necessary. The second type of control is go/no-go control. Go/no-go control requires a project manager to receive approval to continue. This control is often used at milestones (such as those developed in the project charter) or when someone needs to determine if a key deliverable is acceptable or not. If it is acceptable, the project continues as planned. If not, either the work needs to be redone or the project could even be cancelled. For both types of control, resulting change requests can include corrective actions, preventive actions, or defect repair.

The results of monitoring and controlling project work, schedule, budget, risks, or anything else can range from minor to major, depending on how close the actual progress is to the plan. This can be seen in Exhibit 14.4.

Depending on the extent to which actual progress varies from planned performance, the results of monitoring and controlling activities can suggest anything from modifying

Exhibit 14.4



the charter to transferring project deliverables as planned. Some of the monitoring and controlling decisions are listed below:

1. If the actual progress is very different from the original intent, perhaps the project charter needs to be revisited to ensure that the project still makes sense.
2. If progress is somewhat different from what was planned but the charter is still a good guide, perhaps the project plan needs to be adjusted.
3. If the project plan is still a useful guide and progress has minor differences, perhaps adjustments can be made in day-to-day instructions within the project executing stage.
4. Finally, if the results indicate the customer is ready to accept the project deliverables, perhaps it is time to proceed into the project closing stage.

Perform Integrated Change Control George and John are new project managers fresh out of college. Both are approached by internal customers of their projects (managers of departments where the project deliverables will be used). Their customers tell them what a fantastic job the two of them are doing. The customers then say, "This is great! Could you add these couple of little improvements to it? Then it would be even more valuable to me." George, wanting to please his customer, says, "Yes, we can add that little bit." John's immediate answer is, "Let's see what impact that might have on the schedule, budget, quality, and project team. I will be happy to consider it, but I want to be sure to deliver the project results we promised on time and on budget." George, in his eagerness to please the customer, made a classic mistake. Many great projects have been derailed because someone stroked the ego of a project manager who then agreed to changes without understanding their impact.

Perform integrated change control is reviewing all change proposals, estimating their impact on project goals wherever appropriate, approving or declining changes, and managing changes to deliverables, schedules, budgets, and the project management plan. **Change control** is a process wherein change proposals to various project planning elements are acknowledged, formally documented, and either approved or declined after review. Change control includes considering the impact of any change, deciding whether to agree to the change, and then documenting and managing that change. An observant project manager will ensure that changes that were not approved are not somehow slipped in any way by a stakeholder who does not take no for an answer. Proposed changes are documented in a change request such as the one shown in Exhibit 7.13.

The decision to approve the proposed change needs to be made by the appropriate person or group responsible for it. Generally, if the proposed change requires a modification to the project charter (or contract for an external project), then the sponsor and/or customer would decide. If the change does not rise to that level, often a project manager is empowered to make the decision. Some organizations use a **change control board**, which consists of a formal group authorized and responsible for reviewing, evaluating, approving, delaying, or rejecting any changes to any aspect of the project plan by following a formal communication method of documenting the decision process. The change control board often consists of the project manager, sponsor, project core team, and perhaps other key stakeholders. Since some changes may have a far-reaching impact, it is often wise to include people with diverse experience, knowledge, and skills on the change review board.

Change is a reality on virtually all projects. While we cannot predict or plan what changes will occur, we can plan for how we will deal with those changes. Some projects are easier than others to plan, especially the later phases of the project. If the planning team can plan most details at the outset, change control may be the primary method they use for handling change. On other projects, where it is difficult to plan the later phases or

parts in detail until results from the early parts of the project are known, change control is still used, but it is not enough. What is also used in these cases is the rolling wave planning described in Chapter 9. The early parts of the project are planned in detail, and the later parts are planned with fewer details (rough plan) until additional details become available. Often, a detailed plan for the following section of the project is required before being allowed to proceed. Agile projects are planned in a rolling wave fashion.

14.2c Monitoring Project Risk

During project planning, the project team normally develops a risk management plan that is used to guide risk monitoring and response activities. It is also a normal practice to create a risk register to record each identified risk, its priority, potential causes, and potential responses. The risk management plan and risk register are used to monitor and implement responses to project risks and to resolve them when they occur.

Monitor risks is the process of adhering to the risk response plan of tracking identified risks, identifying new risks, monitoring residual risks, and evaluating the effectiveness of the risk response process throughout the project. On some projects, the majority of risk events that materialize are ones that the project team has previously identified. Efforts needed on these risks largely include tracking the identified risks, executing the response plans, and evaluating their effectiveness. It is wise to consider multiple responses to a given risk. This is true both because some risks cannot be fully handled with just one strategy and because the first strategy may not always be the best strategy.

On other projects, however, many unanticipated risks may emerge. This could be partly due to poor or incomplete risk planning. It could also be partly due to events that were so unlikely that the team did not anticipate and plan for them. In either event, specific contingency plans may not be in place to deal with these risks. Identifying these new risks is vital—and the sooner the better. Two categories of project management methods can help to deal with previously unidentified risks. First, the project team in planning may recognize that unknown risks may surface, and they may add a contingency reserve of time, budget, and/or other resources to cover these unknowns. This is a good practice, and the amount of cost and budget reserves that are included can vary extensively based on the customer's perception of risk and the type of project that is involved. Competitive pressures often dictate a lower limit on reserves than what project managers may prefer.

The second category of project management methods includes a number of good practices that project managers often employ anyway. These practices can be classified according to whether the project team has full, partial, or no control over the events, as shown in Exhibit 14.5. Note especially the second column, which deals with risks partially within a project manager's control. A project manager cannot completely control many situations, but by using good leadership and ethics, the project manager can certainly help create a situation in which others want to help the project.

14.2d Implement Risk Responses

Implement risk responses is the process where when a risk event occurs or is quite likely to occur soon, the person assigned to that risk executes the strategy identified in the risk management plan. Exhibit 11.13 outlines the most typical strategies with examples of each. One core team member, assigned to each risk, should be alert to any trigger condition that suggests the risk event may happen and be prepared to implement the response strategy quickly. Possible outcomes of implementing a risk response include updates to the risk register, approved change orders, and perhaps lessons learned so that both this project and future projects may avoid that same or similar risk event in the future.

Exhibit 14.5

Risk Event Resolution Strategies

Risks Within Project Control	Risks Partially Within Project Control	Risks Outside Project Control
Understand and control WBS	Establish limits to customer expectations	Understand project context and environment
Closely monitor and control activity progress	Build relationships by understanding project from client's perspective	Actively monitor project environment
Closely manage all project changes	Use honesty in managing client expectations	Understand willingness or reluctance of stakeholders to agree to changes
Document all change requests	Work with client to reprioritize cost, schedule, scope, and/or quality	
Increase overtime to stay on schedule	Carefully escalate problems	
Isolate problems and reschedule other activities	Build team commitment and enthusiasm	
Research challenging issues early		

Source: Adapted from Hazel Taylor, "Risk Management and Problem Resolution Strategies for IT Projects: Prescription and Practice," *Project Management Journal* 37 (5) (December 2006): 55–60.

14.2e Manage Communications

Manage communications as defined in Chapter 6 is all the work connected with the project communications plan, starting with planning for it; generating it; organizing and sharing it; and, finally, storing and disposing of it. This includes determining project information needs and establishing an information system as described in Chapter 6. Then, while the project is under way during the execution phase, the project manager and team determine any additional information needs that were not already uncovered, collect information on executed work and work in progress, and then report progress to all stakeholders.

Collect Information on Executed Work and Work in Progress Project managers gather data on the work they have authorized to understand the progress being made. This information is necessary for scheduling additional work, for understanding how the project is doing with respect to the schedule and assigned cost, and for quality purposes. A project manager may try to gather data to answer the following typical questions:

- How well is this particular activity proceeding in terms of time and budget?
- How well is the entire project proceeding in terms of time and budget?
- How much more money will need to be spent to complete the project?
- To what extent does the quality of this work meet requirements?
- How many hours of human resources were used to complete this activity, compared to the estimate?
- What methods are worth repeating for future project activities and projects?
- What methods require improvement before we do that type of work again?
- What evidence or data support the answers to the above questions?

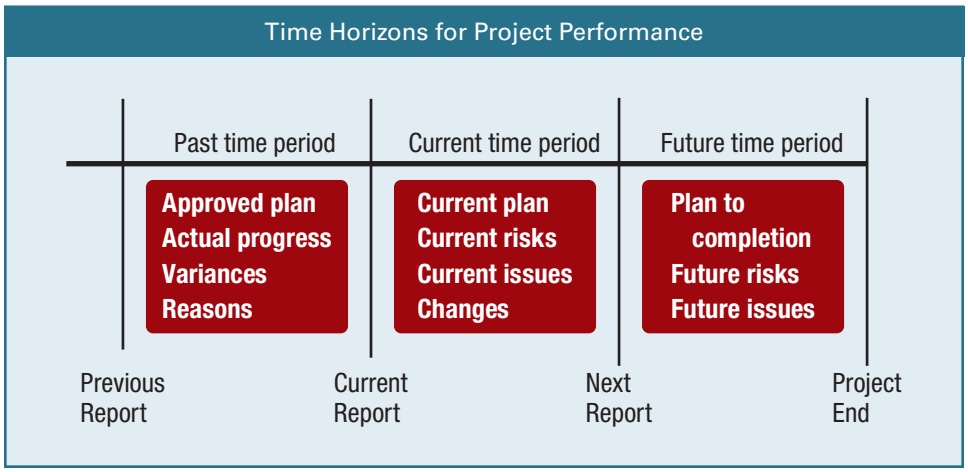
Report Performance Performance reporting includes gathering **work performance data** and using it to create work performance information and reports. Work performance data are the actual and raw observations and measurements during execution of project activities. **Work performance information** is the information from performance data, collected from these processes, analyzed in context, and then integrated, considering relations across areas. **Work performance reports** are the compilation of work performance information in some physical or electronic form that are organized and presented as project documents intended to generate awareness, discussions, decision-making, or other suitable actions.

Performance can be reported either at fixed time intervals or at key project milestones. Detailed progress can be reported informally but frequently within the project team and to functional managers who control resources—perhaps weekly or even daily on a project for which time is critical. More general progress may be reported formally but on a less frequent basis to sponsors, senior management, and clients—perhaps semiweekly or monthly. If regular reports and meetings already exist within the parent organization that can serve for performance reporting vehicles for a project, they can substitute for these reports. On the other hand, if your project needs additional or different meetings and reports, then develop and use them as well.

Progress reporting within the project team and to functional managers who control resources is often done in the form of meetings. The emphasis should be on specifics. Each team member can report progress for each deliverable for which they are responsible: the target date, status, and what other work or information on which progress depends. Once all the deliverables have been reported, the project team can update the risk register and issues log. Recommended changes that are within the project manager's discretion are either approved or rejected and then documented. Recommended changes beyond the project manager's discretion are formally sent to the sponsor or change control board for consideration. Approved changes become part of the project plan with activities, responsibilities, and timing assigned. Consequently, the project baseline will be updated. Finally, progress reporting meetings are a great time to capture lessons learned.

Dod Photo/AGE Fotostock

Exhibit 14.6



Performance reporting to sponsors, management, and clients can be in the form of either meetings or reports. Think in terms of three time horizons, as shown in Exhibit 14.6. It is often helpful to establish an agenda for progress report meetings based upon what sponsors wish to know concerning each of these three time horizons.

1. Past time period—The first time horizon is the immediate period between your last report and now. Looking back at the performance like this, it is important to state what was planned to be accomplished during that time and what was actually accomplished. Any variance or difference between the approved plan and actual performance, along with reasons for the variance, should also be part of the retrospective portion of performance reporting.
2. Current time period—The second time horizon is from now until the next performance report is due: What work is to be accomplished during this time period (current plan)? What risks and issues are foreseen? Finally, what changes need to be approved?
3. Future time period—The third time horizon is after the next reporting period. Sponsors especially want to know what future risks and issues are envisioned because they may like to address them before they become real. Remember the concept of rolling wave planning—the plan for the later part of the project might still be evolving, but what is known about it right now?

14.2f Monitor Communications

Monitor communications is monitoring and controlling communications throughout the project life cycle to make certain that the information needs of all the project stakeholders are met. The project manager and core team often discuss whether the project communications are following the plan, how effective they are, and how to improve their effectiveness.

14.3 Customer Issues

The second major perspective included in a balanced scorecard approach to project control is that of the customer. Customers need the deliverables of the project. They want the results to be useful (quality) and complete (scope).

14.3a Manage and Control Quality

As previously defined in Chapter 12, **manage quality** is the process of using and improving the quality plan and policy to perform tasks that will most likely lead to creating project outputs to customers' satisfaction. This forward-looking, broad management process (often known as quality assurance) both ensures that work is performed correctly and that key stakeholders are convinced that the work is performed correctly.

Also as previously defined in Chapter 12, **control quality** is the activities … used to verify that deliverables are of acceptable quality and that they are complete and correct. Quality control activities include inspection, reviews, and testing. This backward-looking, detailed set of reactive technical activities verifies whether specific project deliverables meet their quality standards.

Quality Management and Control Tools A variety of quality management and control tools can be used effectively on projects. Some of the most common tools and their primary uses on projects are shown in Exhibit 14.7.

The following discussion presents a small example of a project process that is used to demonstrate a few of the project quality tools. A straightforward presentation of each tool is demonstrated. Multiple variations exist for some of the tools, and an interested student can find more detailed examples and instructions in a statistics or quality textbook.

Exhibit 14.7

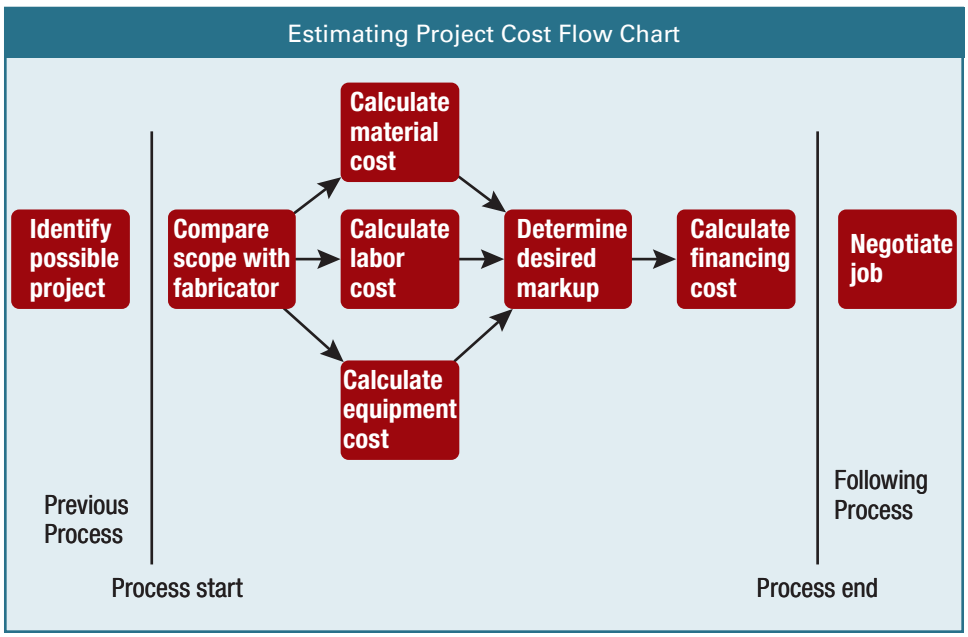
Project Management and Quality Tools

Tool	Chapter	Description
Charter	3	High-level agreement to start project describing authority, scope, expectations, and resources
Lesson learned	3 and 15	Knowledge from experience captured and shared
Stakeholder analysis	6	Identification and prioritization of stakeholder desires
Communication management plan	6	Document that guides and assigns responsibility for communication with stakeholders
Voice of the customer	7	Captured desired benefits and features in customer's own words
Brainstorming	7	Quick generation of many ideas to identify gaps, issues, roadblocks, or potential solutions
Quality metrics	7	Crisp definition of what and how to measure specific performance
Project risk review	11	Thorough document review to uncover risks
Root cause analysis	11	Technique to discover underlying reason for problem
Cause and effect diagram	11	A visual outline, often resembling a fish skeleton, used to identify and organize possible causes of a stated outcome
Supplier, input, process, output, customer (SIPOC)	12	High-level view of process and stakeholders
Quality audit	12	Structured process to ensure project activities comply with organizational policies

Tool	Chapter	Description
Benchmarking	12	Identifying and analyzing best practices for improvement ideas
Flow chart	14	A visual model used to show inputs, flow of work, and outputs and to identify possible data collection points for process improvement
Check sheet	14	A simple, structured form used to gather and organize data for analysis
Pareto chart	14	A vertical bar graph used to identify and plot problems or defects in descending order of frequency or cost
Histogram	14	A vertical bar chart used to show the average, extent of variation, and shape of measurements recorded for a process variable
Run chart	14	A special type of scatter diagram in which one variable is time, used to see how the other variable changes over time
Control chart	14	A run chart with process average and control limits used to distinguish between common and special causes of variation

Flow Chart A flow chart is a tool that project managers use as they begin to control quality. Flow charts can be used to show any level of detail from the overall flow of an entire project (such as a network diagram of the project schedule) down to very specific details of a critical process. Flow charts show clearly where a process starts and ends. A box shows each step in the process. Arrows show the direction in which information, money, or physical things flow. Exhibit 14.8 is a flow chart of the estimating project cost process.

Exhibit 14.8



This is a high-level flow chart of the process. Perhaps the project team looks at this and realizes labor cost estimates are unreliable. They might realize the need for more detailed understanding of this step. One method would be to create a more detailed flow chart of just that step. Another method is to gather some data using a check sheet such as the one shown in Exhibit 14.9.

Check Sheet Check sheets are customized for each application. Decide exactly what data will be useful in understanding, controlling, and improving a process, and create a form to collect that information. It is helpful to also collect the date or time when each event happened and notes regarding the impact or any special circumstances. When creating categories on a check sheet, it is wise to add a category titled "other" because many times, a problem comes from an unexpected source.

Pareto Chart Once a check sheet is used, the gathered data can be displayed on an analysis tool such as the Pareto chart shown in Exhibit 14.10. The purpose of the Pareto chart is to quickly understand the primary sources of a problem using the 80/20 rule, wherein 80 percent of defects often come from only about 20 percent of all the sources.

Note that, in this example, the error of using an incorrect scope shows the highest cost impact by far. Therefore, that is probably the first place the project team looks for improvements.

Cause-and-Effect Diagram Exhibit 14.11 shows how the largest bar on the Pareto chart often becomes the head of the fish on the cause-and-effect diagram—the result that the project team tries to improve.

The cause-and-effect diagram (also known as the Ishikawa diagram, named after its developer, and commonly referred to as the fishbone diagram because it resembles a fish skeleton) is constructed with each "big bone" representing a category of possible causes. For example, in Exhibit 14.13, one of the possible categories is "deliverable design," meaning that maybe something about the design of the project's deliverables contributed to problems with the "head of the fish"—in this case, it is the "incorrect scope" used to estimate the labor cost. Once categories of possible causes are identified, the project team brainstorms ideas with the goal of identifying as many potential causes as possible. Once the team can

Exhibit 14.9

Check Sheet for Labor Cost Estimating

Labor Cost Issue	Dollar Impact	Date Discovered	Action Taken
Incorrect scope used			
Category of labor			
Quantity of labor			
Hourly rate			
Pace of labor learning			
Unexpected experience level			
Mathematical error			
Other (be specific)			

Exhibit 14.10

Pareto Chart of Labor Estimating Process Problems

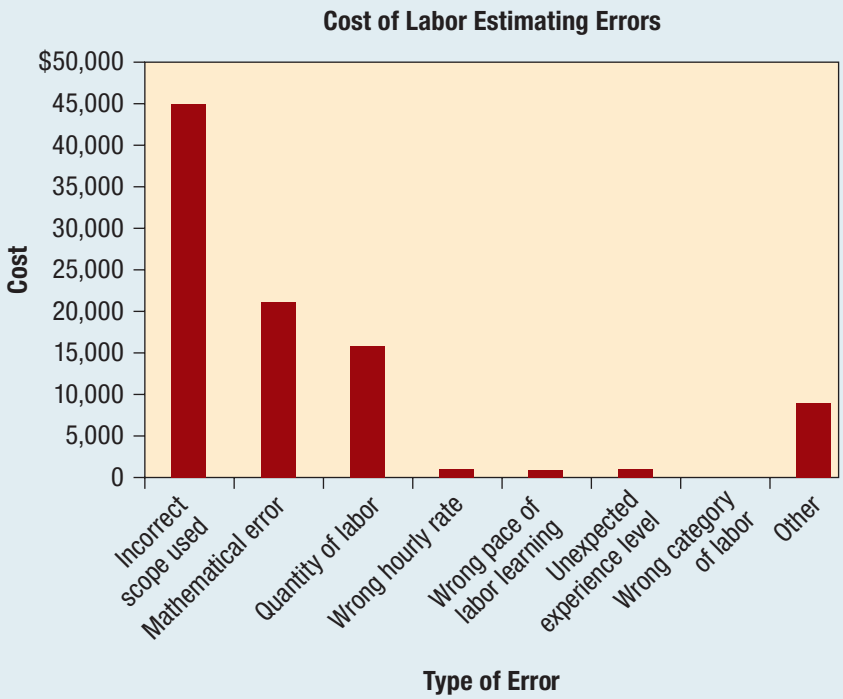
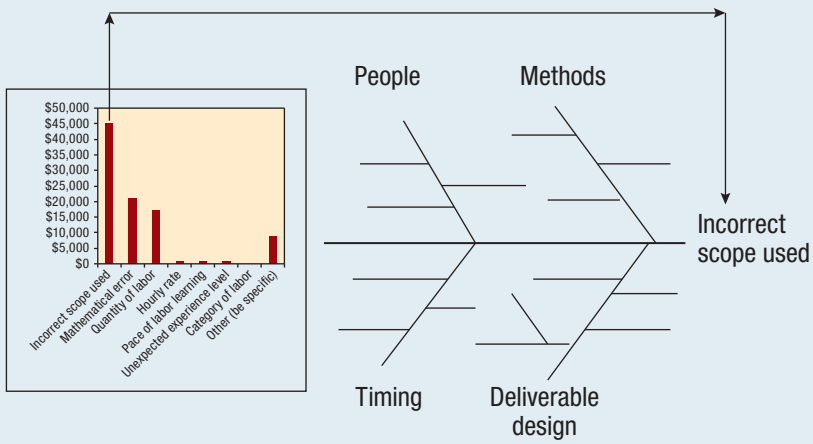


Exhibit 14.11

Pareto Chart Cause and Effect Relationship



think of no additional possible causes, they decide to test one or more possible causes to see if those causes actually have an impact. Testing can be done by gathering more data on the project as it is currently operating. Alternatively, a project team can test a new method and then collect data on it.

Histogram Once the additional data are gathered, they can be analyzed using a histogram, run chart, and/or control chart. For example, if one of the potential causes of using incorrect scope is that the client demands the cost estimate within four days of job notification (i.e., within the timing category), perhaps the charts would appear as shown in Exhibits 14.12, 14.13, or 14.14.

A project manager can interpret several things from a histogram such as the one shown in Exhibit 14.12. First, if nothing unusual is happening, a normal or bell-shaped curve

Exhibit 14.12

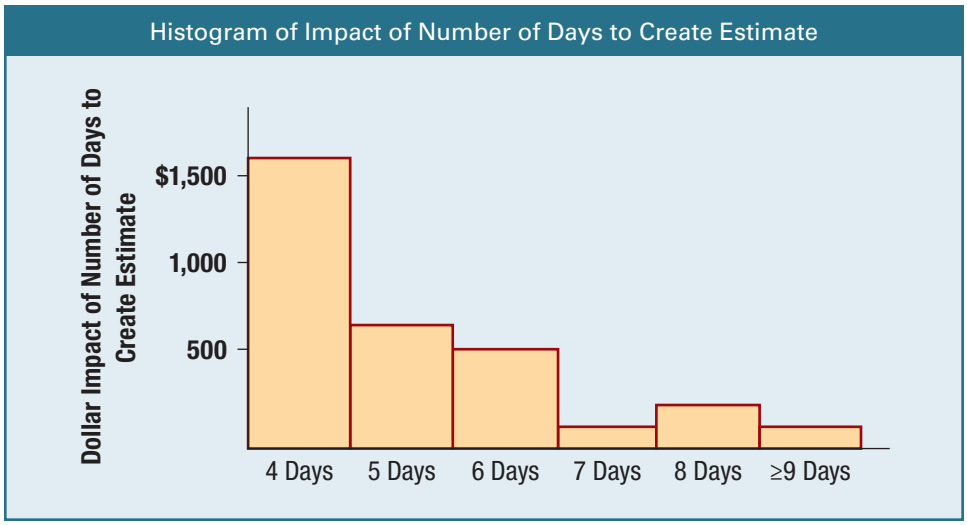


Exhibit 14.13

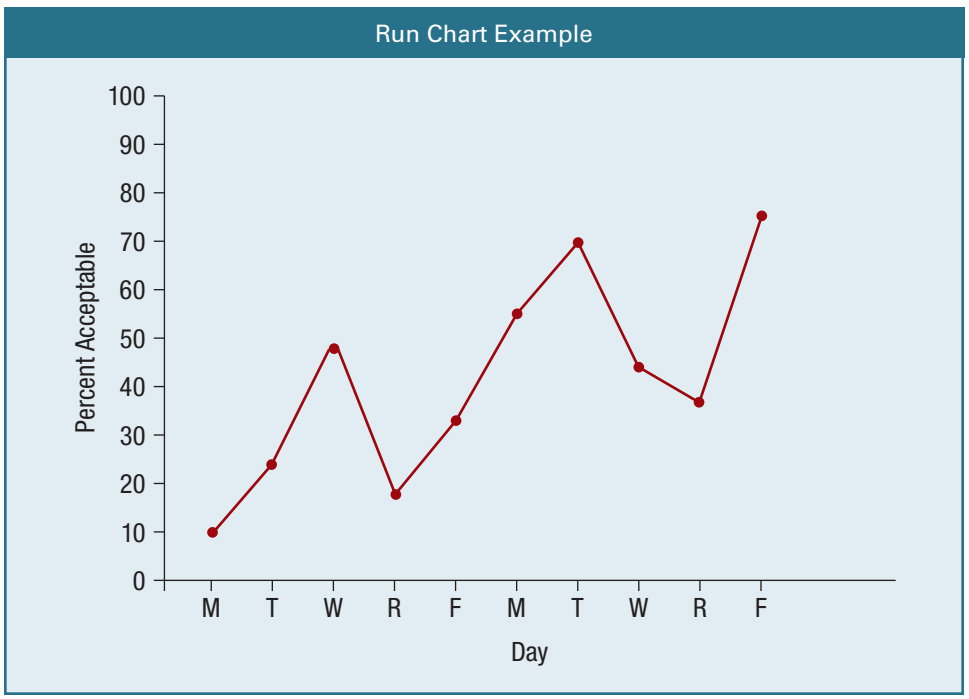
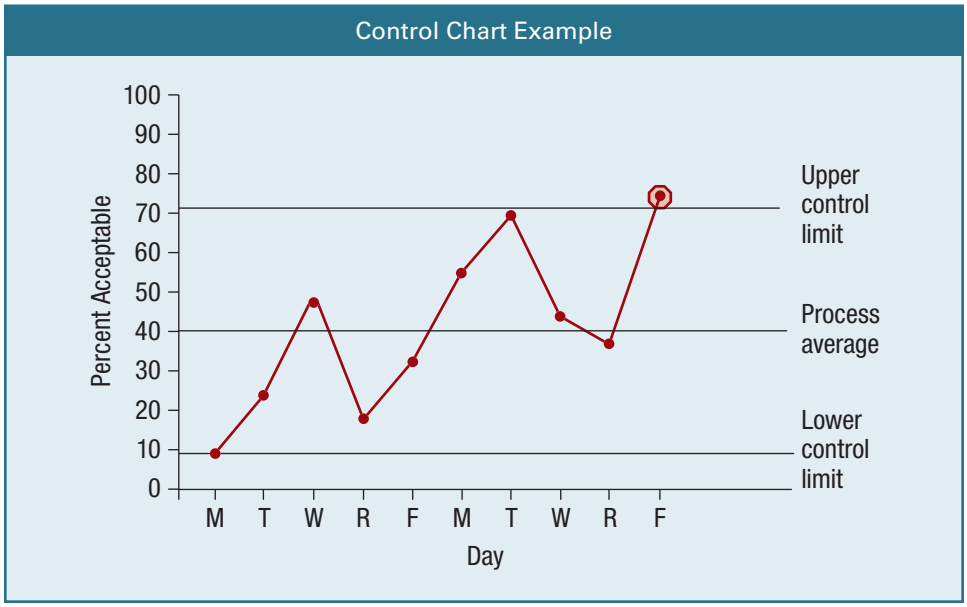


Exhibit 14.14



might be expected. However, this histogram is highly skewed, with much more impact happening when the client demands an estimate within four days. When the client demands the estimate in four days, the impact is approximately $1,600. When comparing that to the total impact of about $15,000 for using the wrong scope, this error appears to explain only a bit more than 10 percent of the total problem. It might be worth changing this, but most of the problem will still exist. Therefore, changing this factor alone does not solve the entire problem.

