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EXAM GUIDE

Joseph Phillips

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For Kyle.

ABOUT THE AUTHOR

Joseph Phillips, PMP, Project+, is the Director of Education for Project Seminars. He has managed and consulted on projects for industries, including technical, pharmaceutical, manufacturing, and architectural, among others. Phillips has served as a project management consultant for organizations creating project offices, maturity models, and best-practice standardization.

As a leader in adult education, Phillips has taught organizations how to successfully implement project management methodologies, information technology project management, risk management, and other courses. He has taught for Columbia College, University of Chicago, and Indiana University, among others. He is a certified technical trainer and has taught over 10,000 professionals. Phillips has contributed as an author or editor to more than 30 books on technology, careers, and project management.

Phillips is a member of the Project Management Institute (PMI) and is active in local project-management chapters. He has spoken on project management, project management certifications, and project methodologies at numerous trade shows, PMI chapter meetings, and employee conferences. When not writing, teaching, or consulting, Phillips can be found behind a camera or on the working end of a fly rod. You can contact him through www.projectseminars.com.

About the Technical Editor

Julie Wiebell, MBA, PMP, is a vice president at JPMorgan Chase and Company managing corporate technology programs. Her project management experience spans more than 10 years working with private, public, nonprofit, Fortune 100, and IT consulting firms. For four years, she facilitated and coordinated the Chase Leadership Academy, a partnership with Big Brothers Big Sisters, to introduce high school seniors to the skills needed in the business world. She has a passion for mentoring, teaching, and professional development.

Julie served on the board of directors for the PMI Central Ohio Chapter from 2005-2006 and currently serves on the Honors Tutorial College Board of Visitors at Ohio University for 2006-2008. She is a PMI member, a certified project management professional (PMP), and has earned a BA in Spanish, a BA in international studies, and a Masters in business administration. In her spare time, she enjoys volunteering for animal rescue associations, coaching MBA students, and marathon training.

CONTENTS AT A GLANCE

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CONTENTS

ACKNOWLEDGMENTS

More than once, I've said that I'm the luckiest guy in the room. I get to write and talk for a living—what could better than that? I'm so grateful for the opportunity to write and must thank the wonderful group of people at McGraw-Hill for their belief in me to write yet another book on project management. Thank you to Tim Green, my good friend and editor, for your guidance, patience, and confidence. Thank you to Jennifer Housh—the best friend a writer could ever have. Lisa McCoy, thank you for helping me to be a better writer. Julie Wiebell, the technical editor for this book, has been a good friend and persistent editor. Thanks, Julie, for all of your hard work. Thank you to Patty Mon for keeping me organized, on target, and consistent with my writing. And thank you to Sue Albert who took my scribbles and then created all the artwork in this book. Finally, thank you to Apollo Publishing Services who put the parts of this book together and made it a reality.

I would also like to thank the hundreds of people who have attended my PMP Boot Camps and project management courses over the past years. Your questions and conversations have helped me create this book and will help thousands of others earn their PMI certifications. Finally, thank you to my friends—Dr. Elizabeth Lee, Rick Gordon, Yolanda Robles, Phil Stuck, and Dr. Lisa Brown; my brothers, Steve, Mark, Sam, and Ben; and my parents.

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INTRODUCTION

This book is divided into two major sections. The first section, which consists of Chapters 1, 2, and 3, discusses the broad overview of project management and how it pertains to the Certified Associate in Project Management (CAPM) and the Project Management Professional (PMP) examinations. Part Two contains Chapters 4 through 13, which detail each of the nine knowledge areas and the PMI Code of Professional Conduct.

If you are just beginning your PMP or CAPM quest, you should read the first section immediately, as it'll help you build a strong foundation for your exam. If you find, however, that you already have a strong foundation in project management and need specific information on the knowledge areas, then move on to the second section. You'll find this section specific to the exam knowledge areas that'll help you—gulp—pass the PMI examination.

The book is designed so that you can read the chapters in any order you like. However, if you examine the *Guide to the Project Management Body of Knowledge*, you'll notice that the order of information presented is the same as the order of information in this book. In other words, you can read a chapter of the PMBOK and then read a more detailed explanation in this book. This book is a guide to the guide. You'll also notice, if you haven't peeked ahead already, that all of the major headings reference to the corresponding PMBOK sections. In addition, practically every question in this book references the PMBOK directly for additional information, so it's a good idea to have the PMBOK handy as you read.

PMP Exam Readiness Checklist

Exam Domain and Exam Percentage	**Chapter #**
Initiating the Project……11%	
Conduct Project Selection Methods	1, 3, 4
Define Scope	1, 3, 4, 5
Document Project Risks, Assumptions, and Constraints	1, 3, 5, 11
Identify and Perform Stakeholder Analysis	1, 2, 3, 4, 5, 10
Develop the Project Charter	1, 3, 4
Obtain Project Charter Approval	1, 3, 4
Planning the Project……23%	
Define and Record Requirements, Constraints, and Assumptions	1, 2, 3, 5, 6, 7
Identify the Project Team and Define Roles and Responsibilities	1,3, 9

Exam Domain and Exam Percentage	Chapter #
Planning the Project……23% (continued)	
Create the Work Breakdown Structure	1, 5
Develop the Change Management Plan	5
Identify Risks and Define Risk Strategies	11
Obtain Plan Approval	1, 4
Conduct the Kick-off Meeting	4, 5
Executing the Project……27%	
Execute Tasks Defined in the Project Plan	1, 4, 5, 6, 7
Ensure Common Understanding and Set Expectations	1, 4, 5, 8
Implement the Procurement of Project Resources	1, 4, 5, 6, 7, 12
Manage Resource Allocation	5, 6, 7, 9, 12
Implement the Quality Management Plan	4, 5, 8
Implement Approved Changes	4, 5, 6, 7, 8, 10, 11, 12
Implement Approved Actions and Workarounds	4, 5, 6, 7, 8, 11
Improve Team Performance	4, 9
Monitoring and Controlling the Project……21%	
Measure Project Performance	5, 6, 7, 8, 10, 11
Verify and Manage Changes to the Project	4, 5, 6, 7, 8, 9, 10, 11, 12
Ensure That Project Deliverables Conform to Quality Standards	4, 5, 8
Monitor All Risks	4, 5, 11
Closing the Project……9%	
Obtain Final Acceptance for the Project	4, 5, 10
Obtain Financial, Legal, and Administrative Closure	4, 5, 7, 10
Release Project Resources	3, 4, 5, 9
Identify, Document, and Communicate Lessons Learned	4, 5, 6, 7, 8, 9, 10
Create and Distribute the Final Project Report	4, 5, 10
Archive and Retain Project Records	10
Measure Customer Satisfaction	1, 3, 4, 8, 9, 10
Professional and Social Responsibility……9%	
Ensure Individual Integrity	9, 13
Contribute to the Project Management Knowledge Base	13
Enhance Personal Professional Competence	9, 13
Promote Interaction Among Stakeholders	4, 5, 10, 13

CAPM Exam Readiness Checklist

Exam Objective	Chapter #
The Project Management Framework……4%	1
The Project Life Cycle and Organization……4%	2, 9
The Project Management Processes for a Project……11%	3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Project Integration Management……11%	1, 4, 5
Project Scope Management……11%	1, 4, 5
Project Time Management……11%	3, 6, 9, 11, 12
Project Cost Management……9%	3, 4, 7, 11, 12
Project Quality Management……7%	3, 8
Project Human Resources Management……7%	3, 9
Project Communications Management……7%	3, 10, 11, 12
Project Risk Management……11%	3, 4, 11, 12
Project Procurement Management……7%	3, 7, 11, 12

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PART I

Project Management Foundation

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CHAPTER

Preparing for the Exam

In this chapter, you will

- Learn to qualify for the PMP and the CAPM certification
- Learn PMP and CAPM exam details
- Create a strategy to pass your project management certification exam
- Learn all about the PMBOK
- Understand details on projects, project management, and operations
- Know how to be a successful project manager
- Work with programs and project management offices
- Qualify for your exam

This is a book on how to pass the Project Management Professional (PMP) and the Certified Associate in Project Management (CAPM) exam.

If you're looking for a book on how to do project management, look elsewhere. If you're looking for a book on how projects, good projects, should operate, this book isn't for you. If you're looking for a primer on project management, move along. There are plenty of excellent books available that can help you reach those goals.

But, if you're looking for a book, a definitive book, on how to pass your project management certification examination, this is the book for you. This book will clearly, quickly, and fully explain how to pass your certification exam the first time. And then you can get back to your life. After all, the exams aren't fun, and I'm certain you've more important things to do than spend more time than what's necessary to pass an exam.

VIDEO Passing your project management certification exam.

What this book will do for you:

- Cover the PMP and CAPM exam objectives in detail
- Allow you to watch me. On the CD, there are several videos of me teaching you exam objectives
- Focus only on exam objectives
- Tell you how to pass the PMP or CAPM exam—not just take the exam

- Offer "roadmaps" for each chapter's content
- Offer 610 total practice questions (Fun!)
- Not be boring
- This first chapter covers many things that will help you prepare for and pass your project management certification exam.

Not everyone can take the PMP or the CAPM exam—you have to qualify first. I think this is great. We, and soon you, don't need the market flooded with the "paper certifications" that other industries have experienced. This certification is special—it proves that the certified professional has documented project management experience, education, and has passed a tough, rigid exam. If it were easy, everyone would do it.

NOTE As this book covers the PMP and the CAPM examinations, there will be some moments where I'll hop from details on one exam to the other. Don't worry—these exams overlap so much that these awkward moments will be few and far between. Besides, if the information I'm sharing doesn't relate to you, yawn, stretch, and then move along to the information that does. I won't hold it against you.

All About the PMP Exam

In order to become a PMP, you need the following (check out Figure 1-1; it's pretty):

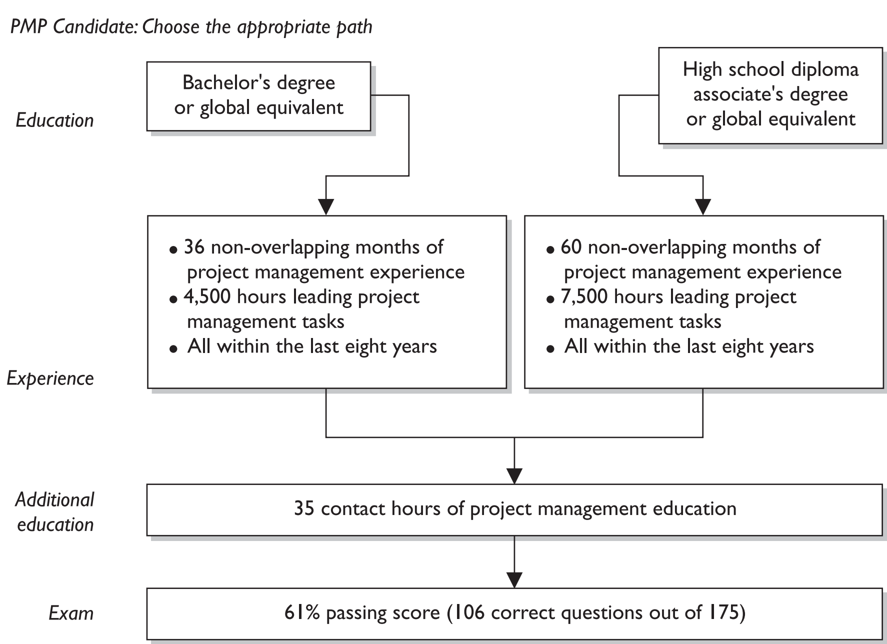


Figure 1-1 The PMP candidate must qualify to take the examination.

- Bachelor's degree or global equivalent and 36 non-overlapping months of project management experience totaling 4,500 hours of project management activities within the last eight years.
- Or a high school diploma, associate's degree, or the global equivalent and 60 non-overlapping months of project management experience totaling 7,500 hours of project management tasks within the last eight years.
- Regardless of your degree, you will need 35 contact hours of project management education. (Ahem—I teach project management classes for companies around the world, including an Exam Boot Camp that satisfies this requirement. E-mail me for details: pmpcapm@projectseminars.com.) Here are PMI-approved methods for accruing the project management education hours:
    - Courses offered by PMI-registered education providers.
    - University or college project management courses.
    - Courses offered by PMI component organizations.
    - Courses offered through your organization.
    - Yes, you can complete your hours through distance learning education companies if they offer an end-of-course assessment.
    - Courses offered by training companies.
    - No, PMI chapter meetings and self-study don't count. (Darn! Just reading this book won't satisfy your project management education hours.)
- Extended review period of each application. Every application will pass through a review period. If your application needs an audit, you'll be notified via e-mail.
- Audit! Not every application is audited, but if your application is selected for an audit, you'll have to provide documentation of your experience, education, and signatures from your supervisors for the projects you've worked on. It's fun, fun, fun. Oh, and PMI can even audit a person after they've "earned" their certification. (Yikes! Here's where honesty is the best policy.)
- Applicants must provide contact information for supervisors on all projects listed on their PMP exam application. In the past, applicants did not have to provide project contact information unless their application was audited. Now each applicant has to provide project contact information as part of the exam process.
- Once the application has been approved, candidates have one year to pass the exam. If you procrastinate taking the exam more than a year, you'll have to start the process over.
- Be good. You will also agree to abide by the PMP Code of Professional Conduct. You can get your very own copy through PMI's Web site: www.pmi.org. We'll cover this code in Chapter 13—something for you to look forward to (no peeking!).

- A score of 61 percent is required to pass the exam. The exam has 200 questions, of which 25 questions don't actually count towards your passing score. These 25 questions are scattered throughout your exam and are used to collect stats on candidates' responses to see if these questions should be incorporated into future examinations. This means you'll actually have to answer 106 correct questions out of 175 live questions.

CAUTION PMP candidates are limited to three exam attempts within one year. If they fail three times within one year, they'll have to wait one year before resubmitting their exam application again. Don't focus on this—focus on passing your exam the first time.

The PMP exam will test you on your experience and knowledge in six different areas, as Table 1-1 shows. You'll have to provide specifics on tasks completed in each knowledge area on your PMP examination application. The following domain specifics and their related exam percentages are taken directly from PMI's Web site on the PMP examination.

Exam Domain	Domain Tasks	Percentage of Exam
Initiating the Project	Conduct project selection methods Define scope Document project risks, assumptions, and constraints Identify and perform stakeholder analysis Develop project charter Obtain project charter approval	11.59 percent
Planning the Project	Define and record requirements, constraints, and assumptions Identify project team and define roles and responsibilities Create the Work Breakdown Structure Develop a change management plan Identify risks and define risk strategies Obtain plan approval Conduct the kick-off meeting	22.7 percent
Executing the Project	Execute tasks defined in project plan Ensure common understanding and set expectations Implement the procurement of project resources Manage resource allocation Implement quality management plan Implement approved changes Implement approved actions and workarounds Improve team performance	27.5 percent

Table 1-1 Test Objectives for the PMP Examination

Exam Domain	Domain Tasks	Percentage of Exam
Monitoring and Controlling the Project	Measure project performance Verify and manage changes to the project Ensure project deliverables conform to quality standards Monitor all risks	21.03 percent
Closing the Project	Obtain final acceptance for the project Obtain financial, legal, and administrative closure Release project resources Identify, document, and communicate lessons learned Create and distribute final project report Archive and retain project records Measure customer satisfaction	8.57 percent
Professional and Social Responsibility	Ensure individual integrity Contribute to the project management knowledge base Enhance personal professional competence Promote interaction among stakeholders	8.61 percent
TOTAL		100.00 percent

Table 1-1 Test Objectives for the PMP Examination *(continued)*

All About the CAPM Exam

The CAPM exam also has requirements in order to qualify for it—and to pass it. Now this part is just goofy. The Project Management Institute (PMI), the fine folks that govern these certifications, have not provided the same level of exam details as they have for the PMP. Don't flip out; the requirements are lighter and the exam score is lower—and this book will prepare you for CAPM success. Figure 1-2 demonstrates the following CAPM examination details:

- High school diploma, global equivalent, or better (basically, if you matriculated from high school you're on your way).
- A whopping 1,500 hours or more as a project team member. You'll have to document what you did on your projects through PMI's Experience Verification Form—and that's one form per project. PMI is a stickler that your projects be projects, not operations. A project has a definite beginning and a definite ending—ongoing endeavors do not count.

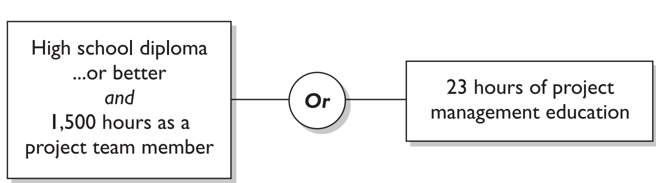


Figure 1-2 How to qualify for the CAPM examination

- Or complete 23 hours of project management education, which you'll document on PMI's Project Management Education Form (PMI really loves these formal documents, don't they?). Here's the cool thing: There's no time limit on when you complete this project management education as long as you can prove it. Note that the class has to be completed prior to completing the CAPM application (finish your class and then finish the CAPM application). (Ahem—I teach project management classes for companies around the world, including an Exam Boot Camp that satisfies this requirement. E-mail me for details: pmpcapm@projectseminars.com.) Here are PMI-approved methods for accruing the project management education hours:
    - Courses offered by PMI-registered education providers.
    - University or college project management courses.
    - Courses offered by PMI component organizations.
    - Courses offered through your organization.
    - Yes, you can complete your hours through distance learning education companies if they offer an end-of-course assessment.
    - Courses offered by training companies.
    - No, PMI chapter meetings and self-study don't count. (Darn! Just reading this book won't satisfy your project management education hours.)
- Like the PMP candidates, your application could be audited. If your application is selected for an audit, you'll have to provide documentation of your experience, education, and signatures of your supervisors for the projects you worked on. It's fun, fun, fun. Oh, and PMI can even audit a person after they've "earned" their certification. (Yikes! Here's where honesty is the best policy.)
- Once your application has been approved, you have one year to pass the exam. If you procrastinate taking the exam more than a year, you'll have to start the process over.
- CAPM candidates must also agree to abide by PMI's Code of Professional Conduct. You can get your very own copy through PMI's Web site: www.pmi.org. We'll cover this code in Chapter 13—something for you to look forward to (no peeking!).

CAUTION Once you're a CAPM, you're a CAPM for up to five years. At the end of the five years, you can move on to the PMP certification, take the CAPM examination again, or choose not to renew your title. Ideally, you'll have accrued enough project management experience to move on to the PMP title.

The CAPM exam has 150 test questions, of which 15 questions are considered "pre-test" questions that don't count towards or against your passing score. Despite the term "pre-test," these questions are seeded throughout the exam to test their worthiness for future exam questions. They don't count against you, but you won't know if you're answering a live question or pre-test question. Either way, you'll have up to three hours to complete the CAPM exam.

The CAPM exam objectives don't go into the same level of detail as the PMP certification does. Our pals at PMI have painted the CAPM objectives with some very broad strokes—which may be a good thing. Table 1-2 provides a breakdown on the CAPM objectives as posted on PMI's Web site (of course, you'll want to double-check www.pmi.org to confirm that these objectives are still valid).

Money and Your Exam

These exams aren't free, and you don't want to waste your hard-earned cash failing the exam. Focus, with my help, on passing the exam on your first shot. But just in case some of your colleagues ask, I've included the retake fees. You can, and should, confirm the costs I've listed here with PMI through their Web site. They've changed fees in the past, and you don't want your exam fees to dig into your beer and pizza cash:

- Join PMI: $119 (you want to join PMI first, as it lowers your exam fee by a few bucks)
- PMP exam for a PMI member: $405
- PMP exam for a non-PMI member: $555
- PMP re-exam for a PMI member: $275
- PMP re-exam for a non-PMI member: $275
- CAPM exam for a PMI member: $225
- CAPM exam for a non-PMI member: $300
- CAPM re-exam for a PMI member: $150
- CAPM re-exam for a non-PMI member: $200

Exam Objective	Percentage of Exam
The Project Management Framework	4 percent (approximately 6 questions)
The Project Life Cycle and Organization	4 percent (approximately 6 questions)
The Project Management Processes for a Project	11 percent (approximately 17 questions)
Project Integration Management	11 percent (approximately 17 questions)
Project Scope Management	11 percent (approximately 17 questions)
Project Time Management	11 percent (approximately 17 questions)
Project Cost Management	9 percent (approximately 14 questions)
Project Quality Management	7 percent (approximately 11 questions)
Project Human Resources Management	7 percent (approximately 11 questions)
Project Communications Management	7 percent (approximately 11 questions)
Project Risk Management	11 percent (approximately 17 questions)
Project Procurement Management	7 percent (approximately 11 questions)

Table 1-2 The CAPM Exam Objectives

Passing the Exam

Let's face the facts: This isn't much fun. Learning is hard work. The PMBOK reads like the printed version of a sleeping pill. You don't want this process to last any longer than is necessary, and your goal should be—it better be—to pass your certification exam on your first attempt. So don't think of "taking the exam," but focus instead on "passing your exam." You will pass your exam, not just take it. You're scheduling a time to pass the exam, not take it. And so on. Pass the thing and get back to your real life.

Just like your projects have plans, you need a plan on how to study, how to prepare, and then how to pass the exam. You can relax on this part—I've done most of the work for you.