Run Chart Perhaps the project team wants to see how one specific aspect of the work process may change over time. If they collect data daily for two weeks and show it on a run chart such as the one in Exhibit 14.13, they could determine trends in how the process is changing over time.

The team could look for three types of variation. First, is there a trend either up or down? In this example, there is an upward trend. Second, is there a repeating pattern, such as a low every Monday or a high every Wednesday? In this case, it is too early to tell. Both Tuesdays are up from Mondays, and both Thursdays are low, but day of week does not seem like the major source of variation. The third type of variation is abrupt changes, such as either a single point far higher or lower than the others or all of the points suddenly being much higher or lower than previous points. The question teams ask when trying to find this variation is: "How big of a change is big enough to count?"

Control Chart Quality control charts are helpful in answering this question. Exhibit 14.14 displays the same data on a control chart with a process average and control limits shown. This chart shows the final point above the upper control limit. This means the variation is enough that it is not likely to have happened purely by chance. Something is causing the variation—some sort of special cause.

When considering any of these quality control tools, remember that it is easy to get lost in the details, but the purpose of quality control is to make sure the agreed-upon scope and quality are met per the project charter.

Khakimullin Aleksandr/Shutterstock.com

14.3b Control Scope

Control scope is the act of closely monitoring the project and product scope status and only allowing necessary changes to the scope baseline. Ideally, project managers and teams practice scope control proactively. They attempt to understand what might cause changes to either the product scope (the features of the project deliverables) or the project scope (the work that must be done to create the deliverables). Once a project team discovers something that may lead to a scope change, their first effort is typically to head it off. It is easiest if the stakeholders can still be satisfied and project objectives can be met without changing the scope. However, many times, it may be necessary to make a scope change. A **scope change** is any change to the project work activities or deliverable. When the scope changes, the project cost and/or schedule also need to change. For this reason, proposed scope changes are processed through the integrated change control system to determine what impact each might have on other critical aspects of the project goals. Some scope changes start as proposed changes to cost or schedule, just as some changes to cost or schedule start as proposed scope changes.

As with any type of proposed change, one must have a scope baseline in order to understand scope changes; that is, the approved scope definition and work breakdown structure must be clearly understood. Only then can the project team determine how big a proposed scope change is, what impact it will have, and how to best manage it.

Variance analysis is the process of determining both the cause and the amount of difference between planned and actual performance. Variance analysis includes determining how large the difference is between the actual and planned scope (or schedule or budget), the reasons for the difference, and whether any action is necessary to resolve it. For scope variances, the action can include updating the scope definition and work breakdown structure.

14.4 Financial Issues

Cost control is obviously a financial issue. Cost, schedule, and scope are often so closely intertwined that they are monitored and controlled simultaneously, and a change in one of them impacts the other two. The amount of all resources required to perform the project has a direct impact on cost, and resources cost money.

14.4a Control Resources

Control resources is a process by which all of the physical resources needed to perform the project are planned and monitored, and changes are made if needed. This occurs throughout the life of the project. Obviously, if resources are not available when needed, the project can be delayed. Likewise, if needed resources are in short supply, the cost and schedule might both be impacted unfavorably. Project managers look ahead at potential trends to proactively solve problems such as availability of resources and work cooperatively with a myriad of stakeholders to ensure the needed resources are available when required.

14.4b Control Schedule and Costs

Schedule and cost control are very similar in concept. The project manager should start with the approved cost and schedule baseline. Then, the current status of the schedule and cost should be determined.

If the schedule or budget has changed from a previously agreed amount, changes should be formally recommended and managed through the integrated change control system to ensure that impacts on other areas are considered. Cost control often has one additional consideration—that is to ensure that no extra money is spent than the authorized amount. This may force other changes on the project, such as delaying the schedule or reducing a part of the project scope. While many methods exist for controlling cost and schedule, the two discussed in this chapter are two of the most common: earned value management and project scheduling software such as MS Project.

Very often, the project manager must work with their company's finance department or CFO to get the proper data on accounts payable, accounts receivable, and other financial information related to the project. The project team may require the help of someone skilled at financial software. If the project manager is not personally adept at using such software, the finance department representative might be included in the project team either as a core team member or in SME capacity.

14.4c Earned Value Management for Controlling Schedule and Costs

Earned value management is a disciplined and quantitative method to integrate scope, cost, and schedule objectives into a single baseline plan for tracking contract performance. Earned value helps a project team to understand the project's progress in terms of cost and schedule as well as to make predictions concerning the project's schedule and cost control until the project's conclusion. Earned value is used as a decision-making tool. The project manager can quickly assess how the project is doing according to the baseline plan and whether the project will end without major cost and/or schedule overruns. The earned value data presents a snapshot of the status of a project at a given point in time (similar to a balance sheet presenting the financial status on a particular day). It is valid only for the day that the cost and schedule progress are measured.

When interpreting earned value management, cost and schedule must be considered independently. A project can be either ahead or behind the planned schedule and either over or under the planned budget. Second, all earned value terms deal with one of two time frames. Each represents either status as of the last date that project data were gathered or a prediction for the end of the project. Exhibit 14.15 lists 11 questions and answers that introduce all the earned value management terms.

Exhibit 14.15 uses an example to show each of the earned value management terms. Currently known values for the example are stated, followed by their definitions. Variances, indexes, and estimates are next defined, and calculations for the example are shown.

Currently Known Values In this example, the first several items are provided:

PV = $250,000, EV = $200,000, AC = $400,000, and BAC = $750,000

Each of these terms also has a formal definition.

Planned value (PV) is "the approved value of the work to be completed in a given time. It is the value that should have been earned as per the schedule."[1] In our example, we expected to spend $250,000 for the work we planned to have accomplished by now.

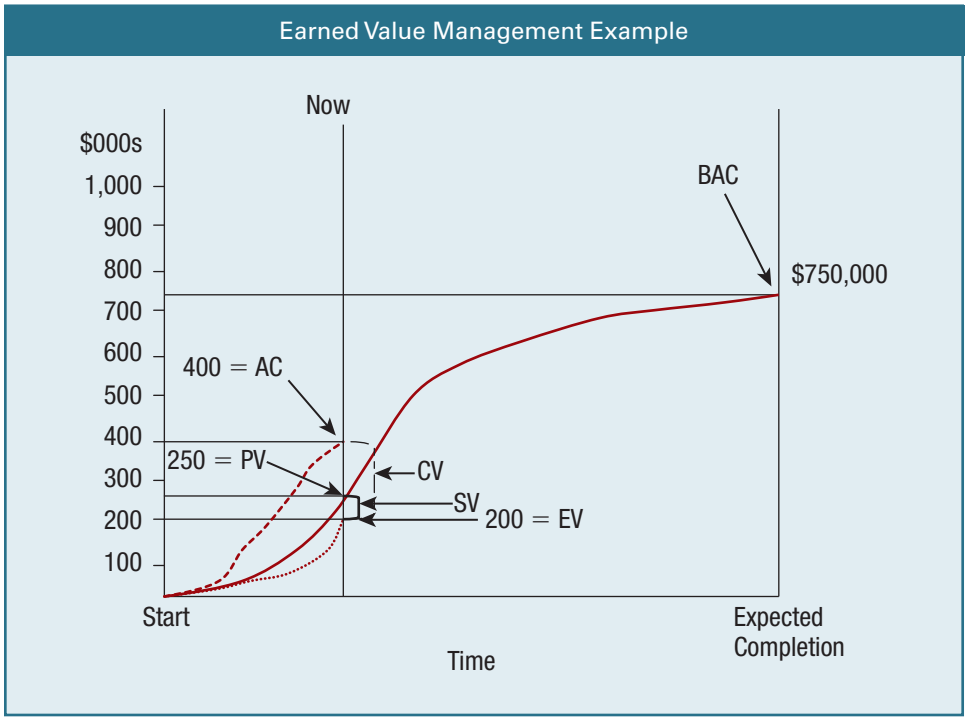
Earned value (EV) is the value of the work actually completed to date. In our example, the work that has been completed is worth $200,000.

Exhibit 14.15

Earned Value Management Terms

Question	Timing	Answer	Acronym
How much work *should be* done?	Now	Planned value	**PV**
How much work *is* done?	Now	Earned value	**EV**
How much did *the* "is done" work cost?	Now	Actual cost	**AC**
How much was the total project *supposed to* cost?	**End**	Budget at completion	BAC
How much *is* the project schedule ahead or behind?	Now	Schedule variance	**SV**
How much *is* the project over or under budget?	Now	Cost variance	**CV**
How efficient is the project *so far* with its schedule?	Now	Schedule performance index	SPI
How efficient is the project *so far* with its budget?	Now	Cost performance index	CPI
How much more do we expect to spend to finish the project?	**End**	Estimate to complete	**ETC**
What do we now think the total project will cost?	**End**	Estimate at completion	EAC
How efficient do we need to be to finish on budget?	**End**	To-complete performance index	TCPI

Exhibit 14.15



Actual cost (AC) is the total of costs incurred in accomplishing work on the activity during a given period. In our example, we owe $400,000 for the work that has been completed.

Budget at completion (BAC) is the total amount budgeted for the entire project. In this example, our approved budget for the entire project is $750,000. Now that we know these four pieces of information, we can calculate answers to all of the remaining questions listed in Exhibit 14.15.

Variances

Schedule variance (SV) is the difference between the earned value (EV) and the planned value (PV), and it denotes schedule performance. In our example, it is calculated as $200,000 − $250,000 = −$50,000. We know we are behind schedule because the variation is negative (unfavorable):

$$\mathbf{SV = EV - PV}$$

Cost variance (CV) is the difference between earned value (EV) and actual cost (AC), which reflects cost performance. In our example, it is calculated as $200,000 − $400,000 = −$200,000. We know we are over budget because the variation is negative (unfavorable):

$$\mathbf{CV = EV - AC}$$

The two variances help us understand, in dollar terms, how poorly or well we are performing on cost and schedule. In this example, we are performing poorly in terms of both cost and schedule. These are commonly used indicators. However, some people prefer to use efficiency measures to understand in percentage terms how well or poorly the project is performing.

Indexes **Schedule performance index (SPI)** is a schedule performance measure expressed as the ratio of earned value (EV) to planned value (PV). In our example, it is calculated by \$200,000/\$250,000 = 80%. We know our project is behind schedule because we only accomplished 80 percent of what we planned:

SPI = EV/PV

With performance indexes, 100 percent means right on plan, less than 100 percent means less efficient than planned, and over 100 percent means more efficient than planned.

Cost performance index (CPI) is a cost performance measure expressed as the ratio of earned value (EV) to actual cost (AC). In our example, it is calculated by \$200,000/\$400,000=50%. We know our project is over budget because we have only received \$0.50 worth of results for every dollar we have spent:

CPI = EV/AC

Now that we understand how we have performed so far (poorly in our example), it is time to forecast how we will perform for the remainder of the project. The simplest way to estimate future performance is to predict that the past performance trend will continue. The following calculations are based upon that assumption. There are projects, however, that may have unusual circumstances in the early stages that are not likely to be repeated later. In those instances, the project manager and sponsor need to use judgment to determine if the original estimates for the remaining work or some other method of estimating it are better predictors. In each case, an estimate is made for the remaining work and added to the actual cost of work completed to provide the overall estimate. We will use the two most common methods of estimating the remaining work.

Estimates **Estimate to complete (ETC)** is the expected budget required to complete all the remaining project work. In our example, if we predict that our future performance will have the same efficiency as our past performance, it is calculated by: (BAC − EV)/CPI = (\$750,000 − \$200,000)/50% = \$1,100,000

First method (Work to date is good estimate of future) ETC = (BAC − EV)/CPI

Unless we improve upon our efficiency, we can expect to pay more for the remaining project work than we originally expected to pay for the entire project!

The second method of calculating the ETC is to believe that the original plan is a better predictor than the work to date (maybe because of unusual circumstances that are unlikely to continue). This method is calculated by budget at completion (BAC) − EV = \$750,000 − 200,000 = \$550,000:

Second method (original plan is good estimate of future) ETC = BAC − EV

Estimate at completion (EAC) is the total cost of completing all the project work expressed as the sum of actual cost to date and the estimate to complete. In our example, if we believe our efficiency to date is a good predictor of the future, it is calculated by \$400,000 + \$1,100,000 = \$1,500,000. On the other hand, if we believe what happened so far will not be repeated and our original plan is good for the remaining work, it is calculated by \$400,000 + \$550,000 = \$950,000:

EAC = AC + ETC

Because our cost efficiency is only half of our plan (as we learned from our CPI), unless we become more efficient, we can expect to pay double our original estimate! Even if we

match our original plan for the rest of the project, we will still be over the budget in the end. Perhaps our sponsor still wants to know what it would take for us to finish on budget.

The **to-complete performance index (TCPI)** is a measure of the cost performance required to complete the remaining project work within the remaining budget. This is the ratio of the remaining work to the remaining budget and on our example is calculated as ($750,000 − $200,000)/($750,000 − $400,000) = 157%. That means that so far, our cost efficiency as measured by our CPI is 50 percent and we need to suddenly raise it to 157 percent for the remainder of the project to complete on budget!

$$\mathbf{TCPI = (BAC - EV)/(BAC - AC)}$$

Each term in earned value management helps project managers understand a bit more about their project's performance. Collectively, the earned value management terms give project managers insight for monitoring and controlling project cost and schedule. In addition to and often in conjunction with earned value management, many project managers use scheduling software to help control their projects.

An example of project status report is presented in Exhibit 14.16

This simplified example of a project status report provides a snapshot of the health (or status) of the project—at a "moment in time"—for the upcoming Projects and Programs Conference. Consider the status report like driving a car. The project team is documenting key information using the "rear view mirror" (where we have been or past time period),

Exhibit 14.16

Project Status Report

Project Health	
X	GREEN: On Track (within cost, schedule, scope parameters)
	YELLOW: In Jeopardy
	RED: Off Track

Weekly Project Status Report

Submitted By	**Joe Smith**
Role:	Project Manager
Project Name:	Projects and Programs Annual Conference
Report Date:	November 27, 2021

Project Objective
To manage and deliver the annual project and programs conference by March 26, 2022, within a cost of $150,000.

Status	*Include color (green, yellow, red) and explanation*
Overall	
Scope	Green: There are 10 deliverables, including Project Closeout. The team worked on four deliverables this week.

Schedule	Green: The conference is 17 weeks away. We are on track for hitting the conference date.
Budget	Green: $140,000 budget remaining ($10,000 spent on deposit to hold venue facility).

Deliverables	*Tasks completed since last report*
Venue	Signed final contract with hotel.
Speakers	Secured keynote speaker and five track speakers.
Registration	Contacted 10 new volunteers to work the registration table.
Sponsorship	Reviewed design for exhibitor space.

Deliverables	*Tasks working on this week (Progress on these tasks will be stated in next report)*
Venue	Get venue room layout on website and ready for conference brochure.
Speakers	Send contracts to keynote speaker and track speakers.
Registration	Follow-up with new volunteers; secure their time slot for registration table work schedule.
Sponsorship	Reach out to five new sponsors with revised sponsorship package.

Issues/Risks	*State problem, status, and next steps*
Sponsorship	Last year's conference sponsors have been slow to respond. Next Steps: The Sponsorship Committee will review the Sponsorship Package and incorporate additional incentives, plus increase social media activity to generate new sponsors.

Comments	*Include any lessons learned*
Lessons Learned: Do not solely rely on the same sponsors. New sponsors can bring additional products and services of interest to conference attendees. Next week's report will include task activities from Marketing and Staffing Deliverables.	

Source: Connie Plowman, PMP-Retired, co-author of *Project Communications: A Critical Factor for Project Success.*

the "front window" (where we are now or current time period), and the "GPS" (where we are going or future time period). Using these horizons—past, current, future—the project sponsor and key stakeholders have a clear vision to lend greater support to the Annual Conference Project Team.

Earned value management—a very useful approach to assess the performance of a project execution—is not without limitations. First, project schedule performance is measured in financial terms and not in time units. Second, it has limited application for projects executed externally; it is applicable for fixed-price contracts only. Further, for many small internal projects and internally executed projects of less strategic importance, organizations may not employ earned value management as it would require resources and efforts.

14.5 *PMBOK Guide 7e* Determining Project Progress and Results

14.5a Stakeholders

The project team works with stakeholders to elicit requirements and expectations about the deliverables. Requirements will lead to articulating acceptance criteria, technical performance measures, and definition of done. These elements, along with project plan performance factors are measured in determining project progress and results. In essence, stakeholders, specifically the client or the product owner, play an important role in defining measures for project progress and results and then making informed decisions based upon how well the project performance is achieving those measures.

14.5b Team

The project team is responsible for identification, analysis, and engagement of both internal and external stakeholders including those who are supportive of the project and those who are neutral or opposed to the project. Eventually, the project team is responsible for developing parameters for measuring project progress and results. In addition to execution of the project, the project team is responsible for communicating project progress and results to all the relevant stakeholders. The team establishes a clear project vision which helps in communicating with stakeholders and developing a shared understanding of how to interpret the progress and results.

14.5c Development Approach

Project cadence—*single delivery, multiple deliveries, or periodic deliveries*—dictates the nature and frequency of determining the process of measuring and reporting project progress and results. Sometimes, periodic deliveries are preferred on a fixed delivery schedule. Another cadence—*continuous delivery*—is about delivering feature increments immediately to customers and is normally used for digital products and services. With continuous delivery, measuring project progress and results would be more frequent.

14.5d Planning

Through the project planning process, a team develops an approach to create project deliverables. Delivery of the project outcomes influences this planning process. In the case of predictive planning, the approach starts with high-level deliverables which are defined using a WBS, which is then used to develop cost and schedule estimates. These plans will firmly define parameters for measuring project progress and results. Monitoring project progress against the project baseline helps in measuring progress at defined milestones. Iterative or incremental approaches can have high-level themes which are decomposed into user stories. A product owner continuously works with the project team, and progress and results are measured continuously and throughout the project.

14.5d Delivery

Deliverables are released throughout the project or near project completion depending on the development approach used. Needless to say, the development approach dictates the process and frequency of determining progress and results. Moving targets of completion

can happen in software development projects, and project teams track the planned rate of project goal achievement relative to the rate of progress toward completion.

14.5e Measurement

Measures for progress and results can be in terms of evaluating performance compared to the plan, tracking use of resources, demonstrating accountability, providing information to stakeholders, assessing whether project deliverable are on track or not, focusing on trade-offs, threats, opportunities, and options, and ensuring deliverables meet acceptance criteria.

14.6 Agile

Comparison of Plan-Driven and Agile Approaches for Determining Project Progress and Results

Determining Project Progress and Results Questions	Plan-Driven	Agile
How is project work directed and managed?	Work is controlled by using the approved project plan plus changes and corrective actions	Work is prioritized by the PO from the backlog, and the team selects items from the work item pool
How is risk managed?	PM and team track and identify risks and implement resolution strategies	PM and team track and identify risks and implement resolution strategies, plus team manages work flow
How is performance reported within the team?	At fixed intervals or milestones team members report on assigned deliverables	Daily team members report to each other what they did, what they plan, and potential obstacles
How is performance reported beyond the team?	PM reviews, documents, and reports for team on past progress and current and future plans at agreed intervals and makes recommendations	Team demos results at each iteration to PO and other stakeholders, PO reports work via releases or quarterly plan
What tools are frequently used to report progress?	Progress report templates and trend and variance analysis using earned value	Kanban boards and trend and variance analysis using burndown charts
How is quality managed and controlled?	Quality tools	Quality tools plus emphasis on verification and validation
How are potential scope changes handled?	Potential scope changes are formally proposed and evaluated using an integrated change control system to identify impacts	No changes are allowed within an iteration; PO can pivot at end of iteration

14.6a Agile Terms

Work item pool	All work to do: new requirements, defects, training, and so on
Manage flow	Teams focus on reducing time to complete work
Work in progress (WIP)	Work that has been started, but has not yet been completed, costs worktime, is not yet of value, and may be obsolete

Minimize WIP	Focus on the work that has been started and finish it promptly
Task switching	Time and concentration are lost when changing the work a person is doing
Waiting	Delays may mean later feedback and task switching, work is not ready
Trend analysis	Quantitative review of changes in performance over time
Burndown chart	A visual presentation that starts at the total amount of planned work for a sprint and works toward zero
Burnup chart	A visual presentation that starts at zero and work their way up toward to the total amount of work expected
Pivot	Changing direction on next sprint based upon customer desires

In this book, we use many Agile terms and definitions from Anantatmula, V., and T. Kloppenborg, *Be Agile Do Agile* (New York, NY: Business Expert Press: 2021).[2]

On Agile projects, change is expected, and the only part that is planned in detail at the outset is the first iteration. Subsequent iterations are planned in a rolling wave fashion. Within an iteration, there is great reluctance to change. Conducted well, Agile projects may have less risk because: communication is so frequent and specific; during each iteration, the team needs to demonstrate that the project deliverables perform correctly; and it is common practice to maintain a visible, monitored, prioritized risk list.

Project work is directed and managed first by the Product Owner selecting and prioritizing work from the release backlog. These items become the iteration backlog of desired work items for the team to create. Any new requirements, defects to be repaired, training, or other work that must be completed are added to this backlog to create the **work item pool**. Team members select items form this to complete—often with additional discussion with the product owner.

Agile project teams use good practice for risk and quality management described elsewhere in this book, but they also emphasize managing work **flow**. By working at a sustainable pace, risks and potential quality issues are quickly identified, discussed, and resolved. Teams focus on **minimizing work in progress (WIP)** by focusing their efforts to the extent possible on completing one work item at a time and reducing multi-tasking. **Task switching** requires a person to stop thinking about one thing and start thinking about another. By reducing this team members can concentrate better on what they are doing with less distraction. One further aspect of managing work flow is to reduce **waiting** time. When work waits on workers, there is more WIP, some of which may contain defects or become unneeded with changing requirements. When workers wait on work, they are not productive. Work at a sustainable, predictable pace reduces waiting time.

Communication is frequent and rapid on Agile projects. Often, a directional indicator showing that things are getting better or worse in some manner showing **trend analysis** is more valuable than a more detailed and polished report. Teams generally display highly visible information radiators so everyone concerned can tell in a transparent manner how the project is proceeding.

Progress report meetings are held within the team every morning as brief (15 minutes) stand-up meetings. Each core team member discusses the previous day as the past time period and today as the current time period. The more distant future is generally not discussed in these meetings.

Documentation often starts very tersely and becomes more complete as the deliverables are better understood. A progressively more complete working product is the primary measure of progress.

Agile projects often use a **Burndown Chart** to show the amount of work remaining. A Burndown Chart is useful to Scrum Masters as it shows how close to plan the team is within a given time box—that is, it is a graphical representation of work effort remaining in an iteration (or similar) versus the days left in an iteration.

The vertical axis is typically the number of effort hours remaining in an iteration. The horizontal axis identifies how many days are left in an iteration. Exhibit 14.17 displays a straight line, which is called the ideal line. It depicts a team with a velocity of 300 effort hours and 10 days of iterations.

The way this works is that each day, the members of the Scrum Team let the Scrum Master know how many effort hours of work they have left to complete for the current iteration. Velocity, which is used to draw the ideal line, is determined by tracking the team's historical progress. Exhibit 14.18 displays a Burndown Chart with the team constantly behind schedule. Some teams display their progress in just the opposite manner using a **burnup chart** with progress starting at zero and progressing upward toward the desired total. Burnup charts are more typically used when numerous changes are expected and it is difficult to predict at the project start about how much work will be needed.

Team members demonstrate product to stakeholders, often encouraging them to play with the new items to make sure the stakeholders find them useful. Stakeholders are encouraged to give candid, quick feedback. Quality is enhanced on Agile projects by having the appropriate team members resolve issues quickly. The product owner may consider feedback and ask the team to **pivot** to different work the end of an iteration. If the project is internal to one organization, this may be just telling the workers to work on something different. If it is for an external project a "change for free" contract clause may be used to provide a positive incentive for both parties to make helpful changes.

The product owner reports to more senior management at the end of a release and/or at the end of a fiscal quarter. Senior leadership of the organization may direct the product owner to make further pivots at those times.

Exhibit 14.17

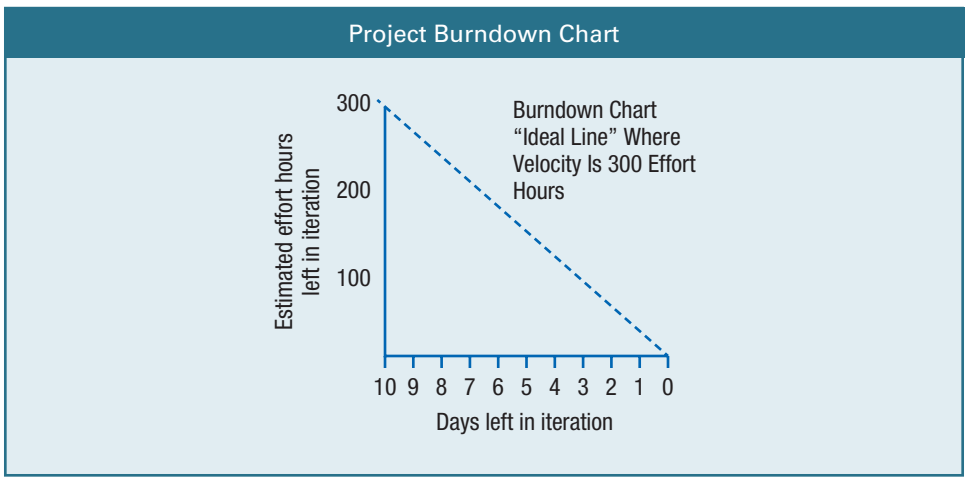
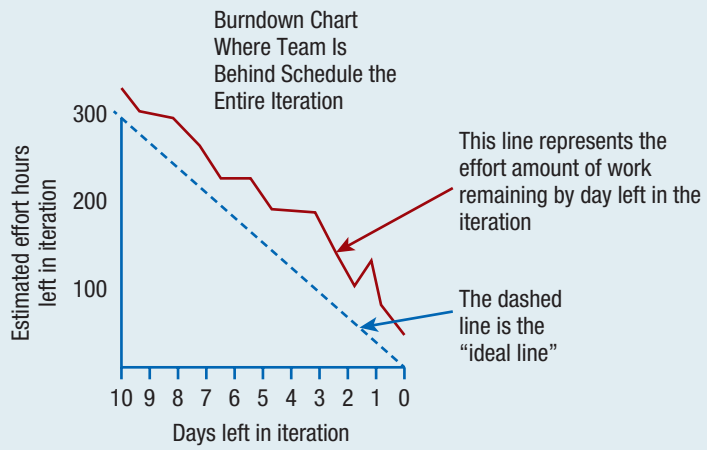


Exhibit 14.18

Burndown Chart Where Team Is Behind Schedule the Entire Iteration



Source: Brain Vanderjack, PMP, MBA, CSM, SAFe Certified, author of *The Agile Edge*.