Creating Your Study Strategy

I'll be your study buddy. You need a realistic timeline and a realistic expectation for studying to pass your exam. You can create whatever strategy you like, but here's my recommended approach to passing your exam. This book has 13 chapters and four appendixes. Each chapter in my book corresponds directly with the PMBOK—except I'm goofy and the PMBOK is boring. Chapter 13, while it doesn't relate directly to the PMBOK, deals with PMI's Code of Professional Conduct. Appendix A explains every project management document mentioned directly in the PMBOK. Appendix B is the summary of all the stuff you absolutely must know to pass your exam. Appendix C is based on the PMP Code of Ethics. It's a bunch of fun. You'll need to be familiar with the Code of Ethics for your exam—and for the rest of your life. Appendix D is all about the CD-ROM, the exams you can find there, and all the great project management videos you can watch (get the popcorn ready). The glossary is a glossary—all the terms I use in this book (yeah, all of them).

VIDEO How to use this book.

At the beginning of each chapter, you'll see an icon that looks like this one. It means that you should hop out to the CD and watch a video of me discussing the key concepts for that chapter. Sometimes I'll include more than one video per chapter, depending on what the topic may be. I recommend that you watch the introductory video for each chapter before starting. The videos are usually short, and I'm providing some good stuff. And you can make fun of my face.

At the end of each chapter, you'll find key terms. Get a stack of index cards and make flash cards of the key terms. You'll use these every day as you plow through this beast of a book—it'll help you keep the early chapters fresh in your mind as you happily move towards the end of this fine piece of literature.

At the end of each chapter, you'll find 20 practice exam questions. These questions are all from information within the chapter to test your comprehension. I've written these questions to be tougher than what you'll likely encounter on the live exam. My logic is that if you can answer my questions, you can answer PMI's questions, too. On the CD, you'll find a Microsoft Excel spreadsheet titled "Exam Scores"—you can see it in Figure 1-3. Enter your chapter scores in the spreadsheet, and you can track which chapters you need more work in and focus your studying time accordingly.

Finally, the CD includes one 200-question practice exam and one 150-question practice exam. Take one of these exams immediately after you finish this book. Keep taking the exam over and over until you can answer every question correctly. (I'm assuming that you won't get 100 percent on the first attempt on this exam. My apologies if you do.)

Once you've mastered the first exam, you're ready to repeat the process with the second. Boy, howdy! Doesn't this sound like fun? It's more fun than taking your live examination twice, I promise.

I've outlined quick references for how you should study and then pass your exam. You may be slightly ahead of other readers in your exam preparations, so I've intentionally left dates and timelines at your discretion. I think a couple of chapters a week is realistic—but I wouldn't do more than five chapters a week. Take some time and create a schedule of when you'll study, and then take measures to make certain you can keep the schedule you create.

Table 1-3 provides a sample strategy that you can modify as you see fit. Your schedule may take more or less time—this is just a sample strategy. I've included a document titled "My Exam Strategy" on the CD so that you can create your own schedule and strategy.

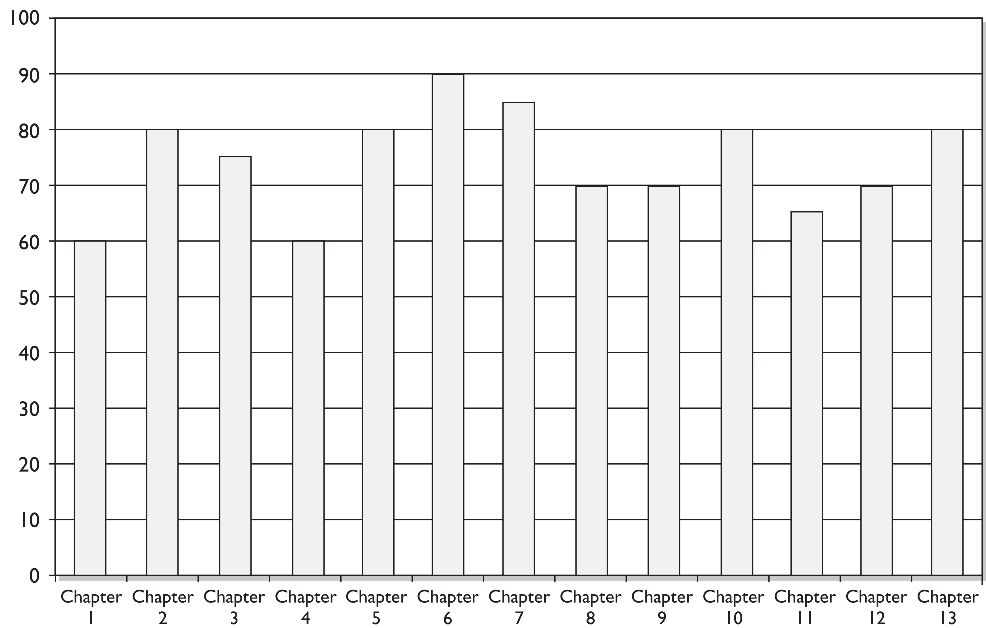


Figure 1-3 You can track your chapter scores to focus your studying times accordingly.

Day	Chapter	Activities
Day 1	1	Complete chapter exam Create and review flash cards
Day 2	2	Complete chapter exam Create and review flash cards
Day 3	3	Complete chapter exam Create and review flash cards
Day 4		Review first three chapter exams Memorize flash cards
Day 5		Watch chapter videos again Review flash cards
Day 6	4	Complete chapter exam Create and review flash cards
Day 7	5	Complete chapter exam Create and review flash cards
Day 8	6	Complete chapter exam Create and review flash cards
Day 9		Review Chapters 4, 5, and 6 Review chapter exams to date Review flash cards Watch videos from Chapters 4, 5, and 6
Day 10	7	Complete chapter exam Create and review flash cards
Day 11		Review chapter exams to date Review flash cards Watch videos from Chapter 7 Practice formulas from Chapters 6 and 7
Day 12	8	Complete chapter exam Create and review flash cards
Day 13	9	Complete chapter exam Create and review flash cards
Day 14	10	Complete chapter exam Create and review flash cards
Day 15		Review chapter exams to date Review flash cards Practice formulas from Chapters 6 and 7
Day 16	11	Complete chapter exam Create and review flash cards
Day 17	12	Complete chapter exam Create and review flash cards
Day 18		Review Chapters 11 and 12 exams Review key terms to date Watch Chapters 11 and 12 videos

Table 1-3 A Sample Study Strategy

Day	Chapter	Activities
Day 19	13	Complete chapter exam Create and review flash cards Download Professional Code of Conduct from www.pmi.org.
Day 20		Complete practice exam on CD Take Exam 1 until a perfect score is achieved
Day 21		Review key terms Watch chapter videos
Day 22	Appendix B	Confirm familiarity with project management documents
Day 23	Appendix C	Confirm knowledge of key project management topics Review flash cards
Day 24		Complete Exam 2 Practice exam until perfect score is achieved
Day 25		Review flash cards Review chapter exams
Day 26		Pass the project management exam Gloat to peers
Day 27		Send e-mail to jdp@projectseminars with comments on this book and how it helped you pass your exam

Table 1-3 A Sample Study Strategy *(continued)*

What Your Exam Is Based On (PMBOK, Section 1.1)

Your project management exam is based on PMI's publication, *A Guide to the Project Management Body of Knowledge*. This is commonly called the PMBOK (pronounced PIM-BACH), and that's how I'll refer to it from now on. I'm not looking to pick fights or be critical, but the PMBOK is drier than wheat toast. It's not an easy read, a fun read, or, much of the time, a complete read.

The PMBOK doesn't aim to define all of the avenues of project management in great detail. Rather, it aims to provide a "general overview" of the good practices of project management. The PMBOK defines the generally accepted consensus of the project management practices that are most widely utilized.

One of my favorite lines from the PMBOK comes from section 1.1: "Good practice does not mean that the knowledge described should always be applied uniformly on all projects; the project management team is responsible for determining what is appropriate for any given project." I love this quote, because it's a fancy way of saying, "Calm down. You don't have to do every freaking process, activity, and system within this book—just determine the processes that are best for your project and then do them correctly."

EXAM TIP Your exam, however, will quiz you on all of the processes, systems, and documents identified by the PMBOK, because all of these characteristics are appropriate for projects, but probably not on every project you'll manage.

When you join PMI, you'll get a CD-based copy of the PMBOK as part of your membership, or you can plunk down a few bucks at your favorite bookstore and get a printed version of the book today. I recommended that you have a copy of the PMBOK for several reasons:

- Your exam is based on the PMBOK. As much as I'd like for your exam to be based on just my writings, it isn't. The PMBOK is what your exam is based on, so you should always reference that book over the one you're reading now.
- This book is based on the PMBOK. Okay, I gave myself an out in the above paragraph, but truthfully, I've worked very hard for my book to be in synch with the PMBOK. I'll reference the PMBOK as we move through the chapters so you can double-check my facts, questions, and figures.
- The PMBOK, as dry as it may be, is an excellent book to have in your project management arsenal. It defines processes, systems, and documents that you'll likely encounter in your project management endeavors.
- Having a copy of the PMBOK on your desk strikes fear and awe into your uncertified colleagues. Well, maybe just the ones from Carlisle, Pennsylvania.

What Is a Project? (PMBOK, Section 1.2)

You're a project manager, so you've probably got a good idea of what a project is already. I'm hoping. The PMBOK defines a project as "a temporary endeavor to create a unique product, service, or result." Projects, like good stories, have a definite beginning and a definite end. A project is over when the product, service, or result is created. Or, in not so pleasant times, when it becomes evident that the project won't be able to create the product, service, or result for whatever reason (skills, cost, time, or any other reason that you can think of why a project might be stopped).

Temping a Project

Some project managers get hung up on the idea of a project being temporary. After all, some projects can last for years or decades—but they don't last forever. Projects are temporary in that they have a definite ending somewhere in the future. Projects—at least, most projects—create something that will last for some time, usually longer than the project team or even the time to complete the project itself. Consider a project to build a house, create a park, or develop a software application. These deliverables will be utilized for some duration of time. In other words, the project ends, but the benefits and deliverables of the project continue.

Notice I said that project deliverables usually last longer than the project itself. There are some special projects where this isn't true—such as a project to host a trade show, an event, or a fantastic party. Once the party is over, the project is also over and all's done.

"Temporary" can also refer to the market window status. Remember the Internet dot-com boom? It was definitely temporary. I'm sure in your business you can identify examples of market windows that were temporary. Project teams are also examples of temporary structures: The team comes together, does the work of the project, and then once the project is over, so is the project team.

Defining a Project's Uniqueness

Ready for a horrible joke? How do you catch a unique rabbit? Unique up on him. (As in, "You sneak up on him." My son loved this joke when he was eight, not so much anymore.) The point of the joke is that uniqueness means that it's different from the rest of your organization's operations. Consider the creation of a new car. The designing, drafting, modeling, and the creative process of creating a new car could be a project. The manufacturing of the automobile, however, typically isn't a project—that's operations. Unique things that a project can create include:

- Products as an end result of a project, such as a piece of software
- Products that are component pieces for other projects, such as the blueprints for a new warehouse
- A new service that will be integrated into your organization's functions, such as a help desk or an Internet application
- A result of your project could create something like a feasibility study, research and development outcomes, or trend analysis

Progressively Elaborating a Project

Progressive elaboration is a process that all projects move through. The project manager and the project team start very broad—typically with a project's concepts—and then the concept is refined with details, studies, and discussion until a project scope statement is formed. The scope statement may pass through additional steps to continue to refine the project's objectives.

Did you ever read any of the Sherlock Holmes stories? Holmes would create a very broad theory of the mystery's solution and then, through a scientific approach and deductive reasoning, narrow his theory over and over until he finally solved the case. He started very broad and then narrowed his hypothesis. This is one example of progressive elaboration, although Sir Arthur Conan Doyle never called it that. Basically, progressive elaboration means that you start with a very broad concept and then, through steady progressions, you gather more detail to clarify the concept your project centers on. Figure 1-4 is a simple example of progressive elaboration with a project to create a new home.

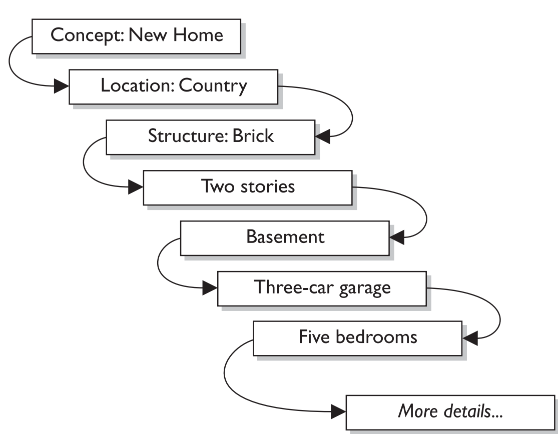


Figure 1-4 Progressive elaboration means progressing through steady, incremental steps.

Why Do Projects?

Projects are typically work that doesn't fall into an organization's normal operations. Basically, projects are chunks of work that need to be completed, but the work doesn't necessarily fall into any predefined function of an organization, such as accounting or sales.

Projects can also be managed by organizations that complete projects all the time for other organizations. Consider an IT consulting company that swoops into company after company to install and configure new networks, servers, or computer software. Or consider an architectural firm that designs buildings for other companies. Or think of practically any service-based business, and you'll find a performing organization that completes projects for other entities.

Organizations that treat practically every undertaking as a project are likely participating in management by projects. This means that they operate by relying heavily on project management principles to complete their work. This isn't unusual in consulting agencies, construction firms, or IT shops—their existence is by management by projects.

Projects are most likely undertaken for any of the following reasons:

- **Opportunity** The market demand may call for a project to create a new product, service, or solution.
- **Organizational needs** I bet you can identify some needs within your company that would make dandy projects: upgrading computers, training your staff, changing the menu in the company cafeteria. Usually, organizational needs focus on reducing costs or increasing revenue, and sometimes both (bonus!).
- **Customers** Your customers have things that they want you to create for them. Sometimes, these requests develop into projects.
- **Technology** Technology seems to change and advance daily, and this often spurs new projects to keep up or ahead of competitors. Know any IT gurus out there managing technical projects?
- **Legal requirements** Laws and regulations can cause new projects. Publicly traded companies have been required to secure their IT data in compliance with the Sarbanes-Oxley Act. Health care organizations must adhere with HIPAA requirements. And U.S. companies have been working with OSHA requirements for years and years. Initial conformance to these requirements often creates new projects.

What Is Project Management? (PMBOK, Section 1.3)

You know what projects are, so what's project management? I can hear you sighing and saying, "It's just the management of a project." And I'd concur, but your exam will likely need a bit more information than that. The PMBOK defines project management as "the application of knowledge, skills, tools, and techniques to meet project requirements."

Managing a project centers on four things:

- Identifying your project's requirements

- Establishing clearly defined project objectives
- Managing project stakeholders by adapting your plans and approaches to keep those folks happy and the project moving along
- Keeping scope, schedule, costs, and quality all in balance

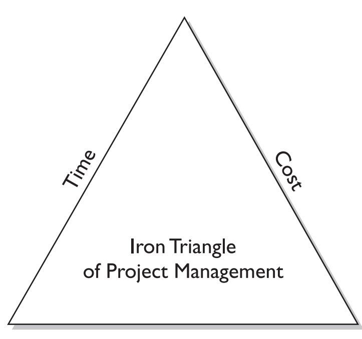
This last point really defines the Iron Triangle of Project Management. Sometimes this is also called the Triple Constraints of Project Management. Figure 1-5 demonstrates the Iron Triangle's concept: All three sides must remain in balance or the project's quality or other facets will suffer. It's not rocket science: If your scope is enormous but your budget and/or schedule is puny, your project will likely suffer, or even fail. Chapters 5, 6, and 7 in this book (and in the PMBOK) focus on these three constraints of scope, time, and cost, so you'll see the Iron Triangle at least three more times.

Back to the PMBOK (PMBOK, Section 1.4)

I follow the PMBOK section by section throughout this whole book. Oh, boy. Of course, I take the PMBOK and expound on it just a bit—I hope you like it. This section is a reflection of the PMBOK's navel-gazing. For some reason, the authors of the PMBOK interject a logical discussion on project management with a pondering on how their book is organized. Okay. You won't be tested on this specifically, but gosh-golly, it's helpful to know as you organize your thoughts and study strategy. So here's the scoop:

- Section 1: The Project Management Framework is made up of the first two PMBOK chapters:
  - Chapter 1: The Introduction sets the tone and paints the big picture of what the PMBOK can do for you. It's breezy and gets you moving into the book, kind of like this chapter.
  - Chapter 2: The Project Life Cycle and Organization discusses the environment where projects happen. The project life cycle describes the phases a project moves through to get from start to completion.
- Section 2: The Standard for Project Management of a Project is a whopper of a section with one chapter: Chapter 3: Project Management Processes for a Project. It discusses the 44 project management processes and the five process

Figure 1-5
Time, cost, and scope comprise the Iron Triangle of Project Management.



groups they live within. It's meaty, and we'll discuss it in depth in Chapter 3 of this book.

- Section 3: The Project Management Knowledge Areas has nine chapters, and each knowledge area gets it own chapter in the PMBOK. Here's a brief overview of each chapter:
    - Chapter 4: Project Integration Management defines how each knowledge area is affected by the control and outcome of the other knowledge areas. It's the gears of project management.
    - Chapter 5: Project Scope Management defines how a project manager should create, monitor, control, and complete the project scope.
    - Chapter 6: Project Time Management defines how the project manager should estimate the project duration, create the schedule, do some fancy math problems with time, and control and react to all aspects of managing the project schedule.
    - Chapter 7: Project Cost Management focuses on the project budget and how it is estimated, spent, audited, and controlled through the project. Cha-ching!
    - Chapter 8: Project Quality Management centers on defining and adhering to the quality expectations of the project stakeholders. We'll examine a whole bunch of charts that measure quality within a project.
    - Chapter 9: Project Human Resources Management delves into the methods to organize, lead, and manage your project team. We'll also discuss some philosophies and human resource theories.
    - Chapter 10: Project Communications Management is all about how a project manager should gather, create, and disperse project information. The basic theme for this chapter is who needs what information, when do they need it, and in what modality.
    - Chapter 11: Project Risk Management describes how you, your project team, and other experts will identify, analyze, and plan responses to risks within your project. We'll cover risk matrixes, contingency reserves, and ways to track risks within your project.
    - Chapter 12: Project Procurement Management is all about buying the products and services your project may need to be successful. Procurement management includes obtaining acquisitions, selecting sellers, and creating contracts. Get your wallet ready.
    - Chapter 13, in this book, doesn't correspond directly to the PMBOK, but correlates to PMI's Code of Conduct. I'll explain how you can answer these questions directly and accurately for your exam. Keep in mind that the Code of Conduct for both the PMP and the CAPM candidates are one-page documents, but you'll have several exam questions on ethics and on adhering to PMI's professional code. I'm certain you'll do fine.

Being a Project Expert (PMBOK, Section 1.5)

You can take a project management class and not be an expert in project management. You can even be a PMP or a CAPM and not be a good project manager. Sorry, but it's true. To be an expert in project management, you need to rely on more than just the tools and techniques and other mechanics of project management. You'll need five things:

- The Project Management Body of Knowledge
- Expertise in your application area and an understanding of the relevant standards and regulations
- An understanding of the environment in which your project takes place in
- General management knowledge and skills
- The ability to deal with people (your interpersonal skills)

These five attributes and how they interact with one another are depicted in Figure 1-6. The goal of this book is to help you pass your certification exam, but I'm certain the goal of passing the exam is to help you advance your career and become a better, more valuable project manager. With that thought process, it's easy to see how these skills are interdependent. Let's take a quick look at each of these project management attributes.

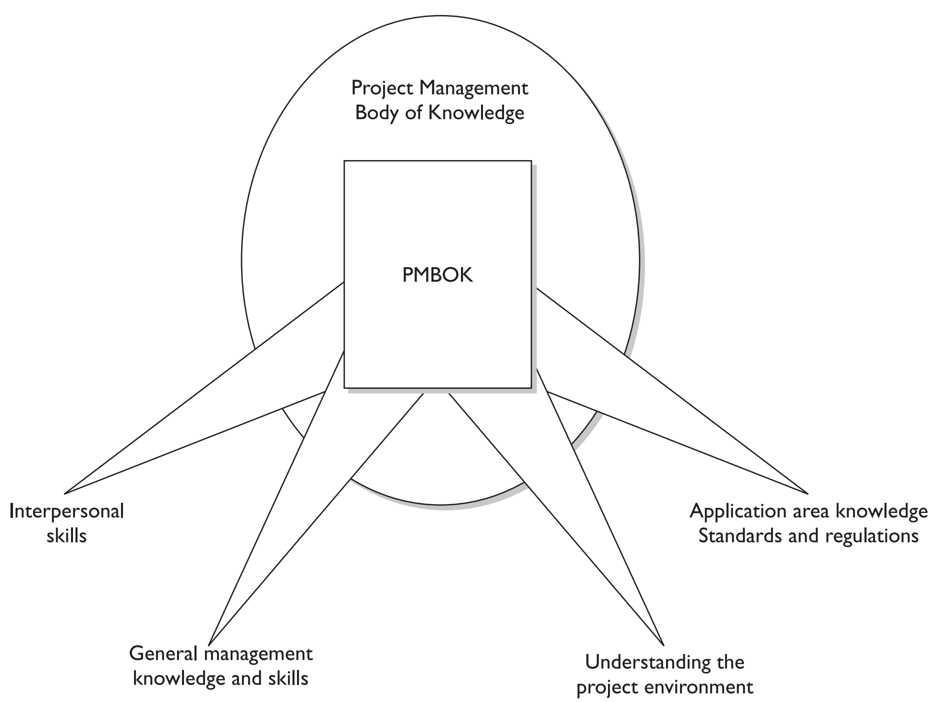


Figure 1-6 The project management areas of expertise overlap one another.