14.7 Using MS Project to Monitor and Control Projects

When used to its fullest, MS Project can be a powerful tool for monitoring and controlling the project schedule, cost, and resources. Once a project has entered into the execution phase, the job of the project manager shifts primarily to tracking the project to see if it is executing according to plan. To understand how MS Project assists in this regard, it is helpful for the project manager to understand the following:

1. What makes a schedule useful?
2. How does MS Project recalculate the schedule based upon reported and inputted actuals?
3. What are the current and future impacts of time and cost variances?

Once these concepts are understood, the project manager can use MS Project to update the schedule in a step-by-step fashion.

14.7a What Makes a Schedule Useful?

To properly control a project, the project manager must provide useful status reports, produce accurate assignment dates, take timely corrective actions, and make other necessary management decisions. This is difficult or impossible to do well without a sufficiently useful schedule. To be useful, three sets of schedule data must exist for comparison purposes. Each set includes dates, duration, work, and cost (along with any approved changes). The three sets are as follows:

1. The Baseline Set (sometimes called the planned schedule)
   a. This set is the original stakeholder-approved scheduled values (as discussed in Chapter 12).
   b. Data includes the *Baseline Start, Baseline Finish, Baseline Duration, Baseline Work*, and *Baseline Cost*.

2. The Actual Set (sometimes called the performance data)
   a. This set is what actually happens during project execution as reported by the resources assigned to project tasks.
   b. Data includes the *Actual Start, Actual Finish, Actual Duration, Actual Work*, and *Actual Cost*.
3. The Scheduled Set
   a. This set is the future estimated time and costs and is calculated by MS Project.
   b. Data includes the *Start, Finish, Duration, Work*, and *Cost*.
   c. Values are continuously recalculated during project execution as tasks and estimates are entered, as the project network is defined, as resources are assigned and balanced, and as actual execution data is entered.

14.7b How MS Project Recalculates the Schedule Based on Reported Actuals

As actual data is entered into a task's *Actual* field, MS Project copies that data into the task's *Scheduled* field, replacing the estimated values. MS Project then recalculates the schedule for future tasks based on a combination of what actually happened and the estimates of the remaining tasks.

14.7c Current and Future Impacts of Time and Cost Variance

With the three sets of data, comparisons can be made between any two of the sets. This is useful in understanding future impacts of various issues, such as:

- Time and cost performance variances from baseline
- Critical path changes
- Resource allocation issues
- Emerging risks
- Remaining contingency and management reserves
- The impacts of proposed changes

14.7d Define the Performance Update Process

The performance update process is simply the project manager updating actual project data as the project is executed. The update process is defined by the project manager informing the project team on who needs to report, what information is needed in each report, and when each report needs to be submitted. The following guidelines will help the project manager keep the schedule updated and accurate.

Who Reports? All team members and suppliers assigned to tasks that were scheduled during the past reporting period need to report. Also, any resource wanting to change the estimate of a soon-to-be-starting task needs to report the new estimate.

What Is Reported? Actual Start, Actual Finish, Actual Duration Complete, and Estimated Remaining Duration are reported. The sooner the project manager learns of variances from estimates, the sooner they can take corrective action, making Estimated Remaining Duration and Actual Finish among the most important values to update accurately.

When to Report? The project manager determines what day of the week resources will report performance ("Status Date" or "As of Date"), as well as the frequency. The Status

Date is usually driven by the date of stakeholder review meetings and the time needed to make adjustments before that meeting. The project manager wants to walk into that meeting with the most accurate and up-to-date status information as possible.

14.7e Steps to Update the Project Schedule

The process of updating the project schedule in MS Project includes six steps as described below. Please note: for the purposes of this chapter's tutorial, a simplified version of the running Suburban Park Homes example has been used.

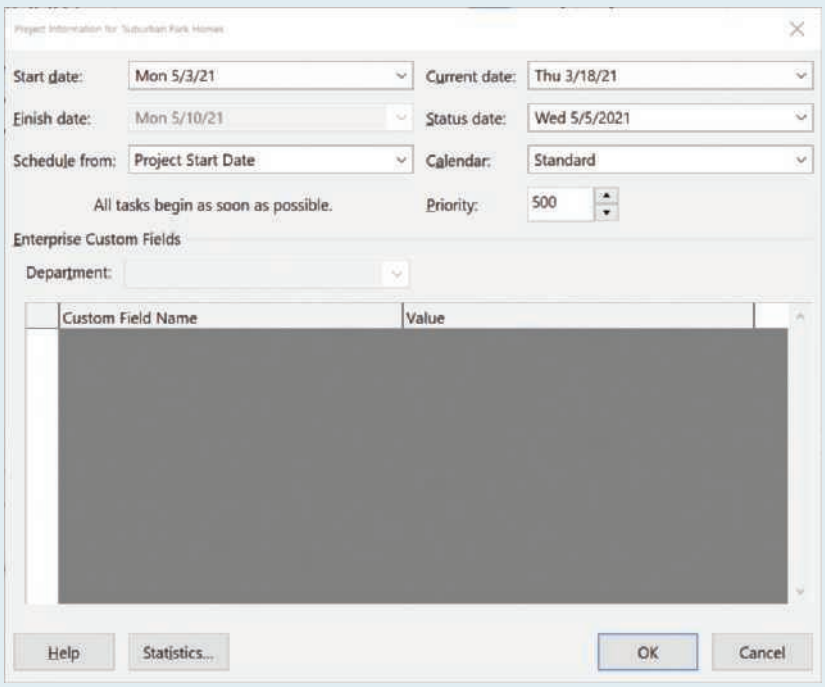
Step 1: Acquire the Performance Data Performance data is duration-based data. From each resource assignment, collect the date when the task started, how much duration has been completed, how much duration remains, and the actual finish date (if the task has been finished).

Step 2: Set the Status Date (as of) The Status Date, or "as of" date, is the date the project manager sets for the team to report on the progress of the project. To be useful, the Status Date must be updated every time the project manager requires performance data reported.

a. Click the **Project Tab>>Properties Group>>Project Information**.
b. Click the "**Status date**" drop-down.
c. Set status date to **5/5/21** (as shown in Exhibit 14.19).
d. Click **OK**.

Exhibit 14.19

Display Status Date Line



Source: Microsoft Corporation.

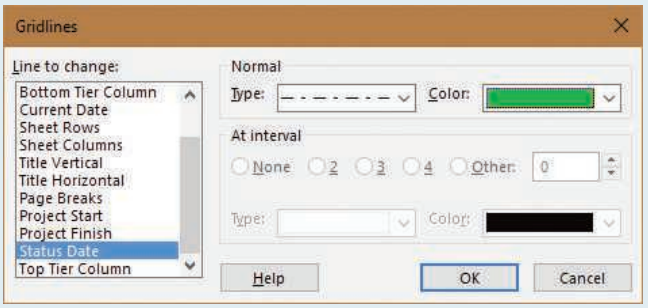
Step 3: Display the Status Date Line on the Gantt Chart Displaying a Status Date line on the Gantt chart provides a visual cue as to how much of the work has been completed for each task (once the update data is entered).

1. Click the **Task Tab>>View Group>>Gantt Chart**.
2. **Right-click** on the right pane>>select **Gridlines**.
3. In the "Line to change list", select **Status Date** (as shown in Exhibit 14.20).
4. In the "Normal" box, choose **dashed dotted line**; choose **Green** for the color.
5. Click **OK**.

Step 4: Enter the Duration-Based Performance Data Exhibit 14.21 shows a simplified Suburban Park Homes project schedule in the Gantt Chart View with resource assigned tasks A–F (Task IDs two through seven) and beginning and end milestones (Task IDs one and eight). To the right of the Task Name column, a user-defined text column has been inserted (**Right click>>Insert Column>>type a heading name**) to record the performance report from the assigned resource(s). The Status Date is end of day on Thursday, May 5, 2021 (denoted by the vertical dashed line in the right side pane of the Gantt view). Resources have been assigned to

Exhibit 14.20

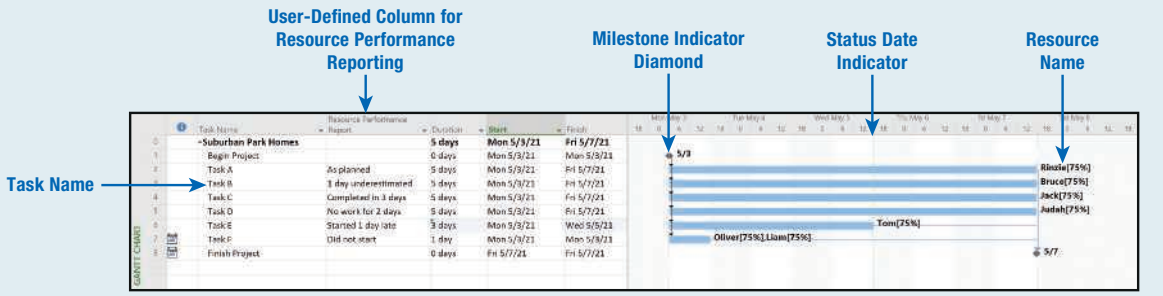
Set the Status Date (as of)



Source: Microsoft Corporation.

Exhibit 14.21

Schedule Before Any Actuals Are Applied



Source: Microsoft Corporation.

each task and are denoted by the resource name in the right-side pane. Updating reported performance data for each task is demonstrated in the next steps.

Anniston reports Task A's performance was as scheduled through the end of day on Thursday (remember that Thursday, May 5 is the Status Date).

1. Click **Task A** in the Gantt chart.
2. Click the **Task Tab>>Schedule Group**>>click **Mark on Track**.
3. Notice a dark progress bar line appears in the Gantt bar through the end of day on Thursday (the Status Date).

Bruce reports Task B's performance as scheduled, but the estimated remaining duration is two days instead of one.

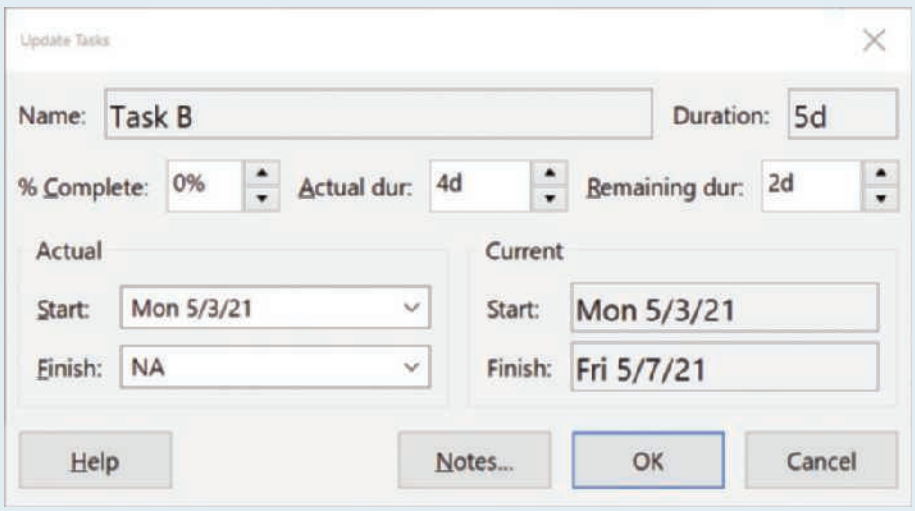
1. Click **Task B**.
2. Click the **Task Tab>>Schedule Group**>>click the **Mark on Track drop-down**>>click **Update Tasks**.
3. In the Update Tasks dialog:
   a. Actual dur: **enter "4d"**.
   b. Remaining dur: **enter "2d"** as shown in Exhibit 14.22.
4. Click **OK**.
5. Notice Task B's duration has updated to six days and extends through the end of day Monday, as shown in Exhibit 14.23.

Jack reports that Task C finished two days early.

1. Click Task C.
2. Click the **Task Tab>>Schedule Group**>>click the **Mark on Track drop-down**>>click **Update Tasks**.

Exhibit 14.22

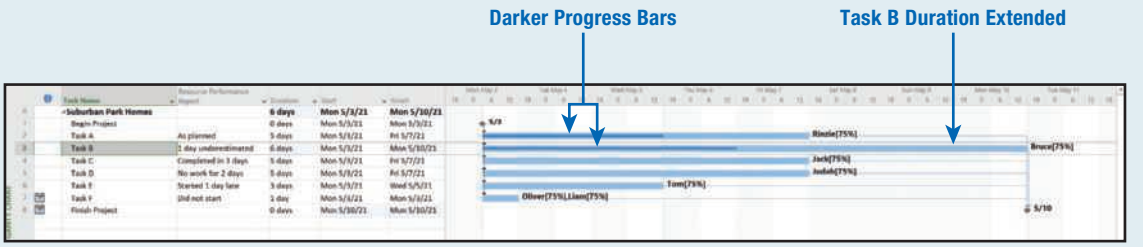
Update Tasks Dialog Box



Source: Microsoft Corporation.

Exhibit 14.23

Gantt Chart View with Activities A and B Updated



Source: Microsoft Corporation.

3. In the Update Tasks dialog:
   a. Actual dur: **enter "3d"**.
   b. Remaining dur: **enter "0d"**.
4. Click **OK**.
5. Notice in Exhibit 14.24 that Task C's duration is now three days and the activity is marked complete (as denoted by a checkmark in the Indicators column).

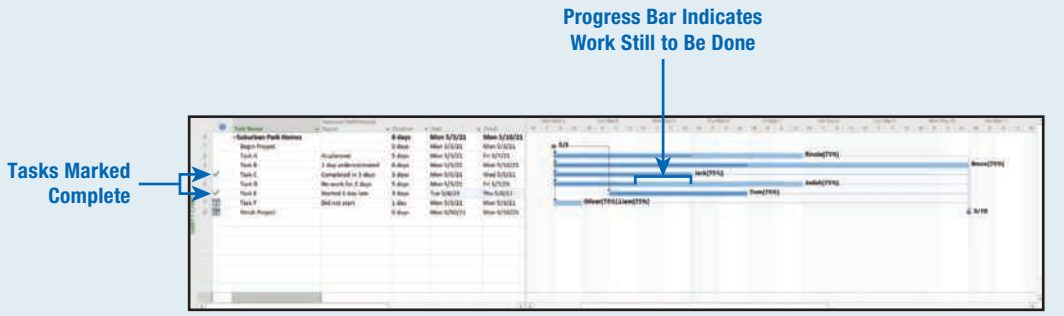
Judah reports that no work was done for two of the five days on Task D.

1. Click Task D.
2. Click the **Task Tab>>Schedule Group>>**click the **Mark on Track drop-down>>**click **Update Tasks**.
3. In the Update Tasks dialog:
   a. Actual dur: **enter "2d"**.
   b. Remaining dur: **enter "3d"**.
4. Click **OK**.
5. Notice Task D's dark progress bar indicates there is still work scheduled for Wednesday and Thursday.

Brady reports that Task E started one day late.

Exhibit 14.24

Gantt Chart View with Actuals Applied to Activities A through E



Source: Microsoft Corporation.

1. Click Task E.
2. Click the **Task Tab>>Schedule Group**>>click the **Mark on Track drop-down**>>click **Update Tasks**.
3. In the Update Tasks dialog:
   a. Actual Start: **enter "5/6/21"**.
   b. Actual dur: **enter "3d"**.
   c. Remaining dur: **enter "0d"**.
4. Click **OK**.
5. Notice that Task E is marked complete.

Oliver and Liam report that no work was done on Task F. This update will be addressed in the next step.

Step 5: Reschedule Remaining Work Both Tasks D and F still have work scheduled for dates prior to the Status date. This work must be moved to start no earlier than the day following the Status Date.

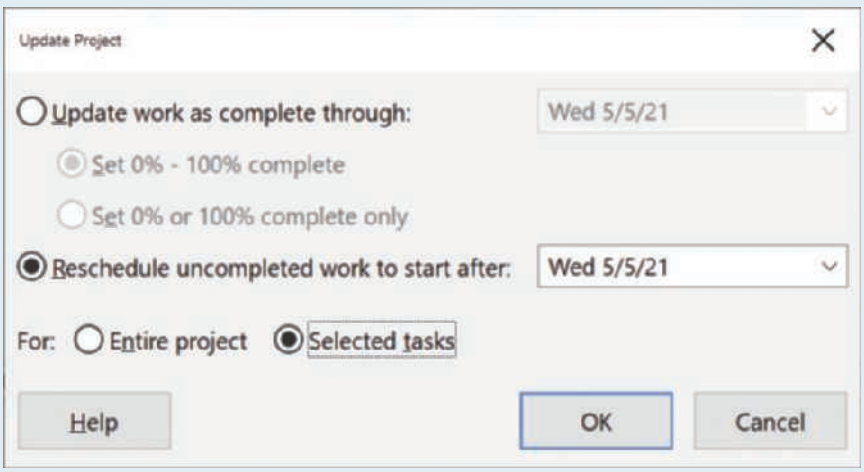
1. Click Task D.
2. Click the **Project Tab>>Status Group**>>click **Update Project**.
3. In the Update Project dialog, click "**Reschedule uncompleted work to start after:"**.
4. Enter the Status Date if not already entered as shown in Exhibit 14.25.
5. Click on **Selected tasks**.
6. Click **OK**.
7. Repeat these steps for Task F.

As seen in Exhibit 14.26, Task D is now split with the completed work showing on Monday and Tuesday, and the remaining work rescheduled to resume on Friday. If a more likely date to resume work is not Friday, the Gantt bar can be dragged to the likely date.

Task F is also scheduled to resume on Friday. When all of a task is rescheduled, a "start-no-earlier" constraint is automatically applied. That constraint can be modified to select a more likely resume date. Ignoring unfinished work that is scheduled earlier than the Status Date is a risky practice.

Exhibit 14.25

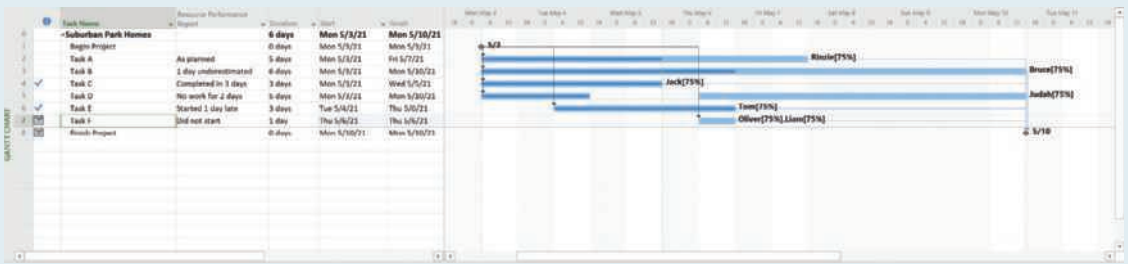
Rescheduling Work on a Gantt Chart



Source: Microsoft Corporation.

Exhibit 14.26

Gantt Chart with Completed Work Rescheduled



Source: Microsoft Corporation.

Step 6: Revise Future Estimates The most accurate estimates are made just before a task gets started. Therefore, at any status meeting, it's a good practice to ask project team members if they believe the estimates for any of their upcoming tasks need updating.

14.8 Replanning If Necessary

Sometimes it becomes necessary to replan a project. The project manager can use the integrated change control system to understand the impact of the proposed changes and to secure approval to make the changes. The changes are then reflected in a revised plan. The schedule, cost, and resource changes can be shown on an updated MS Project schedule. Other changes can be reflected in risk register updates or issues log updates. Two questions still exist regarding replanning: "What kinds of changes might be made in response to the problems?" and "Does the approval for a change need to be escalated to higher management?"

Changes a project manager may need to recommend include reassigning activities to different workers, splitting activities so at least some work can get started, reordering activities so they may be accomplished sooner, borrowing or acquiring additional resources, reducing scope, and so on. Many of these types of change can help a project get back on track; however, make sure the appropriate stakeholders agree with the changes because many times, a change that improves one aspect of a project degrades another.

Consider that people at each level in an organization have the ability to make specific decisions and are generally allowed a certain amount of time to deal with a problem before notifying a superior. Whoever makes the decision is still expected to document it appropriately. If a very minor problem occurs on a project, perhaps a team member can make the decision regarding how to handle it. A bit larger problem may fall in the domain of the project manager. Large decisions may go to the sponsor, and really critical decisions may be sent to the leadership of the parent organization. Escalation answers the question of what kinds of decisions are submitted to a higher level and how much time the lower-level person gets before raising the problem. A person who escalates minor decisions, or even major decisions very quickly, gives the impression of being weak and indecisive. However, a person who does not escalate important decisions or who takes so long to escalate them that the problem has worsened, exhibits poor judgment.

In Agile projects, replanning is conducted by planning for each release and each iteration. Within an iteration, once the planning is complete, very little additional change is allowed.

Summary

For a project manager to effectively determine that the desired project progress is being made and results are being delivered, a multitude of things need to be monitored and controlled. Many of these factors are interdependent, and a project manager must understand how changes in one aspect might impact other aspects of the project and project progress.

Project managers need to monitor and control the actual work of the project or the activities. This entails observing the work as it is executed and making adjustments as needed. Any adjustments that may have a sizable impact must be processed through the project's integrated change control process. Each potential change is proposed, approved or disapproved, and documented, and the approved changes are implemented. A risk register is maintained to keep track of active risks, whether the risk events transpire, and how they are handled. New risks are added as they emerge or as they are discovered, and some risks are retired that are no-longer-relevant.

Project managers also need to control the various aspects of the project that are subject to potential trade-offs—namely, scope, quality, cost, and schedule. When controlling these, the project manager looks for variances—that is, any difference between what was planned and what has actually happened. The project manager also seeks to understand how a change in any one area will impact the others. Several tools exist for helping project managers with this control. Many quality tools are widely used when seeking to understand what the quality level is, where problems may exist, what the root causes are for problems, and how to improve the project processes so the problems do not reoccur. Sponsors and other stakeholders want to understand progress made on the project, current plans, and what might derail the project. Regular progress meetings and reports serve this purpose. Earned value management and MS Project are both quite helpful in understanding, documenting, and improving upon cost and schedule progress.

A big difference in determining progress and results on Agile projects is the frequency of feedback and how quickly it is used for replanning. Agile projects are planned in detail one iteration at a time, with almost no change allowed during an iteration. Some of the specific tools Agile uses are different, but the emphasis remains on performing in such a manner that clients are confident that what the delivers will meet their needs.

Key Terms Consistent with PMI Standards and Guides

directing and managing project work, 509
monitoring and controlling project work, 511
monitor, 511
control, 511
variance, 511
perform integrated change control, 513
change control, 513
change control board, 513
monitor risks, 514
implement risk responses, 514
manage communications, 515
work performance data, 516
work performance information, 516
work performance reports, 516
monitor communications, 517
manage quality, 518
control quality, 518
control scope, 524
scope change, 524
variance analysis, 524
control resources, 525
earned value management, 525
planned value (PV), 526
earned value (EV), 526
actual cost (AC), 527
budget at completion (BAC), 527
schedule variance (SV), 527
cost variance (CV), 527
schedule performance index (SPI), 528
cost performance index (CPI), 528
estimate to complete (ETC), 528
estimate at completion (EAC), 528
to-complete performance index (TCPI), 529

Key Terms Consistent with Agile Practice

Work item pool, 533
flow, 533
minimizing work in progress (WIP), 533
Task switching, 533
Waiting, 533
Trend analysis, 533
Burndown chart, 534
Burnup chart, 534
Pivot, 534

Chapter Review Questions

1. What five aspects of project success are evaluated in the balanced scorecard approach?
2. Give three categories of internal project issues and an example of each.
3. In addition to the WBS, what might trigger project work to be authorized and performed?
4. What is an advantage of letting workers self-control their work?
5. What are two types of control frequently used on projects?
6. What members of the project team should serve on the change control board?
7. What is the difference between work performance data and work performance information?
8. Which time periods are discussed in Agile project progress meetings?
9. What three sets of data should a project manager have after completing a project audit?
10. Give some examples of times in the project life cycle when an inspection might be especially useful.
11. Why is prevention preferable to inspection?
12. What is the difference between an attribute and a variable?
13. The highest bar on a Pareto chart often becomes the "head of the fish" in the _____.
14. What three types of variation should one look for in a Run Chart?
15. How does one calculate schedule variance?
16. What does cost performance index (CPI) measure?
17. What should your initial response be if a customer asks for a change to your project?
18. What is the main purpose of monitoring and controlling a project?
19. What is an Agile Burndown chart?
20. Describe the three time horizons for project performance reporting, what should be reported in each, and why.

Discussion Questions

1. Describe how a project manager can determine project progress for each element in the project balanced scorecard.
2. In your opinion, under what conditions should the sponsor approve a project change, and when is it okay for the project manager to authorize a change? Give an example of each.
3. Give specific examples of risks on a project that are within the team's control, partially within the team's control, and outside the team's control. Tell how you would deal with each.
4. As project manager, what would be your reaction to learning that, as of the last audit, your project's SPI was 105 and your CPI was 80? Why?
5. What is the difference between efficiency and effectiveness? Give an example of something that is one but not the other.
6. In your own words, what is the difference between Manage Quality and Control Quality on a project?
7. List and give an example of when to use each of the seven project quality control tools described in this chapter.
8. Give an example of a common cause and a special cause, and describe how you would address each.
9. If you were sponsoring a project, would you want to be updated in terms of cost and schedule variance or cost and schedule performance indexes? Why?

10. When it comes to monitoring progress, which parts of Microsoft Project schedule do you find most useful? Why?
11. Describe how an Agile project's cadence affects the way results are measured and reported.
12. How are change requests handled on plan-driven projects? On Agile projects?
13. In your opinion, what are the two or three things most important to monitor and control in order to ensure your project will deliver value to your client?