Using the Project Management Body of Knowledge

Yep, back to the PMBOK. Technically, the Project Management Body of Knowledge is the wealth of information that is available to the project management community. As far as your exam is concerned, *A Guide to the Project Management Body of Knowledge* is what's important.

Working with Your Application Area

An application area is your area of expertise, whether it be construction, manufacturing, sales, technology, or something else. And an application can get even more specific if we break down an organization into more detail: functional departments, technical domains, management arenas, and even industry groups, like automotive, health care, and so on. An application area is simply the area of expertise with which the project interacts.

Within most application areas, if not all of them, there are specific standards and regulations that the project management team must consider as they plan their work and implement their project plan. A standard is a generally accepted guideline for your industry, whereas a regulation is a rule that must be followed for your industry or there will be fines and penalties. I like to say that standards are optional and regulations are not. No one ever went to jail because they didn't follow a standard. Plenty of people have visited the big house for not following regulations.

EXAM TIP You probably won't see questions on specific application areas, because the PMP and CAPM certification focus on project management, not the arenas in which projects take place. Just know that application areas are industries and technologies that can host projects.

Understanding Your Project Environment

Every project takes place in an environment—a location and culture where the project will operate. Specifically, the project will affect and be affected by the social, economic, and environmental variables of the project environment. It's paramount for the project manager and the project team to understand the project environment. Every project manager and the project team should consider the following.

Cultural and Social Environment

You and the project team must understand how your project affects people and how those people may affect you and your project. This means it'll behoove the project if you understand the economic, educational, ethical, religious, demographic, and even the ethic composition of the people your project affects. We'll discuss this more in Chapters 9 and 13.

Your project may not have a wide impact on people outside of your organization, so you should still understand and consider the organizational culture of your project. Consider the cultural achievability of your project, the stakeholders within your organization and their political power, and the project manager's autonomy over the project.

International and Political Environment

If your project spans the globe, you and the project will need to consider the international and local laws of where your project will operate and how the conditions of the project may vary based on where the work is being completed. You'll also need to consider fun things like languages, time zone differences, holidays, travel issues, non-collocated teams, and the headaches with video and teleconferences.

Physical Environment

If your project will change the landscape or physical structure of a building, you'll need to consider the ecology; geography; and environmental concerns, laws, and risks that are associated with these changes. Consider a project to build a bridge over a wetland area—there will definitely be ecological, geographical, and environmental concerns to deal with (I'd worry about alligators, too).

Relying on General Management Skills

In order to be a project manager, you have to be a manager. This means you're focused on one important thing: key results. And how do you get results? You'll rely on:

- Accounting skills
- Procurement
- Sales and marketing
- Contracting abilities
- Manufacturing and distribution principles
- Organization and logistics
- Strategic, tactical, and operational planning
- Leverage of the organizational structure and the organizational behavior
- Administration of your project team, reasonable compensation, rewards and recognition, and career paths
- Health and safety standards and regulations
- Using IT to your advantage

If you come from a business background, you'll have an edge on your project management exam. Much of project management is based on management skills, and you can rely, to some extent, on your experience to help answer exam questions. A word of caution, however: The exam is based first upon the PMBOK and then on your skills. Answer your questions according to the PMBOK first.

Dealing with People

As a project manager, you have to interact with people—lots of people. You need interpersonal skills to work with, motivate, lead, and manage other people. Specifically, you'll need the following interpersonal skills:

- **The ability to effectively communicate** Communications is the core of project management and will likely take up most of your time.

- **A knack for influencing the organization** This is simply the ability to get things done. (Wink, wink—I, and the PMBOK, are hinting at politics, power, negotiations, and tradeoffs.)
- **A penchant for leading** Project managers are leaders, not followers. You need to be able to lead the project team, stakeholders, and even vendors towards the vision of the project.
- **Motivating people** Can you energize and excite people about your project? You need to.
- **Negotiating and managing conflicts** A good project manager has the ability to negotiate, lead negotiations, and resolve conflicts in the best interest of the project.
- **Solving problems** Projects are often full of problems that you'll need to figure out. Want to know a secret? Your project management certification exam is just one example of where you can apply problem-solving. The questions are tricky, and you'll have to use some brain power to deduce the right choice.

Examining the Project Management Context (PMBOK, Section 1.6)

Projects typically fall under some other umbrella within an organization: project portfolio management, project offices, or programs. The project management context describes all the different environments where a project may reside.

Your real-live organization may have one, all, or even none of these descriptions—don't sweat it. For your exam, however, you'll need to be familiar with these different organizational situations and how each one affects the project and the project manager.

Working with Programs

A program is a collection of related projects organized to gain benefits from the projects collectively that wouldn't be realized if the projects were managed independently. Consider a program of building a skyscraper. There could be lots of projects within the skyscraper program: structure, elevators, electrical, plumbing, and tons more.

If each project were managed independently, a lot of work would have to be duplicated within the construction of the new skyscraper. But by creating a program, time and effort can be saved by managing projects collectively. For example, the electrician, the telephone installer, and the network engineer can pool their resources to pull the electrical cables, telephone cables, and network cables all at once.

The point to take away from this discussion on programs is that projects are usually contributing one major deliverable and can work together to save time, effort, and dollars.

Opening Your Portfolio

Project portfolio management is the selection, management, and collection of projects within an organization. Unlike a program, the projects may not be directly related, but they contribute to the organization's overall strategic plan. For example, a construction company may have a collection of projects in which some are high-profile projects that could change a city's skyline, and other projects are minor and might be just the construction of a small garage or home.

The portfolio of projects defines the rules for selecting, maintaining, and even funding the projects within an organization. We all know that a company usually has only so much money to invest in the project it selects. Project portfolio management defines the projects that should be selected based on need, risk and reward, return on investment, and practically any other issues an organization identifies.

Unfortunately, or fortunately depending on how you look at it, project managers aren't usually directly involved in project portfolio management. This activity is generally reserved for senior management, as they decide which project best propels an organization's mission, purpose, and strategy. Project managers inherit upper management's vision and then manage the projects they've been assigned.

Working with Subprojects

A subproject is just a project that's been lopped off from a larger project. For example, a project to build a new house may create a subproject for all of the home automation, home theater, and home network installation. The subproject is managed as its own project but has constraints and requirements within the confines of the larger project to create the new home. Other examples of subprojects include:

- A single phase within a project life cycle could be a subproject. A good example is the phases of construction on a new home: permits, excavation, foundation, framing, and so on. Each phase could be a subproject.
- Human resource skill sets are often identified as subprojects. Consider all of the work a plumber, electrician, carpenter, and other skilled workers can do. The related work of each professional could form a subproject.
- Specialized technology, materials, or activities could be subprojects. The installation of a new type of siding for our home construction project could be considered a subproject, where we'd use a team of specialists to manage and complete the subproject.

Working with Project Management Offices

A project management office, often just called a PMO, oversees all of the projects within an organization and supports all of the project managers within an organization. PMOs can be organized to manage all projects within an organization, within departments, or even by the nature of the project work, such as IT versus marketing. Sometimes, a project management office might be called a project office or a program office.

Most PMOs support the project manager and the project team through software, training, templates, standardized policies, and procedures. PMOs often coordinate communications across projects, offer mentoring to project managers, and help resolve issues between project team members, project managers, and stakeholders. Project managers working with a PMO typically report to a chief project officer or program officer, depending on the organizational structure.

Chapter Summary

You're done with Chapter 1. Congrats!

In this chapter, we talked about the requirements of what it takes to be a project management professional and what it takes to be a certified associate in project management. Which one are you geared for? Depending on which certification you're going to achieve, you'll create a strategy on how you'll use this book, your time, and the PMBOK to pass the examination.

The PMBOK describes the 44 management processes and how these processes map to the nine knowledge areas of project management. This book, like the PMBOK, discusses in greater detail (and, ahem, clarity) these same processes and knowledge areas you'll need to be familiar with to pass your certification exam.

We also discussed what a project is—and is not. You now know that a project is a short-term endeavor to create a unique product or service. Projects are created for any number of reasons, from marketplace demand to solving a problem within an organization.

Projects, regardless of why they were created, move through a progressive elaboration to provide complete descriptions and wholeness of their goals and objectives. Recall that progressive elaboration typically starts with a broad synopsis of a project's goals, and through rounds of discussion, analysis, and brainstorming, the characteristics of a project become more detailed until, finally, the project vision is created.

A project manager must understand the environment and circumstances that the project will operate in. The locale, culture, and conditions surrounding the project can affect the project's success as much as the project manager's ability to lead and manage the facets of the project and the project team. If a project management office exists, it can provide training and support for the project manager and the project team to effectively lead and complete the project work.

Your next step in your certification quest is to create flash cards on the key terms and then complete the 20-question exam. Keep moving!

Key Terms

***A Guide to the Project Management Body of Knowledge* (PMBOK)** A PMI publication that defines widely accepted project management practices. The CAPM and the PMP exam are based on this book.

Application areas The areas of expertise, industry, or function where a project is centered. Examples of application areas include architecture, IT, health care, or manufacturing.

Certified associate in project management (CAPM) A person who has slightly less project management experience than a PMP but has qualified for and then passed the CAPM examination.

Cultural and social environment Defines how a project affects people and how those people may affect the project. Cultural and social environments include the economic, educational, ethical, religious, demographic, and ethic composition of the people affected by the project.

Deliverable A product, service, or result created by a project. Projects can have multiple deliverables.

General management skills These include the application of accounting, procurement, sales and marketing, contracting, manufacturing, logistics, strategic planning, human resource management, standards and regulations, and information technology.

International and political environment The consideration of the local and internal laws, languages, communication challenges, time zone differences, and other non-collocated issues that affect a project's ability to progress.

Interpersonal skills The ability to interact, lead, motivate, and manage people.

Iron Triangle of Project Management A triangle with the characteristics of time, cost, and scope. Time, cost, and scope each comprise one angle of the triangle; if any side of the Iron Triangle is not in balance with other sides, the project will suffer.

Physical environment The physical structure and surrounding that affect a project's work.

Program A collection of related projects working in unison towards a common deliverable.

Progressive elaboration Describes the process of gathering project details in steady, uniform steps. This process uses deductive reasoning, logic, and a series of information-gathering techniques to identify details about a project, product, or solution.

Project A short-term endeavor to create a unique product, service, or result. The end result of a project is also called a deliverable.

Project environment The location and culture of the environment where the project work will reside. The project environment includes the social, economic, and environmental variables the project must work with or around.

Project Management Institute (PMI) An organization of project management professionals from around the world supporting and promoting the careers, values, and concerns of project managers.

Project management office (PMO) A central office that oversees all projects within an organization or within a functional department. A PMO supports the project manager through software, training, templates, policies, communication, dispute resolution, and other services.

Project management professional (PMP) A person who has proven project management experience and has qualified for and then passed the PMP examination.

Project portfolio management The management and selection of projects that support an organization's vision and mission. It is the balance of project priority, risk, reward, and return on investment. This is a senior management process.

Subprojects A smaller project managed within a larger, parent project. Subprojects are often contracted work whose deliverable allows the larger project to progress. Consider the electrical wiring of a new building to be a subproject of the parent project, which is the actual construction of the new building.

Triple Constraints of Project Management Also known as the Iron Triangle. This theory posits that time, cost, and scope are three constraints that every project has.

Questions

1. A series of activities to create a unique product or service by a specific date is best described as which one of the following?
   - **A.** A program
   - **B.** An operation
   - **C.** A project
   - **D.** A subproject
2. Which of the following is likely to be part of an operation?
   - **A.** Providing electricity to a community
   - **B.** Designing an electrical grid for a new community
   - **C.** Building a new dam as a source for electricity
   - **D.** Informing the public about changes at the electrical company
3. Of the following, which one is the best example of progressive elaboration?
   - **A.** It is the process of decomposing the work into small, manageable tasks.
   - **B.** It is the process of taking a project from concept to completion.
   - **C.** It is the process of taking a project concept to a project budget.
   - **D.** It is the process of identifying the business needs of a potential project.
4. Your organization would like to create a new product based on market research. This new product will be created by a project. This is an example of which one of the following reasons to launch a new project?
   - **A.** Organizational need
   - **B.** Customer request
   - **C.** Market demand
   - **D.** Legal requirement
5. A program is which one of the following?
   - **A.** A very large, complex project
   - **B.** A collection of small projects with a common goal
   - **C.** A collection of projects with a common cause
   - **D.** A collection of subprojects with a common customer

6. Who manages programs?
   A. Management
   B. Project sponsors
   C. Project managers
   D. Program managers
7. You have an excellent idea for a new project that can increase productivity by 20 percent in your organization. Management, however, declines to approve the proposed project because too many resources are already devoted to other projects. You have just experienced what?
   A. Parametric modeling
   B. Management by exception
   C. Project portfolio management
   D. Management reserve
8. Of the following, which is not part of the Iron Triangle?
   A. Quality
   B. Time
   C. Scope
   D. Cost
9. Of the following, which statement is correct?
   A. A project manager must use every process identified within the PMBOK on every project.
   B. A project must use every tool and technique as identified within the PMBOK on every project.
   C. A project manager must use the most appropriate processes on every project.
   D. A project manager must agree that he will use the most appropriate tools and techniques on every project.
10. Projects are temporary endeavors to create a unique product, service, or result. Which one of the following does not relate to the concept of "temporary" in project management?
   A. The project team
   B. The market window status on which the project is capitalizing
   C. The project deliverable
   D. The project manager

11. A project creates a unique product, service, or result. Which one of the following is a result?
    A. A new piece of software
    B. A new airplane
    C. A feasibility study
    D. A call center
12. What is the difference between a standard and a regulation?
    A. A standard is optional; regulations are not.
    B. A standard is not optional; a regulation may be.
    C. A standard is rarely optional; regulations are never optional.
    D. A standard is a guideline; a regulation is a request.
13. A project manager needs five areas of expertise to be successful. Which one is not one of the five areas of expertise?
    A. Application area knowledge
    B. An understanding of the project environment
    C. PMP or CAPM certification
    D. Interpersonal skills
14. Which one of the following is not a characteristic of a project's cultural and social environment?
    A. Economics
    B. Time zone differences
    C. Demographics
    D. Ethics
15. You are the project manager of the KHGT Project, which will span four countries around the world. You will need to consider all of the following characteristics of the international and political environment except for which one?
    A. International, national, regional, and local laws
    B. Customs
    C. Customers
    D. Holidays
16. Which one of the following is not an example of an interpersonal skill?
    A. Financial management and accounting
    B. Sales and marketing
    C. Conflict management
    D. Health and safety practices

17. What is a subproject?
    - **A.** It is a smaller project that supports a parent project.
    - **B.** It is a project that is performing below expectations.
    - **C.** It is a project that has been experiencing project spin-off.
    - **D.** It is delegation of a project phase.
18. Where will a project manager most likely get project management mentoring?
    - **A.** Project Management International
    - **B.** American Society for Quality
    - **C.** The project management office
    - **D.** Subject matter experts
19. Which one of the following is an example of operations?
    - **A.** Creating a new community park
    - **B.** Designing a new car
    - **C.** Sending monthly invoices to an organization's 25,000 customers
    - **D.** Removing an old server and replacing it with a newer one
20. When considering the selection of projects to be initiated, project portfolio management considers all of the following except for which one?
    - **A.** Risk/reward categories
    - **B.** Lines of business
    - **C.** The project manager's experience
    - **D.** General types of projects

Answers

1. **C**. A project is a temporary endeavor to create a unique product, service, or result. Deadlines and cost constraints are tied to the project. A is incorrect because programs are a collection of projects working towards a common cause. B is incorrect because operations are ongoing activities of an organization. D, a subproject, describes a project that is part of and supports a larger project. For more information, see the PMBOK, Section 1.2.1.
2. **A**. Providing electricity to a community is the best example of operations, as it is an ongoing activity. B, C, and D are all examples of projects, as they are temporary and create a unique product, service, or result. For more information, see the PMBOK, Section 1.2.2.
3. **B**. According to the PMBOK, progressive elaboration means developing in steps and then continuing by increments. A describes the process of breaking down the project scope into the task list. C is not a valid choice for this question. D is part of stakeholder analysis, and is not the best answer for this question. For more information, see the PMBOK, Section 1.2.1.3.

4. **C**. Projects can be created for a number of reasons, and this example supports the market demand choice. A, an organizational need, is a project to satisfy an internal need. B is incorrect because no specific customer asked for this new product. D is incorrect because there is no legal requirement to create the new product. For more information, see the PMBOK, Section 1.2.3.
5. **C** best describes a program. A program is a collection of projects working together to gain benefits by managing the projects as a group rather than on an individual basis. A, B, and D are not attributes of programs. For more information, see the PMBOK, Section 1.6.1.
6. **D**. Programs are managed by program managers. A, B, and C are incorrect choices. For more information, see the PMBOK, Section 1.6.1.
7. **C**. Project portfolio management is the management, selection, and assignment of projects that support an organization's business objectives. A, B, and D are not valid answers. For more information, see the PMBOK, Section 1.6.2.
8. **A**. Quality, while important, is not part of the Iron Triangle of Project Management. B, C, and D comprise the Iron Triangle. For more information, see the PMBOK, Section 1.3.
9. **C**. A project manager does not have to use all of the processes within the PMBOK, only the most appropriate. A, B, and D are incorrect statements, as the project manager does not use every process or tool and technique within the PMBOK. For more information, see the PMBOK, Section 1.1.
10. **C**. Most projects create a deliverable that will outlive the project itself. A, B, and D are incorrect, as these attributes are temporary in nature. For more information, see the PMBOK, Section 1.2.1.1.
11. **C**. The PMBOK gives the concept of creating feasibility as a result. A, B, and D describe products and services. For more information, see the PMBOK, Section 1.2.1.2.
12. **A** is the best choice, as standards are optional while regulations are not. B, C, and D do not accurately describe the difference between standards and regulations. For more information, see the PMBOK, Section 1.2.5.2.
13. **C**. Believe it or not, you don't have to be a PMP or a CAPM to be a successful project manager. A, B, and D are valid characteristics of a project manager. For more information, see the PMBOK, Section 1.5.
14. **B**. Time zone differences are not part of the cultural and social environment, but are part of the international and political environment. A, C, and D are part of the cultural and social environment. For more information, see the PMBOK, Section 1.5.3.
15. **C**. Customers are not part of the international and political environment. A, B, and D are part of this environment. For more information, see the PMBOK, Section 1.5.3.

16. **A**. Financial management and accounting is not an interpersonal skill. B, C, and D are examples of interpersonal skills, so these choices are invalid for this question. For more information, see the PMBOK, Section 1.5.5.
17. **A** best describes a subproject, which is a project, sometimes smaller than the original, that supports a parent project. B, C, and D do not accurately describe a subproject. For more information, see the PMBOK, Section 1.6.3.
18. **C**. Project managers will most likely receive mentoring from the project management office. A is not a valid choice. B is not a valid choice because ASQ does not provide mentoring for project managers. D is not the best choice for the question because the PMBOK specifically identifies the PMO as a source for mentoring. For more information, see the PMBOK, Section 1.6.4.
19. **C** is the best example of operations, as the answer implies that this work is done every month. A, B, and D are all unique endeavors that may be done once or just occasionally, but are not part of ongoing operations. For more information, see the PMBOK, Section 1.2.2.
20. **C**. While the experience of the project manager is likely considered during the assignment of projects, it is not considered during project portfolio management. A, the risk and reward of the project is considered. B and D, the lines of business and the general types of projects, are also considered as part of project portfolio management. For more information, see the PMBOK, Section 1.6.2.

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CHAPTER 2

Managing a Project

In this chapter, you will

- Learn how a project moves through phases
- Learn how to work with project stakeholders
- Understand how different organizations operate
- Know the types of organizational structures and their characteristics

You've got lots of work to do as a project manager: meetings, planning, coordination, leading the project team, and ensuring that the project work is done according to the project plan. You're with the project all the way, from the get-go to the final closure report. You work with project stakeholders to gather requirements, keep them posted on the progress, and manage their influence over the project as much as possible. It's an ongoing job that ends just after the project work does.

While your job as the project manager centers on getting the project work done, we know that it's really more than just doing the project work. Logistics and problem-solving cling to the project like socks to a wool skirt. That's what you'll learn in this chapter (no, not about socks).

VIDEO Working through a project's life cycle.

Identifying the Project Life Cycle (PMBOK, Section 2.1)

Projects are born, they live, and then they die. Morbid, isn't it? But that simple analogy of being born, living, and dying is exactly what the Project Management Institute (PMI) calls the duration of a project: the project life cycle. A project life cycle is the project from start to finish. Every project in the world has its own life cycle. Consider any project you've ever worked on, whether it is in construction, manufacturing, or information technology. Every project was born (initiated), lived (planned, executed, monitored, and controlled), and then died (closing). That's the project life cycle.

If we were to visit a technology guru and check out his projects, he'd have a different life cycle from what a construction company's projects may have. Every project life cycle is unique to the nature of the work being completed.

EXAM TIP Because every project has its own life cycle, regardless of the application area, it's tough for PMI to ask specific questions on this subject. You'll likely encounter questions about what a project life cycle is, but not on the activities that would take place in a project's life cycle.

Examining a Project Life Cycle

A project is an uncertain business: the larger the project, the more uncertainty. It's for this reason, among others, that projects are broken down into smaller, more manageable phases. A project phase allows a project manager to see the project as a whole and yet still focus on completing the project one phase at a time.