PMP Exam Study Questions

1. In regard to Project Work, which activity refers to "reviewing the progress and capturing project performance data with reference to the project plan, developing performance measures, and communicating performance information?"
   a. controlling
   b. monitoring
   c. executing
   d. managing
2. Juan is a project manager for a project that has been baselined and is now under way. When a customer approaches Juan and asks him to increase the project's scope, Juan's response should be to _____.
   a. comply with the customer's request if it seems reasonable
   b. determine the schedule performance index (SPI)
   c. perform integrated change control
   d. calculate the Estimate to Complete (ETC)
3. Which of the following formulas represents the schedule performance index (SPI)?
   a. EV/PV
   b. EV − PV
   c. EV − AC
   d. EV/AC
4. If your sponsor asks for an estimate as to how much more money your team needs to complete all project work as scheduled, which of the following formulas might you use?
   a. BAC − EAC
   b. EV/PV
   c. (BAC − EV)/CPI
   d. (BAC − EV)/(EAC − AC)
5. What is the final step in the *Perform Integrated Change Control* process?
   a. Review Change Proposals
   b. Manage changes to deliverables and Project Management Plan
   c. Estimate impact of proposed changes on project goals
   d. Approve or Decline change requests
6. Which quality control tool is a special type of vertical bar chart that is used to identify the primary (vital few) sources that are responsible for causing most of a problem's effects, often referred to as the 80/20 rule?
   a. Ishikawa diagram
   b. Pareto diagram
   c. Control chart
   d. Force field analysis
7. Which quality control tool is sometimes referred to as a "fishbone diagram" because it places a problem statement at the head of the fishbone and uses each "big bone" in the fish's skeleton as a category of probable cause, in order to determine the root cause of the problem?
   a. Ishikawa diagram
   b. Pareto diagram
   c. Control chart
   d. Burndown chart
8. Good project management practice suggests a need to include a _____ within the cost baseline in order to cover identified risks that are accepted, and for which responses have been developed.
   a. contingency reserve
   b. project buffer
   c. control account
   d. management reserve
9. The "methodology that combines scope, schedule, and resource measurements to assess project performance and progress" is called _____.
   a. cost management (CM)
   b. funding limit reconciliation
   c. triple constraint management
   d. earned value management (EVM)
10. The "To Complete Performance Index" (TCPI) is a measure of the cost performance required in order to finish the outstanding work within the remaining budget. The formula for this index is _____.
    a. BAC − EAC
    b. AC + BAC − EV
    c. EV/AC
    d. (BAC − EV)/(BAC − AC)

Exercises

1. Use the following information to answer parts a through h. Describe what the results of each calculation mean to you as a project manager. What do you propose to do?

$$PV = \$500{,}000$$
$$EV = \$350{,}000$$
$$AC = \$550{,}000$$
$$BAC = \$1{,}200{,}000$$

   a. Schedule variance (SV)
   b. Cost variance (CV)
   c. Schedule performance index (SPI)
   d. Cost performance index (CPI)
   e. Estimate to complete (ETC—first method)
   f. Estimate to complete (ETC—second method)
   g. Estimate at completion (EAC)
   h. To-complete performance index (TCPI)

2. Use the following information to answer parts a through h. Describe what the results of each calculation mean to you as a project manager. What do you propose to do?

$$PV = \$25{,}000$$
$$EV = \$30{,}000$$
$$AC = \$29{,}000$$
$$BAC = \$1{,}000{,}000$$

   a. Schedule variance (SV)
   b. Cost variance (CV)
   c. Schedule performance index (SPI)
   d. Cost performance index (CPI)
   e. Estimate to complete (ETC—first method)
   f. Estimate to complete (ETC—second method)
   g. Estimate at completion (EAC)
   h. To-complete performance index (TCPI)

3. A project manager has just learned that the schedule performance index (SPI) for their project is 85 percent. The calculation of the cost performance index (CPI) is 107 percent. How would you describe this project both in terms of budget and schedule?
4. Document the flow of a project work process. Be sure to identify the starting and ending points.
5. Create a check sheet to gather data regarding a step in the process flow chart you constructed in Exercise 4 above.
6. For a cost savings project, you have captured data that show the following costs: delays between operations = \$900; broken/missing tools = \$1,200; water losses = \$3,700; poor seals = \$1,500; other = \$2,000. Construct a Pareto chart. What would your next course of action be?
7. For a productivity improvement project, you discover the most frequent cause of delays in receiving payment is incorrect invoices. Construct a fishbone diagram to identify possible reasons for this problem. What action do you recommend with the results of your fishbone diagram?
8. Using the data below, construct a run chart to visualize how the number of customer complaints is changing over time. Describe what you find in terms of trends, repeating patterns, and/or outliers.

Date	Day	Complaints
1	Mon	14
2	Tue	17
3	Wed	11
4	Thu	12
5	Fri	21
8	Mon	15
9	Tue	21
10	Wed	19
11	Thu	22
12	Fri	23
15	Mon	27
16	Tue	11
17	Wed	29
18	Thu	31
19	Fri	35

9. Using the data below, construct a schedule in MS Project. Show where the project is ahead and/or behind schedule. Be specific. Which activities did the best? Which had the most problems?

Planned Start	Planned Finish	Actual Start	Actual Finish
8/31	9/5	8/31	9/5
8/25	9/8	8/25	9/8
9/5	9/8	9/5	9/8
8/25	9/2	8/26	9/3

Planned Start	Planned Finish	Actual Start	Actual Finish
8/26	8/27	8/28	8/29
8/25	9/8	8/28	9/8
8/25	9/6	8/29	9/6
8/25	9/1	8/29	9/6
9/1	9/2	9/5	9/11
9/1	9/6	9/5	9/11
9/1	9/8	9/6	9/14
9/8	9/15	9/13	9/22
8/25	10/26	8/31	10/31
8/25	9/16	8/31	9/23
9/16	9/29	9/23	10/9
9/16	9/19	9/23	9/25
9/20	9/28	9/30	10/6
9/20	9/21	9/30	10/21

Planned Start	Planned Finish	Actual Start	Actual Finish
9/22	9/28	10/3	10/28
9/16	9/27	9/26	10/27
9/16	9/20	9/27	10/10
9/21	9/26	10/6	10/16
9/28	10/6	10/15	11/6
9/28	10/5	10/22	11/5
10/7	10/10	11/7	11/20

10. Find a company (or other organization) that has a reputation for excellence in some aspect of project work. Benchmark their methods and determine how you can use the results to help your team improve.
11. Create a process improvement plan using the DMAIC model in Exhibit 4.10 to improve a project work process either for your own project or for another one.

Integrated Example Projects

Suburban Homes Construction Project

The project monitoring and controlling phase is where most of the resources are employed for project execution, and it is essential that the project execution happen strictly according to the project plan. Projects often experience changes during the execution because everything cannot be anticipated. However, Suburban Homes has an excellent track record of completing projects on time and within the budget and delivering its products to the customer's satisfaction.

With its plans to expand operations to other states, Suburban Homes is acutely aware of its inadequacies in new working environments and with new stakeholders. Specifically, it is even more concerned with risk management, change management, quality expectations, and communication issues.

Suburban Homes has requested to review and modify its existing project management practices and processes. They want to use your comprehensive understanding of the importance of project baselines for scope, cost, and schedule. They also want to use your knowledge of project control, progress reports—including earned value analysis—the importance of communications, and change control. Specifically, you are requested to develop templates and checklists to do the following:

- Develop a communication (formal and informal) plan with details about frequency, intended receivers, and medium of communication.
- Review and modify the change management plan.
- Monitor risks and develop a risk response plan.
- Revise the quality assurance plan and incorporate new quality control tools and techniques.

Heritage Arboretum Development Project

A Kanban board showing work done, in progress and to do for the arboretum project is shown in Exhibit 14.27.

Exhibit 14.27

Questions:

1. What ongoing risks do you envision for this project? How do you believe each should be monitored and controlled?
2. Which communications within and beyond the team do you feel can be most impactful? Why?
3. Plan, conduct, and document one of the following meetings for the next iteration for this project given the current state of work in the Kanban above:
   a. Iteration planning
   b. Stand-up
   c. Demonstration
   d. Retrospective

Semester Project Instructions

For your semester project, complete the following:

1. Document the change requests and their disposition (if you have had any changes proposed to your project).
2. Identify any changes to your risk register, with new risks added and/or old ones removed.
3. Show any quality tools you have used and explain how you interpret and act upon the results from them.
4. Show your progress updates on MS Project.
5. If you are tracking cost on your project, show the most current status of the 10 earned value management terms.
6. Create one key deliverable for your project. This should be one deliverable that your sponsor asked your team to create when you wrote the charter. Gather information regarding your process of creating the deliverable.
7. Describe trade-off issues on your project. These can include trade-offs between the needs of your sponsor's organization, the project, and your project team. The trade-offs can also be within the project objectives and constraints of scope, quality, time, cost, other resources, and stakeholder satisfaction.
8. Show the information you have collected using the information retrieval and distribution system you set up (introduced in Chapter 6).

Project Management *in Action*

Controlling, Monitoring, and Reporting Projects at a Major Medical Center

The Emergency Medicine Division of Cincinnati Children's Hospital Medical Center typically has a large number of active quality improvement projects that require effective control, monitoring, and reporting. Division leadership aims for three levels of effective monitoring, controlling, and reporting:

1. Team-level monitoring: Self-monitoring progress against process and outcome measures at daily, weekly, or monthly intervals.
2. Division-level monitoring: Main outcome and select process measures reported to division leaders who can then guide and support teams as needed.
3. Institutional-level monitoring: Progress of the main outcome was followed and presented along with that of other projects to institutional leadership and other stakeholder groups.

An essential part of effective monitoring is the development of a well-defined aim. Each aim is associated with a primary outcome measure and is supported by process measures. For the division's strategic flow project, the primary aim was a reduction in the length of stay for patients, which was supported by process measures representing specific intervals of time, such as time from arrival in the department to being seen by a physician and time from being able to leave the department to actually leaving.

Team-Level Monitoring

Team-level monitoring functions in slightly different ways from those of the other two levels. On the ground, the feedback loop for evaluating tests needs to be nimble and timely. Rather than using a single outcome measure to gauge progress, teams utilize a number of process measures, the collection of which typically represents the main identified outcome measure of a given project. Process measures are tracked frequently as the teams conduct tests within the system. During the course of a project, these measures are often displayed in daily, weekly, and monthly formats. Ad hoc analysis supplements these measures, particularly for tests that are run for discrete periods of time.

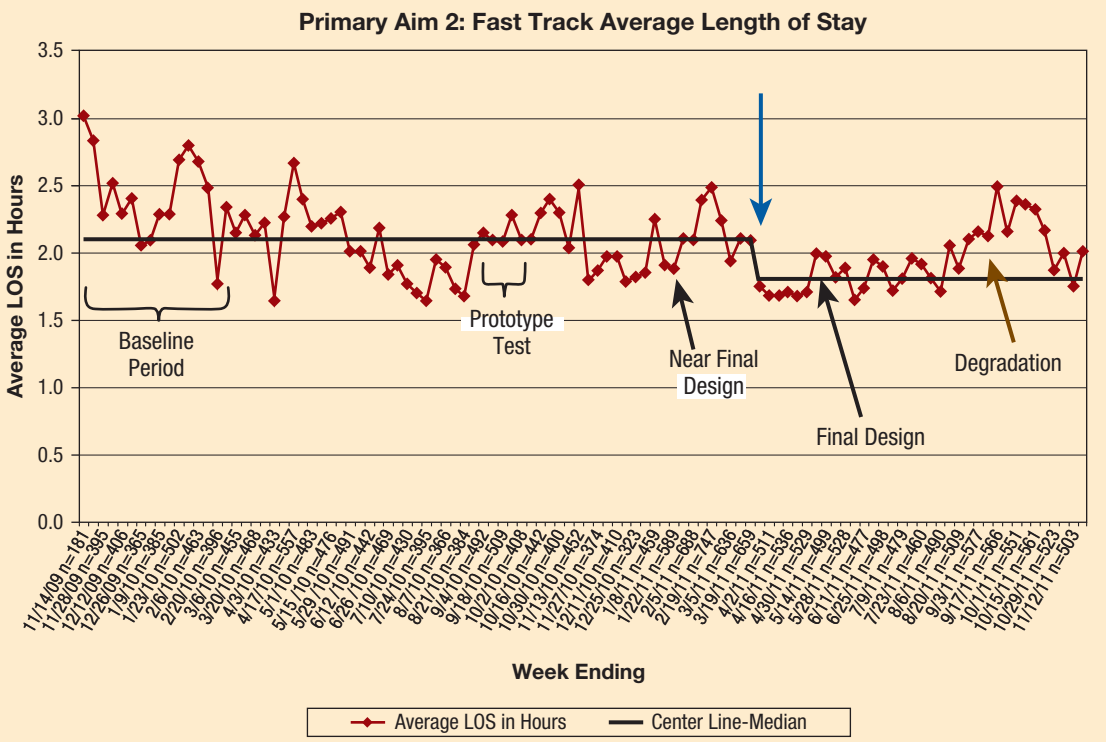
At this level, changes are tested for short periods of time. Individual tests are evaluated using process measures; often, the daily variants of the measure or ad hoc analysis are employed, particularly in the first three to six months of a project or during intensive periods of testing. Teams meet weekly and discuss tests, adapting, adopting, or abandoning tests as they are evaluated. Weekly charts are used to minimize the noise of day-to-day variance, and teams monitor these over time. Monthly charts are used to view larger trends over time and are more important in months six through twelve as changes are implemented and systems experience this change for longer periods of time. An example measure used by a team is shown in Exhibit 14.28.

Division-Level Monitoring

Individual teams organize work into 90-day blocks for planning, execution, and reporting purposes. Teams formally report after each 90-day cycle to a group of senior leaders using a pre-established reporting template. Team

Exhibit 14.28

Example of High-Level Dashboard Report Template



Source: Michael Buncher, and Kartik Varadarajan, Cincinnati Children's Hospital, Division of Emergency Medicine.

Exhibit 14.29

Example of High-Level Dashboard Report Template

Cincinnati Children's
change the outcome

Care Delivery System Dashboard
Emergency Services - Overall Front Page
Data for November 2012

Domain	Site of Care	Measures	Priority	Baseline (period)	FY2011	FY2012	Current	FY2013 Goal	Reporting Frequency	Desired Direction	Trend (each pt= 1 quarter)
Capacity Management (Access, Flow, and Productivity)		4 Rolling 12 month average LOS in hrs (discharged patients)	AI	2.9 (FY9/10)	2.69	2.78	2.8	2.40	M	↓	
		5 Rolling 12 month average LOS in hrs (admitted patients)	AI	5.24	4.57	4.52	4.5	4.23	M	↓	
		6 Left without being seen (YTD)	MO		1.56%	1.83%	1.86%	2%	M	↓	

Source: Michael Buncher, and Kartik Varadarajan, Cincinnati Children's Hospital, Division of Emergency Medicine.

presentations typically last 20 minutes and include data reporting in the form of annotated run charts for all key performance measures. Teams share special challenges and seek guidance on issues blocking progress. Teams also share goals, work plans, and predictions of key measure progress for the next 90-day cycle. A formal leadership letter follows each team presentation summarizing key discussion points and action items.

High-Level Reporting Structure and Management (Macro)

At the highest level, individual team progress is displayed on a department-wide dashboard. Aggregating each individual measure across all projects, this dashboard is designed to provide visibility to department leads, institutional stakeholders, and hospital leadership on the progress of projects. Historical data for measures, along with current performance, yearly goals, and immediate past quarterly performance, are indicated. High-level trend lines are provided, and links to individual charts are embedded within the dashboard itself. A dashboard example is shown in Exhibit 14.29.

The intent of this dashboard is to provide hospital leadership with a high-level view of recent progress on individual projects. Reporting at this level occurs monthly to department leadership and three times a year to institutional leadership. Feedback from these groups is given to teams depending on progress.

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Endnotes

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Chapter 15

Finishing the Project and Realizing the Benefits

Chapter Objectives

Core Objectives:

15-1 Summarize how to determine when a project should be terminated early.

15-2 Describe the process for terminating a project in normal completion time.

15-3 Justify the importance of the project closing activities.

15-4 Create and present a transition plan for the project, including a plan for ongoing support and sharing lessons learned.

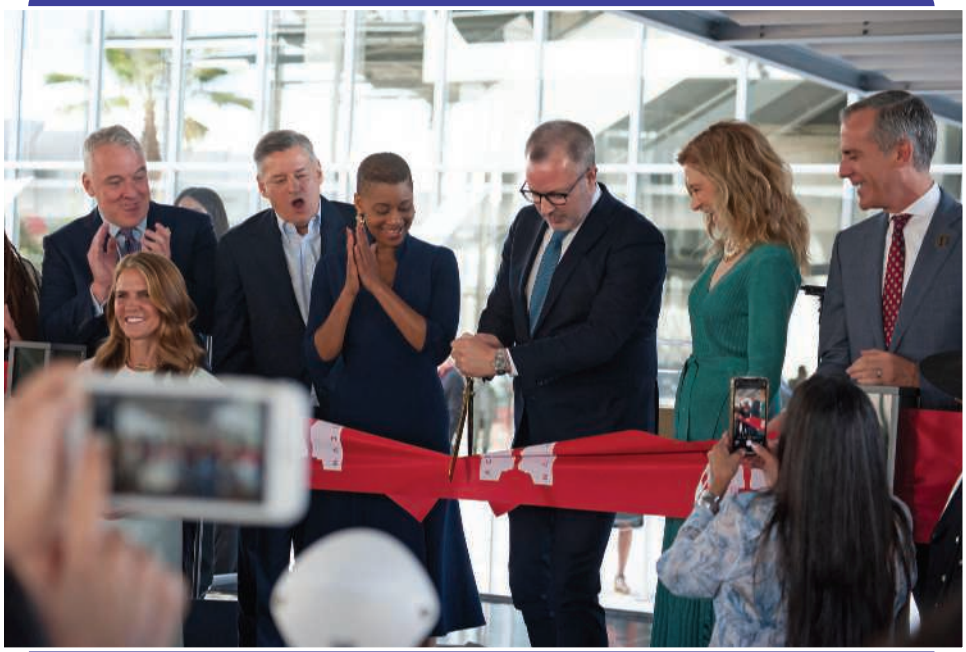
15-5 Capture, document, and share project lessons learned.

15-6 Secure customer feedback and acceptance of the project.

15-7 Close your projects administratively and technically.

Agile Objective:

15-8 Describe processes associated with capturing and using knowledge gained from Agile projects (if your team was to move together onto a new project).



Robert Landau/Shutterstock.com

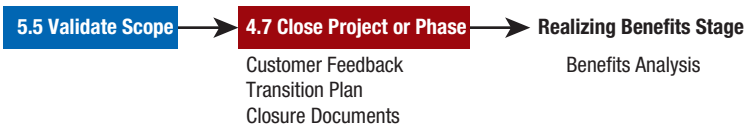
After managing a number of projects to successful completion, it wasn't until I was overseeing a project in Trinidad and Tobago that I fully realized the importance of the project team celebrating its success.

Trinidad and Tobago is the southernmost Caribbean island, seven miles off the coast of Venezuela. The client company, Trinmar Limited, was formed as a joint venture between Texaco and Petrotrin, wholly owned by the government. Texaco had recently sold its equity share in Trinmar, leaving state-owned Petrotrin to produce 35,000 to 40,000 barrels of oil per day.

Many of the rigs Trinmar inherited were over 25 years old and declining in production. In addition to building a new organization and strategy, Trinmar faced the difficult decision of whether to upgrade the existing rigs or invest in building new rigs.

Our consulting team quickly identified over 80 potential projects. Working closely with the executive team, we were able to facilitate a portfolio optimization process to establish the strategic criteria and help Trinmar evaluate, prioritize, and make decisions regarding each project. The company invested in only a few new capital projects, while focusing on monthly well output and proactive preventative maintenance, resulting in an overall increase in production.

PMBOK Guide 6e Coverage



Note: Refer to Appendix A to view the entire *PMBOK 6e* flowchart.

PMBOK Guide 7e

Domains:

- **Stakeholders**
- **Team**
- **Development Approach & Lifecycle**
- **Delivery**

Flying in from Miami to discuss the final steps of the project closing process, I was greeted at the airport by the company driver offering a gift bag. Inside was a polo shirt with a company logo and a card. The day was spent in semiformal meetings with company executives and the portfolio team. We presented and discussed the culmination of customer reviews that had been conducted throughout the project—customer feedback, areas for improvement, lessons learned, project results, and approval of the final deliverables.

The evening had a much different tone, with live music, local delicacies, and drinks flowing freely. All company executives and their spouses were joined by everyone associated with the project. Several team members brought relatives, including cousins. Partway into the evening, the CEO stood and made an announcement, describing the project's success and complimenting our partnership. He personally recognized everyone associated with the project. Each team member received an award of accomplishment and had their picture taken with the CEO. Before he left, the CEO pulled me aside and said, "Mr. Miller, on behalf of our company and country, we sincerely thank you for hosting us with this generous celebration."

When I arrived back at the hotel early the next morning after settling the evening's bill, I saw the gift bag and finally opened the card. It read "Mr. Bruce Miller cordially invites you and your guest to join us in a celebration of our project's success."

It was only later that I was sheepishly told by one of my fellow consultants that he had offered to have our company sponsor the celebration and did not have the chance to tell me in advance. But the true impact of the celebration—reflected in the sincere joy and pride of the project team members as they received the sincere thanks of their CEO—had already proven the value of the event.

—Bruce Miller, PMP, managing partner, Xavier Leadership Center, Xavier University

Projects are often started with great enthusiasm. They serve as vehicles to accomplish important strategic objectives of an organization. Many factors during the course of a project may impact its success. Regardless of the level of success achieved by the project, going out on a strong note is good for everyone involved in the project. Project completion is either pleasant and predictable or unpleasant and unexpected. In the first case, the project team successfully meets project goals. In the second case, reasons could be different: performance might be inadequate, the project deliverable may no longer be needed, or project constraints such as time or cost may prevent the team from completing the project.

Design Pics Inc/Alamy Stock Photo

A project moves into the closing stage when its customers validate that the scope is complete and accept the project deliverables. A project can close as planned or be terminated early. In either event, closing activities include securing customer feedback and approval; planning and conducting a smooth transition of project deliverables to a client or into ongoing operations; capturing, archiving, and sharing lessons learned; performing administrative closure; celebrating success; and providing ongoing support.

15.1 Validate Scope

Validate scope is formally accepting the completed project deliverables. Stakeholders validate that scope is complete with interim deliverables throughout the project and with final deliverables near the end. When the stakeholders formally accept the final project deliverables, the project completes the executing stage and proceeds into the closing and realizing stages. To illustrate, imagine you have contracted with a construction company to build a new home. Before you close on the house, you want to make sure the house has been properly finished and a certification of occupancy is obtained. Therefore, the common practice is to have a "walk-through," where as a customer you literally walk through the house with a representative from the building company. The representative points out features and describes how things work. You try light switches, look at the finish, and consider all of the things you wanted (and agreed to pay for) in the house. Often, a few little things are not yet finished, and these can form a "punch list" of items to complete. The **punch list** is the list of "work items that are identified during a final inspection that need to be completed."

If the punch list is small enough and unfinished things are minor, as a customer you agree to formally take possession of the house subject to the contractor finishing the punch list items. Once you formally agree the work is complete and agree to take possession, the house becomes an accepted deliverable.

However, if there are major concerns and/or a long punch list, you may decide not to formally accept the house until certain things are complete. Most projects are like this: The customer only formally accepts the deliverables once they are convinced they will

work as planned. At that point, the buyer provides the seller with a formal written acceptance, and the project transitions from the executing stage to the closing stage.

Project managers need to ensure that all the project work has been successfully completed. They can refer to the charter, scope statement, WBS, schedule, and all communications plans to verify that everything they committed to do is actually done. Many organizations also use project closeout checklists that itemize typical project activities and/or deliverables. These can be used to assign responsibility to each item concerning project closeout. An example of a project closeout checklist is shown in Exhibit 15.1.

Exhibit 15.1

Example Project Closeout Checklist

Project Name: Closeout Date:

Project Team:

Project Manager:
Sponsor:

Item	Who	Target Date	Completion Date
Final Certificate of Occupancy			
Punch List Complete			
Notice of Punch List Completion			
Certificate of Substantial Completion			
Utilities Transferred to Owner			
Notice to Owner on Insurance			
Facility Manual			
As-Built Drawings			
Attach Job Files to Database			
Update Projects Database			
Final Retainage Billing			
Release of Subcontractor Retainage			
Complete Subcontractor Evaluations			
Team Close-Out Meeting			
Send Out Owner Survey			
Bond Release			
Estimating Feedback Cost Report			

Approved for Closeout:

Project Manager _____ Sponsor _____ Vice President–Construction _____

15.2 Terminate Projects Early

Ideally, all projects continue until successful conclusion, with all deliverables meeting specifications and satisfying customers. However, this is not always the case. Sometimes, a project is terminated before its normal and logical completion. Early termination can be the result of a mutual agreement between the contractor and buyer. Other times it happens because of default by one of the parties (for cause), technical obsolescence, a change in needs of the customer, or for the convenience of the buyer.

Mutual Agreements On some projects, by closeout, not all of the deliverables are completed. Remaining deliverables need to be integrated into another project, stopped altogether, or continued as a lesser project or a further phase of the final project. If both parties agree to stop the project before its planned completion, a negotiated settlement may take place. If some of the deliverables or documentation is not complete, the project manager may need to negotiate with the customer. Perhaps the customer would rather have most of the capability now rather than all of it later. The project team may have made a larger-than-expected breakthrough in one area and can negotiate with the customer to deliver more in that area and less in another. Ideally, both parties agree what deliverables or partial deliverables go to the buyer and what compensation goes to the seller, and any outstanding issues are resolved. If agreement cannot be reached by direct negotiations, either legal or alternative dispute resolution methods can be used to reach a settlement. Perhaps it is in the best interest of all parties to finish the project as is and part as friends.

Terminations for Default Terminations for default occur for projects executed externally and often result from a problem with the project's cost, schedule, or performance. A buyer can also decide to terminate a project early because they have lost confidence in the contractor performing the project. Good project management practices consistently applied throughout the project can lessen the chance of early termination for cause by managing stakeholder expectations and by delivering what the customer wants, on time, and on budget.

Terminations for Convenience of Buyer Projects can also be cancelled for the convenience of the buyer. This can happen through no fault of the contractor. Sometimes, the buyer faces unexpected difficulties or changing priorities. If a customer decides to terminate a project for convenience, it invokes a contract clause. This clause normally stipulates that the contractor is reimbursed for the money it has spent up to that point and the customer takes ownership of the deliverables in whatever form they currently exist. Internal projects can also be terminated if organizational priorities change.

Project managers can pursue two avenues to possibly head off early termination. First, a project manager who has been serious about managing stakeholder relationships may be able to find other stakeholders in the customer organization or elsewhere who can provide some funds to keep the project viable—even if the scope has to be reduced. Second, the project manager can look internally to find ways of continuing with the project, but at lower cost.

Project managers serve as the strongest advocates for their projects throughout the project's life. Considering that most projects face many challenges, this unwavering support is often critical to project success. However, when a project is no longer needed or no longer viable, or it is not possible to complete the project schedule and cost targets, project managers owe honest and timely communication to their parent organization. Project managers need to present the facts of project progress and make recommendations for early termination if they feel it is warranted.

If a decision is made to terminate a project early, the project manager is obligated to communicate this decision to their team quickly and honestly. Let the team know as soon as possible and tell them exactly why the decision was made. Care must be taken to ensure that no unjust blame is placed on anyone. It is absolutely unethical to have reputations and careers suffer for a termination in which the impacted party was not at fault. Once a decision is made and communicated to terminate a project early, much of the remaining work is similar to that of a project that is completed as planned.

15.3 Close Project

As stated in Chapter 1, closing a project entails finalizing all activities needed to finish the project. The remainder of this chapter details what a project team does when finishing a project as planned. Customers are asked both to accept the project deliverables and to provide feedback. Lessons learned are collected and shared (hopefully you have been capturing lessons learned throughout the project) at the project completion. Contracts are closed. Participants are recognized, rewarded, and reassigned. Reports are created and archived. Success is celebrated, and the project team ensures that customers receive the ongoing support they need to use the project deliverables successfully.

A few key challenges arise at the end of projects. One is to keep the right workers engaged until project completion. Some of the final activities are administrative. Often, project team members are assigned to new projects that are more exciting and cause distraction.

15.3a Write Transition Plan

A project manager may decide to create a **transition plan** to help the customer to use the project deliverables successfully. Project transition plans are a sort of instruction manual of how the customer should use the project deliverables once the project team has completed its work.

The reason a project is performed is that some person or organization needs the resulting deliverables. Some project deliverables are created by one group and turned over to another group. Sometimes the group performing the project also uses the results or deliverables. In either case, a transition plan can ensure that all responsibilities are considered and all deliverables—whether complete or not—are handed over, with appropriate documentation, to the people who will use them. If any activities remain incomplete when the deliverables are transitioned, they should be itemized, and responsibility for each incomplete deliverable should be clearly identified. For example, if a home buyer wanted to close on a house before everything is complete, a punch list of remaining items would be determined, and the contractor would agree to complete them. A transition plan helps to ensure the following:

- Quality problems are avoided during the transition.
- The project deliverables move into their service or operational role.
- The needed maintenance, upgrades, and training take place.

15.3b Knowledge Management

The fourth area identified in using the balanced scorecard approach to controlling and improving projects is growth and innovation. While the portion of this pertaining to team development is covered in Chapter 5, the portion concerning knowledge management is covered here. Knowledge management should occur throughout the project life, but it may become most apparent as a project comes to an end. Project customers, whether internal or

external to a company, can provide valuable feedback concerning both the project process and results. Ask them what they think! Exhibit 15.2 is a simple form for asking project customers for their opinions.

Capture Lessons Learned **Lessons learned** are the useful knowledge gained by project team members as they perform a project and then reflect on both the process of doing the work and the results that transpired. Lessons can include what worked well that the project team members think should be copied and/or adapted for use on future work. Lessons can also include areas for which a different method may yield better results. Furthermore, information about mistakes and what went wrong should be captured to avoid repeating them again. The project meeting Plus-Delta evaluation template shown in Exhibit 6.17 is an example of capturing lessons learned at the end of

Exhibit 15.2

Project Customer Feedback Form

Customer: _____ Date: _____

	Rating	Comments
1. How would you rate the quality of our deliverables?	1 Poor Avg. 5 Excellent	_____
2. How well did we control schedule?	1 Poor Avg. 5 Excellent	_____
3. How well did we control budget?	1 Poor Avg. 5 Excellent	_____
4. How would you rate stakeholder relationships?	1 Poor Avg. 5 Excellent	_____
5. How effective were our communications?	1 Poor Avg. 5 Excellent	_____
6. Overall, how would you rate your satisfaction?	1 Poor Avg. 5 Excellent	_____
7. How can we improve?	_____ _____	

a project meeting. Lessons can also be captured at milestones and at the end of a project. On long-duration projects, it is often better to capture lessons frequently because people may not remember clearly what happened a few weeks or months earlier. Therefore, the best project managers capture lessons learned early and often. A project manager may wish to capture lessons learned first from the core project team and then from all of the stakeholders.

The first step in capturing end-of-the-project lessons learned is for the project manager to send an e-mail asking the participants to identify major project issues. Then, the actual meeting begins with each participant writing their top issues on a flip chart or other workspace where everyone can see them. Once all participants have listed their top issues, the entire group can vote on the top five (or perhaps top ten on a large project). Then the project manager can go through one top issue at a time by asking leading questions to determine what went wrong and how it might be avoided in future projects.

Likewise, the participants can list significant successes on the project and discuss factors that contributed to each. They can then ask what practices can be used to re-create similar successes on future projects.

Some organizations use a standard form for capturing project lessons learned, such as the one shown in Exhibit 15.3.

Disseminate and Use Lessons Learned The process of capturing and discussing lessons learned is valuable learning for the participants. However, for the remainder of the organization to capitalize on those lessons, a method must be established for documenting and sharing the lessons. More organizations effectively collect lessons learned than effectively disseminate and use them. One problem is deciding how to store the lessons so all workers in an organization can easily access them. Some organizations have created databases, shared folders, or wikis for this purpose.

Many organizations that do a good job with lessons learned have one person assigned to "own" and be responsible for designing and maintaining the lessons-learned database. Every project team that collects lessons then sends the new lessons to this "owner," who compares the new lessons with existing lessons and decides whether to modify, combine, or add the lessons and to possibly remove an old lesson. Thus, the database only grows when unique and useful new lessons are added. Another idea some organizations use is to have the person who submitted each lesson list their cell phone number and e-mail so another person considering the lesson can contact them to ask questions or to clarify. This is especially helpful because it is hard to document all tacit knowledge, and even if a person did so, the lessons would be so long, many people would not take the time to read them.

Coding each lesson by factors such as the type of project, stage in project life cycle or project phase, issue it concerns, and project knowledge area helps future project teams to access information easily when they search for new lessons to apply. Many organizations find that it is helpful to have a limited number of categories and have each lesson stored according to the category in which it is best suited. The ten *PMBOK Guide* knowledge areas can be a useful starting point when determining useful categories. Exhibit 15.4 shows thirteen categories used by a company along with two or three lessons in each category.

Another problem is that most people are busy and do not seek lessons learned. One way to overcome this is for sponsors to sign charters only if lessons from other recently completed projects are included or considered. That forces project teams to consider what lessons they can use.

Exhibit 15.3

Lessons-Learned Project Closing Document

D.D.Williamson
World Leader in Caramel Color

Project Number:
Closing Date:

PROJECT CLOSING DOCUMENT:

As your project comes to a close, please capture continuous improvements, lessons learned and issues to consider for future projects. Please focus on the positive aspects that would help other teams in the future and you would like to see done again (+) and on things that could be changed/improved upon in the future (Δ). These learnings will be entered into a database for future reference to help all associates.

Criteria	Plan	Actual	Learnings (+/Δ)
Outcome • Future state achieved? • Success measure (attach graph/data)			
Schedule • Milestones • Completion			
Cost (Cap Ex)			
Hours required: • Project Manager • Sponsor • Core team members • SMEs			

Risks and Countermeasures	
Anticipated	**Unanticipated**

Communication Plan Implementation	
What worked well (+)	**What did not work (Δ)**

Other Learnings	
What worked well (+)	**What did not work (Δ)**

Source: Elaine Gravatte, D. D. Williamson.

Another effective way to transfer lessons is to assign roles to people. One person in the organization can serve as process owner with responsibility to continue to improve that particular project work process regardless of what project it is performed on. Also, every project team member can have an additional role as improvement team member.

Exhibit 15.4

Lessons-Learned Example	
Accountability:	Use formal accountability and measurement systems down to the individual performance level. Ensure all team members have clearly defined roles and responsibilities.
Buy-In and Commitment:	It is helpful when directors attend project meetings. Be sure sponsor secures buy-in from other executives. Involve people with decision-making authority early in the project.
Communication:	Develop and follow a communications management plan to develop trust. Communication about change needs to be ongoing. Communication needs to be early and ongoing with all key audiences and stakeholders.
Complexity:	Many projects are multifaceted and involve numerous trade-offs that need to be managed. Project manager should attend some client meetings and sponsor should attend some team meetings to ensure integration.
Culture and Change:	Lean concepts challenge the organization's culture for data collection and transparency. Commitment to transparency and change is needed prior to project initiation. Educating leaders in change management strategies helps them deal with resistance.
Expectations:	Set and state clear expectations. Define and stay within scope. Manage expectations of sponsor, stakeholders, customers, and project team.
Meetings:	Team members should be prepared with previous meeting minutes, agenda, and project updates. End a meeting with clear action items and due dates for each team member. Plan meetings in advance to make them more efficient.
Planning:	Have well-defined roles and responsibilities. Scale planning at the appropriate level of detail. Expect many revisions.
Process Improvement:	Always discuss what we could have done better. Keep working to sustain results on completed projects. Investigate feedback provided to assure it is understood and utilized as appropriate.
Project Team:	Listen to and respect input from all team members. Let each team member be responsible for setting their own timetable to the extent possible. Determine in advance how the project team will make decisions.
Scope:	Define success early. Be specific about scope. Manage scope creep.
Sponsor Support:	Sponsors and other leaders need to publicly endorse the project and remove barriers. Speak candidly and informally to your sponsor in addition to formal reports. Obtain sponsor's signature on charter before proceeding.
Stakeholders:	Invite key stakeholders to specific meetings. Be sensitive to the political climate within your client's organization. Be open to constructive criticism and other input from stakeholders.

Some lessons learned are more effectively transferred by informal means such as conversations, unscheduled meetings, or having a project team member also serve as a team member on another project. An organization that seriously uses a lessons-learned process makes continual improvements in its project management processes and develops an organizational learning culture. Even the best lessons learned are only of value if they are used!

Closure of a project entails ensuring that all work has been accomplished, all resources have been reassigned, and all documentation is complete. The project manager and team can review the project charter, WBS, and schedule to make sure that everything that was promised was delivered. They can review the issues log and risk register to ensure all items on both of them have been addressed. They can review the communications plan to check that all the documentation was created. The customer feedback and scope verification should also be reviewed to ensure that everything was accomplished to the satisfaction of the customer.

However, closure activities can take place during the project execution as well. Many of the quality assurance activities fall in that category. Also, the project team can review the communications plan to check that all documentation was created and used as mandated, which brings a closure to the project communication plan.

15.3c Create the Closeout Report

Many organizations have formal procedures for closeout reports and archiving project records. The **closeout report** usually includes a summary status of the project that can be gleaned from progress reports. The closeout report also normally includes lessons learned. Finally, the closeout report often contains a review of the project's original justification. Did the project accomplish what it was originally approved to do? This is an important question because many projects change along the line. The exact timing, costs, and deliverables may have changed, but did the project still accomplish its goals? Finally, the project manager needs to ensure that the records are in a workable format and stored in a manner that will allow others in the organization easy access for lessons learned, financial audits, or other uses.

Capturing tacit knowledge of project team members is a critical aspect of knowledge management in projects. The team members have the best understanding of the entire project as they have committed their full time to the project and executed the project plan. As is commonly said, if anything is constant on a project, it is change. With this in mind, constructive feedback from the project team members is important (Exhibit 15.6) before the team members transition to another project.

Exhibit 15.5

Closeout Report Template

This deliverable, required for each small project, contains the project charter, the original work breakdown structure, summary of weekly progress reports, and client feedback summary.

Project Summary Report for Project _____

Task or Item Description	Satisfactory	Unsatisfactory	Comments
A. Project charter updated and included			
B. Original WBS included			
C. Weekly progress report summary included			
D. Client feedback summary included			

Exhibit 15.6

Project Team Transition to New Project

Congratulations! You and your team have successfully completed the project. Now, how can your team best transition to the next project?

Know that "[s]trengths-based project teams integrate their knowledge, skills, and practice of strengths development with project management tools and techniques, equipping the project team to **apply** and maximize their collective strengths to successfully complete their project on time, within budget, and according to the project objectives and specifications."[1] Therefore, an experienced strengths-based project team knows how to work together, considers the tasks in front of them, and leverages their strengths toward successfully completing their project. At the end of each project, it is critical that the project team captures their collective team strengths and how they effectively applied those strengths on their project.

Before starting the next project, consider this four-step process, then complete the following action plan template:

1. **Review:** Document what the team has, including their strengths (talents, skills, knowledge, areas of expertise) and project management tools. Capture what has "worked" for the team as they successfully completed their previous projects.
2. **Identify:** Look at the team's upcoming project challenges (or major tasks).
3. **Articulate:** Select the best project management tools, techniques, and strengths to use toward the challenges/major tasks.
4. **Create:** Develop an action plan for applying and tracking the project team's collective strengths.

CHALLENGE TRACKING – Action Plan Template
Applying your Project Team's Collective Strengths

Describe the new challenge (or major task) facing the project team.	What collective strengths from the team could you apply?	What are the expected results?	What support does the team need from the customer or sponsor?

So hit the ground running on your next project in just four steps: Review, Identify, Articulate, and Create an Action Plan. Strengths-based project teams finish the project strong and start the next project even stronger!

Source: Martha Buelt, MA and Connie Plowman, PMP, authors of *Developing Strengths-Based Project Teams*.

15.4 Post-Project Activities

15.4a Reassign Workers

Project managers owe the members of their team timely updates for their personnel records. In addition, project managers should provide honest recommendations, help team members secure their next assignments, and notify them rapidly of any issues of consequence. Wise project managers know it is ethical to treat their members well. If a project manager develops a reputation for taking good care of team members, it becomes much easier to recruit team members for future projects. Helping good workers secure follow-on work is one of the most important things a project manager must do toward the end of a project. Consequently, many project team members will be eager to work again for that project manager and will share their good experience with others in the organization.

It is important to understand aspirations and recognize individual strengths of all the project team members to make recommendations for future project assignments. Ideally, it would be immensely beneficial for organizations when individual aspirations

and professional goals are aligned with project objectives. The project manager plays an important role in advising senior management and support in meeting this issue of strategic importance.

15.4b Celebrate Success and Reward Participants

The successful conclusion of a project should be celebrated for many reasons. Perhaps one way to understand the many reasons is to utilize a play on the very word *celebrate:*

Challenge
Energize
Limit
Exert
Believe
Recognize
Acknowledge
Transition
Ease Stress

When people are reminded of their recent accomplishments, they realize they just met a large **challeng**e and are motivated to undertake new challenges. The team members are frequently **energized** to finish the last few administrative chores so they can move on to another project. By recognizing their accomplishments, they are now ready to say "the project is over; we will **limit** any additional work on this project." The team members **exert** themselves to finish the last few items. Celebrations can persuade members to **believe** they can do just a bit more than they might otherwise think is possible. Celebrations are excellent times to **recognize** and **acknowledge** both effort and results. Celebrations mark **transition** points as people leave one project and move on to another. Finally, celebrations of success **ease** the stress of working hard for a prolonged period of time trying to accomplish a project.

Edhar Yralaits/Dreamstime.com

When a primary project deliverable is quite visible, such as a new building, celebrating right at the project site makes sense. People feel successful partly just by observing the deliverable. When the project deliverables are less visible, project managers can still create ceremonial deliverables to demonstrate the project results. Project managers may use specially packaged software, oversized checks, posters of thanks from customers, or other creative means of visualizing project results.

15.4c Provide Ongoing Support

Ultimately, a project manager should ensure that customers can effectively use the project deliverables. This may include providing ongoing support in the forms of training, change management, and/or other services. A transition plan can guide this support. Project managers aim to create useful project deliverables on time and on budget. They want to turn those deliverables over to capable and satisfied customers who will directly provide more project work in the future and who will enthusiastically tell others how pleased they are.

15.4d Ensure Project Benefits Are Realized

Many organizations insist that project managers follow up with customers weeks or months after the project deliverables are put to use. One of the most important measures of project success is how well the customers can use the project deliverables. When considering the full impact of the project results, project managers are encouraged to consider direct customers and other stakeholders (people), and also how the results contribute to the other parts of the triple bottom line—profit for the parent company and sustainability of the planet.

15.5 *PMBOK Guide 7e*

- Stakeholders
- Team
- Development Approach & Lifecycle
- Delivery

15.5a Stakeholders

In moving from process-based standards (*PMBOK 6e*) to principle-based standards (*PMBOK 7e*), PMI makes clear that the goal of project management is to provide value to stakeholders. We may do this through deliverables, but the desired outcome is not the deliverables themselves but rather the value and benefits they afford our stakeholders. As such, satisfying our stakeholders is the ultimate way of measuring our project's success. If we have been engaging with stakeholders throughout the project and gauging their satisfaction along the way, there should be no surprises in terms of how they feel about our project at completion.

15.5b Team

A couple key actions toward the end of an iteration or project are recognizing team members' contributions and capturing retrospectives or lessons learned. Team members should be recognized for their work and any professional growth they have experienced through their time on the project.

Lessons learned can refer to both tacit and explicit knowledge and should be captured in such a way that future teams can look back to them for guidance. When done well, the organization as a whole gains knowledge through the experience of performing projects.

15.5c Development Approach & Lifecycle/Delivery

If we have been using an adaptive lifecycle, we have been working with the product owner all along to elicit what they are looking for and what features are most important. We prioritized the most important features first and strive to deliver something of value in every iteration. It is ultimately up to the product owner to decide when we have gone as far as is necessary, based on the "definition of done."

If, by contrast, we have been using more of a predictive approach to our project, we may not have much to deliver until near the end of the project. Regardless, our success will be based on whether we have the stakeholder's needs. A successful project may provide benefits to the organization that last well beyond the project's close.

15.6 Agile Projects

Organizations often create templates for closeout reports such as the one in Exhibit 15.5. See the Project Management in Action feature at the end of this chapter for more ideas on how to effectively capture, share, and use lessons learned.

Scope needs to be validated on any project so the customer can formally accept the deliverables and state their satisfaction. On Agile projects, scope is validated at every iteration and release when the team demonstrates to the customer how the items they produced work. Customers often are encouraged to play with the draft or partial outcomes and respond with their suggestions for improvement. This frequent and early direct feedback from customers and other stakeholders improves solutions and increases customer satisfaction.

If the customer decides not to continue a project, the Product Owner can use a money for nothing contract clause. The development team gets the pre-agreed amount of money

Exhibit 15.7

Comparison of Plan-Driven and Agile Approaches for Finishing the Project and Realizing Benefits

Finishing the Project and Realizing Benefits Questions	Plan-Driven	Agile
When is scope validated?	At the end of the project or phase	In demonstrations at the end of iterations and releases
How do you terminate a project early?	By mutual agreement, default, or convenience of buyer	Product Owner pivots using money for nothing or change for free contract clauses
How is knowledge management handled?	Lessons learned are captured at the end of a phase or project and added to a repository	Retrospectives are conducted at the end of every iteration
What happens to team members at the end of the project?	They are individually reassigned or disbanded	The team is reassigned as a unit
How is ongoing support handled?	Through a transition plan	Through a transition plan

so they can be paid while they seek other work. The client team gets to skip additional product features if they decide those added features will not be worth the time and money needed to create them. If the customer decides to keep working, but on different aspects of the solution, the Product Owner can invoke a change for free contract clause so the development team can keep working, but just in a different direction.

Knowledge management is hugely important on Agile projects. At the end of every two- to four-week iteration, a ceremony (meeting) called a retrospective is held to determine what worked well and what can be improved with focus on improving the current project, not just future projects. It is often the case when asked what worked well and what did not, many team members initially do not have much to offer. Therefore, many project managers will use gimmicks and jokes to liven the mood and truly get team members to share and even joke about what happened. That way, not only do good ideas surface but because most team members discussed them, there also is widespread buy-in.

At the end of an Agile project the team is often reassigned as a whole team to a new project. Some organizations call their Agile teams *squads* and keep their squads together. This allows teams to reach higher levels of team development, not having to go through team forming and storming stages with each new project. Wise Agile project leaders use the transition from one project to another to deliberately develop their teams as described in Exhibit 15.6.

The last milestone for an Agile project is delighted customers. This delight is measured not just when the solution is transitioned to the customer, but often weeks or months after the solution has been in use. Development teams need to determine what kind of support the client may find useful and how to best deliver that support. Thus, the project team keeps the same close contact and two-way communication with the client after delivering results as they did all through the project.

15.7 Using MS Project for Project Closure

15.7a Creating Project Progress Reports

As your project executes and eventually enters into the closing phase, there are likely to be multiple occasions where you must generate project reports to share with stakeholders. Often, organizations have existing templates, web portals, or other specific methods they want used to report project data. If not, you can quickly create customized or prebuilt (canned) reports within MS Project to share with project stakeholders. Using the simplified Suburban Park Homes project from Chapter 14, the following will demonstrate how to create a canned project report. However, you can easily create these reports with any MS Project file.

Create a Customizable Canned Report Although the **Report Tab** gives the project manager the option to create a new report from scratch (**Report Tab>>View Reports Group>>New Report**), it also contains a variety of canned reports from which to choose, including Resources, Costs, and In-Progress reports. There are also several Dashboard style reports that provide overviews of the project, for example, the "Project Overview" in Exhibit 15.8 and "Cost Overview" in Exhibit 15.9. The variety of canned reports, and the ability to customize them once generated, greatly reduces the need for the project manager to struggle with creating a new report from scratch. To create a Project Overview report like the one in Exhibit 15.6, do the following:

1. Click the **Report Tab>>View Reports Group>>Dashboards>>Project Overview**.

Once generated, the elements of the report can be manipulated and customized. Element position can be changed by clicking and dragging to different areas of the report, and fonts, colors, shading, and effects can be altered by double-clicking elements to open formatting

Exhibit 15.8

Project Overview

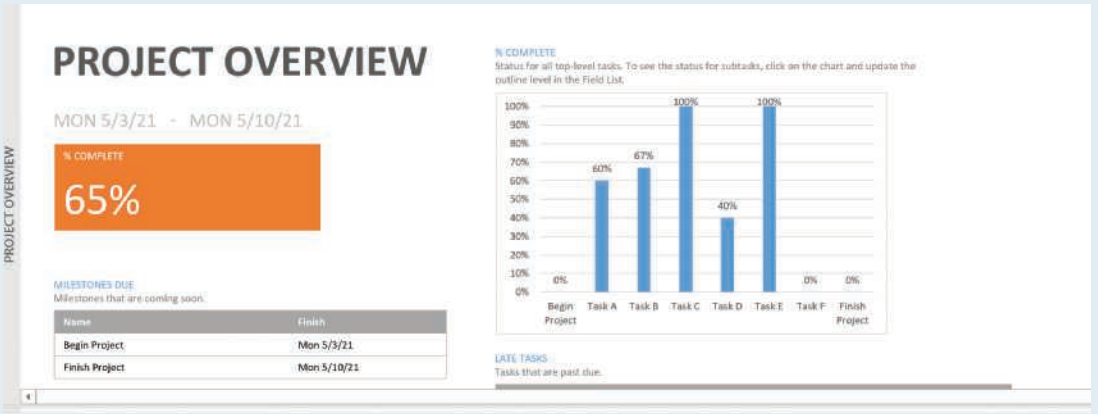
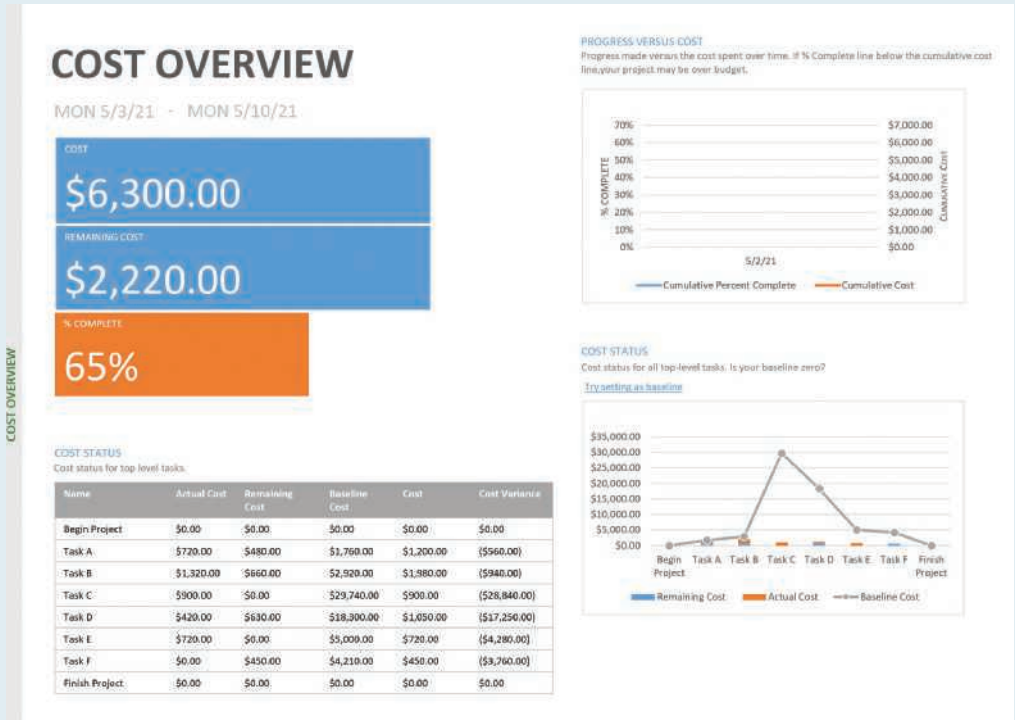


Exhibit 15.9

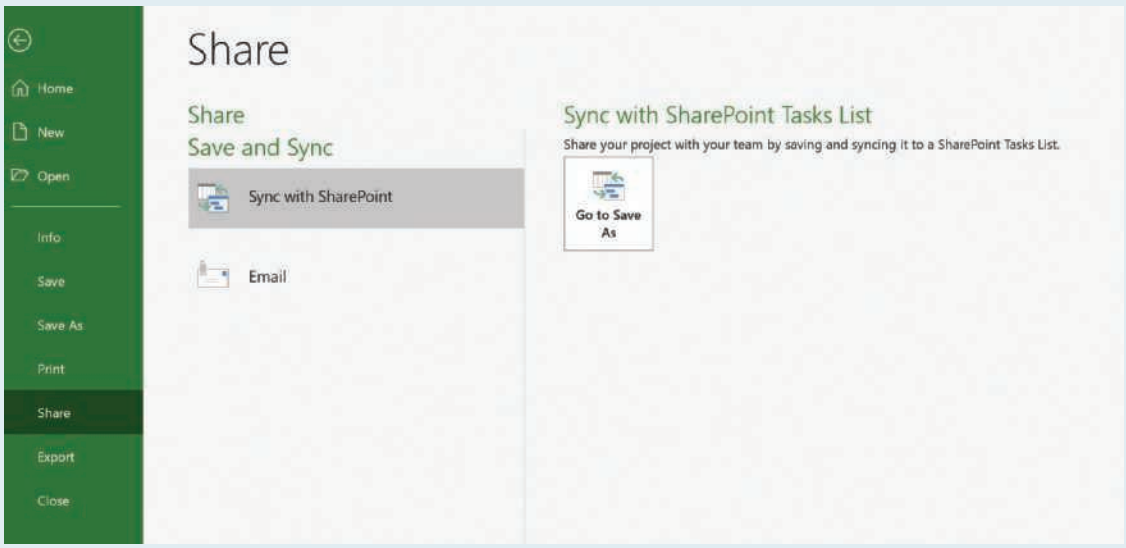
Cost Overview



panels. In addition, images from a file can be added to the report if desired. Formatting techniques and image insertion follow the same conventions as other Microsoft Office applications. Many of the controls for formatting can also be accessed from the **Design Tab** once the report is active on-screen.

Exhibit 15.10

MS Project Share Menu



Sharing Reports Once the report is formatted to your specification, it can be printed or saved as a PDF and published to e-mail, a web portal, or other location. MS Project has native support for sharing to e-mail or MS SharePoint in the **File>>Share** menu options, as seen in Exhibit 15.10.

Export a Report to MS Excel MS Project can also export a variety of reports to MS Excel. The following steps will create a customizable report, as seen in Exhibit 15.11:

1. Click the **Report Tab>>Export Group >>Visual Reports**.
2. Click the **Resource Summary Tab**>> select **Resource Remaining Work Report**.
3. Click **View**.
4. The report will build and then open in MS Excel (where it can be customized and distributed).
5. Click **Close** to close the Visual Reports dialog (Exhibit 15.12) in MS Project.