A life cycle is almost always comprised of multiple phases. You can identify a project life cycle, most often, by the phases that may exist within the project. A construction project may, for example, move through these phases:

- Research
- Pre-construction
- Site work
- Foundation
- Framing
- Rough-in
- Interior finishes
- Exterior finishes
- Landscaping

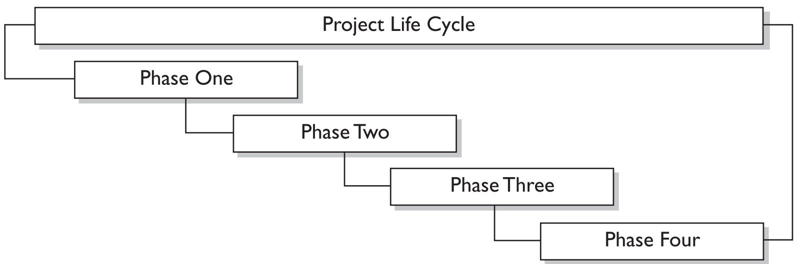
The end result of a phase generally creates a project deliverable and allows the project to move toward its completion. Check out the preceding list. Just because a phase has been completed does not necessarily mean that the next phase can automatically begin. A phase-end review is needed to determine that the phase has met all of its obligations and then to authorize the initiation of the subsequent phase. A phase-end review is also known as a phase exit, phase gate, or a kill point.

EXAM TIP A kill point is an ideal opportunity to "kill" a project at the end of a phase.

Imagine a construction project to build a new sports complex for your city. The foundation of the entire sports complex may not need to be 100 percent complete for the framing of the building to begin. The framing could begin as long as the risk associated with starting this phase of the project was acceptable. The practice of overlapping phases is called fast-tracking (we'll see this again in Chapter 6 in a discussion on project time management). While fast-tracking does save project time, it can increase project risk.

EXAM TIP Fast-tracking is an example of schedule compression, but it can increase project risk. Fast-tracking is not the same as lead time, which is negative time between project activities.

In most organizations, regardless of the project manager's experience, management wants to see proof of progress, evidence of work completed, and good news of how well the project is moving. Phases are an ideal method of keeping management informed of the project progression. The following illustration depicts a project moving from conception to completion. At the end of each phase, there is some deliverable that the project manager can show to management and customers.



Project Life Cycle Characteristics

Because every project in the world is unique, it's impossible to say what exactly must happen in every phase of the project life cycle. There are, however, characteristics of every project life cycle that are universal:

- Phases are typically sequential and allow subsequent phases to begin.
- Project costs and staffing requirements are generally low at the project's beginning phases, while costs and resources are highest in the project's intermediate phases. As the project moves towards completion, the cost and resource requirements generally wane.
- The likelihood of the project's success is always lowest during the early phases of the project. As the project moves towards completion, the likelihood of the project success increases.
- Stakeholders have the highest influences on the project's product during the initiating phases, as Figure 2-1 demonstrates.

Every project moves through phases, and phases comprise the project life cycle. Phases are logical approaches to segmenting the work, but they primarily allow management, an organization, or a project manager to have better control over the work done in each phase. Each phase within a project determines:

- The work that will happen in each phase
- The deliverables that will be created as a result of each phase
- How the phase deliverables will be reviewed, approved, and validated
- The needed resources for each phase
- How each phase will be approved to allow successor phases to launch

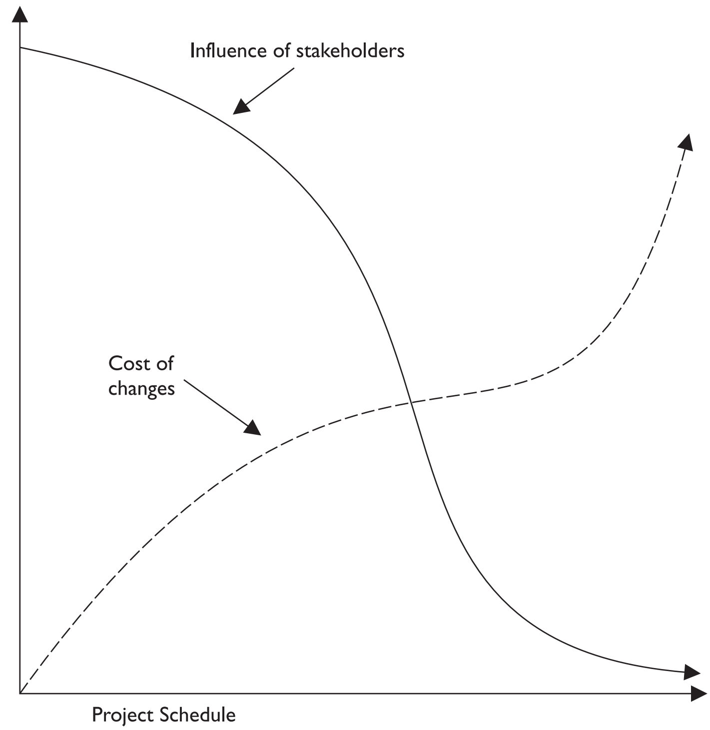


Figure 2-1 Stakeholder influence wanes as the project moves towards completion. Cost due to changes increases as the project moves towards completion.

Comparing Project Life Cycles and Product Life Cycles

There must be some distinction between the project life cycle and the product life cycle. We've covered the project life cycle—the accumulation of phases from start to completion within a project, but what is a product life cycle?

A product life cycle is the whole life of the product the project has created. If your company had a brilliant idea to create a new piece of software, initiated and managed a project to create the software, and then implemented the software, that would be most of the product life cycle. The remainder of the product life cycle is the usage and support of the software until some day, sadly, the software is determined to be out-of-date and retired from your organization. The product life cycle is the whole gosh-darn span of time, from concept to project to usage to retirement.

Meeting the Project Stakeholders (PMBOK, Section 2.2)

Stakeholders are those fine folks and organizations who are actively involved in the project or who will be affected by its outcome—in other words, people, groups, businesses, customers, and communities that have a vested interest in the project. If you're a project manager who is working with a senior project manager, or if you are assisting the project manager, you are a stakeholder as well.

Stakeholders may like, love, or hate your project. Consider an organization that is hosting a project to move all their workers to a common word-processing application. Everyone within this organization must now use the same word-processing application. Your job, as the project manager, is to see that it happens.

Now, within your project, you've got stakeholders that like the project; they're in favor of the project deliverable. Other stakeholders love the project—they cannot wait for all of the organization to use the same application for word processing. These people are considered positive stakeholders. And, sigh, there are those stakeholders who hate your project and want to do everything they can to make your project fail. Yep, these people are negative stakeholders.

Stakeholders, especially negative stakeholders, may try to influence the project itself. This can be attempted in many ways:

- Political capital leveraged to change the project deliverable
- Change requests to alter the project deliverable
- Scope addendums to add to the project deliverable
- Sabotage, through physical acts or rumors, gossip, and negative influence

EXAM TIP Any stakeholder that is opposed to, threatened by, or wants your project to just go away is a negative stakeholder.

Your role as a project manager is to identify, align, and ascertain stakeholders and their expectations of the project. You may lead the project or work with another project manager to confirm the alignment of stakeholder priorities within the project. Stakeholder identification is not always as clear-cut as in the preceding example. Because stakeholders are identified as people who are affected by the outcome of your project, external customers may be stakeholders in your project, too.

Consider a company that is implementing a frequent customer discount project. External customers will use a card that tracks their purchases and gives them discounts on certain items they may buy. Is the customer in this instance a stakeholder? What if the customer doesn't want to use the card? Is she still a stakeholder?

Stakeholders can go by many different names: internal and external customers, project owners, financiers, contractors, family members, government regulatory agencies, communities, cities, citizens, and more. The classification of stakeholders into categories is not as important as realizing and understanding stakeholders' concerns and expectations. The identification and classification of stakeholders does allow, however, the project manager to deliver effective and timely communications to the appropriate stakeholders.

NOTE In high-profile projects, where stakeholders will be in conflict over the project purpose, deliverables, cost, and schedule, the project manager may want to use the Delphi technique to gain anonymous consensus among stakeholders. The Delphi technique allows stakeholders to offer opinions and input without fear of retribution from management.

Key Project Stakeholders

Beyond those stakeholders affected by the project deliverable, there are key stakeholders on every project. Let's meet them:

- **Project manager** The project manager is the person—which could also be you, the certified associate in project management (CAPM) or project management professional (PMP)—who is accountable for managing the project. He guides the team through the project phases to completion.
- **Customer/user** The customer is the person or group that will use the project deliverable. In some instances, a project may have many different customers. Consider a book publisher for children. The bookstores distribute the children's book; the adults pay for the book; the children read the book. There is also some consideration given to the user versus the customer. The user uses the product; the customer pays for it. A stakeholder can be both a user and a customer.
- **Performing organization** On your project, you'll have a project team. Whom do the team members work for? The performing organization is the entity that employs the people responsible for completing the project work. In some instances, the performing organization can be a vendor whose project team is completing the project work for another entity: the customer.
- **Project team members** The project team is the collection of individuals that will, hopefully, work together to ensure the success of the project. The project manager works with the project team to guide, schedule, and oversee the project work. The project team completes the project work.
- **Project management team** The people on your project team who are involved with the project management activities. Recall the administrative staff in a projectized structure? Those people are also stakeholders; anyone who contributes to the project is a stakeholder.
- **Sponsor** The sponsor authorizes the project. This person or group ensures that the project manager has the necessary resources, including monies, to get the work done. The project sponsor is someone within the performing organization who has the power to authorize and sanction the project work, and who is ultimately responsible for the project's success. Ideally, project sponsors shield the project manager from attacks, scope changes, and authority challenges.
- **Influencers** These are people who may not be directly affected by the project's product, but their position within the organization can influence a project. Consider the purchaser for your client. He or she may not be affected by the outcome of your project, but can influence the purchasing decision of the organization.

- **PMO** The project management office (PMO) is considered a stakeholder of the project it oversees. If an organization does not have a PMO, then this stakeholder, of course, isn't valid.

Managing Stakeholder Expectations

Have you ever had an experience that didn't live up to your expectations? Not much fun, is it? With project management and the large number of stakeholders, it's easy to see how some stakeholders' expectations won't be realistic due to cost, schedule, or feasibility. A project manager must find solutions to create win-win scenarios between stakeholders.

EXAM TIP If you want to manage stakeholders' expectations, you have to know who they are first. Identify the stakeholders, and then you can identify their requirements. Once the expectations are identified, get them on paper! Nothing beats documentation.

Managing Expectations in Action

Consider a project to implement new Customer Relationship Management (CRM) software. In this project, there are three primary stakeholders with differing expectations:

- The sales director primarily wants a technical solution that will ensure fast output of order placements, proposals, and customer contact information—regardless of the cost.
- The marketing director primarily wants a technical solution that can track call volume, customer sales history, and trends with the least cost to implement.
- The IT director wants a technical solution that will fan into the existing network topology, have considerable ease of use, and be reliable—without costing more than 20 percent of his budget for ongoing support.

In this scenario, the project manager will have to work with each of the stakeholders to determine a winning solution that satisfies all of the project requirements while appeasing the stakeholders' demands. The project manager assistant may interview these stakeholders with the project manager to rank their priorities, along with required and optional results for the project deliverables.

Specifically, the solution for the conflict of stakeholders is to satisfy the needs of the customer first. Customer needs, or the business need of why the project was initiated, should guide the project through its life cycle. Once the project scope is aligned with the customer's needs, the project manager may work to satisfy the differing expectations of the stakeholders.

Identifying the Organizational Influences (PMBOK, Section 2.3)

Projects happen within organizations, and in most instances, the organization is larger than the project. This means that your project has to answer to someone, some department, or even a customer of the organization. As much as I'd like to call all of the shots on all the projects I manage, and I'm sure you wish the same, we both know we have to answer to someone within our organization. The people who project managers answer to are the influencers within an organization.

How a project is influenced is largely based on the type of organization that the project is occurring within. Project-centric organizations fall under two big umbrellas:

- Organizations that exist primarily to perform projects for others. Think of architects, IT consulting firms, engineering firms, consultants, and just about any other agency that completes work for others under a contractual basis. (This is what I do as a writer and corporate educator.)
- Organizations that use management by projects to manage their business. These organizations manage their work through their project management system. An IT department, for example, may treat an upgrade of all their network servers as a project. A manufacturer may treat a customer's job as a project. In the traditional sense, these activities are part of their operations, but because there's a definite beginning and ending to that specific work, they're taking advantage of a project management system they've adapted or created.

You also have to consider the maturity of the organization where the project is being hosted. A large internal organization that's been established for years and years will likely have a more detailed project management system than a startup entrepreneurial company. The standards, regulations, culture, and procedures influence how the project should be managed, how the project manager will lead and discipline the project team, reporting relationships, and the flow of communications that will take place. Consider the cultural components within an organization:

- Defined values, beliefs, and expectations of the project work
- Policies and procedures, both within the organization and external to the organization (consider the policies that govern the banking industry, for example)
- Defined authority for the project manager and over the project managers
- Defined working hours and work ethics of the project team, project manager, and management

Completing Projects in Different Organizational Structures

Organizations are structured into one of six models, the organizational structure of which will affect the project in some aspect. In particular, the organizational structure will set the level of authority, the level of autonomy, and the reporting structure that the project manager can expect to have within the project. Figure 2-2 shows the level of authority for the project manager and the functional manager in each of the organizational structures. The organizational structures we'll discuss include:

- Functional
- Weak matrix
- Balanced matrix
- Strong matrix
- Projectized
- Composite

NOTE Being able to recognize your organizational structure with regards to project management will allow you to more effectively leverage and position your role as a project manager.

Functional Organizations

Functional organizations are entities that have clear divisions regarding business units and their associated responsibilities. For example, a functional organization may have an accounting department, manufacturing department, research and development department, marketing department, and so on. Each department works as a separate entity within the organization, and each employee works in a department unique to their area of expertise. In these classical organizations, there is a clear distinction between an employee and a specific functional manager.

Functional organizations do complete projects, but these projects are specific to the function of the department that the project falls into. For example, the IT department could implement new software for the finance department. The role of the IT department is separate from the finance department, but the coordination between the two would be evident. Communication between departments flows through functional

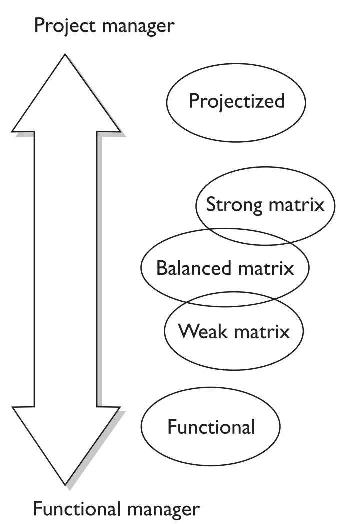


Figure 2-2 The organizational structure determines the authority that the project manager and functional manager will have.

managers down to the project team. Project managers in functional organizations have the following attributes:

- Little power
- Little autonomy
- Report directly to a functional manager
- The project manager may be known as a project coordinator or team leader
- The project manager's role is part-time
- The project team is part-time
- The project manager may have little or no administrative staff to expedite the project management activities

Matrix Structures

Matrix structures are organizations that have a blend of departmental duties and employees together on a common project. These structures allow for project team members from multiple departments to work toward the project completion. In these instances, the project team members have more than one boss. Depending on the number of projects a team member is participating in, she may have to report to multiple project managers as well as their functional managers.

Weak Matrix

Weak matrix structures map closely to functional structures. The project team may come from different departments, but the project manager reports directly to a specific functional manager. Project managers in weak matrix organizations have the following attributes:

- Limited authority
- Management of a part-time project team
- Project role is part-time
- May be known as a project coordinator or team leader
- May have part-time administrative staff to help expedite the project

Balanced Matrix

A balanced matrix structure has many of the same attributes as a weak matrix, but the project manager has more time and power regarding the project. A balanced matrix still has time-accountability issues for all the project team members because their functional managers will want reports on their time within the project. Project managers in a balanced matrix have the following attributes:

- Reasonable authority
- Management of a part-time project team
- Full-time role as a project manager
- May have part-time administrative staff to help expedite the project

Strong Matrix

A strong matrix equates to a strong project manager. In this type of organization, many of the same attributes for the project team exist, but the project manager gains power when it comes to project work. The project team may also have more time available for the project, even though the members may come from multiple departments within the organization. Project managers in a strong matrix have the following attributes:

- A reasonable-to-high level of power
- Management of a part-time to nearly full-time project team
- Full-time role as a project manager
- A full-time administrative staff to help expedite the project

Projectized Structure

The projectized structure is at the pinnacle of project management structures. This organizational type groups employees, collocated or not, by activities on a particular project. The project manager in a projectized structure may have complete, or very close to complete, power over the project team. Project managers in a projectized structure enjoy a high level of autonomy over their projects, but also have a higher level of responsibility regarding the project's success.

Project managers in a projectized structure have the following attributes:

- High-to-complete level of authority over the project team
- Works full-time on the project with his team (though there may be some slight variation)
- A full-time administrative staff to help expedite the project

Composite Organizations

On paper, all of these organizational structures look great. In reality, there are few companies that map to only one of these structures all of the time. For example, a company using the functional model may create a special project consisting of talent from many different departments. Such project teams report directly to a project manager and will work on a high-priority project for its duration. These entities are called composite organizations because they may be a blend of multiple organizational types.

Table 2-1 summarizes the most common organizational structures and their attributes.

Working with Your PMO

Recall that a PMO is a schmancy club where all the project managers get together for cigars and martinis. Not really—I just wanted to see if you were paying attention. The PMO coordinates the activities of all the project managers. Its primary goal is to create a uniform approach on how projects operate within the organization. PMOs can exist in any structure, but are most common in matrix structures and in projectized environments.

	Functional	Weak Matrix	Balanced Matrix	Strong Matrix	Projectized
Project Manager's Authority	Little or none	Limited	Low to moderate	High	High to total
Resource Availability	Little or none	Limited	Low to moderate	High	High to total
Budget Control	Functional manager	Functional manager	Mixed	Project manager	Project manager
Project Manager's Role	Part-time	Part-time	Full-time	Full-time	Full-time
Project Manager's Administrative Staff	Part-time	Part-time	Part-time	Full-time	Full-time

Table 2-1 Organizational Structures and Their Influence on Project Managers

The role of the PMO is typically to support the project management in the form of templates, project management software, training, leadership, and even granting authority for the project's existence. Often, the PMO provides the administrative support a project manager can expect in a projectized environment.

Here's the big caveat with PMOs: Project team members in a projectized environment are traditionally on one project at a time. A PMO, however, may elect to share project team members between projects if it best serves the organization. So basically, there's no hard and fast rule for the assignment of project team members to an individual project if they are reporting to the PMO rather than directly to the project manager. For your CAPM or PMP exam, keep this in mind: The project managers report to the PMO, and the PMO may exercise its authority over the project managers' control of the project team.

Defining a Project Management System

A project management system is a collection of tools, resources, a project management methodology, and defined procedures a project manager uses to complete a project. Project management is typically defined for the organization, and the collection of tools and resources is considered the project management system—it's the approach to managing projects within an organization.

Your project management plan defines how your project will work with and utilize the project management system on which your organization relies. Of course, you don't have to have a project management system, but most companies do. A project management system will vary based on the project's application area, organizational structure, and the project complexity.

If an organization is using a PMO, the PMO will likely control and dictate the functions of the project management system. For your PMI exam, know that a project management system defines the processes and procedures a project manager is to follow to complete a project.

Chapter Summary

Studying for your project management exam can be its own project. You have a sense already where this project is going: to your certification. Sooner or later, your certification project will end and you'll move on to other goals. Projects are the same way. They have a life of their own, and it's called the project life cycle.

Every project, regardless of the application area, follows its own logical path from initiation to closure. Within the project life cycle, there are phases that allow the project to move towards completion. At the end of a phase, the project should create some deliverable or condition that allows the next phase to begin. Sometimes, depending on the associated risk, phases are allowed to begin even when previous phases are not completed; this is fast-tracking.

A project has the most uncertainty of finishing successfully at the beginning because it's a long, long way to completion. As a project moves closer to completion, the likelihood of project success increases because the completion of phases moves the project closer to completing the project objectives. Also, at the start of the project, stakeholders have the highest influence on the project's deliverables. This means they can easily pick and choose and change their minds over and over because nothing has been created yet. When the project begins to create deliverables and move towards closure, it becomes increasingly difficult for stakeholders to change their minds on what the project deliverable should be. Stakeholders can still change their mind (and they often do), but it'll usually cost more time and money the later they wait to announce changes to the project requirements.

Speaking of stakeholders, the folks who have a vested interest in the outcome of a project, it's up to the project management team to define all of the stakeholders within a project. If the project team fails to identify a key stakeholder, trouble and risk can ensue. Recall that stakeholders can also be positive or negative, depending on their position on the project's purpose and the desired project deliverable.

The organizational structure can help the project team identify the stakeholders, but the organizational structure also identifies the project manager's authority. This authority ranks from low to high in the following order of organizational structures: functional, weak matrix, balanced matrix, strong matrix, projectized.

Project management offices support the project manager by providing software, templates, training, and often administrative staffing.

For your exam, pay special attention to the attributes of a project life cycle and its phases. You'll also want to zoom in on the organizational structures and their characteristics. You'll likely encounter questions in which you, as the project manager, will need to respond to a scenario. The response will be determined by the organizational structure within which the project manager is operating.

Key Terms

Balanced matrix structure An organization where organizational resources are pooled into one project team, but the functional managers and the project managers share the project power.

Composite structure An organization that creates a blend of the functional, matrix, and projectized structures.

Customer/user The person(s) who will use the project's deliverables.

Deliverable A verifiable, measurable product or service created by a phase and/or a project.

Functional structure An organization is divided into functions, and each employee has one clear functional manager. Each department acts independently of the other departments. A project manager in this structure has little to no power and may be called a project coordinator.

Influencers Persons who can positively or negatively influence a project's ongoing activities and/or the project's likelihood of success.