15.7b Archiving Project Work

Just as software such as MS Project can be useful in planning, managing, and reporting on a project, it also can be useful when closing out a project and leveraging the benefits for future projects. Specifically, it is helpful to complete and archive the schedule and to capture lessons learned from to the scheduling process:

1. Complete the schedule to maximize its future usefulness. This includes the following:
   - Applying performance data
   - Applying approved changes
   - Ensuring all activities are complete

Exhibit 15.11

Resources Remaining Work Report

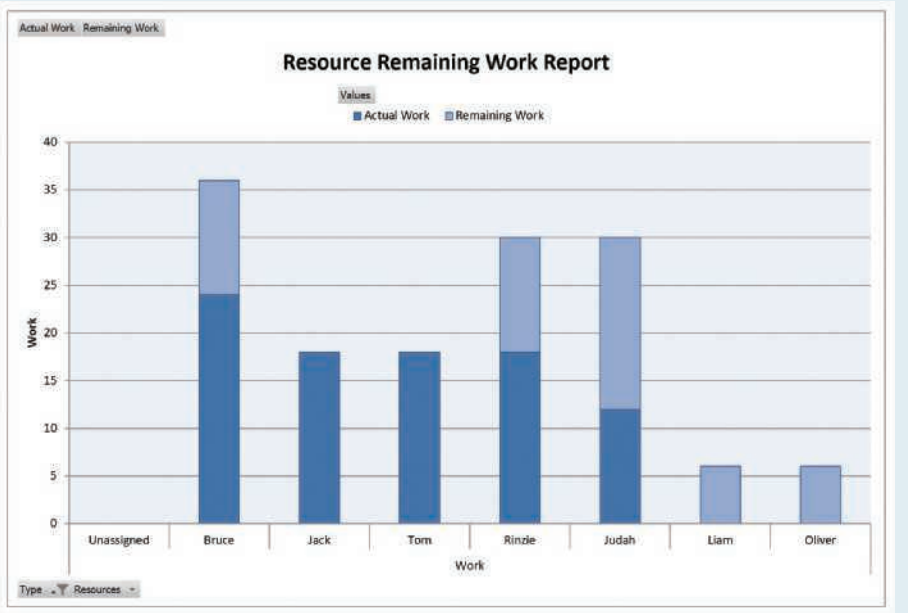
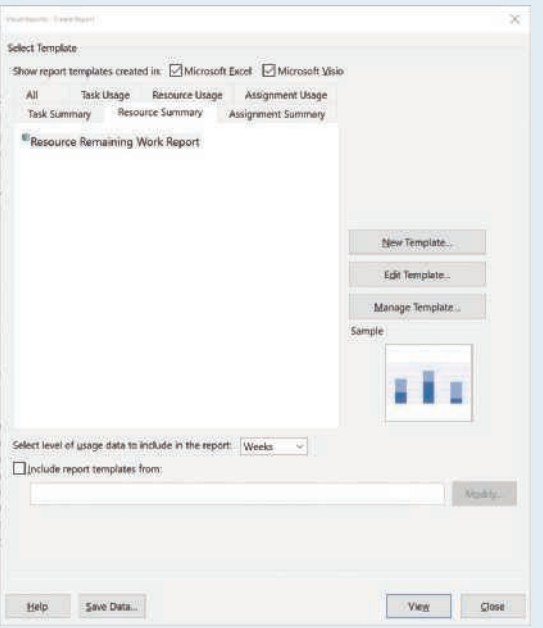


Exhibit 15.12

Visual Reports Dialog



2. Archive the schedule for use as a template or "starter" file. A good way to start a new project, particularly if it is similar in nature, is to reference or build from the last project:
   - Decide the data format—MS Project or a longer-term format.
   - Schedule data from the Gantt chart can easily be copied and pasted into applications like MS Excel or Word.
   - Decide which baselines to keep (if there were multiples due to changes).
3. Capture and publish lessons learned about the effectiveness and efficiency of the employed schedule and cost management processes. Having this data as you start your next project, particularly the lessons learned, will give you an edge. Consider retaining items such as the following:
   - Frequency and method of team member performance data collection
   - Activity duration maximum and minimum limits
   - Status reporting to stakeholders
     - Communication technologies employed and their effectiveness
     - Schedule and cost estimate accuracy
     - Max Units value—maximum availability of a resource for work
     - WBS structure

Summary

Hopefully, most projects will be successfully completed. However, some projects are terminated early either because the customer is dissatisfied or wishes to invest their time and money in a different way. Regardless of whether a project was terminated early or on time, a variety of closeout procedures are required. All activities must be completed, money paid and accounted for, documentation completed and distributed, workers reassigned and rewarded, *lessons learned* recorded, and success celebrated. A project manager would like to end a project with team members eager to work for her again and satisfied customers who will either hire the project manager (or her organization) again or direct other potential customers her way with their enthusiastic singing of her praises.

Agile project teams often stay together after a project is complete and start work on another project together. Those teams support the transition of their solution to their clients and maintain close working relationships with those clients to ensure their continued success and satisfaction.

Key Terms Consistent with PMI Standards and Guides

validate scope, 554
punch list, 554
transition plan, 557
lessons learned, 558
closure of a project, 562
closeout report, 562

Chapter Review Questions

1. When does a project move into the closing stage?
2. What is *validate scope*?
3. What is the purpose of a "punch list"?
4. What should a project manager refer back to in order to make sure that all planned work has, in fact, been completed?
5. Under what conditions can a project be terminated early?
6. If both parties agree to stop the project before its planned completion but cannot reach an agreement via direct negotiation, what can be done?

7. In what situations might a termination for default occur?
8. When might a contract clause be invoked? What types of clauses are often used on Agile projects?
9. What are customers asked to do at project closing?
10. What should be done with any activities that remain incomplete at the time of project closure?
11. What is the first step in capturing lessons learned at the end of a project?
12. How is a project transition plan similar to an instruction manual?
13. What does a typical closeout report include?
14. How can Microsoft Project be useful during the closing stage of a project?

Discussion Questions

1. Give two examples of why a project might be terminated early for cause and two examples of why a project might be terminated early for convenience.
2. How can a project manager help to prevent a project from being terminated early?
3. If an early termination of their project seems likely, what two avenues can a project manager explore to increase the likelihood of being able to continue the project?
4. A project manager is in the finishing stage of their project. It is apparent that one of the project's deliverables will not be completed before the project is wrapped up. What options does the project manager have for this uncompleted deliverable?
5. You are the project manager overseeing creation of a new website for a nonprofit food bank. What deliverables will your project produce? What value and/or benefits are you providing to your client?
6. How does celebrating the completion of a project benefit the project manager?
7. Why is it important to go through the process of closing, even for projects that are terminated early?
8. Why is it important as a project manager to help your team members secure follow-up work toward the end of your project?
9. Imagine you are creating a lessons-learned database for a recent project you have completed. What would you list as your top issues? Your top successes?
10. The sponsor of a large multiphased project you are managing suddenly decides to terminate the project early. How do you respond? How and when do you notify your team members?
11. Comparing Agile and predictive projects, name two ways project closings are similar and two ways in which they are different.

PMP Exam Study Questions

1. The process of meeting with customers and/or key stakeholders to formalize acceptance of completed project deliverables is called _____.
   a. validate scope
   b. control scope
   c. close procurements
   d. manage stakeholders
2. During which project management process would a company auditor verify that all contracts have been completed and all required purchasing standards and methodologies have been followed for the project?
   a. Validate scope
   b. Close contracts
   c. Close project or phase
   d. Conduct procurements
3. Terminations for _____ often result from a problem with the project's cost, schedule, or performance.
   a. convenience
   b. completion
   c. default
   d. confidence
4. The main objective of a project is to provide _____to the customer:
   a. deliverables
   b. lessons learned
   c. work
   d. value
5. If the buyer decides to terminate a project early, their responsibilities to the contractor are laid out in the project's _____.
   a. work breakdown structure (WBS)
   b. communications plan
   c. scope statement
   d. procurement agreement

6. During the "close project or phase" process, the team and project manager may wish to review the _____.
   a. project charter
   b. WBS
   c. risk register
   d. all of the above
7. What key input is required before a project or project phase can move to the closing stage?
   a. Accepted deliverables
   b. Change Requests
   c. Updated Issues Log
   d. Work Performance Reviews
8. The new management team at a large company has reevaluated ongoing initiatives and has identified new goals and objectives for the year. They direct that all contracts in progress be terminated immediately. This is an example of _____.
   a. management by objectives
   b. termination for cause
   c. termination for convenience
   d. termination by consensus
9. What serves as an instruction manual in order to help the customer use the project deliverables as intended?
   a. lessons-learned database
   b. transition plan
   c. executed work contract
   d. issues log
10. Contracts can be terminated early for any of the following reasons *except*:
    a. default
    b. mutual agreement
    c. convenience of buyer
    d. convenience of seller

Exercise

1. Utilizing the ideas in Exhibits 15.1 and 15.3, create a project closeout checklist for a project of one of the following types:
   - Information systems
   - Research and development
   - Quality improvement
   - Organizational change

Integrated Example Projects

Suburban Homes Construction Project

The closeout phase is often assigned less importance because project-executing organizations are in a hurry to assign resources to new projects as quickly as possible while the project is still in the closing phase. The construction industry is no different. As soon as the construction work is complete, the resources are assigned to new projects and the closeout phase is often managed by only a few people responsible for tying up any loose ends. This is often the source of customer dissatisfaction.

Project closeout consists of two important activities. First, it is about formalizing acceptance of the project or phase and bringing it to an orderly end, and second, closing the contract after ensuring its completion and then settlement of the contract.

Suburban Homes realizes that there is a scope to improve its existing closeout processes and practices for both scheduled completion and unexpected termination of projects. The existing closeout process includes the following:

- Take stock of entire project.
- Tie up loose ends.
- Write the final report.
- Ensure that documentation is in good order.
- Account for and reassign resources.
- Meet with customers to ensure their needs are addressed.
- Prepare for the handover with warranty documentation.

To improve customer satisfaction, Suburban Homes is planning to redefine its closeout process. Adam Smith has requested that you develop a checklist for closing the project. The closeout process must address the following:

- Improve morale and instill a sense of achievement in the project team.
- Enhance customer satisfaction.
- Close the contract properly to avoid future legal implications.
- Provide Suburban Homes with a detailed project cost.
- Capture lessons learned for easy retrieval and use them to improve the performance of future projects.

Heritage Arboretum Development Project

As of the writing of this textbook, The Heritage Center Arboretum has been through five releases and is planning its sixth. The rapid development that has characterized the arboretum to this point is evolving into more gradual continued development and more ongoing governance and maintenance. While the team will still plan more development, considerably more effort is being expended into creating a transition plan.

The Product Owner and the Development Team have decided it makes sense at this time to update the master plan. This will hopefully encourage all stakeholders to suggest what they feel are important considerations in ongoing development, governance, maintenance, and ongoing support.

The team is assessing the condition and measuring the size of all the designated representatives of each tree species. They are reporting those assessments and measurements along with a list of new species planted to Arbnet.org as part of the annual renewal of their arboretum status.

Questions:

1. What should the team consider including in their transition plan?
2. Besides Arbnet.org, who should the team report to and what should they report?
3. How should the team capture lessons learned?
4. Since the team is part of the Township Tree Committee, what would you suggest for their next project?

Semester Project Instructions

For your example project, complete the following:

1. Capture customer feedback concerning your project using the questions from Exhibit 15.2 or other questions of your choice.
2. Capture lessons learned from your project to date using the questions from Exhibit 15.2 or other questions of your choice. Show how you will use these lessons both to improve the remainder of your project and for the next project on which you may work. Organize the lessons into categories such as *PMBOK* knowledge areas, ideas from Exhibit 15.4, or your own ideas.
3. Create a transition plan so that the recipients of your project deliverables will be capable and enthusiastic users. Secure client acceptance of your project.

Project Management *in Action*

The Power of Lessons Learned

Projects are discrete. They have a beginning and an end, at which time the project team disbands and moves on to other things. Despite the fact there has inevitably been significant tacit learning during the project, there is often only a limited capture of this into a sharable form for future reuse. Too often, as the project team dissolves, the learning fades into the memories of individuals' minds. This makes it extremely difficult for others to benefit in the future from the insights learned. The usual excuses for this

loss echoing through the corridors include "just too hard," "not enough time," "team disbanded before we had the chance," and many more. The key error here is the incorrect assumption that learning during or from projects is an "added bonus" or a "nice-to-have luxury." This is not the case in best practice environments.

Those fortunate enough to work on a well-led project will have observed how learning is just part of how we work together. Experienced and knowledgeable project leaders understand the value in capturing ***lessons learned***, as an embedded part of normal daily activities. They engage the team to deliberately harness knowledge and highlight lessons throughout the project to provide insights and enhance performance (during the project and beyond). The value of doing this greatly outweighs the costs of implementation when it is done well and there is a culture of trust and collaboration. This capture of learning at each stage builds the capabilities of those involved and can form a knowledge base to be used by the team or by others in future stages and future projects. In some cases, this knowledge base remains only in the heads of those involved because there is no attempt to capture it in explicit form. This is a mistake because it is difficult to transfer this knowledge beyond the immediate team (although it can be to some extent if there is a culture of storytelling and low staff turnover).

There are many barriers to developing an effective lessons-learned knowledge base, and culture is often the primary villain. If people involved in the project are not reflective and not willing to invest a little time to capture and share their insights, the lessons are not captured. Equally, organizational culture influences the motivation to look at what has been learned through the discovery process *before* the project starts.

Good projects start with more questions than answers:

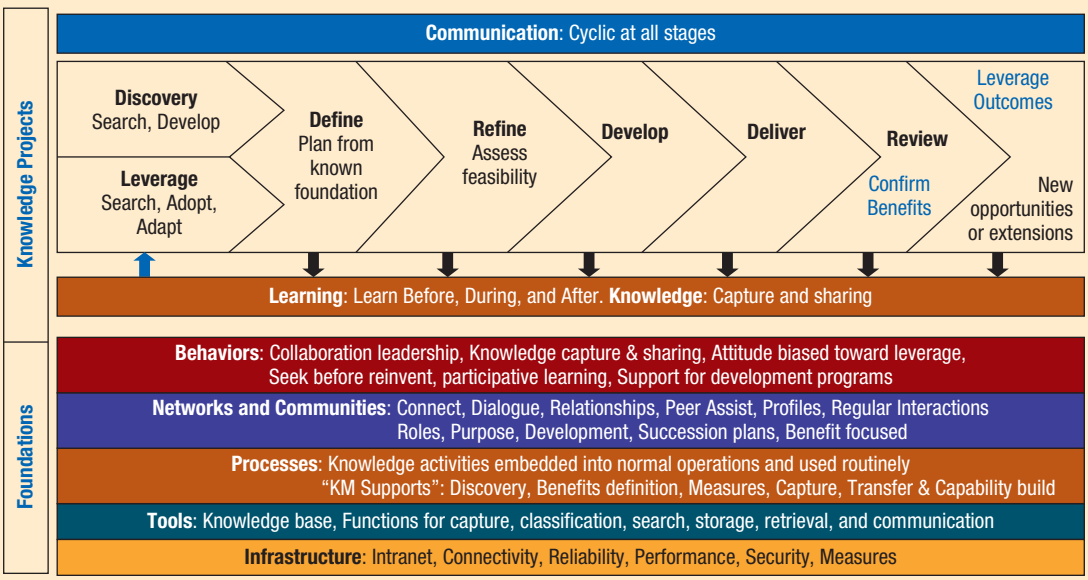
Has this been done before?

Did it work? If so, why? If not, why?

What has changed since the last time? (Something that did not work before might now—*if* the context is different.)

If we did it the same, would it still work, or do we need to adapt it?

These questions can be effectively answered only *if* there is some access to what was learned previously and those seeking answers can find it in a convenient and trusted way. This is why talking to someone you know and trust, who was actually involved in the prior project, is always the preferred option. However, in modern organizations, this is becoming increasingly difficult to achieve because of challenges such as high use of contracted team members, high employee mobility, regular restructures, incomplete records in lessons-learned



systems (which may be poorly designed), and the fast change of supporting technologies. So what other good options exist?

Some organizations (including NASA and the U.S. military) have developed quite sophisticated lessons-learned databases. These are usually supported by processes that require people to submit comments into the project systems that will help other people in the future. Over time, these *"what we know"*–based systems build a large volume of data that can be interrogated to provide relevant insights when you need them (hopefully proactively to avert a potential risk becoming an issue, rather than reactively when the issue has occurred). These systems work best when people make it part of their normal work activities to record *both* errors and their solutions as well as what went right and why. Insights of both types are essential to ongoing success. The danger of rigid processes and systems is that people do not see the value in recording something that they believe is for the benefit of unknown others in the future and will not help them (but costs them precious time). So they either just don't do it, or they record only very basic, nonspecific information that will not be particularly helpful for someone in a future context. Some organizations have a "stick" approach and link recording of quality lessons learned to performance reviews or project sign-offs. Others take a "carrot" approach and reward those who record effective lessons learned as judged by other people who found and applied the lessons.

Another approach used by an international project management organization is to combine a content-based system (as described above) and an understanding of *"who knows what."* People seeking insights can ring a "service desk" with their questions and the (experienced) employee answering the phone discusses what it is they need to find out. The service person can be from a range of backgrounds, such as a librarian, a semi-retired employee with a long history of the organization's projects, a specialist, or a nominated representative of an internal group such as a technical committee or community of practice. Sometimes these people will know the answer, but if they do not, they can find a person or document that can guide the seeker. This PM organization records all questions asked and the relevant resources that helped the seeker in a database that can be interrogated in the future. This hybrid of tacit and explicit knowledge was found to be highly effective for fast discovery of ideas. It enabled good ideas to be quickly applied elsewhere and helped to prevent reinvention of ideas already developed in other parts of the organization. It also enabled the discovery process at the beginning of projects to reduce repeating of errors from earlier experiences.

"Successful people learn from their mistakes AND the mistakes of OTHERS." —Sir John Templeton

Source: Arthur Shelley, http://www.organizationalzoo.com/about/arthur_shelley.

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APPENDIX A

PMP and CAPM Exam Prep Suggestions

Introduction

The Project Management Professional (PMP) and Certified Associate in Project Management (CAPM) are globally recognized professional certifications administered by the leading global project management professional group—Project Management Institute (PMI). CAPM is appropriate for an undergraduate with limited work experience, and PMP is appropriate for either a nontraditional undergraduate or an MBA with three or more years of full-time project management experience or its equivalent. Both test detailed knowledge of the ***Guide to the Project Management Body of Knowledge, Sixth Edition (PMBOK Guide 6e)*** and ***Seventh Edition (PMBOK Guide 7e)***.

Study Aids in *Contemporary Project Management, Fifth Edition (CPM5e)*

Several features of this text have been designed to help you study for and pass the CAPM and PMP exams. These features include the following:

- Appendix B shows where each **2021 PMP Exam Outline** Task is covered in text
- Appendix C is a detailed color-coded flowchart of all ***PMBOK Guide 6e*** processes with major outputs and most common flows depicting work and information. (This flowchart is interactive in the electronic version of the text, enabling the student to go directly to where the material is covered.)
- Appendix D is a spreadsheet showing ***PMBOK Guide 6e*** knowledge areas, process groups, and processes
- Partial flowchart of ***PMBOK Guide 6e*** processes and major outputs (color-coded by process group) and flows covered in each chapter at the start of the chapter
- Lists of ***PMBOK Guide 7e*** domains covered in each chapter at the start of the chapter
- Short description of how ***PMBOK Guide 7e*** domains impact each chapter
- Glossary of all terms defined in chapters consistent with both ***PMBOK Guide 6e*** and ***PMBOK Guide 7e*** along with the latest versions of 15 PMI standards, practice guides, and extensions to the ***PMBOK Guides***
- Agile comparison table at the start of the Agile section in each chapter
- Glossary of terms consistent with Agile practice
- Ten PMP/CAPM practice questions at the end of each chapter
- Test bank questions tagged to **2021 PMP Exam Outline** Task

General Guidance

In 2021 the PMP exam changed radically. Prior to that, the exam was tied tightly to the current *PMBOK Guide*. Now PMI has redesigned the exam and describes it in their 2021 Exam Content Outline. This may be frequently adapted, and the current version is always available for download at their website (https://www.pmi.org/certifications/project-management-pmp). Appendix B shows the current version, along with the exact chapter of this text in which each task is covered.

In short, the current version of the PMP exam is now 50% based upon plan-driven or predictive projects (mostly from *PMBOK Guide 6e*) and 50% a combination of Agile (referred to by PMI as adaptive) and hybrid projects (more from *PMBOK Guide 7e*). Further, the exam is based 50% on a process view of projects, 42% people, and 8% business environment (the latter two are based much more on *PMBOK Guide 7e*). The exam content outline breaks down the three domains of people, process, and business environment into thirty-five tasks. There will be at least one exam question on each task.

In our chapter-by-chapter suggestions at the end of this appendix, we list the tasks that are covered in each chapter. Some chapters, such as the chartering chapter, cover parts of quite a few tasks while others, such as the scheduling and budgeting chapters, focus in-depth only on one task.

You need to read through the *PMBOK Guides 6e* and *7e* carefully. Look up words you do not know because some questions are vocabulary, and the correct answers are from the *PMBOK Guide* Glossary.

Put a Post-it Note on page 25 of the *PMBOK Guide 6e* and page 14 of *PMBOK Guide 7e*. The inside front cover of ***Contemporary Project Management, Fifth Edition* (*CPM5e*)** shows the chapter in which each *PMBOK* process is covered. It is a spreadsheet mirroring page 25 of the *PMBOK Guide 6e*. Every time you study a new process, note carefully what process group and knowledge area it falls in. As you study each process, note the inputs, tools and techniques, and outputs. Many of the questions are scenario questions that deal with timing (what would you do first in a situation?). Since the output of one process is often the input to another process, noting inputs and outputs will help you identify what goes first or last. The *PMBOK Guide 6e* we have created for this text and shown in the front will help you understand visually the order in which work on projects should be accomplished.

We encourage you to use *CPM 5e* in conjunction with the *PMBOK Guide 6e and 7e*. *PMBOK Guide 6e* is the "what" of project management (essentially a 756-page encyclopedia of project management); *PMBOK Guide 7e* is the "why"—based upon principles rather than processes (shorter, at 370 pages, but still a lot to memorize!); and *CPM 5e* is the "how" with examples. For many people, the explanation of "how" along with examples make it much easier to remember all the detailed "what" and "why" that will be tested. Few people are good at memorizing encyclopedias.

Ten example questions, typical of those seen on the actual exams, are given in each chapter, with the answers, rationale, and page references in the instructor's manual. Many additional questions are in the test bank.

Always answer questions according to the PMI standard, not the way you would necessarily do it in your industry or the way an emotional appeal suggests. If one answer is a general category and other answers are specific examples, often the correct answer is the more general one. Choose the answer that is most correct most of the time, not one that is sometimes correct in certain circumstances.

Test Format

We suggest you either make a note sheet or flashcards to study. You will not be able to bring a note sheet to the exam, but you can study it right up to the moment you begin the exam. You will be given paper for notes and you may write down as many formulas as you can remember before you start with the questions. Many people write down formulas they have a hard time memorizing so they can study them just before the exam starts.

At any place in the *PMBOK Guide* where you find a list of three, the question might ask which of the following is *not*. … Therefore, when studying inputs, tools, and techniques, or outputs of a particular process, try to remember any time there is a list of three items.

If a question is long, read the last sentence first. That is the question and the rest is the background.

Most questions are multiple-choice with four possible answers. Answer all questions because the only thing that is scored are correct answers. When in doubt, take a guess instead of leaving it blank. For each question, you can answer and move on, answer and mark it to return later, or not answer it. We suggest that you never return to the questions you feel confident enough to answer without marking. A few questions use different formats including multiple correct responses, matching, and drag-and-drop. There are 180 questions for the PMP exam and 150 questions for the CAPM exam. You have 230 minutes for the PMP and 180 minutes for the CAPM. In both cases, it should be more than enough time. There are two 10-minute breaks—one after 60 questions and the other after 120 questions. You are not allowed to return to the questions you answered before the breaks.

PMBOK Guide 7e

Chapter 1, Section 6 of this text is an overview of *PMBOK Guide 7e* and the *Standard for Project Management* that accompanies it. Be sure to understand both, including the twelve principles and the eight domains. All fourteen other chapters of this text briefly describe the impact this new version of the *PMBOK Guide* has on the material covered in that chapter.

PMBOK Guide 6e

Each of the ten knowledge areas includes at least one planning process. Several include one managing process from the executing group, and all include at least one process in the monitoring and controlling process group. Make sure you understand the subtle differences between the monitoring and controlling processes in knowledge areas that include both such as quality. The key to understanding the difference is there are some things the project manager can directly control, but there are plenty of other things the project manager can only influence (monitor).

Many processes occur in parallel with other processes and/or are repetitive. However, some processes clearly occur before others. Know the order! The partial flowcharts at the start of each chapter and the comprehensive flowchart on the inside back cover will help you to visualize the order.

Most knowledge areas include quite a bit of vocabulary. You not only want to remember the official *PMBOK Guide* definition but also what each really means when it is applied. *CPM* helps with the application. All definitions in the *CPM* glossary are consistent with *PMBOK Guide 6e* and *7e*.

Several knowledge areas refer to audits. In this context, an audit is meant to improve the way work is performed.

The *PMBOK Guide* uses the term *register* for a repository of information. For example, the stakeholder register is the recorded information about project stakeholders—who they are, what they want, how they are prioritized, and so forth. Risks are recorded in a risk register in a similar fashion. The repository for issues, on the other hand, is called an *issue log*. In yet another repository example, requirements are often stored in a requirements traceability matrix. In each case, think of these repositories as living documents that change with project progress and additional information. Know the types of information that each may include. We now include a short summary of each knowledge area.

Project Integration Management

Integration describes how decisions in one aspect of a project often impact another area, such as when a change is proposed, it may impact cost, schedule (time), and scope. In fact, if a question deals with one of those three items (such as cost), the correct answer may include the other two. One way to consider integration is to imagine a very large project in which different people plan portions, so integration is used to make sure the entire plan makes sense. The last integration process—*Closing the Project*—ends with capturing lessons learned. *Develop Project Charter* is the integration process that occurs during initiation. Chapter 3 of *CPM* is all about writing and approving the charter.

The first process overall is *Develop Project Charter*, and the last process overall is *Close Project or Phase*—both of which are integration processes. Capturing lessons learned and archiving or distributing them are both part of an executing process called *Manage Project Knowledge* and the last activity (Close Project or Phase) to be performed is part of project closure.

There may be multiple questions on the project management plan. This is the umbrella plan with many subsidiary plans such as budget and schedule. You can note two-headed arrows between the process of developing the project management plan and planning all of the subsidiary portions of the plan. You will also note arrows from developing the project management plan into many of the executing processes. A plan is baselined at the end of planning when all parties agree on the scope, schedule, and budget. Any changes after that time should go through an integrated change control process. Of course, if using Agile, the overall scope is only confirmed at a high level, and the scope for a given iteration is confirmed just prior to the start of that iteration. Change is greatly resisted within an iteration.

Project Scope Management

Scope is defined by what is and what is not included in the project. Product scope is the features and functions of the project deliverables (products, services, or results). Project scope is the work performed to deliver the product, service, or result with the specific features and functions.

A work breakdown structure (WBS) is like the outline of the project. It includes all of the project deliverables, including interim and detailed deliverables—everything that needs to be produced. It does not include the work activities needed to create those deliverables. *Define Activities* is considered a schedule management process. The work package is the lowest level on the WBS.

Scope, time, and cost are all highly interrelated. All have multiple planning processes and one monitoring and controlling process. Scope is defined incrementally on Agile projects.

Project Schedule Management

Rolling wave planning is a form of progressive elaboration in which the near term is planned in great detail, while the latter parts of the project are planned in a much more general fashion, with the intent to plan them more carefully when the time draws nearer. Agile is a form of rolling wave planning that is gaining popularity. Agile notes are included in one section of each chapter of this book.

Be able to schedule using activity on node (AON) (also called precedence diagramming method or PDM). Also know how to use alternative dependencies of SS, FF, and SF and lead and lag. Know the difference between free float (no other activity is impacted) and total float (the entire project is not impacted, but the next activity in line is). Be able to compute the critical path using the two-pass method so you can answer questions regarding float. Also be able to compute the enumeration method so you can more quickly answer what-if questions, such as *what will happen if an activity now takes five days instead of eight?*

Crashing speeds up the schedule by performing certain critical path activities faster than normal, but it usually costs more money. Fast-tracking speeds up the schedule by performing activities concurrently that are normally performed in sequence. This often adds risk to the project.

Resource optimization techniques include resource leveling and resource smoothing. Know the difference! Resource leveling postpones certain noncritical activities so a resource is not overloaded, but this often requires more time to complete the project. Resource smoothing also reduces the demand for overloaded resources, but not beyond the point where the project schedule would need to be lengthened.

Network diagrams, Gantt (bar) charts, and milestone schedules are all approved means of showing project schedules.

Project Cost Management

Know how to construct a time-phased, bottom-up project budget and the difference between various means of estimating costs and needed reserves, as shown in Chapter 8. Know how to calculate earned value and the definitions of all of the terms in Chapter 14. Be prepared that you may see questions that ask you to calculate Estimate to Complete in different ways depending on whether the work to date is deemed to be representative of future work or not. Know common financial terms such as those in Exhibits 2.9 and 10.1.

Project Quality Management

Manage Quality is a forward-looking, executing process and gives stakeholders confidence the project team can do the work correctly. It is proactive and includes management systems and audits to ensure people are working correctly. *Control Quality*, a monitoring and controlling process, is technically looking at deliverables and asking if they pass specific standards. It looks backward to determine if the outputs are good enough. Both *Manage Quality* and *Control Quality* are needed. In addition to what is in the *PMBOK® Guide*, know the quality tools and the quality control terms. The project manager has ultimate responsibility for quality (and almost everything else). In addition, each person has primary responsibility for their own work. Prevention keeps errors out of the process, while inspection keeps errors away from the customer.

Project Resources Management

All of Chapter 5 in *CPM* and parts of Chapter 9 apply to Project Resources Management. There are multiple lists in this knowledge area, so try to understand the differences among items dealing with topics such as teams, power, conflict, and negotiation, as shown in the exhibits.

Know the differences between functional, matrix, and projectized forms of organization. A simple summary is in Exhibit 4.6. Make sure you understand the differences between various roles, as described in Chapter 4. While roles can be shown on an organizational chart or described in a document as text, they are often also shown in a matrix. A matrix may be called a RAM or RACI. Know the stages of team development. Scenario questions are often used to distinguish stages. Know forms of power and conflict resolution.

Project Communications Management

According to PMI, project managers spend about 90 percent of their time on communication in one way or another. Know how to calculate the number of communication channels based upon the formula channels $= (n^2 - n)/2$, when n is the number of people on a team. Authorization to perform work is always a formal communication, but it need not be

written. Communication can be more complex in a matrix organization. A war room is a single location where the project team can keep their stuff and use it for any purpose. Exhibit 14.6 is an easy visual to help understand performance reporting.

Project Risk Management

The purpose of project risk management is to reduce the risk to a level acceptable to decision-makers. It is *not* to eliminate all risks. Consider both positive risk (opportunity) and negative risk (threat). The most risks occur at the start of the project life cycle, but each risk costs the most money if identified late in the life cycle after decisions are already in place. In charters, risks are identified, qualitative analysis is performed by asking the probability and impact of each, and response planning is conducted for major risks. Qualitative analysis is performed on every project. If that is not enough, quantitative analysis is also performed, and you should be familiar with a few of the most common types. All risk management processes occur throughout the project life cycle.

Project Procurement Management

Procurement in the sixth edition of the *PMBOK Guide* includes only three processes of *Plan, Conduct,* and *Control Procurements*. Understand contracts, both in general and each specific type. Understand the differences among various procurement documents. The RFI is *not* used to solicit an offer, while the others are. Sole source is when only one vendor is available, but single source is when a decision is made to select a specific vendor. Know the unique contract clauses sometimes used in Agile projects.

Project Stakeholder Management

The *PMBOK 6e Guide* process of *Identify Stakeholders* includes identifying each potential stakeholder, determining what interest(s) each has in the project, and prioritizing the long list of stakeholders so more attention can be paid to the most powerful and important stakeholders. This occurs very early as part of the initiating process group. Most projects have multiple stakeholders with conflicting desires, and the increased focus created by establishing stakeholder management as a distinct process group reflects this.

Ethics

Know the code of Ethics and Professional Responsibility very well! There are more questions per page on this short document than on any other topic. You may download this document from http://www.pmi.org/about/ethics/code for free. It has aspirational standards as ideal goals and mandatory standards as bare minimums in the four areas of responsibility, respect, fairness, and honesty.

Chapter-by-Chapter Suggestions

Since you are using this textbook to learn project management, we feel it is a great resource to study for the PMP exam. For each chapter, we list general study suggestions and specifically mention the exam content tasks that are included. We suggest you make sure you feel you can state something about each exam content task listed. In addition to the general suggestions for study in each chapter, be sure to read the short section on *PMBOK Guide 7e* impact on that chapter and the exhibit showing the differences between plan-driven and Agile practices on the content of that chapter.

Chapter 1: Introduction to Project Management

Exam Content Outline topics:
Broad introduction to many topics needed to understand for the exam including, *PMBOK 6e* and *PMBOK 7e* structures, Agile introduction, and comparison of predictive and Agile project roles.

Chapter 2: Project Selection and Prioritization

Exam Content Outline topics:
Negotiate project agreements, deliver business value with urgency, engage stakeholders, plan and manage budget and resources, plan and manage procurement, and establish project governance.

Chapter-specific suggestions:
You won't see a whole lot of questions on either of these tests pertaining to portfolio or program management, since these happen at an executive level, beyond the

purview of individual projects or project managers. At the same time, it is imperative that you understand the interrelationship of portfolio and project management, as well as how they relate to an organization's mission: the mission leads to strategic objectives, and projects are the primary vehicle through which these objectives are achieved.

As with other chapters, make sure you are familiar with the terms—especially *statement of work* and *business case*—and be prepared to put them into context with real projects. You will ultimately need to know how to calculate net present value. Finally, be familiar with the common causes of project failure and how to prevent them.

Chapter 3: Chartering Projects

Exam Content Outline topics:
Lead a team, address and remove obstacles for team, negotiate project agreements, build shared understanding, define team ground rules, deliver business value with urgency, manage communications, assess and manage risks, engage stakeholders, plan and manage budget and resources, plan and manage schedule, plan and manage quality of products/deliverables, plan and mange scope, integrate project planning activities, determine appropriate project methods, establish project governance, manage project issues, ensure knowledge transfer, evaluate and deliver project benefits and value.

Chapter-specific suggestions:
Whether you are studying for the CAPM or PMP exam, you will likely see many questions pertaining to the order in which processes occur and deliverables are produced throughout the lifecycle of a project. In this chapter about the project charter, it is important to remember that the various sub deliverables and processes are all encompassed within the *Initiating* phase. In fact, it is the ratification of the project charter that allows us to proceed from the *Initiating* to the *Planning* phase.

In other words, even though the charter and its components represent a high-level project plan, you should think of this as the "preplanning" because it is still in rough-draft form and will be significantly expanded upon during the *Planning* phase. So, if you plan to sit for one of these tests, make sure you know the logical order of the steps involved in creating a charter, but also keep in mind that every single one of these precedes the more-detailed processes to come.

Chapter 4: Organizational Capability: Structure, Culture, and Roles

Exam Content Outline topics:
Determine appropriate project methods, establish project governance, plan and manage project/phase closure or transitions, evaluate and address business changes for impact, and support organizational change.

Chapter-specific suggestions:
When it comes to studying for the CAPM or PMP exams, make sure you know the Project Management Code of Ethics & Professional Conduct inside and out. This is one of the few things *not* found in the *PMBOK Guide* itself but can be accessed directly from the PMI website. While only eight pages long, this code generally shows up multiple times on either test, thus providing a great deal of "bang for your buck" in terms of studying.

In this chapter, we highlight the fact that a project's life cycle is often industry-specific or even unique to an organization. Regardless, PMI has identified five generic Process Groups, representing the stages that are typical of most projects. These include *Initiation, Planning, Executing, Monitoring & Controlling, and Closing*. You will be expected to know these in a great deal of detail, including inputs and outputs of each stage; into which process group and knowledge area each of the forty-nine individual processes fit; and how these processes interact with one another. This flow is shown graphically on the inside back cover of this book. This will require a tremendous amount of studying and should not be underestimated.

Chapter 5: Leading and Managing Project Teams

Exam Content Outline topics:
Manage conflict, lead a team, support team performance, empower team members and other stakeholders, ensure team members and other stakeholders are trained, build a team, address and remove obstacles for team, negotiate project agreements, build shared understanding, engage and support virtual teams, define team ground rules, use emotional intelligence to help team, and establish project governance.

Chapter-specific suggestions:
While PMI absolutely recognizes the importance of the "soft skills" regarding management and communication, you shouldn't expect to see many—if any—questions

directly from the lists in this chapter. Rather, you will be expected to understand the best practices we describe and to apply them to mock situations. One type of question you will see in many guises has to do with change requests. Whether a customer, sponsor, or team member requests a change, if you have already completed your project management plan, any change must go through a change request process. In other words, it may be your natural instinct to want to please the person making the request—especially if the change seems small—but the best practice/correct answer will always be to go through the change control process (more information on this is provided in Chapters 7 and 14).

Other test questions you may see from this chapter include the stages of team development—forming, storming, norming, performing, and adjourning—and both capturing and utilizing lessons learned.

Chapter 6: Stakeholder Analysis and Communication Planning

Exam Content Outline topics:
Empower team and other stakeholders, ensure team members and stakeholders are trained, collaborate with stakeholders, build shared understanding, mentor relevant stakeholders, manage communications, engage stakeholders, manage project issues, and evaluate and deliver project benefits and value.

Chapter-specific suggestions:
There is a great deal of overlap between Project Communications Management and Project Stakeholders Management. Besides developing the project charter—which is like a mini pre-plan that gives the project manager and team the authority to begin planning in more detail—the only other activity that takes place during the Initiating Process Phase is *Identify Stakeholders*.

The main work of the next phase—the Planning Process Group—is creating the Project Management Plan. The project management plan is the aggregate of plans from each of the ten knowledge areas, including the Communications Management Plan and Stakeholders Management Plan. As always, you will need to be familiar with the inputs, tools, and techniques, and outputs that go into each.

Chapter 7: Holistic Scope Planning

Exam Content Outline topics:
Deliver business value with urgency, plan and manage quality of products/deliverables, plan and manage scope, manage project changes, evaluate and deliver project benefits and value, and evaluate and address business changes for impact.

Chapter-specific suggestions:
It has been said that the discipline of project management lends structure to common sense. Nowhere is this truer than with scope planning. If you can remember to conduct your planning with the end goal in mind, many of the processes and activities in this chapter will seem intuitive. Another way of saying this is that you will work backward from the outcome you desire (a successful product and/or project).

Begin by identifying what it would take for your product—and your project—to be successful. Be sure to include your customers and end users in making this determination (*Collect Requirements*), as well as subject matter experts who can speak to the technical expertise needed and the feasibility of the project plan. Identify the final deliverables, as well as any important interim deliverables. For Agile projects, this is initially more about identifying problems that need solutions rather than identifying specific deliverables.

Discussing these deliverables and what it will take to produce them is a good chance for the team to further *Define Scope*, or determine what is included—and *not* included—in your project.

Once you have the main deliverables, you will use the process of decomposition to break them down into smaller pieces, thus creating a Work Breakdown Structure. It is important to remember that the WBS deals with *things,* not activities (though on a very small project, these are often planned concurrently). The lowest level of the WBS is the "work package," which is small enough that it can be easily planned and overseen by one person.

To be sure, this is an oversimplification of everything that goes into planning scope, and you will need to be fluent in all the activities and processes in this chapter in order to pass a CAPM or PMP test. But it can be helpful to remember that there is an organizing structure to all this work—one that begins with the end result in mind.

Chapter 8: Scheduling Projects

Exam Content Outline topics:
Plan and manage schedule

Chapter-specific suggestions:
The scheduling portion of Project Management has been around for decades and is well established. It is also easier to quantify than some of the other knowledge

areas, so you should be prepared to make calculations based on a variety of information, including Start and Finish times, activity durations, and logical dependencies. Make your decisions and calculations with an eye toward maintaining the critical path above all else, since delays in the critical path will put your entire project behind schedule.

Chapter 9: Resourcing and Accelerating Projects

Exam Content Outline topics:
Lead a team, build a team, engage and support virtual teams, deliver business value with urgency, plan and manage budget and resources, plan and manage schedule, and plan and manage procurement.

Chapter-specific suggestions:
Keep in mind how resourcing a project ties into the other project work you have completed so far. When resourcing your project, a good starting place is to take the WBS you created and use it to identify resources needed (human and other). Make sure you are very familiar with all steps of *Plan Resource Management,* as well as two important deliverables: the staffing management plan and resource breakdown structure (RBS).

As is the case with scheduling and budgeting, resourcing projects is a hands-on skill, and you should anticipate that the majority of resource questions you may see will be exercises. Since the critical path determines the project's duration, you will need to know all things pertaining to it—especially how to calculate it and how, if required, to reduce the critical path (fast-tracking or crashing).

Chapter 10: Budgeting Projects

Exam Content Outline topics:
Plan and manage project budget and resources

Chapter-specific suggestions:
You are likely to see at least a couple of questions pertaining to methods of cost estimating. Be able to identify parametric, analogous, and bottom-up estimating by description or with an example. Make sure you know the relative benefits and weaknesses of using each.

While budgeting occurs in countless domains, budgeting for projects is different in several ways from budgeting for ongoing operations. Specifically, you will need to familiarize yourself with the "S curve" of project expenditures and predict and answer questions about cash-flow problems that may result. Also, make sure you know the difference between contingency and management reserves and who controls each.

Chapter 11: Project Uncertainty Planning

Exam Content Outline topics:
Address and remove obstacles for team, assess and manage risks, manage project changes, manage project issues, and evaluate and address business changes for impact.

Chapter-specific suggestions:
As a project manager, your goal is to complete your project on time, on budget, at an agreed-upon level of quality, and to the satisfaction of your client and other stakeholders. Uncertainty, ambiguity, complexity, volatility, and risks are anything that could impede—*or help*—you in this goal. Remember that, according to the Project Management Institute, project risks can be negative or positive. The strategies for dealing with negative risks, or threats, are as follows: avoid, transfer, mitigate, research, and accept. Conversely, the strategies for dealing with positive threats, or opportunities are the following: exploit, enhance, share, research, and accept.

In creating a risk management plan, the first step is to identify all possible risks. While it may seem counterintuitive (and, therefore, you may see a question or two about it on your CAPM or PMP test), you do not want to plan for all risks. That is why your next step is to categorize them based on both probability of occurrence and potential impact. Only the risks that emerge as "major" based on these two criteria are actively planned for. All projects make use of qualitative planning, and larger projects often proceed to quantitative planning (it may help you to remember that the "l" in *qualitative* comes alphabetically before the "n" in *quantitative)*. You won't need to be an expert, but you should be familiar with the most common quantitative assessments.

Chapter 12: Project Quality Planning and Project Kickoff

Exam Content Outline topics:
Deliver business value with urgency, engage stakeholders, plan and manage schedule, plan and manage quality of products/deliverables, plan and manage scope, integrate project planning activities, manage project changes, establish project governance, ensure knowledge transfer, and plan and manage project compliance.

Chapter-specific suggestions:
You are likely to see a few elements from this chapter on your test. One of the paramount things to remember is the difference between quality assurance (forward-looking/preventative) and quality control (backward-looking/inspection) and how a quality policy or plan can integrate the two.

Understand how to follow an improvement model such as PDCA or DMAIC and know the difference between common causes and special causes of variation. Be familiar with the contributions of some of the thought leaders in the field of quality—especially Deming and Juran. Finally, know what ***Six Sigma*** means and why it is relevant and be prepared to use its standard deviation formula to determine whether a process is in control or out of control. We delve into more specific quality tools in Chapter 14.

Chapter 13: Project Procurement and Partnering

Exam Content Outline topics:
Manage conflict, empower team members and other stakeholders, negotiate project agreements, collaborate with stakeholders, build shared understanding, mentor relevant stakeholders, engage stakeholders, plan and manage procurement, and establish project governance.

Chapter-specific suggestions:
Some of the questions you will see on the material covered in this chapter will be at least partly based on vocabulary. For example, there are several types of contracts, and some of their names are similar, but you need to completely understand the difference between terms such as *cost-plus-award-fee* and *cost-plus-incentive-fee*, as well as when each type of contract may be used and how each type of contract divides risk between buyer and seller.

Likewise, similar terms are used in the seller selection process, and you will need to know the difference between a Request for Information (RFI), Request for Quotation (RFQ), and Request for Proposal (RFP) and to apply that knowledge to a variety of questions/problems. Be sure to understand the Agile contract clauses that may be used.

Chapter 14: Determine Project Progress and Results

Exam Content Outline topics:
Deliver business value with urgency, manage communications, assess and manage risks, engage stakeholders, plan and manage schedule, plan and manage quality of products/deliverables, plan and manage scope, manage project changes, manage project artifacts, establish project governance, manage project issues, plan and manage project compliance, evaluate and deliver benefits and value, and evaluate and address business changes for impact.

Chapter-specific suggestions:
You can expect to see several questions using Earned Value Management (EVM) on either exam, and you will not be provided with the formulas. We recommend that you memorize all of the following formulas and write them down on the blank paper you are provided as soon as you enter the testing room so you can refer to them throughout the test:

CV (cost variance) = EV − AC
SV (schedule variance) = EV − PV
CPI (cost performance index) = EV/AC
SPI (schedule performance index) = EV/PV
ETC (estimate to complete) = (BAC − EV)/CPI = BAC − EV
EAC (estimate at completion) = AC + ETC
TCPI (To-complete performance index) = (BAC − EV) / (BAC – AC)

You will need to apply these formulas for the test, so refer back to Section 14.4c of this book to review abbreviations, when to use each formula, and how to interpret the results. In addition to EVM, you can expect at least a few questions pertaining to the *Integrated Change Control* process. Remember that once the project management plan is approved and you have a baseline, any proposed change to schedule, budget, or scope needs to go through the change control process. With Agile projects, almost no changes are allowed within an iteration, though substantial changes to the project plan can be made between iterations.

Chapter 15: Finishing the Project and Realizing the Benefits

Exam Content Outline topics:
Deliver business value with urgency, manage project artifacts, ensure knowledge transfer, plan and manage project/phase closure or transitions, and evaluate and deliver benefits and value.

Chapter-specific suggestions:
Fewer than 10 percent of the PMP test questions concern the Closing Process Group. That said, there are no formulas and only a handful of processes associated

with closing, so you should do well if you can remember a few important things.

First, all closing activities—whether contractual, administrative, or other—fall under the *Close Project or Phase* process.

Second, PMI likes to stress knowledge management, so remember the importance of capturing, storing, and disseminating lessons learned (this can and should happen throughout the project). This needs to take place whether or not the project reaches a successful conclusion.

Third, *Close Project or Phase* is the very last step of a project. It cannot be completed until *everything else* has taken place. *Close Project or Phase* is also known as the Administrative Close, since it involves gathering and storing lessons learned, writing reports, and updating project documents. Whether or not a project reaches a successful conclusion, recognize that the project manager often has limited authority and that the sponsor should be involved in *Close Project*.

Ending Suggestions

Do not underestimate either the CAPM or the PMP exam! The first-time pass rate typically is between 50 and 70 percent, and that includes many people who have taken exam-prep courses. However, we have taught many of these prep courses and many of our students have successfully passed both exams using these suggestions. We are repeatedly told that by comparing the "what" from *PMBOK Guide 6e* and the "why" from *PMBOK Guide 7e* with the "how" and examples from this book (*Contemporary Project Management*), people felt very well prepared. Good luck and let us know how you did!

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APPENDIX B

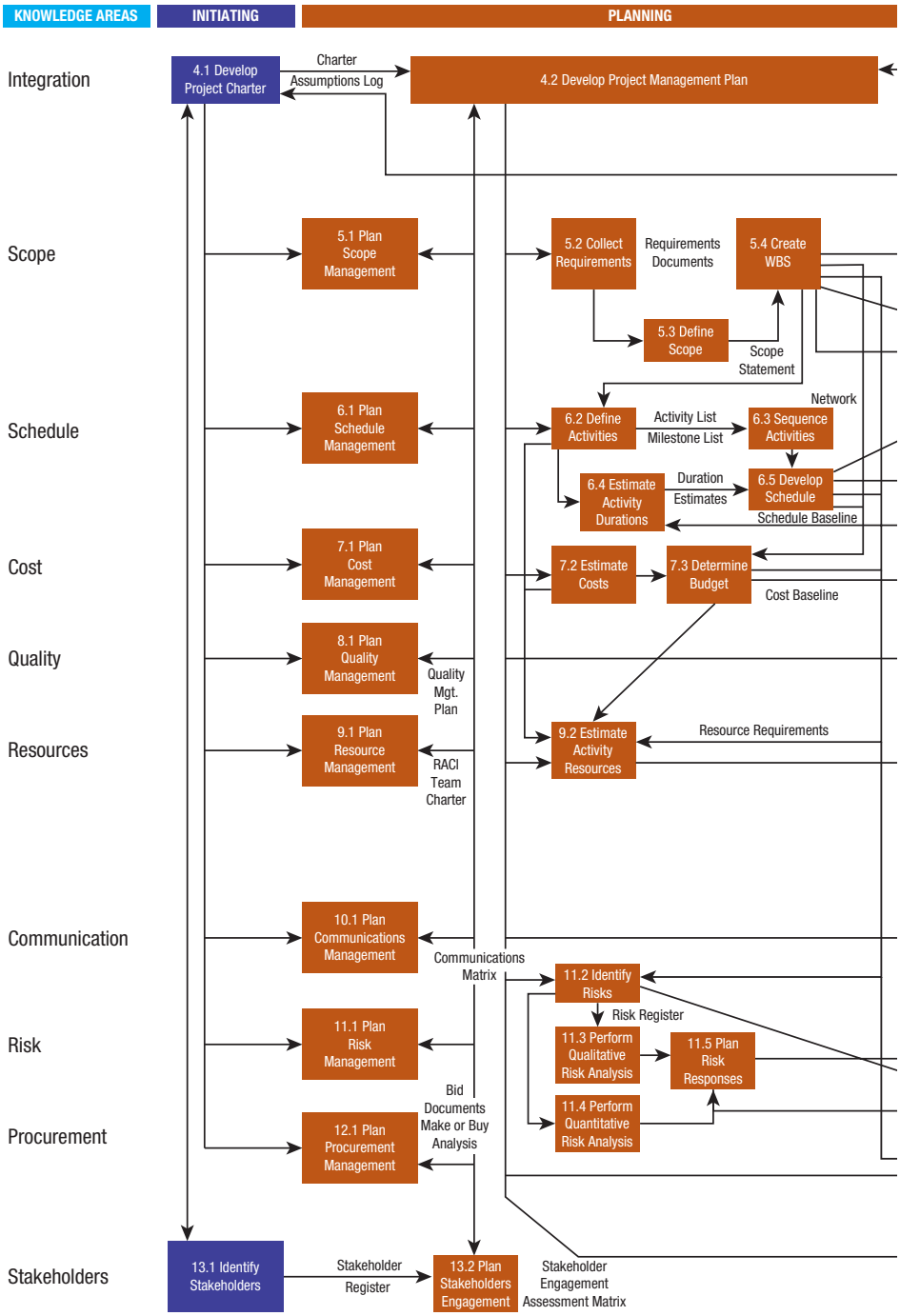
PMP Exam Content Outline in *Contemporary Project Management 5e*

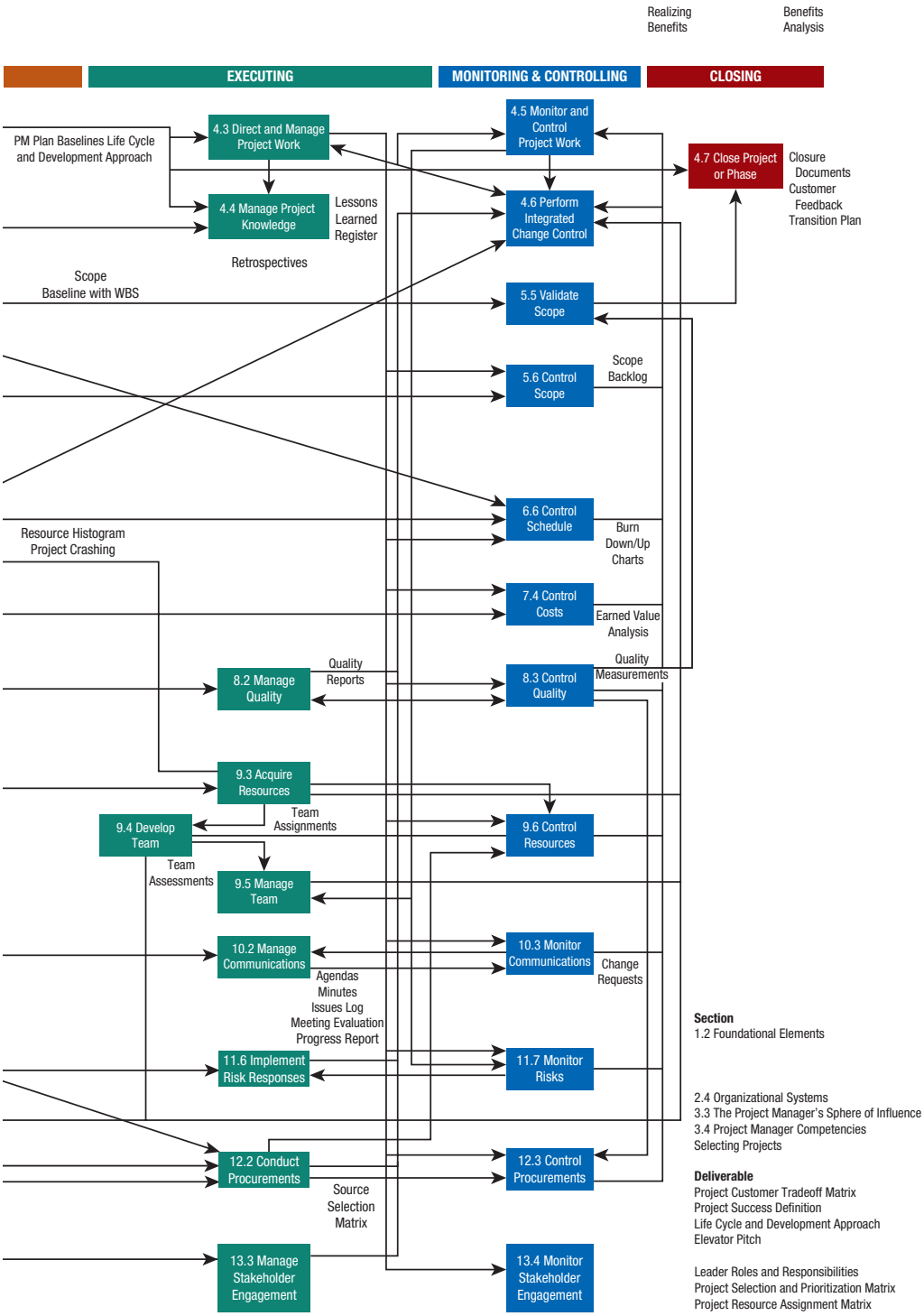
Domain and Task#	Task	Chapters Covering This Task
People 1	Manage conflict	5, 13
People 2	Lead a team	3, 5, 9
People 3	Support team performance	5
People 4	Empower team members and stakeholders	5, 6, 13
People 5	Ensure team members/stakeholders are trained	5, 6
People 6	Build a team	5, 9
People 7	Address and remove obstacles for team	3, 5, 11
People 8	Negotiate project agreements	2, 3, 5, 13
People 9	Collaborate with stakeholders	6, 13
People 10	Build shared understanding	3, 5, 6, 13
People 11	Engage and support virtual teams	5, 9
People 12	Define team ground rules	3, 5
People 13	Mentor relevant stakeholders	6, 13
People 14	Use emotional intelligence to help team	5
Process 1	Deliver business value with urgency	2, 3, 7, 9, 12, 14, 15
Process 2	Manage communications	3, 6, 14
Process 3	Assess and manage risks	3, 11, 14
Process 4	Engage stakeholders	2, 3, 6, 12, 13, 14
Process 5	Plan and manage budget and resources	2, 3, 9, 10
Process 6	Plan and manage schedule	3, 8, 9, 12, 14
Process 7	Plan and manage quality of products/deliverables	3, 7, 12, 14
Process 8	Plan and manage scope	3, 7, 12, 14
Process 9	Integrate project planning activities	3, 12
Process 10	Manage project changes	7, 11, 12, 14
Process 11	Plan and manage procurement	2, 9, 13
Process 12	Manage project artifacts	14, 15
Process 13	Determine appropriate project methods	3, 4
Process 14	Establish project governance	2, 3, 4, 5, 12, 13, 14

Process 15	Manage project issues	3, 6, 11, 14
Process 16	Ensure knowledge transfer	3, 12, 15
Process 17	Plan and mange project/phase closure or transitions	4, 15
Business 1	Plan and manage project compliance	12, 14
Business 2	Evaluate and deliver benefits and value	3, 6, 7, 14, 15
Business 3	Evaluate and address business changes for impact	4, 7, 11, 14
Business 4	Support organizational change	4

APPENDIX C

Flowchart of *PMBOK Guide 6e* Processes and Major Deliverables





APPENDIX D

PMBOK Guide 6e Coverage in *Contemporary Project Management 5e*

The numbers refer to the text page where the process is defined.