Kill point The review of a phase to determine if it accomplished its requirements. A kill point signals an opportunity to kill the project if it should not continue.

Negative stakeholder A stakeholder who does not want a project to succeed. He or she may try to negatively influence the project and help it fail.

Performing organization The organization whose employees or members are most directly involved in the project work.

Phase The logical division of a project based on the work or deliverable completed within that phase. Common examples include the phases within construction, software development, or manufacturing.

Phase exit The review of a phase to determine if it accomplished its requirements.

Phase gate The review of a phase to determine if it accomplished its requirements.

Phase-end review The review of a phase to determine if it accomplished its requirements. A phase-end review is also called a phase exit, a phase gate, and a kill point.

Positive stakeholder A stakeholder who wants a project to exist and succeed. He or she may try to positively influence the project and help it succeed.

Product life cycle The life cycle of the product a project creates. For example, a project can create a piece of software; the software then has its own life cycle until it becomes defunct.

Project life cycle The collection of phases from the start of a project to its completion.

Project management office (PMO) A business unit that centralizes the operations and procedures of all projects within the organization. The PMO supports the project manager through software, templates, and administrative support. A PMO can exist in any organizational structure, but it is most common in matrix and projectized structures.

Project management system The defined set of rules, policies, and procedures that a project manager follows and utilizes to complete the project.

Project stakeholder Anyone who has a vested interest in a project's operation and/or its outcome.

Projectized structure An organization that assigns a project team to one project for the duration of the project life cycle. The project manager has high-to-almost-complete project power.

Strong matrix structure An organization where organizational resources are pooled into one project team, but the functional managers have less project power than the project manager.

Weak matrix structure An organization where organizational resources are pooled into one project team, but the functional managers have more project power than the project manager.

Case Study

Managing Projects from Start to Completion

The Riverside Community Park Project was an endeavor to create a 140-acre community recreation park alongside the White River. The project, led by Thomas Stanford and assisted by Jan Steinberg, included many deliverables for the community, including:

- A walkway along the river connecting restaurants and neighborhoods
- Hiking trails
- Baseball and soccer fields
- Water access points
- Picnic areas
- Children's playgrounds
- An indoor family swimming facility
- Parking areas

Examining the Project Deliverables

The first phase the project moved through was in-depth planning and development. The project scope was broken down into four major categories:

- River-related deliverables, such as docks and fishing areas
- Structural-related deliverables, such as the indoor swimming facility
- Environment-related deliverables, such as the hiking trails
- Common areas, such as the picnic and parking areas

Each of these deliverables was broken down into components that could, in turn, be broken down into exact deliverables for the project. For example, the indoor swimming facility included the excavation of the grounds for the building, the construction of the building, and the indoor swimming pool.

Each deliverable was broken down to ensure that all of the required components were included in the project plan. Each category of deliverables went through a similar process to ensure that all of the deliverables were accounted for and that the project plans were complete. Stanford and Steinberg worked with a large project team that specialized in different disciplines within the project work.

For example, Holly Johnson of EQHN Engineering served as team lead for the river-related deliverables. Johnson has years of experience in construction projects dealing with lakes, rivers, and manufactured waterways. Her expert judgment contributed to the development of the plan and the breaking down of the work.

Don Streeping of RHD Architecture and Construction helped Stanford develop the requirements, features, and components of the indoor swimming facility. RHD Architects designed the building and swimming facilities for the project and helped map out the timeline for a feasible completion and successful opening day.

Grey Jansen with the Department of Natural Resources and Marci Koening with the Department of Urban Planning worked with Stanford to create several different hiking trails and a pedway along the riverfront. The elaborate trail system offers challenging hikes to pleasant strolls. In addition, the pedway allows visitors to walk through more than 50 acres along the river and to visit restaurants, shopping centers, and other commercial ventures within the park. Without Jansen's and Koening's expertise, the project would not have been a success.

Finally, John Anderson led the team responsible for the common areas. The children's playgrounds are top-notch, and there is ample parking and access to the park. In addition, Anderson's team created soccer fields and two baseball diamonds for Little League usage.

Examining the Project Phases

When the project was launched, the 140-acre tract was a marshy, brush-filled plot of land that was mostly inaccessible to the general public. In order for this undertaking to be successful, the project had to move through several phases. Many of the deliverables, such as the parking areas and maintenance roads, had to be created first in order to allow the equipment and workers to access the sites throughout the park.

Phase One

The first phase of the project was in-depth planning. Stanford and Steinberg worked with each of the team leaders and other experts to coordinate the activities to create the deliverables in a timely fashion. In order to maximize the return on investment, the project's plan called for immediate deliverables for the public.

The planning phase of the project resulted in:

- The project plan and subsidiary plans, such as cost, risk, and scope management plans
- Design specifications for each of the major deliverables
- A schedule that allows for the deliverables to work in tandem and for them to support one another throughout the project plan
- The creation of a work authorization system
- Continued community buy-in for the project

Phase Two

Once the project's plan and coordination between teams was realized, John Anderson's crew went to work on Phase Two of the project: creating accessibility. This phase of the project became known as the "Rough-In" phase because roads, parking, and preparation of the park were needed immediately. This phase resulted in:

- Access roads throughout the park
- Entry roads to the park at several points throughout the city
- Junction roads that allowed easy access for construction equipment to be stored on-site for the project's duration

Phase Three

Phase Three of the project allowed each team to begin its work independently, with an eye towards common delivery dates. For example, Johnson and Jansen had expertise in separate deliverables: the water access points and the trails throughout the park. The project plan called for trails along the river and through the woods, which would be built by Johnson's crew. In tandem with the hiking trails, Johnson's team went to work on the river pedway. At several points along the river pedway, trails from the woods would connect to the paved surface. These two deliverables were timed so that both teams would work together on connecting the nature trails with the river pedway. In addition, caution had to be taken to preserve the environment in the woods and in the water.

Streeping's primary responsibility was the creation of the indoor swimming facility. This deliverable required excavation, the digging and creation of the indoor swimming pool, and the construction of the facility to house the indoor swimming pool. Streeping had to coordinate the construction with Anderson, as the swimming pool needed the largest parking area in the compound. Stanford and Steinberg worked with each team leader to facilitate a common schedule for each of the deliverables.

This phase saw its first completed deliverable for the project: A children's playground was opened near the park entrance that the public could begin using immediately. The playground can easily host up to 75 children at once and has parking for up to 50 cars. In addition, a picnic shelter was opened adjacent to the playground. Because of the proximity of the park and playground to nearby shops and restaurants, this deliverable was well-received from the community, and the public began enjoying the facilities immediately.

Other deliverables in the phase included:

- Restroom facilities installed at several points throughout the park
- Excavation of several water access points
- Excavation for the swimming facility
- Clearing and leveling for the soccer and baseball fields

Phase Four

Phase Four of the project focused on creating more usable deliverables for the general public. The focus was on the hiking trails throughout the park and partial completion of the river pedway. The hiking trails required brush to be removed, some trees to be removed, and the land to be graded for passable hiking. The pedway was initially formed as a cement path that will be blacktopped once it is connected throughout the park. Like the hiking trails, the pedway required the removal of brush and trees while considering the environmental preservation of the river.

Jansen's and Anderson's teams worked together to clear the pedway, remove the brush along the riverbank, and preserve the older trees to create a stunning walk along the river. To create maximum deliverables, the pedway was implemented at opposite ends of the 50-acre trail, with plans to be connected at acre 25. This allows the public to enjoy the deliverables in increments from either end of the park.

This phase created these deliverables:

- Seven of the ten hiking trails in the system were cleared and opened for public usage.
- A total of 30 acres of the river pedway were completed (15 acres on both ends of the pedway).
- The swimming pool was excavated and the cement body of the pool was installed.

Phase Five

Phase Five of the project was perhaps the most exciting, as it completed several deliverables:

- The remaining three of the hiking trails were completed. These trails included bridges over small creeks that feed into the White River.
- The remaining 20 acres of the river pedway were excavated and completed with the cement pour. Citizens can now walk or ride their bikes the entire 50-acre length alongside the river.
- The soccer and baseball facilities were installed, which included restrooms, concession stands, bleachers, fences, and dugouts. The fields were also seeded and fertilized, and will be officially open for public use next spring when the grass is healthy.

Phase Six

Phase Six of the project was the longest, but most satisfying. This phase focused on the completion of the indoor swimming facility. The structure includes two Olympic-sized swimming pools, diving boards, locker rooms, sauna and steam facilities, and a restaurant. The building is situated on a hill that overlooks the river pedway—it is the crown jewel of the park. The facility was completed as planned and was opened to the public.

This phase also included:

- The completion of blacktopping the 50-acre pedway along the river
- Closing and sodding of the temporary construction equipment corral
- Installing the remaining playgrounds and picnic areas throughout the park
- Opening the water access points, including a commercial dock for fishermen and boaters
- The official opening of the soccer and baseball fields

Controlling Project Changes

Throughout the project, the public had many requests for changes to the project scope. The project scope was quite large, and the project budget had limited room for additional changes without requesting additional funds.

When changes were proposed, such as the addition of tennis courts to the common areas, they were considered for validity, cost, risk, and the impact on the project scope. A Change Control Board, which Stanford initiated, considered the proposed changes and then approved or declined the changes based on predetermined metrics, such as time, cost, and overall change on the original project scope.

When the project was initiated, a public meeting was held to gather input from the community on the deliverables they would most like to see in the park. At this point of the project, the stakeholders—the community at large—had a great opportunity to voice their opinions on what the park should and should not include. Once a consensus was created for the park deliverables and a scope was created, it became challenging for anyone to add to it.

Some changes, however, proved valuable and were added to project deliverables. For example, the commercial fishing and boating dock within the park was a viable opportunity for a local businessman to provide a service for boaters and the community at no cost to the project. Koening and Johnson worked with the business to ensure that it met the city codes, safety regulations, and fit within the scheme and overall effect of the project.

Other changes, such as the tennis courts, were declined. While there very well may be many tennis players in the community, this request was denied for several reasons:

- The city already supports many tennis courts in the community.
- A private tennis club is in the vicinity of the park, and they protested the addition of the tennis courts, as this would have an economical blow to their business.
- No tennis players requested the courts at any of the public meetings discussing the creation of the park.

Changes, especially in a project of this size, had to be tracked and documented. Any changes that were approved or declined were cataloged for reference against future change requests that may have entered the project.

Questions

1. The project life cycle is comprised of which of the following?
   A. Phases
   B. Milestones
   C. Estimates
   D. Activities

2. Marci Koening, the project manager for the ERP Project, is about to complete the project phase review. The completion of a project phase is also known as which of the following?
   A. Lessons learned
   B. Kill point
   C. Earned value management
   D. Conditional advancement
3. Which of the following best describes a project deliverable?
   A. The resources used by the project to complete the necessary work
   B. The resources exported from the project as a result of the project work
   C. The end result of a project planning session
   D. A verifiable, measurable work product
4. The compilation of all the phases within a project equates to the ___________ _________.
   A. Project life cycle
   B. Product life cycle
   C. Project completion
   D. Project processes
5. Which of the following describes the early stages of a project?
   A. High costs and high demands for resources
   B. A high demand for change
   C. A high demand for project team time
   D. Low costs and low demands for resources
6. At which point is the risk of failure the lowest, but the consequence of failure the highest?
   A. During the early stages
   B. During the middle stages
   C. During the final stages
   D. Risk of failure is even across all project phases
7. Project team members are most likely to work full-time on a project in which of the following organizational structures?
   A. Functional
   B. Weak matrix
   C. Strong matrix
   D. Projectized

8. Why would an organization divide a project into phases?
   A. To provide better management and control of the project
   B. To identify the work that will likely happen within a phase of the project
   C. To identify the resources necessary to complete a phase of the project
   D. To define the cashflow requirements within each phase of the project
9. All of the following are true statements about the project life cycle, except for which one?
   A. The project life cycle defines the work to be done in each phase of the project
   B. The project life cycle defines the deliverables that each phase will create
   C. The project life cycle defines who is involved in each phase
   D. The project life cycle defines how much each phase will cost
10. You are the project manager of a new project. When is the level of failing to achieve the objectives the highest within your project?
    A. There is not enough information provided to know for certain
    B. At the start of the project
    C. At the end of the project
    D. During the intermediate phases of the project
11. Which one of the following is an example of a positive stakeholder?
    A. The comptroller within your organization
    B. A customer who is eager for your project's deliverable
    C. An environmental group that has claims against your project
    D. A union
12. None of the following are key project stakeholders, except for which one?
    A. Union
    B. Influencer
    C. Technical interface
    D. Inspector
13. You are a project manager acting in a functional organization. The functional manager and you disagree about several deliverables the project will be creating. The functional manager insists that you begin the project work now. What must you do?
    A. Begin work
    B. Resolve all of the issues with the functional manager before you begin working
    C. Continue planning, as you are the project manager
    D. Begin work as long as the issues don't affect the project deliverables

14. You are a project manager working under a PMO. Your project resources are shared among several projects. To whom will the project team members report?
    A. The project manager of each project
    B. The functional managers
    C. The PMO
    D. The project manager of their primary project
15. At what point in the project may stakeholders most cost-effectively recommend changes to the project deliverable?
    A. Before the project charter is created
    B. At the start of the project
    C. During the intermediate phases
    D. During the final phase of the project
16. An organization has elected to kill a project. When is this decision most likely made?
    A. At the end of a phase
    B. At the start of a phase
    C. When the project is not meeting its financial requirements
    D. When technology has superseded some of the technology used within the project
17. Nancy is a project manager for the NHG Corporation. She has identified several positive stakeholders for her construction project and a few negative stakeholders. Nancy and the project team have been meeting regularly with the positive stakeholders, but have not met with the negative stakeholders. What can happen if Nancy ignores negative stakeholders?
    A. Her project will likely succeed without any objections
    B. Her project may suffer poor political capital from the negative stakeholders
    C. Her project will risk failure to bring the project to a successful end
    D. The negative stakeholders will not have an opportunity to communicate with the project manager
18. All of the following are cultural attributes of an organization, except for which one?
    A. Policies and procedures
    B. Work ethics
    C. View of authority relationships
    D. Experience of the project management team

19. The project management plan defines which one of the following?
    - A. Who the project manager will be
    - B. How the project manager will use the project management system
    - C. When the project team will be assembled and released
    - D. How the deliverable will be shipped to the customer
20. Who has full authority over project funding in a weak matrix?
    - A. The project manager
    - B. The functional manager
    - C. The PMO
    - D. The project sponsor

Answers

1. **A**. The project life cycle is comprised of phases. B is incorrect because milestones may exist within the project plan, but they do not comprise the project life cycle. C is wrong because estimates are not directly related to the project life cycle. D is incorrect because activities comprise the phases within the project life cycle, but not the project life cycle itself. For more information, see the PMBOK, Section 2.1.
2. **B**. The completion of a project phase may also be known as a kill point. Lessons learned is a collection of information and knowledge gained through an experience, typically a phase, within the project, so A is wrong. Earned value management can happen at different times throughout the project, not just at the end of a project phase; therefore, C is wrong. D, conditional advancement, is a term that is used to describe the conditions that must be present for the work to continue on a project. Conditional advancement, however, does not have to happen only at the end of a project phase. For more information, see the PMBOK, Section 2.1.2.
3. **D**. A deliverable is something that can be verified and measured. A defines the resources in order to create the deliverable. B is an inaccurate statement. C defines how the work and resources will be utilized in order to create the project deliverable, not the deliverable itself. For more information, see the PMBOK, Section 2.1.2.
4. **A**. The project life cycle is comprised of all of the project phases within a project. B describes the life of many projects that create a unique product or service. C and D are incorrect because they do not accurately describe the project life cycle. For more information, see the PMBOK, Section 2.1.
5. **D**. Projects typically have low costs and low demands for resources early in their life cycle. Choices A, B, and C are incorrect statements in regards to projects. For more information, see the PMBOK, Section 2.1.1.

6. **C**. As the project moves closer to completion, the likelihood of risk diminishes, but should the project fail, its consequence is the highest because of the time, monies, and effort invested in the project. A, B, and D are incorrect in regards to risk assessment in a project. For more information, see the PMBOK, Section 2.1.1.
7. **D**. Projectized structures often have project team members assigned to the project on a full-time basis. A, B, and C are incorrect because these structures have part-time project teams. For more information, see the PMBOK, Section 2.3.3.
8. **A**. Organizations often divide projects into phases to make the management and control of the project easier and more productive. B and C are incorrect because these statements identify an attribute of a phase, not the reason to create all phases. D is incorrect because this statement is not true for all projects; in addition, cash flow forecasting is part of planning and is not universal to all project phases. For more information, see the PMBOK, Section 2.1.
9. **D**. The project life cycle does not define how much each phase of the project will cost. The project life cycle does define the work to be done in each phase, the deliverables each phase will create, and the resources needed in each phase, so choices A, B, and C are incorrect. For more information, see the PMBOK, Section 2.1.1.
10. **B**. Projects are most likely to fail at the start of the project. As the project moves closer to the project completion, its odds of finishing successfully increase. A is not an accurate statement. C is incorrect because the project is more likely to finish successfully at the end of the project. D is also incorrect because the intermediate phases show progress towards project completion. The closer the project moves away from its start and towards completion, the higher the odds of success are. For more information, see the PMBOK, Section 2.1.1.
11. **B**. The eager customer is an example of a positive stakeholder. A, the comptroller, is usually an influencer and not a positive or negative stakeholder for most projects. C, the environmental group that has claims against your project, is an example of a negative stakeholder. D, the union, is another example of a project influencer. In this example, the union is neutral, but there are instances when a union could become either a positive or negative stakeholder. For more information, see the PMBOK, Section 2.2.
12. **B**. An influencer is the only key stakeholder the PMBOK specifically addresses out of those listed within this question. A, the union, and C, the technical interface, could be examples of influencers, but not in every project. D, an inspector, is not a key stakeholder in every project, although an inspector could be considered an influencer if one were involved with your project. For more information, see the PMBOK, Section 2.2.
13. **A**. Because you are working within a functional organization, you have little to no power, and the functional manager has all of the power. You must obey the functional manager and get to work. B, C, and D are all incorrect choices for the project manager in a functional structure. For more information, see the PMBOK, Section 2.3.3.3.

14. **C**. When resources are shared and a PMO exists, the project resources report to the PMO. A is true in a matrix structure without a PMO. B is correct in a functional structure. D is not valid. For more information, see the PMBOK, Section 2.3.4.
15. **B**. It's easiest and least costly for stakeholders to ask for changes at the start of the project. A is incorrect, as changes can easily be requested after the charter is created but before the project work begins. C is not true, as changes may affect work that has already been completed. D is absolutely false, as these changes may have the highest cost on the project.
16. **A**. The end of a phase is also known as a kill point. B is inaccurate, as projects are most likely killed at the end of a project phase, not its start. C is incorrect, as the most likely answer is A. D is also incorrect, as technology may change, but the demand for the project deliverable may not. If technology has changed, the project may elect to upgrade the technology being used to the newer available technology. For more information, see the PMBOK, Section 2.1.2.
17. **C**. Nancy cannot simply ignore the negative stakeholders. Their influence on the project may cause the project to fail. Nancy must work with the negative stakeholders to squelch their protests, or consider their demands to ensure compliance or agreement with their issues. A, B, and D are all inaccurate outcomes of ignoring the stakeholders. For more information, see the PMBOK, Section 2.2.
18. **D**. The experience of the project management team is not a cultural attribute of an organization. A, B, and C—the policies and procedures, the work ethics, and the view of authority relationships—are all classic examples of an organization's culture. For more information, see the PMBOK, Section 2.3.2.
19. **B**. The project plan defines how the project management system will be used. A is incorrect; the project charter defines the project manager. C is incorrect because the staffing management plan (see Chapter 9) defines how the project team will be assembled and managed. D is incorrect because not every project will need to ship a deliverable to a customer. For more information, see the PMBOK, Section 2.3.5.
20. **B**. The functional manager has the power over the project funding, not the project manager. A, C, and D are all incorrect statements, as these do not define the authority of the project manager in a weak matrix structure. For more information, see the PMBOK, Section 2.3.3 and Figure 2-6 in the PMBOK.

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CHAPTER 3

Examining the Project Processes

In this chapter, you will

- Understand how the five project management process groups interact
- Understand the activities of project initiation
- Know how to plan a project
- Know how a project team executes the project plan
- Know how a project manager monitors and controls a project
- Know how to close a project

Projects are chockablock full of processes. A process is a set of actions and activities to achieve a product, result, or service. It's the work of project management to move the work of the project towards the deliverable the project aims to create. As you'll discover in this chapter, there are 44 project management processes that a project manager and the project team use to move a project along. The whole goal of these processes is to have a successful project, but a project's success is based on more than just leveraging these processes. A successful project depends on four things:

- Using the appropriate processes at the appropriate times. A project manager must recognize situations within the project that call for different processes and then determine which process or combination of processes is most needed to meet the project objectives.
- Following a defined project management approach to take the product specifications and meet the project objectives, and then fulfill customer expectations.
- Conforming the project and the project management approach to the customer requirements and expectations.
- Balancing the project's time, cost, scope, quality, resources, and risk while meeting the project objectives.

Sure, sure all of this sounds so easy on paper, doesn't it? Project management is not an easy task, but the goal of a certified project manager is to recognize the situations, react to the problems or opportunities, and move the project work towards the customer's requirements. The 44 project management processes are the actions that help any project manager do just that.

This chapter covers the entire project management life cycle. We'll follow the activities that happen in each of the project management process groups and what the results of those actions are.

VIDEO Moving through the project management processes.