Project management (PM) processes and knowledge areas 10–11
Projects and strategic planning 37–41
Portfolio and program management 41–45
Project life cycle 8–9, 72, 124–126
Organizational influences 113–124

***PMBOK Guide 6e* Coverage**					
Knowledge Areas	**Initiating Process Group**	**Planning Process Group**	**Executing Process Group**	**Monitoring & Controlling Process Group**	**Closing Process Group**
Project Integration Management	Develop Project Charter 79–87	Develop Project Management Plan 454–455	Direct and Manage Project Work 509–511 Manage Project Knowledge 219	Monitor and Control Project Work 511–514 Perform Integrated Change Control 513–514	Close Project or Phase 10, 557–563
Project Scope Management		Plan Scope Management 241–242 Collect Requirements 242–246 Define Scope 246–249 Create WBS 265–269		Validate Scope 554–555 Control Scope 524	
Project Schedule Management		Plan Schedule Management 278 Define Activities 282–285 Sequence Activities 285–288 Estimate Activity Durations 279 Develop Schedule 281–282		Control Schedule 279	
Project Cost Management		Plan Cost Management 371–372 Estimate Costs 372–383 Determine Budget 384–387		Control Costs 387, 525	
Project Quality Management		Plan Quality Management 434	Manage Quality 449–451, 518	Control Quality 451–453, 518	
Project Resources Management		Plan Resource Management 10 Estimate Activity Resources 326	Acquire Resources 156–159 Develop Team 159–175 Manage Team 175–177	Control Resources 525	
Project Communications Management		Plan Communications Management 215–219	Manage Communications 515–517	Monitor Communications 517	
Project Risk Management		Plan Risk Management 404–410 Identify Risks 410–414 Perform Qualitative Risk Analysis 414 Perform Quantitative Risk Analysis 416–417 Plan Risk Responses 418–421	Implement Risk Responses 514	Monitor Risks 514	

Project Procurement Management		Plan Procurement Management 478, 479–482	Conduct Procurements 482–487	Control Procurements 490
Project Stakeholder Management	Identify Stakeholders 205-210	Plan Stakeholder Engagement 211	Manage Stakeholder Engagement 213–214	Monitor Stakeholder Engagement 214–215

Source: Adapted from *A Guide to the Project Management Body of Knowledge (PMBOK Guide)*, 6th ed. (Newtown Square, PA: Project Management Institute, Inc., 2017): 31.

APPENDIX **E**

MS Project Instructions in *Contemporary Project Management 5e*

Chapter	MS Project
3	MS Project Introduction Ribbon, Quick Access Toolbar, view panes, Zoom Slider, Shortcuts, Scheduling Mode Selector Setting Up Your First Project Auto schedule, start date, identifying information, summary row Create a Milestone Schedule Key milestones, zero duration, must finish on, information
7	Set Up a Work Breakdown Structure (WBS) Understand the WBS definitions and displays Enter WBS Elements (tasks), Create the outline, Insert WBS Code Identifier column, Hide or show subtasks detail
8	Using MS Project for Critical Path Schedules Set Up the Project Schedule Set or update the project start date, Define organization's working and non-working time Build the Network Diagram and Identify the Critical Path Enter tasks and milestones, edit the timescale, understand and define task dependencies, assign task duration estimates, identify the critical path, understand the network diagram view Display and Print Schedules
9	Define Resources Resource views, max units, resource calendars Assigning Resources Basic assignment, modify an assignment Identify Overallocated Resources Resource usage and Detailed Gantt views together Overallocated Resources Finding overallocated resources, dealing with overallocations Crashing a Critical Path Activity
10	Develop Bottom-Up Project Budget Assignment costs, task costs, various cost perspectives Develop Summary Project Budget
12	Baseline the Project Plan First time baseline, subsequent baselines, viewing variances
14	Using MS Project to Monitor and Control Projects What Makes a Schedule Useful? How MS Project recalculates based on reported actuals, current and future impacts of variances, define the performance update process (who, what, when) Steps to Update the Project Schedule Acquire performance data, set and display status date, Enter duration-based performance data, reschedule remaining work, revise future estimates
15	Close Project Creating project progress reports, sharing reports, export a report to MS Excel, archive project work, capture and publish lessons learned

APPENDIX F

Answers to Selected Exercises

Note: Some chapters have only behavioral material and do not have exercises.

Chapter 2

2-1 Select Project A first since Project A scored considerably higher than all others (A=78 vs. B=54, C=56, and D=44). The second project to be selected is Project B, but Project C is in a virtual tie, so it may be best to discuss the relative merits of each, perhaps considering additional *tiebreaking* criteria, before making the final selection.

2-3 Answers vary. The criteria developed would apply to projects that either are starting with a new compound (entirely new drug that may take a long time to get to market), a variation on a compound that is already partially studied (getting a variation of a drug to market sooner), or the purchase of a drug another company has fully or partially developed (perhaps getting the drug to market much quicker). Some criteria might include: speed in getting a new pharmaceutical to market, probability of success, cost of the project, and similarity with the company's existing products (alignment). The weightings can also vary, but students should be prepared to explain the logic behind why they chose the weights they did. Speed in getting a drug to market should be one of the highly rated criteria.

Chapter 3

3-1 & 3-2 Answers vary depending on the assignment. There should be a clear description of exactly *what* (scope overview) the team will do and *why* (business case) it is important. Each of those statements should be of one to four complete sentences and should be easy to understand.

3-3 Answers vary. Use the four-column format of Exhibit 3.6. Both the current and future state descriptions should be very brief—about three or four words. The future state is likely to be something like "satisfying, profitable picnic." The milestones need to make sense and enable a stakeholder to judge each with easily measurable acceptance criteria.

Chapter 4

4-1 Answers vary depending on the scenario. Use rationale for the chosen structure. An example scenario might be an R&D organization that started many projects and canceled many early, but the remaining projects typically grew to be very large. In this situation, you might suggest a matrix structure. Tell why—such as the need for resource-sharing among the many start-ups, but also the need for specific attention to the large projects that survive.

4-3 Answers vary. You need to detail specific behaviors and determine which category from Exhibit 4.16 each represents.

Chapter 7

7-3 Answers vary. Here is a typical WBS:

1 Campus Event
- 1.1. Site
  - 1.1.1. Selection
  - 1.1.2. Environment
  - 1.1.3. Neighbors
  - 1.1.4. Preparation
  - 1.1.5. Cleaning after
  - 1.1.6. Handover
- 1.2. Promotion
  - 1.2.1. Campus newspapers
  - 1.2.2. Internet
  - 1.2.3. Other
- 1.3. Finance
  - 1.3.1. Sponsorship
  - 1.3.2. Tickets
  - 1.3.3. Budget
  - 1.3.4. Audit

1.4. Human Resources
  1.4.1. Marketing
  1.4.2. Security
  1.4.3. Ticket sales
  1.4.4. Management
1.5. Entertainment
1.6. Staging

Chapter 8

8-1

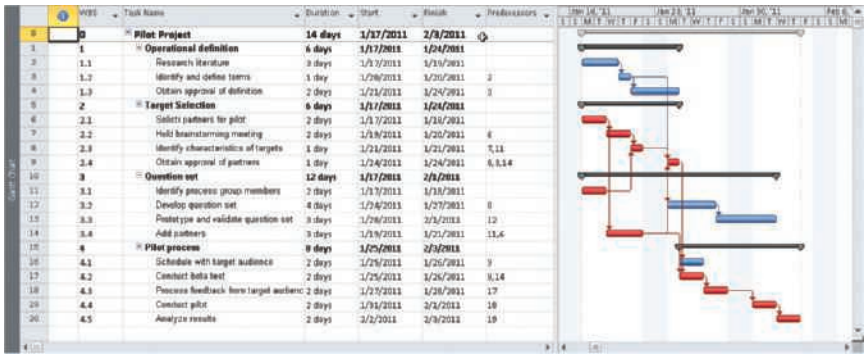
ES	EF
Activity Name	
Slack	
Duration	
LS	LF

8-3 A and B are predecessors, while C is a successor.

8-5

	A	B	C	D	E
Early start	0	12	16	12	19
Early finish	12	16	17	19	22
Late start	0	14	18	12	19
Late finish	12	18	19	19	22
Slack	0	2	2	0	0

8-9



Source: Microsoft Corporation

Chapter 9

9-3

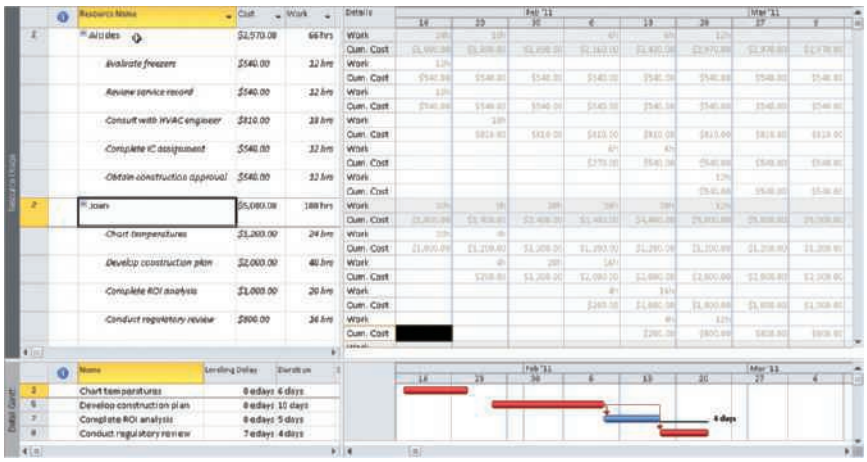
Activity	Predecessor	Normal Time	Normal Cost	Crash Time	Crash Cost	Crash Cost per Day
A	B	5	200	4	350	150
B		8	220	8	220	n/a
C	B	6	250	4	650	200
D	A	9	500	5	600	25
E	A, C	10	150	9	500	350
F	E	10	500	9	650	150
G	D, F	8	400	6	900	500

9-4

Source: Microsoft Corporation

Chapter 10

10-2 You can calculate the answers to this on MS Project, on Excel, or by hand. You first need to create the project schedule, create resource assignments, assign costs to each resource, and assign resources to each task. You will discover Alcides has a conflict right away, but one of the activities can be delayed within its slack. Joan has a conflict late that will force the noncritical task to be delayed, which will delay the entire project. The cumulative costs for the entire project are $13,960. In the MS Project screen capture below, it may be noted that the final task, conduct regulatory review, was delayed since it conflicted with the previous task, conduct ROI analysis. The total budget for the project remains unchanged, but the project is now scheduled to take a bit longer, and the cash flow corresponds to the schedule.



Source: Microsoft Corporation

Chapter 11

11-1 Answers vary. An example follows.

Major Risks	Contingency Plans
1. No back-up plan	1. Write a back-up plan
2. Security	2. Continuous internal communication w/security
3. Presidential candidate unavailable	3. Refer to back-up plan
4. Date not available	4. Find different venue/ renegotiate contract
5. Important donor not invited	5. Ensure updated, accurate list
6. Low attendance	6. Invitations/Adv./PR in timely manner
7. No or low media interest	7. Have and execute media plan
8. Issue with speaker	8. Establish crisis plan
9. Loss of money	9. Budget/forecasting
10. Overextending staff and resources	10. Set realistic expectations and stick to them

11-5 Answers vary. Show logical relationships and triggers that should be something easily observable that occurs before the risk event. For example, major risk 6 in Exercise 1 above (low attendance) could have a trigger in low response to RSVPs that are sent out two weeks before the event.

Chapter 12

12-2 Within a quality management plan, some or all of the following topics should be addressed with the supporting documentation and definitions:

- The mission and quality policy of the organization
- Roles and responsibilities of management and staff with respect to audit and/or quality activities
- Quality system description
- Personnel qualifications and training; implementation of work processes
- Corrective actions procedures
- Standard operating procedures
- Quality improvement description
- Procurement of items and services
- Documentation and records
- Computer hardware and software

12-5 Answers vary. Include the entire quality policy because it is likely to be short. Articulate specifically some ways the policy will guide the project. An example from Colgate follows:

Colgate Quality Policy: *Our goal is to provide consumers with the highest-quality products by assuring their performance, consistency, safety, and value. This commitment is rooted in our corporate values and is essential to our continued growth and success. We will meet our comprehensive "Global Colgate Quality Standards" in the design, manufacturing, and distribution of our products as well as meet or exceed all government requirements and consumer expectations worldwide. We will maintain these high-quality standards as we design and manufacture our products by the most efficient means possible to ensure they are affordable to the greatest number of consumers throughout the world. Our commitment to quality is vital to all we do.*

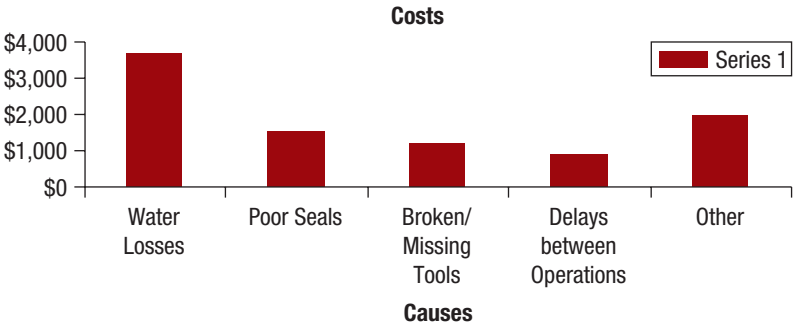
Performance, consistency, and safety are all dimensions of quality that are stressed. Value is also mentioned. Time is not. This would suggest that quality is the most important variable for their projects, followed by cost. The schedule then might take a backseat.

Chapter 14

14-1

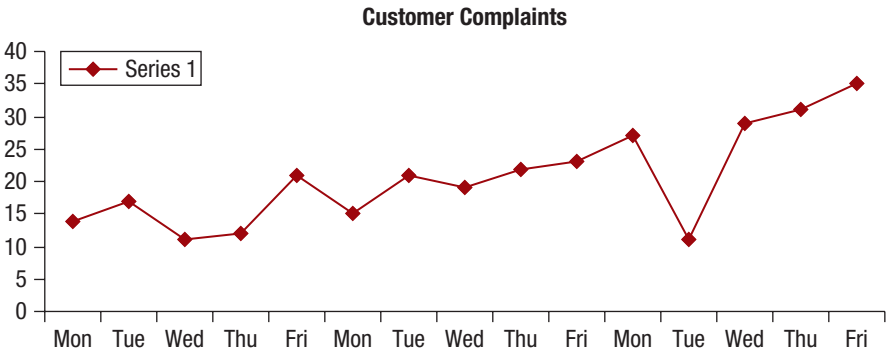
a. Schedule variance (SV). EV − PV = −$150,000. This project is behind schedule.
b. Cost variance (CV). EV − AC = −$200,000. This project is over budget.
c. Schedule performance index (SPI). EV/PV = 70%
d. Cost performance index (CPI). EV/AC = 64%
e. Estimate to complete (ETC—first method). (BAC − EV)/CPI = $1,328,125
f. Estimate to complete (ETC—second method). BAC − EV = $850,000
g. Estimate at completion (EAC). AC + ETC = $1,878,125
h. To-complete performance index (TCPI) = (BAC − EV)/(BAC − AC) = 131%

14-6



The next course of action would be to investigate the top issue: water losses.

14-8



There is an upward trend. Tuesday of the final week appears to be an outlier (it is considerably below others near it). There does not appear to be a strong repeating pattern.

APPENDIX G

Project Deliverables

Project Deliverable	Chapter(s)	*PMBOK Guide 6e* Process	*PMBOK Guide 7e* Domain	PMP Exam Task
Customer Trade-Off Matrix	1	Develop Project Charter	all domains	People Task #9
Project Success Definition	1	Develop Project Charter	all domains	Business #2
Elevator Pitch	2	Develop Project Charter	Stakeholders Team Development Approach Planning Uncertainty	Business #2
Project Selection and Prioritization Matrix	2		Stakeholders Team Development Approach Planning Uncertainty	Process #1 and Business #2
Project Resource Assignment Matrix	2	Plan Resource Management	Stakeholders Team Development Approach Planning Uncertainty	Process #1, 5
Project Charter	3	Develop Project Charter	Stakeholders Team Development Approach & Lifecycle Planning Measurement Uncertainty	People #8, 9, and 10, Process #9 and Business #2
Assumptions Log	3	Develop Project Charter	Stakeholders Team Development Approach & Lifecycle Planning Measurement Uncertainty	Process #15
Life Cycle and Development Approach	4	Develop Project Management Plan	Team Development Approach & Lifecycle Project Work Tailoring (additional section of *PMBOK® 7e*)	Process #5, 6, 7, 8, and 9

Project Deliverable	Chapter(s)	*PMBOK Guide 6e* Process	*PMBOK Guide 7e* Domain	PMP Exam Task
Leader Roles and Responsibilities	4		Team Development Approach & Lifecycle Project Work Tailoring (additional section of *PMBOK® 7e*)	People #2, 7, 8, 9, 10, 11, 12, 13, and 14
Team Charter	5	Plan Resource Management	Team Stakeholders Development Approach Planning Delivery Measurement Uncertainty Stakeholders Development Approach Planning Delivery Measurement Uncertainty	Business #1
Team Assessments	5	Develop Team	Team Stakeholders Development Approach Planning Delivery Measurement Uncertainty	People #3, 8
Stakeholder Engagement Assessment Matrix	6	Plan Stakeholder Engagement	Stakeholders Team Planning Delivery Measurement	People #4, 9, 13, Process #4, Business #2
Communication Matrix	6	Plan Communications Management	Stakeholders Team Planning Delivery Measurement	People #9, 10 Process #2, 4
Meeting Agenda	6	Manage Communications	Stakeholders Team Planning Delivery Measurement	People #12, Process #2
Meeting Minutes	6	Manage Communications	Stakeholders Team Planning Delivery Measurement	Process #2
Issues Log	6	Manage Communications	Stakeholders Team Planning Delivery Measurement	People #12, Process #3, 10, 12

Project Deliverable	Chapter(s)	*PMBOK Guide 6e* Process	*PMBOK Guide 7e* Domain	PMP Exam Task
Meeting Evaluation	6	Manage Communications	Stakeholders Team Planning Delivery Measurement	Process #3
Requirements Traceability Matrix	7	Collect Requirements	Team Development Approach Planning Delivery Measurement Uncertainty	People #10, Process #5, 8, 10, Business #2
Scope Statement	7	Define Scope	Team Development Approach Planning Delivery Measurement Uncertainty	Process #8
Scope Baseline with WBS	7	Create WBS	Team Development Approach Planning Delivery Measurement Uncertainty	Process #8
Story Map	7	Define Scope		
Activity List	8	Define Activities	Team Development Approach Planning Delivery Measurement Uncertainty	Process #5, 6
Milestone List	8	Define Activities	Team Development Approach Planning Delivery Measurement Uncertainty	Process #6
Network	8	Sequence Activities	Team Development Approach Planning Delivery Measurement Uncertainty	Process #6
Duration Estimates	8	Estimate Activity Durations	Team Development Approach Planning Delivery Measurement Uncertainty	Process #6

Project Deliverable	Chapter(s)	*PMBOK Guide 6e* Process	*PMBOK Guide 7e* Domain	PMP Exam Task
Schedule Baseline	8	Develop Schedule	Team Development Approach Planning Delivery Measurement Uncertainty	Process #6
Kanban Board	9	Develop Schedule		
RACI Chart	9	Plan Resource Management	Team Development Approach & Lifecycle Project Work	Process #5, 6
Resource Histogram	9	Develop Schedule	Team Development Approach & Lifecycle Project Work	Process #5, 6
Project Crashing	9	Develop Schedule	Team Development Approach & Lifecycle Project Work	Process #6, 10
Cost Baseline	10	Determine Budget	Planning Measurement Uncertainty	Process #5, 6, 7
Risk Register	11	Identify Risks	Stakeholders Team Delivery Measurement Uncertainty	Process #3
Project Management Plan Baseline	12	Develop Project Management Plan	Stakeholders Team Work Delivery Measurement Uncertainty	Process #5, 6, 7, 8, and 9
Bid Documents	13	Plan Procurement Management	Stakeholders Planning Work Measurement	Process #11
Make or Buy Analysis	13	Plan Procurement Management	Stakeholders Planning Work Measurement	Process #11
Contract Type Justification	13	Plan Procurement Management	Stakeholders Planning Work Measurement	Process #11

Project Deliverable	Chapter(s)	*PMBOK Guide 6e* Process	*PMBOK Guide 7e* Domain	PMP Exam Task
Source Selection Matrix	13	Conduct Procurements	Stakeholders Planning Work Measurement	Process #11
Change Request	14	Perform Integrated Change Control	Stakeholders Team Development approach Planning Delivery Measurement	Process #10, 15
Progress Report	14	Monitor Communications	Stakeholders Team Development approach Planning Delivery Measurement	Process #2, Business #2
Earned Value Analysis	14	Control Costs	Stakeholders Team Development approach Planning Delivery Measurement	Business #1, 2, 3
Burn-Down Chart	14	Control schedule		

APPENDIX H

Strength Themes Applied to Project Management

Theme*	Project Management Version
Achievement	You must accomplish something every day. You have great stamina and internal motivation. When you finish one task, you quickly want to work on another so you can complete milestones. You manage proactively by setting plans, working to achieve them, and asking people to report progress.
Activity	You want to make decisions and start quickly. Results of early actions will provide input into following decisions and actions. You want to be judged by your actions and results. You encourage others to action and help them overcome obstacles. You create a sense of urgency and energy when needed.
Adaptability	You live in the moment. Decisions made now create the future. You keep making progress in the face of unknowns. You balance conflicting demands of tasks and people, of various stakeholders, of risks, and of proposed changes. You understand reality, bring emotional stability, and do not need to control everything.
Analysis	You are objective, search for reasons, and want to see proof. You ask questions, research intensively, and then develop logical explanations. In ambiguous situations you simplify concepts, recognize patterns, understand limits, describe causes and effects, and establish order. You fearlessly make honest decisions based upon facts.
Arrangement	You are organized yet flexible. You have defined values and priorities. You arrange people and other resources, improving work processes to best achieve your primary objectives. You thrive on cooperation and collaboration in complex settings. You depend on honest, timely, and transparent information to make rapid adjustments.
Belief	You possess enduring core values that guide and energize your behavior. You walk the talk as a dependable and trustworthy sounding board. You are committed to work and people, encouraging your team to display high ethics and to help others.
Command	You take charge, directly sharing your opinions and aligning people to your goals. You challenge others and lead forcefully when necessary. You thrive in crisis, making rapid decisions and encouraging others to take risks.
Communication	You speak and write clearly. You place high value on human interaction, talking with—not to—people. You tell stories to enliven your ideas, gain commitment, and maintain enthusiasm. You ask good questions, listen well, and help others express their feelings. You "think out loud" and encourage collaboration.
Competition	You want to outperform everyone either individually or as a team. This invigorates you and helps you achieve your ambitions. You define, measure, and ensure progress. You select contests you believe you can win and then celebrate your successes.
Connectedness	You believe everything happens for a reason and is part of something larger. Your thinking extends beyond your self-interests. You see no boundaries and celebrate when people find common ground around shared meaning. Your hopefulness helps you achieve personal and organizational goals.

Theme*	Project Management Version
Context	You look back to understand the original purpose and past actions that shaped the present. You share stories to connect with people. You ask questions and take time to understand root causes. This perspective gives you confidence to decide what is enduring and what can change, inspiring confidence in followers.
Deliberation	You are a private person who identifies and analyzes risks, plans carefully, avoids problems, trusts your instincts, and makes no hasty decisions. You help others consider all factors in sensitive decisions. You have a few close friends in whom you confide. You only praise when it is well deserved.
Development	You see potential and small improvements in people. You enjoy observing, advising, encouraging, challenging, and improving inexperienced people. You encourage teams to try, fail, and try again, helping them set appropriate expectations and celebrate success. By mentoring individuals you develop effective teams.
Discipline	The world can be chaotic, but you create predictability with plans, priorities, routines, timelines, and structures. Through your attention to detailed planning and consistent execution, you create order and deliver effective and timely results. You carefully monitor progress, adhere to uncompromising standards, and celebrate excellence.
Empathy	You are highly instinctive and feel the emotions of others so strongly it is as if they were your own. You do not necessarily agree with others' choices, but you understand. You respect everyone's feelings and help them express them. People trust your discretion and you help resolve conflict.
Consistency	You treat everyone the same, with clear rules based upon values. You create a predictable and calm environment. You value loyalty and routines and accurately document requirements.
Focus	You work best when you know what is important and have a clear end goal. You define outcomes, determine priorities, set intermediate goals, follow through, make mid-course corrections, and deliver results. You concentrate deeply and are impatient with delays. You help others set goals and concentrate on critical issues.
Futurism	You are intrigued by the future and enjoy describing your conceptions of it. Your emotional yet realistic contemplations help others to understand how supporting your project helps them accomplish their goals.
Harmony	You look for a common ground to find agreement. You value expert perspectives, perhaps merging ideas as long as you retain your basic values and shared sense of purpose. You have a calm, facilitating manner, avoid confrontation, bring practical knowledge, and strive for consensus.
Ideation	You are energized by finding new perspectives on familiar situations. You are innovative and creative, love to brainstorm, and strive to make things better. You take calculated risks and share excitement. You create useful plans, overcoming resource limits and risks.
Inclusiveness	You feel the pain of those who are left out and understand the power of a larger team of active and unified participants in which all voices are heard. You are accepting, as you feel we are all equally important. You ensure information and decision making are widely shared.
Individualization	You perceive differences in how people think, feel, and behave. You bring out the best in each person and foster effective, diverse teams in which everyone is encouraged to do what they do best. As a mentor and leader, you treat each person according to their unique needs and dreams.
Input	Your curiosity enables you to be a great researcher. You enjoy being up to date and gathering and sharing information. You view whatever you collect—ideas or tangible items—as resources. You may be an expert or good at making concepts seem real.
Intellection	You enjoy taking quiet time to read and think. While your thoughts may be focused or diverse, you often generate wisdom and clarity. You help your team make better decisions by asking great questions, giving your honest opinions, and engaging in deep conversations.

Theme*	Project Management Version
Learning	You are energized by the process of learning and considering possibilities. You excel on short project assignments and as a change agent where you need to learn quickly. As you continuously study and improve you gain confidence. You help your team improve by co-learning with them and tracking lessons learned.
Maximization	Your greatest joy is taking good performance of your own, of another individual, or of a team to a higher level. You prefer to capitalize upon raw talent. You strive for quality and excellence.
Positivity	You always see and communicate the good. You lift others with your enthusiasm. Life and work are fun. You give people frequent praise and focus on making progress no matter the situation. Your hope for the future, good humor, and eagerness to celebrate make you a valued team member.
Relating	You enjoy being around your close friends, learning about their feelings and goals. You derive satisfaction from working hard with these friends. You honor trust and show respect.
Responsibility	You enjoy volunteering, and when you commit, no one needs to check your progress. You have the highest ethics, usually fulfilling your many obligations, and making amends when you cannot. You are a serious, dedicated role model. You may feel overwhelmed, but you are satisfied when you complete commitments.
Restoration	You diagnose problems, determine root causes, and implement solutions. Bad news with no sugar coating motivates you, whether it concerns people or things. You can identify risks and devise contingency plans in advance.
Self-Assurance	Your confidence inspires others. You research issues and listen to experts, but then make up your own mind and act decisively. You completely commit to critical challenges not because you have no fear, but because you know someone needs to lead and you are bold and resolute.
Significance	You want to make a lasting difference in this world and be known for it. You dream big dreams, need affirmation, fear failure, but are comfortable with risk and public scrutiny. You champion others' needs and achievements. You want to associate with other top performers.
Strategy	You plan backward from goals to various means of accomplishing them. You see patterns where others see chaos. You research alternatives and select one—often avoiding potential problems. You see the big picture and are flexible concerning how to achieve it.
Woo	You enjoy meeting new people and discovering common interests or other connections. The thrill of meeting a new person may be greater than developing a deep relationship. You naturally put people at ease and facilitate interchange of ideas. You ask questions and get others to support your goals.

*All theme names are trademarks by Gallup, Inc.

Index

Terms from the *PMBOK Guide* are set in bold in this index.

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