Loving the Project Management Processes (PMBOK, Section 3.1)

Before we get too deep into this chapter, learn this: You do not have to do every single project management process on every single project. The project manager and the project team must determine which project management processes are most appropriate for each project. Once the needed processes have been identified, the project manager and project team must also determine to what extent the processes are needed. The processes are tailored to their project. As a heuristic, larger projects require more detail than smaller projects.

The 44 project management processes have been recognized as good practices for most projects, but they are not a mandate for good practices on all projects. For your Project Management Institute (PMI) examination, however, you'll be tested on all of the project management processes in detail. Yep. Although you may not use all of the project management processes in the real world, the exam will test you on all of the processes as if you do. Why? Because there is, no doubt, more than one way to manage a project. PMI isn't stubborn enough to say it's our way or no way—that'd be unreasonable.

The approach that PMI does take, however, is based somewhat on W. Edwards Deming's Plan-Do-Check-Act cycle, as Figure 3-1 demonstrates. In Deming's model, adapted by the American Society for Quality, the end of one process launches the start of another. For example, the end of the planning process allows the launch of the doing process. Once the work has been completed, you check it. Based on the results of your investigation, you'd move right into the acting process, which means you're responding to the results of your checking process.

PMI's project management model, which we'll see throughout this chapter, is a bit more involved than the Plan-Do-Check-Act approach. Figure 3-2 demonstrates the big picture of project management. The components of the model are called the process groups. Process groups are collections of the processes you'll be doing in different situations within your project. You've experienced, I'm sure, that projects are initiated, planned, executed, monitored and controlled, and then closed. There are distinct actions that fit nicely within each one of the process groups—that's the gist of this chapter.

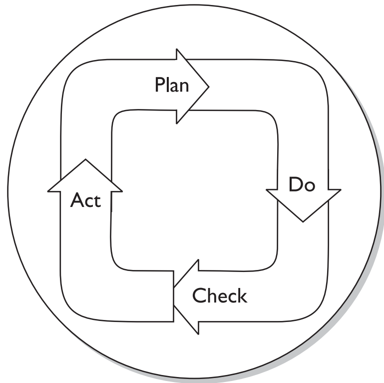

Figure 3-1
PMI's project management model is based on the Plan-Do-Check-Act cycle.

Examining the Process Group Interactions

At first glance, the project management model seems simple. With more study, however, you'll see how complex the interactions between the groups can be. First, project managers realize that there is more than one way to manage a project. Second, these processes and their interactions are the generally accepted best approach to project management. Having said that, there is no hard and fast rule as to the order in which a process should occur once the project is in motion. The nature of the project, the scenario, and the experienced conditions, along with the culture and maturity of the organization, will dictate which process is the best process at any given project moment.

The general consensus on the order of the process groups is as follows:

1. Initiating
2. Planning
3. Executing
4. Monitoring and controlling
5. Closing

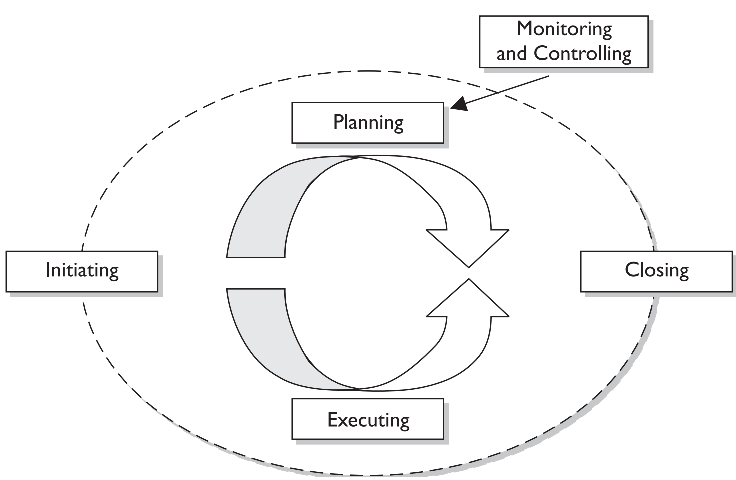

Figure 3-2
All projects move through five process groups to reach their completion.

The caveat is that a project manager can move between planning, executing, and the monitoring and controlling process groups on an as-needed basis. For example, during project execution, a new risk could be identified. The project manager and project team move back into the planning phase to determine how to respond to the new risk, and then they'll continue to monitor and control the project for additional risks.

EXAM TIP The generally accepted flow of the process groups is also for more than just projects. A project manager can use the processes within these groups for each phase of a project.

Choosing the Appropriate Project Processes (PMBOK, Section 3.2)

A moment of clarity: There's a bunch of processes in project management. Sure, we've already established that you won't need all of these processes for every project you manage, but you can be darned certain that you'll need all of the processes to pass your Certified Associate in Project Management (CAPM) or Project Management Professional (PMP) exam. Let's dive in and check out these process groups and all their kids—the 44 project management processes.

You've already learned the five process groups: initiating, planning, executing, monitoring and controlling, and closing. These groups are universal to all projects, from building the pyramids to rolling out the latest, greatest whiz-bang software over your IT network. It doesn't matter; project management is project management. Figure 3-3 captures all of the processes in the most likely order in which they should happen—if they're going to happen (remember, you don't need all of the processes on every project, every single time).

Working with Process Groups

Project management is more than just getting the project work done. It's the management, leadership, and execution of the project team. (And by execution, I mean the project team executing the project plan, not you executing the team—although that can be tempting at times.) As you agree to manage a project, you'll move through some logical activities to get your project moving along. These are the process groups that are universal to project management. Let's take a more detailed look at these process groups and the type of work that will be happening in each:

- **Initiating** Management and/or your customer is authorizing the project or a project's phase to begin.
- **Planning** You and the key stakeholders are defining and refining the project's goals and objectives. Once the project's objectives have been defined, you and the key stakeholders will plan on how to reach those objectives.

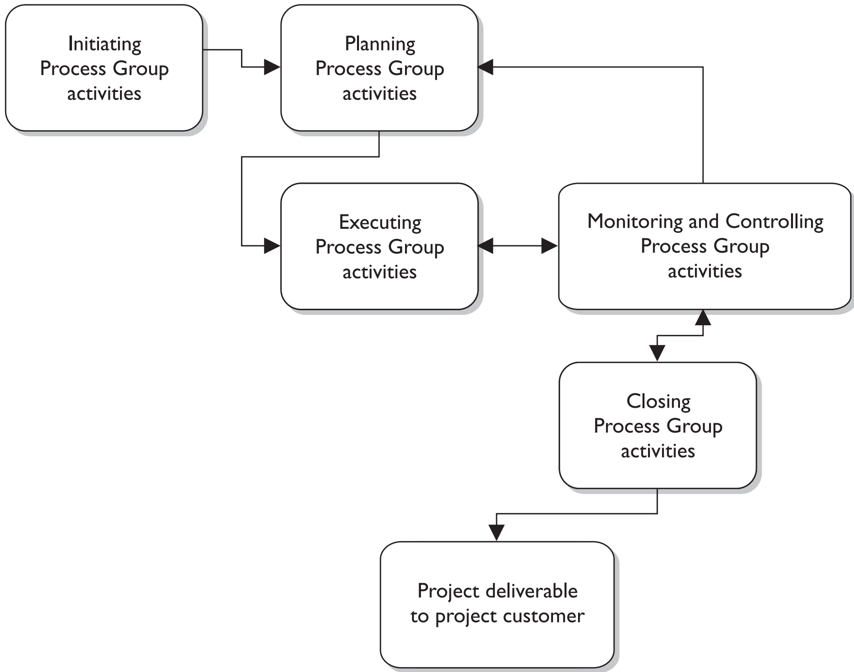

Figure 3-3 Process groups happen in the same order on every project; processes don't always.

- **Executing** Now that you have a project plan, it's time to put the plan into action. You've heard the saying, "Plan your work and now work your plan?" This is the "working of the plan" part.
- **Monitoring and controlling** Your project team is doing the work, but it's up to you to measure and monitor things to ensure that the project team is doing the work as it was planned. The results of your measurements—primarily in cost, time, scope, and quality—will show discrepancies between what was planned and what was experienced. These discrepancies are your project variances.
- **Closing** Boy, howdy! There's nothing more fun, usually, than closing a project. This process group focuses on formal acceptance of the project's deliverable. The closing process group also focuses on bringing the project or project phase to a tidy ending.

Now that you've got the big picture on these process groups, let's take that in-depth look at each group and all the business that happens within each one. Hold your excitement!

Initiating Your Project (PMBOK, Section 3.2.1)

The initiating process group starts all the project fun; it's the formal processes that start a project or a project phase. These initiating processes, which I'll delve into in one moment, are often done outside of the project manager's domain of control. For example, a company's project portfolio management may not include any input from the project managers within their firm. The senior management could choose which projects should be initiated and funded long before the project managers get involved. In other organizations, the project manager may be involved from the project conception all the way through the project closure. As a general rule, the initiation of a project happens, to some extent, without the project manager, but the initiation process group is included as part of the project management life cycle.

EXAM TIP Projects are authorized, not the project manager. You do not have a project until you have an approved charter.

The project manager is assigned during initiation, and the inputs from the original project initiator and/or the project sponsor are considered throughout the initiation processes. One of the first activities of the project is to document the project assumptions and constraints. Here's the difference between these two:

- Assumptions are things believed to be true but not proven to be. For example, construction projects plan to complete their work during the spring and summer months because of cooperating weather. It's an assumption that the weather will be agreeable for their work during these seasons as opposed to the winter months, although this isn't always true.
- Constraints are anything that restricts a project manager's options. For example, a customer must have the project deliverable by a specific date. Or the project must not exceed $2 million dollars. Or the software must be compatible with an Oracle database. Usually, any project requirement preceded by "must" is a good sign of a constraint.

Assumptions and constraints are documented in the project charter. The project charter officially authorizes the project and is authorized outside of the project boundaries. This means that the charter should come from some entity that is above the project manager and the functional managers involved in the project. Figure 3-4 illustrates this concept. While the project management team may help write the charter, the funding and authorization come from higher up in the organization or by the project customer.

At the start of each project phase, especially on larger projects, it's ideal to repeat the initiating processes to ensure that the project remains focused on the business needs the project is to solve. This includes the availability of the needed project resources (cash, people, materials, and equipment), and based on this discovery, the project should be allowed to continue on to the next phase, delayed, or (gulp!) cancelled. An-

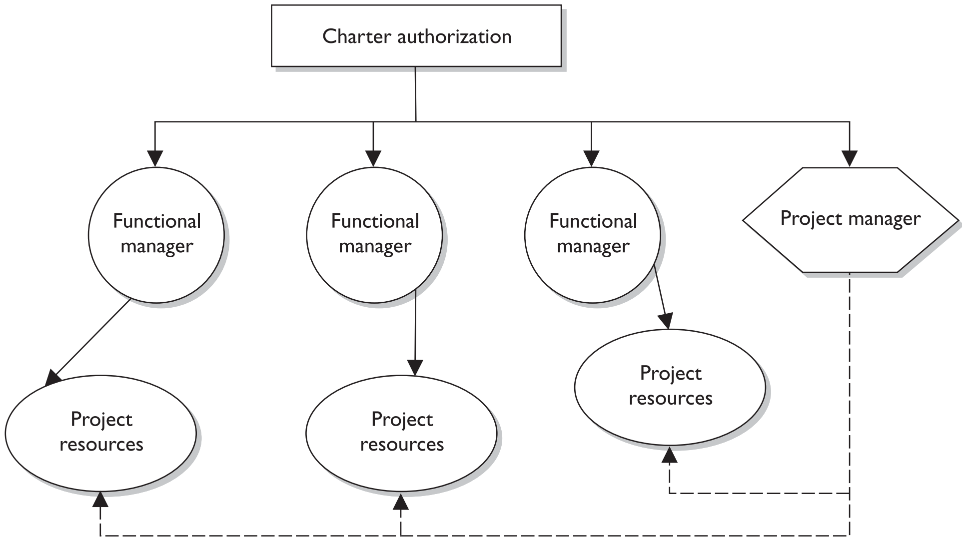

Figure 3-4 Project charters come from outside of the project boundaries.

other benefit of moving through these initiating processes at the start of each phase is that it allows the performing organization to determine if the original business need that the project was created to solve is still valid; if not, the project can be killed. Yes, killed; remember that the end of a phase is called a project kill point.

When a project or phase is moving through the initiating phase, the project manager needs to include the key stakeholders in the processes. This is a "PMI-ism," but it's also some real-world advice: Including the stakeholders during the initiating phase accomplishes several things for the project:

- It creates shared ownership of the project
- It ensures deliverable acceptance at project or phase closure
- It improves stakeholder satisfaction
- It facilitates communication between the project manager and the stakeholders

Developing the Project Charter

The project charter is created during the initiation process group. Recall that the project charter authorizes the project or, in a larger project, the charter initializes the project phase. The charter documents the business need, defines the project deliverable, and names the project manager. In order to create the project charter, you'll need the following inputs:

- **Contract** You won't always need a contract, but if an organization performs projects for other organizations, such as a consulting firm, the contract serves as a key input to creating the project charter.

- **Project statement of work** This document defines the product, service, or result that the project will be creating.
- **Enterprise environmental factors** Here's a new term that you'll be seeing lots of throughout the remainder of this book. Enterprise environmental factors are any external or internal organizational factors that can affect a project's success. Enterprise environmental factors include the culture, organizational structure, resources, commercial databases the project will use, market conditions, and your project management software.
- **Organizational process assets** This is another term that you'll see throughout the Project Management Body of Knowledge (PMBOK) and during our time together in this book. "Organizational process assets" is a fancy way of describing how a company does business; it includes the processes and procedures unique to an organization, plans, guidelines, and knowledge bases, such as the lessons learned documentation from past projects and any relevant historical information.

Developing the Project Scope Statement

Technically, really technically, the project scope is not finalized until the project moves into the project planning process group. However, here in the initiation process group, a high-level, broad project scope is developed. This first edition of the project scope defines the project, project deliverables, product requirements, project boundaries, acceptance procedures, and scope control. If you're managing a project that includes multiple phases, this high-level document would address each phase as it begins. In order to create this project scope statement, you'll need some familiar items:

- Project charter
- Project statement of work
- Enterprise environmental factors
- Organizational process assets

Planning the Project (PMBOK, Section 3.2.2)

Projects fail at the beginning and not the end. It's up to effective planning, or the project will be doomed. The whole point of the planning process group is to develop the project management plan. The good news is that the entire project doesn't have to happen in one session; in fact, planning is an iterative process, and the project manager and the project team return to the planning phase as needed to allow the project to move forward.

Ask any project manager if changes ever happen in their projects, and they'll give you a sad yes (unless they lie). Changes, often the nemesis of a project manager, require the project manager and the project team to revisit these planning processes to consider the impact of the changes on the entire project. This may include, unfortunately, revisiting the initiating processes and making changes to the project charter, although this is a drastic and infrequent event.

One approach to project management that has gained fans in the past few years is rolling wave planning. Rolling wave planning, seen in Figure 3-5, entails iterations of planning throughout the project life cycle. Changes and conditions within the project require the project manager and the project team to revisit the planning processes and then move on to the project. Rolling wave planning can also be experienced in larger projects, where a project team plans in detail for the immediate work and leaves the future work less planned. As the project approaches each phase, detailed planning is experienced, creating iterations, or waves, of planning.

The project manager and the project team should create an environment where stakeholders can participate and contribute to the project's planning processes. A project manager wants to use the skills and knowledge of the stakeholders to help define the project scope and the product scope, as well as to ensure that the project work will deliver upon the stakeholders' expectations.

A frequent question that I get from students of my project management classes centers on project management planning. I'm asked, "If planning is so important and iterative, how does a project manager know when the planning process group should end?" Of course, planning cannot, thankfully, continue forever. There must be project boundaries and considerations of the enterprise environmental factors that dictate the amount of time a project team invests in the initial planning and the project work. As a project moves into execution and, by default, monitoring and controlling, the project team can revisit the planning processes as needed to allow the project to continue. For example, if new risks are identified within the project, then additional planning is required to evaluate and respond to the risks.

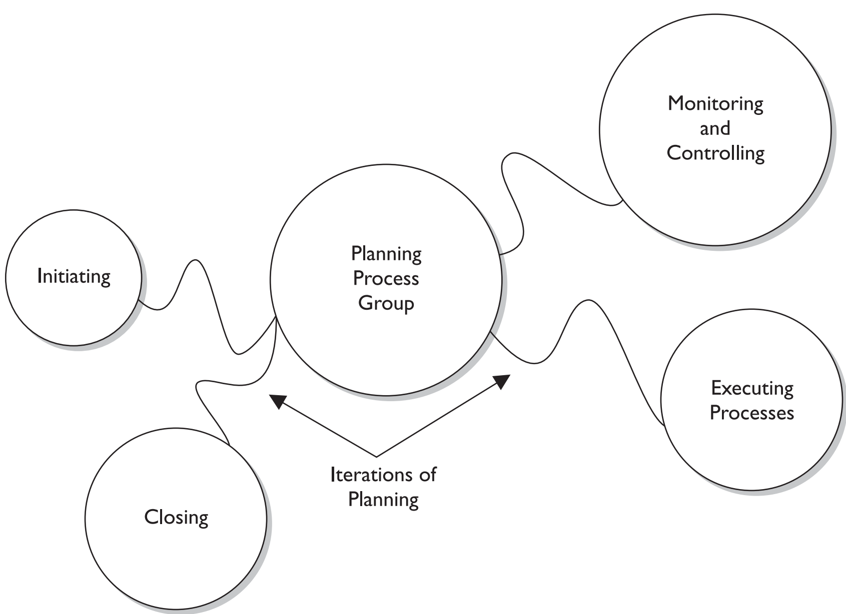

Figure 3-5 Rolling wave planning allows for iterations of the planning processes.

EXAM TIP The planning process group has 21 processes. This section contains a brief overview of each of these processes and their inputs and outputs. Don't worry—you don't need to memorize these for your PMI examination. I recommend that you become familiar with these to the point that you'd recognize the type of work associated with each process, but don't invest too much time memorizing the inputs and outputs of each process.

Developing the Project Management Plan

The project management plan is not one plan, but a collection of subsidiary plans that dictate how the project will operate within that knowledge area. It also defines how the project will operate within planning, executing, monitoring and controlling, and closing phases. In order to create the project management plan, you'll need:

- A preliminary project scope statement
- Project management processes
- Enterprise environmental factors
- Organizational process assets

Planning the Project Scope

In Chapter 5 we'll discuss and dissect the project scope in detail. For now, know that the project scope is the work that must be done in order to create the product, service, or result the project aims to deliver. The project manager, the project team, and the stakeholders work together to define the project scope; their goal is to create the project scope management plan. The project scope management plan defines how the project scope will be defined, verified, controlled, and how the project's work breakdown structure (WBS) will be created. The WBS, if you're not familiar with the term, is a breakdown of the project scope, and is often called the scope baseline. In order to create the project scope management plan, you'll need:

- Enterprise environmental factors
- Organizational process assets
- A project charter
- A preliminary project scope statement (created during project initiation)
- A project management plan

Defining the Project Scope Statement

Now that the project has a project scope management plan, the project manager, project team, and the key stakeholders can go about defining the actual project scope. The project scope statement serves as a basis for all future project decisions. As part of defining the project scope, several inputs are needed:

- Organizational process assets
- Project charter

- Preliminary project scope statement
- Approved change requests

The last bulleted item, approved change requests, considers the iterative nature of the planning process group and allows change requests to be considered and fleshed into the project scope as needed and approved. This process group has many outputs that are related to the project scope:

- Project scope statement
- Requested changes
- Project scope management plan updates

Creating the Work Breakdown Structure

The WBS is created in the planning process group. This process takes the project scope and breaks it down into smaller, more manageable components. In Chapter 5, we'll discuss the WBS, its purpose, and its creation. In order to create a WBS, you'll need the following:

- Organizational process assets
- Project scope statement
- Project scope management plan
- Approved change requests

As a result of creating the WBS, the project manager will get some extras, wanted or not:

- WBS
- Project scope statement updates
- WBS dictionary (this defines all of the components within the WBS)
- Scope baseline
- Project scope management plan updates
- Change requests

EXAM TIP The WBS is a cornerstone to project management. If you're stumped on a question and one of the choices is WBS, go ahead and choose that. It may not always be the best choice, but I'd wager that it predominantly will be.

Defining the Project Activities

Once the WBS has been created, the project manager and project team can examine the deliverables and then determine the actual work to create the things the WBS promises. This is activity definition. To complete this process, you'll need:

- Enterprise environmental factors
- Organizational process assets
- Project scope statement

- WBS
- WBS dictionary
- Project management plan

As a result of defining the project activities, the project team will receive these outputs:

- Activity list
- Activity attributes
- Milestone list
- Requested changes

Sequencing the Project Activities

It's a logical progression from defining the project deliverables and the activities needed to create them to putting those activities in a particular order. In order to sequence the project activities, the project team will need:

- Project scope statement
- Activity list
- Activity attributes
- Milestone list
- Approved change requests

Like the majority of the processes in planning, the output of the processes often includes other project elements that may be needed for later purposes in project planning. Activity sequencing is no different; the outputs of this process are:

- Project schedule network diagrams (you'll learn more about these in Chapter 6)
- Activity list updates
- Activity attributes updates
- Change requests

Estimating the Resources

The project manager needs to know what resources will be required for each of the project activities. In order to complete this process, you'll need the following inputs:

- Enterprise environmental factors
- Organizational process assets
- Activity lists

- Activity attributes
- Resource availability
- Project management plan

Once the project manager has completed estimating the resources, she'll receive several outputs as a result of this process:

- Activity resource requirements
- Activity attributes updates
- Resource breakdown structure (this shows the types of resources the project needs, such as professional engineers, structural engineers, or Computer Aided Design [CAD]/Computer Aided Manufacturing [CAM] operators)
- Resource calendar updates (the resource calendar, which you'll see again in Chapter 9, defines when the project resources are available)
- Change requests

Estimating the Activity Durations

Once the project manager knows what activities are required and in what order the activities should happen, it's time to estimate how long each activity will take to complete. In order to create the activity duration estimates, the project manager will need:

- Enterprise environmental factors.
- Organizational process assets.
- Activity list.
- Activity attributes.
- Activity resource requirements.
- Resource calendar.
- Project management plan.
- Risk register. (This is a repository of the project's risks and their attributes. Chapter 11 discusses the risk register.)
- Activity cost estimates.

While this process primarily creates the duration of each of the project's activities, the project manager may also have activity attribute updates.

Developing the Project Schedule

The project schedule is more than just the sum of how long each event will take. The project schedule considers the availability of the project resources, the risks, the attributes of the project activities, and more. Chapter 6 will focus on this process, but for now, here are the inputs required to create the project schedule:

- Organizational process assets
- Project scope statement
- Activity list
- Activity attributes
- Project schedule network diagrams
- Activity resource requirements
- Resource calendars
- Activity duration estimates
- Project management plan
- Risk register

Based on these inputs to the schedule development, the project team will have several outputs:

- Project schedule (this is the calendar that defines when the project will take place, including the working hours, access to the job site, and any other time constraints put on the project)
- Schedule model data
- Schedule baseline
- Resource requirements updates
- Activity attributes updates
- Project calendar updates
- Requested changes
- Project management plan updates
- Schedule management plan updates

Cost Estimating

Projects cost money, and every stakeholder with a checkbook wants to know how much the project will cost. This process focuses on estimating the costs for the project. The following serve as inputs to this process:

- Enterprise environmental factors
- Organizational process assets
- Project scope statement

- WBS
- WBS dictionary
- Project management plan
- Schedule management plan
- Staffing management plan
- Risk register

These inputs will help the project manager create the following outputs of cost estimating:

- Activity cost estimates
- Activity cost estimates supporting detail
- Change requests
- Cost management plan updates

Budgeting the Project Work

Once the project manager has created the cost estimate, he'll aggregate the individual activities and their attributes, such as labor and materials, to create a cost baseline for the project. This process requires several inputs:

- Project scope statement
- WBS
- WBS dictionary
- Activity cost estimates supporting detail
- Project schedule
- Resource calendars
- Contract (if applicable)
- Cost management plan

The outputs of cost budgeting are:

- Cost baseline
- Project funding requirements
- Cost management plan updates
- Change requests

Planning for Quality

The project manager, the project team, and the key stakeholders will work together to determine how the project will ascertain the expected levels of quality within the project.

Chapter 8 will discuss quality in detail, but for now, there are several inputs to this quality planning:

- Enterprise environmental factors
- Organizational process assets
- Project scope statement
- Project management plan

As a result of planning for the quality, the project management team will create the following outputs:

- Quality management plan
- Quality metrics
- Quality checklists
- Process improvement plan
- Quality baseline
- Project management plan updates

Planning for Human Resources

Of course, the project will need people to do the work—that's the project team! Chapter 9 discusses human resource planning in detail. This process specifically focuses on creating the staffing management plan, defining the project roles, defining reporting relationships, and defining responsibilities of the project team members. Here are the required inputs for human resources planning:

- Enterprise environmental factors
- Organizational process assets
- Project management plan
- Activity resource requirements

Once all the planning is completed, the project manager will have these outputs:

- Roles and responsibilities
- Project organization chart
- Staffing management plan

EXAM TIP Remember that the autonomy of the project manager must also be considered when planning for human resources. The organizational structure will indicate what level of autonomy the project manager has. Functional structures concede very little power to the project manager, while granting most of the authority to the functional managers. The matrix structures describe the power of the project manager in relation to the functional manager: weak, balanced, or strong. Project managers have the most authority in a projectized environment.

Planning for Project Communications

It's been said that 90 percent of a project manager's time is spent communicating. With that factoid, it's no wonder that the project manager will want to plan to communicate effectively. Here are the required inputs to get this process started:

- Enterprise environmental factors
- Organizational process assets
- Project scope statement
- Project management plan
- Constraints
- Assumptions

The only output of this process is the communications management plan. Now there's something to discuss. (I will in Chapter 10.)

Planning for Project Risks

The project manager, the project team, and the key stakeholders will plan how to manage risk and the associated risk management activities. We'll cover this process in Chapter 11, but here are the inputs for this process for now:

- Enterprise environmental factors
- Organizational process assets
- Project scope statement
- Project management plan

This process also has but one output: the risk management plan.

Identify the Project Risks

Once the risk management plan has been created, the project management team can go about the process of identifying all the good and naughty risks within the project. In order to get this fun started, they'll need these inputs:

- Enterprise environmental factors
- Organizational process assets
- Project scope statement
- Risk management plan
- Project management plan

This process will create the central repository of project risks: the risk register. Chapter 11 explains the risk identification process and the risk register in greater detail.

Completing Qualitative Risk Analysis

Qualitative risk analysis is completed in the planning process group and "qualifies" the identified risks for additional study and analysis. Here are the inputs for this process:

- Organizational process assets
- Project scope statement
- Risk management plan
- Risk register

The only outputs of this process are updates to the risk register. In particular, the identified risks' qualitative attributes should be updated in the risk register.

Completing Quantitative Risk Analysis

This process aims to quantify the risk exposure for the risks in the project. This process is covered in more detail in Chapter 11. Here are the inputs for this process:

- Organizational process assets
- Project scope statement
- Risk management plan
- Risk register
- Project management plan
- Project schedule management plan
- Project cost management plan

Like qualitative analysis, quantitative analysis has but one output: updates to the risk register.

Planning the Risk Responses

Okay, the project manager, the project team, and all the key stakeholders have had some serious fun identifying and performing analysis on the project risks. Now it's time to get down to the business of planning the responses to the identified risks. There are only two inputs to the risk response planning process:

- Risk management plan
- Risk register

This process may take some time, and will create three outputs:

- Risk register updates
- Project management plan updates
- Risk-related contractual agreements (think of errors-and-omissions insurance; not every project will have a risk-related contract)

Planning for Purchases and Acquisitions

When a project manager needs to purchase something for the project, there are usually rules and procedures she must follow within her organization. Buying services and products for a project requires many inputs:

- Enterprise environmental factors
- Organizational process assets
- Project scope statement
- WBS
- WBS dictionary
- Project management plan
- Risk register
- Risk-related contractual agreements
- Resource requirements
- Project schedule
- Activity cost estimates
- Cost baseline

All of these inputs allow the project manager and the project team to consider and evaluate what needs to be purchased, determine what risks may need to be considered, and then decide how the purchasing will commence. Chapter 12 centers on procurement, but here are the outputs of this process:

- Project management plan
- Contract statement of work (this is what the vendor will do for the buyer)
- Make-or-buy decisions
- Change requests

Planning for Contracting

Once the project manager and the vendors have a deal, there needs to be a contract that defines the offer and consideration of the deal. That's what this process is all about—documenting the purchase requirements between the buyer and seller. Here are the inputs for this process:

- Project management plan
- Contract statement of work
- Make-or-buy decisions
- Project management plan
- Risk register

- Risk-related contractual agreements
- Resource requirements
- Project schedule
- Activity cost estimate
- Cost baseline

All of these inputs help the project manager make the best purchasing decisions, and will create the following outputs:

- Procurement documents (these are the purchase orders, statements of work, proposals, bids, and other purchase documents you'll see in Chapter 12)
- Evaluation criteria
- Contract statement of work

Executing Processes (PMBOK, Section 3.2.3)

The executing processes allow the project work to be performed. It is the execution of the project plan, the execution of vendor management, and the management of the project implementation. The project manager works closely with the project team in this process to ensure that the work is being completed and that the work results are of quality. The project manager also works with vendors to ensure that their procured work is complete, of quality, and meets the obligations of the agreed contracts.

Throughout the project, variances may happen. A variance is simply the difference between what was planned and what was experienced. For example, there are cost variances, schedule variances, and even scope variances. When variances happen within a project, the project manager and the project team retreat to the planning process group, analyze the variance, and determine the best method to respond. The response may, in turn, cause the project management plan to be changed, which could, in turn, affect the activities of the execution process group.

This process group is about getting the project work done. You can plan as much as you want, but it's in the doing that matters. This process group consumes the project budget more than any other group because the project team is doing the work, using the materials, and relying on the vendors to deliver upon their contracts. This process group has seven processes.

Managing and Executing the Project Plan

This is the heart of the project: getting the work done. This process guides, directs, and leads the project team to complete their assignments according to the project management plan. The project team's performance is measured, and that information will serve as input to performance reviews later in the project (team members be warned!). Here are the inputs for managing and executing the project plan:

- Project management plan.

- Approved corrective actions. (A corrective action brings project work back into alignment with the project plan.)
- Approved preventive actions. (A preventive action is a risk-related action that avoids risk within the project; think of a workaround to a problem within your project.)
- Approved change requests.
- Approved defect repair. (A defect repair is an activity to repair a mistake within the project; think of a painter who painted a wall the wrong shade of green. Oops!)
- Validated defect repair.
- Administrative closure procedure.

The outputs of project execution are:

- Deliverables.
- Change requests.
- Implemented change requests.
- Implemented corrective actions.
- Implemented preventive actions.
- Implemented defect repair. Work performance information. (This is the performance measurement of the project team and the project work as a whole.)

Performing Quality Assurance

Quality assurance (QA) is a management process that all projects adhere to within an organization. QA will be discussed in more detail in Chapter 8. Here are the inputs to performing quality assurance:

- Quality management plan
- Quality metrics
- Process improvement plan
- Work performance information
- Approved change requests
- Quality control measurements
- Implemented change requests
- Implemented corrective actions
- Implemented defect repairs
- Implemented preventive actions

All of these QA input processes will help the project management team create the following outputs:

- Change requests
- Recommended corrective actions
- Organizational process assets
- Updates
- Project management plan updates

Acquiring the Project Team

The project team doesn't join the project until the execution process group. This is a great example of how the planning process group is an iterative process. The project manager is in planning and then shifts to execution to acquire the project team. Now the project team and the project manager return to planning to create the project management plan. In order to complete the team acquisition, the following inputs are needed:

- Enterprise environmental factors
- Organizational process assets
- Roles and responsibilities
- Project organization charts
- Staffing management plan

Using these inputs, the project manager creates the following outputs:

- Project staff assignments
- Resource availability determination
- Staffing management plan updates

Developing the Project Team

Developing the project team is an execution process that seeks to determine and, if necessary, improve the skill sets of the project team members. This process, which I'll talk about in Chapter 9, also focuses on improving the interaction, communication, and trust of the project team members. You'll need the following inputs to facilitate project team development:

- Project staff assignments
- Staffing management plan
- Resource availability

This process only creates one little, but important, output: team performance assessment. Team performance assessment will help the project manager make decisions on how to better manage and lead the project team members—and perform future team development exercises.

EXAM TIP Team development is more than lunch. PMI likes team development exercises, so think of white water rafting trips and team excursions away from the office with the entire project team.

Distributing Project Information

The project manager has to disperse information to keep the project stakeholders informed of the project's health, status, and pending actions. In order to disperse information, the project manager will rely on the communications management plan. As a result of dispersing information, the project manager will keep stakeholders informed, but will also have two direct outputs:

- Organizational process assets updates
- Change requests

That was a tough one, yes?

Requesting Seller Responses

Remember all that fun earlier with procurement? Now the project manager is waiting for those pesky vendors to respond to the procurement documents. In order to complete this executing process, the project manager will need the following inputs:

- Organizational process assets
- Procurement management plan
- Procurement documents

As a result of this process, the project manager will receive three outputs:

- Qualified sellers list. (This list may evolve within the performing organization or on a project-by-project basis. Either way, these are the vendors who the project manager is allowed to purchase from because they meet certain defined qualifications.)
- Procurement document package. (This is all of the related procurement documents between the buyer and the seller.)
- Proposals.

Choosing the Best Seller

Now that the sellers have provided their responses to the project manager's procurement documents, it's time to choose which seller is best for the project. This process, which Chapter 12 covers in detail, also deals with negotiating for the best deal with the vendors. Here are the inputs to this process:

- Organizational process assets
- Procurement management plan
- Evaluation criteria
- Procurement document package

- Proposals
- Qualified sellers lists
- Project management plan
- Risk register
- Risk-related contractual agreements

This process creates the following outputs:

- Selected sellers
- Contract
- Contract management plan
- Resource availability determination
- Procurement management plan updates
- Requested changes

Examining the Monitoring and Controlling Process Groups (PMBOK, Section 3.2.4)

Wouldn't the project management life be even greater if all of the projects went off without a hitch? If only the project team, the project work, the stakeholders, and the vendors would cooperate. Oh, but we know that projects have to be constantly monitored like a three-year-old in a china shop.

This process group focuses on monitoring the project work for variances, changes, and discrepancies so that corrective action can be used to ensure that the project continues to move towards its successful completion. This means lots of measuring, inspecting, and communicating with the project team to ensure that the project plan is followed, variances to the plan are reported, and responses can be expedited.

This process group also is concerned with changes that may attack the Iron Triangle of Project Management: time, cost, and scope. As changes are allowed into the project, or changes sneak into a project through scope creep, they must be examined for their overall effect on the project's execution and, ultimately, on the project deliverable. Chapters 5, 6, and 7 will cover scope, time, and cost control, but project managers also have to be concerned with quality control. It doesn't do much good if a project is completed on time and on budget, but the deliverable is fouled, full of errors, and of poor quality. Chapter 8 will examine control in detail. Let's take a quick look at each of the 12 processes within this group.

EXAM TIP While there are 12 processes within the monitoring and controlling process group, it doesn't mean that the project manager needs to use all 12 of the processes for every project. In fact, according to the PMBOK, the project team should determine which of these processes are needed for their project.

Monitoring and Controlling the Project Work

What'd you expect to be doing in the monitor and control process group? This process is the heart of the process group, and includes the entire collection of project characteristics, such as time, cost, and quality statistics. Based on the collected statistics, the project manager can measure the project success, identify trends, make forecasts, create project reports, and take actions to improve the project. Here are the inputs for this process:

- Project management plan
- Work performance information
- Rejected change requests

The outputs of monitoring and controlling the project work will give the project team five outputs:

- Recommended corrective actions
- Recommended preventive actions
- Project forecasts
- Recommended defect repairs
- Change requests

Managing Integrated Change Control

Integrated change control is a process that examines how a change affects all parts of a project. Consider a change to the project scope on a project you've worked on. The change likely affected the project cost, the project schedule, and the expectations of the project quality. The change may also have affected other regions of your project: risk management, communications, human resources, and even procurement. Integrated change control manages the approved changes within a project, how and when the changes may occur, and determines if a change to the project may have already occurred. This process, as fun as it is, happens from project initiation through project closing. There are many inputs for this process:

- Project management plan
- Requested changes
- Work performance information
- Recommended preventive actions
- Recommended corrective actions
- Recommended defect repairs
- Project deliverables

These inputs and this process will help the project manager and the project team create the following outputs:

- Approved change requests
- Rejected change requests
- Project management plan updates
- Project scope statement updates
- Approved corrective actions
- Approved preventive actions
- Approved defect repairs
- Validated defect repairs
- Project deliverables

Verifying the Project Scope

If you were to hire an architectural firm to build your next mansion, you'd periodically visit the house under construction to ensure that the workers and the architects were building according to the plans you provided them. At the end of the project, you'd walk through the home and create a "punch list" of all the things that needed to be changed or repaired according to your agreement. The architectural firm would work with you to ensure that you're happy with the deliverable you asked for and the deliverable they have created for you. This is scope verification: the formal acceptance by inspection of the project deliverables. Here are the inputs the project manager needs to facilitate this process with the project customer:

- Project scope statement
- WBS dictionary
- Project scope management plan
- Deliverables

The customer would inspect and then, hopefully, formally accept the project work or provide feedback on what needs to be corrected or changed. Here are the outputs of scope verification:

- Formal acceptance of the project deliverables
- Change requests
- Recommended corrective actions

Controlling the Project Scope

Once the project scope statement has been created, it is paramount to guard the scope from unauthorized changes and to follow a scope change control system within the project to ensure that any approved changes reflect the changes through cost, time, scope, quality, and the other knowledge areas within the project. Here are the inputs to perform this process:

- Project scope statement
- WBS
- WBS dictionary
- Project scope statement management plan
- Performance reports
- Approved change requests
- Work performance information

The outputs of this massive and not-so-enjoyable process are:

- Project scope statement updates. (Makes sense, right? If changes are approved to the project scope, then the changes have to be reflected in the scope statement, the WBS, and the WBS dictionary.)
- WBS updates.
- WBS dictionary updates.
- Scope baseline updates.
- Change requests.
- Recommended corrective actions.
- Organizational process asset updates.
- Project management plan updates.

Controlling the Project Schedule

This process isn't a mystery: It's simply keeping the project on schedule so that it finishes on time as planned. When variances happen within the project, the project manager and the project team have to plan how to respond to these schedule variances. I'll discuss scheduling and schedule control in Chapter 6. For now, here are the inputs for this process:

- Schedule management plan
- Schedule baseline
- Performance reports
- Approved change requests

This process creates several outputs:

- Schedule model data updates
- Schedule baseline updates
- Performance measurements

- Change requests
- Recommended corrective actions
- Organizational process asset updates
- Activity list updates
- Activity attribute updates
- Project management plan updates

Controlling the Project Cost

Have you ever noticed that it's usually easier to get more time than money for your projects? Management dreads hearing that a project will cost more due to errors and variances. This process aims to prevent cost overruns and control the expenses within a project. There are many inputs for this process:

- Cost baseline
- Project funding requirements
- Performance reports
- Work performance information
- Approved change requests
- Project management plan

Chapter 7 is all about managing project costs, including creating cost estimates and budgets. Here are the outputs of cost control:

- Cost estimate updates
- Cost baseline updates
- Performance measurements
- Forecasted completion
- Change requests
- Recommended corrective actions
- Organizational process asset updates
- Project management plan updates

Performing Quality Control

Quality control (QC), which is covered in Chapter 8, is all about keeping the mistakes out of the project—and ultimately away from the customers—before the project is declared finished. QC is considered an inspection-driven process, because that's the primary activity involved with it. Here are the inputs to perform this process:

- Quality management plan
- Quality metrics

- Quality checklists
- Organizational process assets
- Work performance information
- Change requests
- Deliverables

QC creates many outputs that can help the project manager and the project team improve the project performance and ensure that the project work is completed correctly for the customer. Here are the outputs of QC:

- Quality control measurements
- Validated defect repairs
- Quality baseline updates
- Recommended corrective actions
- Recommended preventive actions
- Requested changes
- Recommended defect repairs
- Organizational process asset updates
- Validated deliverables
- Project management plan updates

Managing the Project Team

This process centers on you, the project manager. It's how you will manage, track performance, offer feedback, resolve issues, and manage your project team in the best interest of the project. There are many inputs to this process:

- Organizational process assets
- Project staff assignments
- Roles and responsibilities
- Staffing management plan
- Team performance assessment
- Work performance information
- Performance reports

As you lead your project team through their project work—and to the project deliverable—you'll be completing this process. There are several outputs of managing the project team:

- Change requests
- Recommended corrective actions

- Recommended preventive actions
- Organizational process asset updates
- Project management plan updates

Reporting Project Performance

Management, your project team, key stakeholders, and the project customer will want the project manager to keep them abreast of the project performance. That's what this process is all about. There are seven inputs to performance reporting:

- Work performance information
- Performance measurements
- Forecasted completion
- Quality control measurements (if you don't measure, you can't improve)
- Project management plan
- Performance measurement baseline
- Approved change requests
- Deliverables

As the project manager shares the project performance information, there will be five outputs:

- Performance reports
- Forecasts
- Change requests
- Recommended corrective actions
- Organizational process asset updates

Managing the Project Stakeholders

Recall that a stakeholder is anyone who has a vested interest in the outcome of the project. Traditionally, the project stakeholders refer to the recipients of the project deliverable, but there's more to being a stakeholder than just that. Stakeholders include the project team, vendors, customers, management, and even the project manager. The project manager has to manage more than just the project team. The stakeholders need some management, too. Often, the stakeholders need more attention than the project team, because they're worried, fretting, and just anxious about the deliverable you're creating for them. Much of stakeholder management is simply communicating with the stakeholders. There are two inputs:

- Communications management plan. (This plan tells you who needs what information, when they need it, and the expected modality of the communication.)
- Organizational process assets

As you manage the project stakeholders, there will be several outputs:

- Resolved issues (it's a good feeling to have issues resolved)
- Approved change requests
- Approved corrective actions
- Organizational process asset updates
- Project management plan updates

Monitoring and Controlling Project Risks

A risk is an uncertain event or condition that can affect the project's outcome. Project managers often think of risks as negative events, but that's not always the case. Many risks, such as using a new material, a new vendor, or a new approach to the project work, aren't negative, but have positive outcomes. Chapter 11 will discuss both positive and negative risks in detail. There are five inputs to the risk monitoring and controlling process:

- Risk management plan
- Risk register
- Approved change requests
- Work performance information
- Performance reports

Risk monitoring and control happens throughout the project's life cycle, not just once. As this process is completed, there will be six outputs:

- Risk register updates
- Change requests
- Recommended corrective actions
- Recommended preventive actions
- Organizational process asset updates
- Project management plan updates

Administering the Project Contracts

If a project manager has to complete the procurement management process, she will also need to administer the project contracts. This process, which Chapter 12 explores, ensures that the relationship between the buyer and the seller remains intact, reviews how the seller is performing by the terms of the contract, and works with the seller to ensure they continue to abide by the agreed contractual terms. This process has six inputs:

- Contract. (You need a contract in order to manage one.)
- Contract management plan.
- Selected sellers.
- Performance reports.

- Approved change requests. (Change requests can affect the product or service the seller is providing.)
- Work performance information. (This input is primarily concerned with the performance of the work as completed by the seller.)

Contract administration creates many outputs:

- Contract documentation
- Change requests
- Recommended corrective actions
- Organizational process asset updates
- Project management plan updates
- Procurement management plan
- Contract management plan

Closing the Project (PMBOK, Section 3.2.5)

In project management, there are few things more rewarding than closing a project. It's extremely satisfying, and sometimes sad, to officially close a project and move along to other challenges. This final project management process group has but two processes, but it's no less important than the other process groups within a project. The goals of closing a project are to officially confirm that all of the needed processes have been completed, that the deliverables have been transferred to the user or organization, and that the project is done.

Project closure is also concerned with the success of the project, and these processes can be used when a project may be cancelled before reaching the desired deliverables. If a project has multiple phases, the processes within this group can be used for each phase and at the end of the project.

Closing the Project

This is the goal: close the project and get back to your life. There are several inputs to project closure:

- Project management plan
- Contract documentation
- Enterprise environmental factors
- Organizational process assets
- Work performance information
- Deliverables

When the project manager closes a project, several outputs are created and completed:

- Administrative closure procedure
- Contract closure procedure

- Final product, service, or result
- Organizational process asset updates

Closing the Project Contracts

If a project manager has worked with vendors on a project, then there are processes that must be completed during project closure to ensure that all of the terms of the contract have been met. This allows the project manager to confirm that the seller has met its obligations and that the project manager's organization has also met the obligations of the contract before the project is closed. Here are the inputs to this process:

- Procurement management plan
- Contract management plan
- Contract documentation
- Contract closure procedure

As a result of performing these activities, there are two outputs of this process:

- Closed contracts
- Organizational process assets updates

Examining How the Processes Interact (PMBOK, Section 3.3)

The five project management process groups are not unlike the Rubik's Cube toy; what you do in one area affects all the other areas. In project management, the interactions between the processes are somewhat chronological; but often, the processes are iterative, transient, and allow the project management team to shift from process group to process group. The process groups allow for plenty of overlap throughout the whole project. For example, the extent of the monitoring and controlling processes is directly affected by the planning process group.

You've seen throughout this chapter that the output of one process is often an input to another process group. The planning process group is the best example of this axiom; project plans are created and then executed for each knowledge area. As a project moves through its life cycle, the activities of project management—that is, the 44 individual processes—interact, overlap, and share commonalities that allow the project to move forward. Figure 3-6 demonstrates the concept of how processes overlap within a project. Note that in a multiphase project, these processes can be applied to each individual phase and to the project as a whole.

All of these processes are not needed on every single project—only the processes that are relevant to the specific project are needed. For example, a low priority, simple "Move-Add-Change" (MAC) project within an organization likely won't need to complete all 44 processes in order for the project to be completed successfully. However, a four-year project to build a skyscraper will likely use all 44 processes.

Constraints within a project are often seen as process inputs. Consider any project you've worked on where management has enforced a project deadline. The deadline is

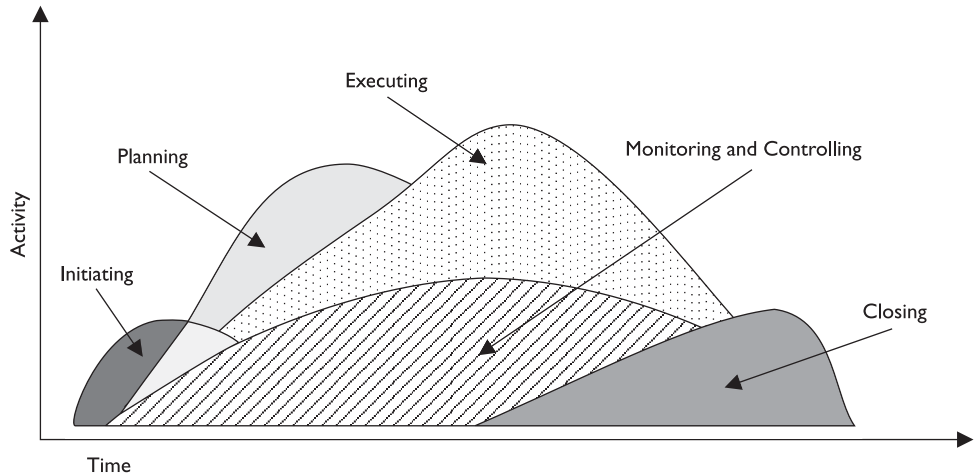

Figure 3-6 Process groups naturally interact throughout the project.

a constraint that may not allow the project team to determine the best completion through normal project planning, but rather by working backwards from the deadline. Constraints that serve as inputs to process groups can cause additional risks on schedule and quality, can increase project costs, and may even require the project scope to be reduced to hit the project's target preset end date. No fun for anyone!

Chapter Summary

Don't you feel great now that you've seen all of the project management processes, the process groups where they live, and how all these processes interact with one another? Your PMI examination is all about project management, and project management is, of course, all about the processes needed to complete the project. Projects move through a project management life cycle of initiating, planning, executing, monitoring and controlling, and, ultimately, closing.

The project management processes span the entire project, which means that not only do the processes live inside of the process groups we've covered here, but also the activities of the processes can be lumped into one of the nine knowledge areas of project management. Part II of this book deals with the project management knowledge areas. With that in mind, it's only appropriate to see all of these in one schmancy chart in Table 3-1. I've also included a quick reference to each chapter where these processes and their corresponding knowledge areas intersect. Enjoy!

Table 3-1 is a great reference for all of the project management processes, but it doesn't, and cannot, demonstrate how processes interact. Processes are allowed to interact based on the situations within the project. Not all of these processes will interact on every project, and not every process is needed on every single project. Your CAPM or PMP examination will likely test you on all of these processes, however, since it's possible for a project to use all 44 project management processes.

Knowledge Area	Initiating	Planning	Executing	Monitoring and Controlling	Closing
Project Integration Management Chapter 4	Develop project charter Develop preliminary project scope statement	Develop project management plan	Project plan execution	Monitor and control the project work Manage integrated change control	Close project
Project Scope Management Chapter 5		Scope planning Scope definition Create WBS		Scope verification Scope control	
Project Time Management Chapter 6		Activity definition Activity sequencing Activity resource estimating Activity duration estimating Schedule development		Schedule control	
Project Cost Management Chapter 7		Cost estimating Cost budgeting		Enforce cost control	
Project Quality Management Chapter 8		Quality planning	QA activities	QC activities	
Project Human Resources Management Chapter 9		HR planning	Acquire project team Project team development	Manage project team	
Project Communications Management Chapter 10		Communications planning	Information distribution	Performance reporting Manage stakeholders	
Project Risk Management Chapter 11		Risk management planning Risk identification Qualitative analysis Quantitative analysis Risk response planning		Monitor and control risk	
Project Procurement Management Chapter 12		Plan purchases and acquisitions Contract planning	Request seller responses Select sellers	Contract administration	Contract closeout

Table 3-1 The Project Management Process Groups and Corresponding Knowledge Areas

Key Terms

Assumption A belief that may or may not be true within a project. Weather is an example of an assumption in construction projects.

Change request A documented request to add to or remove from the project scope.

Closing process group The project management process group that contains the activities to close out a project and project contracts.

Constraint A condition, rule, or procedure that restricts a project manager's options. A project deadline is an example of a constraint.

Corrective action A corrective action brings project work back into alignment with the project plan.

Cost baseline The aggregation of the project deliverables and their associated costs. The difference between the cost estimates and the actual cost of the project identifies the cost variance.

Defect repair The activity to repair a defect within the project.

Enterprise environmental factors Any external or internal organizational factors that can affect a project's success. Enterprise environmental factors include the culture, organizational structure, resources, commercial databases the project will use, market conditions, and your project management software.

Executing process group The project management process group that provides the activities to carry out the project management plan to complete the project work.

Initiation process group The project management process group that allows a project to be chartered and authorized.

Monitoring and controlling process group The project management process group oversees, measures, and tracks project performance.

Organizational process assets The methodology an organization uses to perform its business, as well as the guidelines, procedures, and knowledge bases, such as the lessons learned documentation from past projects and any relevant historical information.

Planning process group The project management process group that creates the project management plan to execute, monitor and control, and close the project.

Preventive action A risk-related action that avoids risk within the project. A workaround to a problem within your project is an example of a preventive action.

Process An activity to create a product, result, or service. Project management processes allow the project to move towards completion.

Project calendar The calendar that documents when the project work will occur.

Project charter A document that comes from outside of the project boundaries and authorizes the existence of a project.

Project deliverable The output of the project.

Project scope statement The project scope defines the project, the project deliverables, product requirements, project boundaries, acceptance procedures, and scope control.

Resource calendar The calendar that documents which project resources are available for the project work.

Risk An uncertain event or condition that can have a negative or positive impact on the project.

Risk register A central repository of the project risks and their attributes.

Rolling wave planning Iterations of planning throughout the project life cycle.

Schedule baseline The expected timeline of the project. The difference between the planned schedule and the experience schedule reveals schedule variances within the project.

Scope baseline The sum of the project deliverables. The WBS is often called the project scope baseline. The differences between the WBS and what is created is a scope variance.

WBS dictionary A document that defines every identified element of the WBS.

Workaround An immediate response to a negative risk within the project. This is an example of a corrective action.

Work breakdown structure (WBS) A breakdown of the project scope; often called the scope baseline.

Questions

1. What is a project process?
   - **A.** The creation of a product
   - **B.** The progressive elaboration resulting in a product
   - **C.** A series of actions that bring about a product, result, or service
   - **D.** A series of actions that allow the project to move from concept to deliverable
2. There are five project management processes that allow projects to move from start to completion. Which one of the following is not one of the project management process groups?
   - **A.** Initiating
   - **B.** Planning
   - **C.** Communicating
   - **D.** Closing

3. Of the following, which is the logical order of the project management processes?
   A. Initiating, planning, monitoring and controlling, executing, closing
   B. Initiating, planning, executing, monitoring and controlling, closing
   C. Planning, initiating, monitoring and controlling, executing, closing
   D. Planning, initiating, executing, closing, monitoring and closing
4. The ongoing process of project planning is also known as __________________.
   A. Constant integration planning
   B. Rolling wave planning
   C. Continuous planning
   D. Phase gates
5. You are the project manager for the AQA Project. You would like to include several of the customers in the project planning sessions. Your project leader would like to know why the stakeholders should be involved since your project team will be determining the best method to reach the project objectives. You should include the stakeholders because ______________.
   A. It generates goodwill between the project team and the stakeholders.
   B. It allows the stakeholders to see the project manager as the authority of the project.
   C. It allows the project team to meet the stakeholders and express their concerns regarding project constraints.
   D. It allows the project team to leverage the skills and knowledge of the stakeholders to develop the project plan.
6. You have requested that several of the stakeholders participate in the initiation of the project. Why is this important?
   A. It improves the probability of shared ownership.
   B. It allows for scope constraints.
   C. It prevents scope creep.
   D. It allows for effective communications.
7. What is the purpose of the planning process group?
   A. To initiate the project work
   B. To determine the project cost
   C. To determine the Iron Triangle of Project Management
   D. To develop the project management plan

8. When is a project manager selected?
   - A. Planning phase
   - B. Executing phase
   - C. Initiation phase
   - D. When the project charter is approved
9. Which one of the following statements best describes what project management is?
   - A. Project management is the application of knowledge, skills, tools, and techniques to project team members to meet project requirements.
   - B. Project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements.
   - C. Project management is the collection of the project management processes used on every project.
   - D. Project management is the application of the project management processes that are used on every project.
10. In order for a project to be successful, there must be four conditions. Which one of the following is not a condition required for project success?
    - A. The project team must select the appropriate processes to meet the project objectives.
    - B. The project team must select applicable knowledge areas in order to meet the project objectives.
    - C. The project team must comply with requirements to meet stakeholder needs, wants, and expectations.
    - D. The project team must balance the competing demands of scope, time, cost, quality, resources, and risk to create a quality product.
11. When a project manager and a project team choose the processes that they deem applicable to their project, this is called what?
    - A. Tailoring
    - B. Faulty project management
    - C. Functional project management
    - D. Rolling wave planning
12. In which process group will the project team be acquired?
    - A. Initiating
    - B. Planning
    - C. Executing
    - D. Monitoring and controlling

13. You are the project manager of a new project. You have worked with management to identify several initial assumptions and constraints for your project. Where will these items be documented?
    - **A.** Project management plan
    - **B.** Project scope statement
    - **C.** Project charter
    - **D.** Risk management plan
14. When does a project become officially authorized?
    - **A.** When the project charter is written
    - **B.** When the project is funded
    - **C.** When the project team is assembled
    - **D.** When the project charter is approved
15. When does the vast majority of a project's budget get expended?
    - **A.** During the planning process group activities
    - **B.** During the execution process group activities
    - **C.** During the initiation process group activities
    - **D.** During the procurement process group activities
16. You have identified a negative risk within your project and would like to implement a workaround to the risk. A workaround is an example of what?
    - **A.** Corrective action
    - **B.** Defect repair
    - **C.** Preventive action
    - **D.** Poor project management
17. Which process group can provide feedback between project phases?
    - **A.** Planning
    - **B.** Executing
    - **C.** Monitoring and controlling
    - **D.** Closing
18. Which process aims to eliminate causes of unsatisfactory performance?
    - **A.** Scope verification
    - **B.** Scope validation
    - **C.** Quality control
    - **D.** Cost control

19. A project has been cancelled. Which process must happen next?

A. Scope control

B. Procurement management

C. Contract closure

D. No additional process is needed because the project has been cancelled.

20. Management has determined that your project must be completed by December 30. This date is an input to your planning process group and is considered what?

A. Constraint

B. Enterprise environmental factor

C. Organizational process asset

D. Assumption

Answers

1. **C**. A process, the focus of this chapter, is a set of interrelated activities that brings about a product, result, or service. A is incorrect because it does not fully describe a process, but more of a project. B is incorrect because progressive elaboration is not a description of a process, but rather a description of incremental refinements of a definition of a product, service, or result. D is also incorrect because this statement describes project phases. For more information, see the PMBOK, Chapter 3 introduction, and the glossary definition of a process.
2. **C**. Communicating is a process, but it is not a process group. A, B, and D are all incorrect choices because they are project management process groups. For more information, see the PMBOK, Section 3.2.
3. **B**. Projects logically move through initiating, planning, executing, monitoring and controlling, and closing. Choices A, C, and D are all incorrect because these are not in the logical order of the project management process groups. For more information, see the PMBOK, Section 3.2.
4. **B**. Rolling wave planning is the progressive detailing of the project management plan. A is not a valid project management term. C is not an appropriate answer. D, phase gates, describes the end of a project phase. For more information, see the PMBOK, Section 3.2.2.
5. **D**. Stakeholders should be involved in the planning processes because they have specific skills and knowledge that the project team can use to develop the project plan. A may be true, but it is not the best answer for this question. B is not valid because it is not the purpose of involving the stakeholders. In addition, the project manager may not be seen as the project authority in

every project (consider public projects and functional organizations). C is incorrect because this is not the purpose of involving the stakeholders. For more information, see the PMBOK, Section 3.2.2.

6. **A**. Stakeholders should participate in project initiation because it improves shared ownership of the project, deliverable acceptance, and stakeholder satisfaction. B, C, and D are all false statements about the involvement of stakeholders in the initiation processes. For more information, see the PMBOK, Section 3.2.1.
7. **D**. The purpose of planning is to develop the project management plan. A is incorrect; this is the purpose of the initiating process group. B and C are incorrect because these may occur during planning, but these are not the primary purpose of the planning process group. For more information, see the PMBOK, Section 3.2.2.
8. **C**. The project manager is selected during the initiation process group. A, B, and D are all false because these answers do not define when the project manager is selected. For more information, see the PMBOK, Section 3.2.1.
9. **B**. Project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements. This is a direct quote from the PMBOK. A, C, and D do not describe what project management is. For more information, see the introduction to Chapter 3 in the PMBOK.
10. **B**. The project team does not select which knowledge areas are needed for the project to be successful, so this statement is false and is not a condition required for project success. Chapters 4 through 12 in this book and the PMBOK describe the nine knowledge areas that are applicable for every project. A, C, and D are correct statements for a successful project. The fourth condition of a successful project is that a defined approach to adapt the product specifications and plans to meet the project requirements is used within the project. For more information, see the introduction to Chapter 3 in the PMBOK.
11. **A**. The project team tailors the project processes to their individual project. B is incorrect, as this is good project management, not faulty project management. C describes an organizational structure, not tailoring. D is incorrect because rolling wave planning defines the iterations of project planning. For more information, see the introduction to Chapter 3 in the PMBOK.
12. **C**. The project team is acquired in the executing process group. A, B, and D are all incorrect because the team is not acquired during these groups. For more information, see the PMBOK, Section 3.2.3.3.

13. **C**. The initial constraints and assumptions are documented in the project charter. A, B, and D are all incorrect choices because the initial constraints and assumptions are documented in the project charter not in the project management plan, the project scope statement, or the risk management plan. For more information, see the PMBOK, section 3.2.1.
14. **D**. The project is not authorized until the charter is approved. A is incorrect because a charter can be written by the project management team and still not be approved. B is incorrect because a project is chartered, typically and technically, before being funded. C is incorrect because team acquisition happens during the execution process group—well after project initiation, which is where the charter comes from. For more information, see the PMBOK, Section 3.2.1.
15. **B**. When the project team completes the project work, the project's budget is expended. A, C, and D are all incorrect because the vast majority of the project's budget is not consumed during these process groups. For more information, see the PMBOK, Section 3.2.3.
16. **C**. A workaround is an example of a preventive action. A, corrective action, is an action to bring future project performance in alignment with the project plan. B, defect repair, is the repair of flawed work. D is not a valid answer. For more information, see the PMBOK, Section 3.2.4 and the definition of workaround in the PMBOK glossary.
17. **C**. The monitoring and controlling process group provides feedback between project phases. A, B, and D are all incorrect because these process groups do not provide feedback between project phases. For more information, see the PMBOK, Section 3.2.4.
18. **C**. Quality control aims to eliminate causes of unsatisfactory performance; this process is part of the monitoring and controlling process group. A, scope verification, aims for scope acceptance decisions. B is not a valid PMI term. D, cost control, is concerned with controlling project costs. For more information, see the PMBOK, Section 3.2.4.7.
19. **C**. When a project is cancelled, the closing processes must still happen. In this example, the only closing process mentioned was contract closure. A, B, and D are all invalid because these processes do not happen if a project is closed or cancelled. For more information, see the PMBOK, Section 3.2.5 and Section 3.2.5.2.
20. **A**. A preset project deadline is an example of a project constraint. B is incorrect because enterprise environmental factors are not constraints. C, organizational process assets, are not constraints but resources for the project management team. D is incorrect, as assumptions are things believed to be true but not proven to be true. For more information, see the PMBOK, Section 3.3.

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PART II

Project Management Professional Testing Areas

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CHAPTER 4

Managing Project Integration

In this chapter, you will

- Learn what project integration management does for the project manager
- Develop the project charter
- Develop the preliminary project scope statement
- Create the project management plan
- Manage the project's execution
- Monitor and control project work
- Understand how integrated change control works
- Close a project

What the heck is *project integration management*? This is the heart of project management and is made up of the day-to-day processes the project manager relies on to ensure that all parts of the project work together. Project integration management is about the project manager making the best decisions for work, resources, project issues, and all the logistics of the project so that it is completed as planned.

Project integration management is also about making tradeoffs between competing objectives and alternatives. As a project manager, I'm certain you've worked with stakeholders when each wants something that would cancel out a characteristic another stakeholder wants: Bob says he wants the house painted green, and Nancy wants it painted red. Or your client wants your organization to design a reliable, fast network operating system for thousands of users as long as it doesn't cost more than a few dollars. Competing objectives require negotiations, balance, and lots and lots of aspirin.

VIDEO Working with project integration management.

In the first part of this book, I discussed the project management life cycle and the 44 project management processes. These processes are not isolated elements, but overlap, interact, and complement one another. Project integration management is the coordination and support of these project management plans. It also considers the interrelation of the nine knowledge areas and how actions in one knowledge area affect all the others.

Developing the Project Charter (PMBOK, Section 4.1)

All projects officially start with a project charter—a formal document that authorizes the project. So what's so great about the charter? It's the document that gives you, the project manager, the authority to use resources to do the project work. It's a powerful document. The project manager is assigned to the project as early as possible, and ideally while the charter is still being developed. The project manager needs to be assigned, without a doubt, before the project moves into the project planning process group.

In many organizations, the project manager is the person writing the charter, and that's fine—really!—but the charter cannot be signed by the project manager. The charter is backed by a project initiator, typically called the project sponsor, at a level within the organization where this person can allocate funding and resources for the project. In other words, the project manager can't sign the charter because he's not "powerful" enough within the organization to assign resources and funds to his own project.

EXAM TIP The project charter authorizes the project, but not necessarily the project manager, and also defines the project manager's level of authority.

Charters are typically created by an enterprise, government agency, a program manager, or a project steering committee (sometimes called the portfolio organization). Charters are written so that a project can answer or satisfy one of the following reasons:

- Market demand
- Business need
- Customer request
- Technological advance
- Legal requirement
- Social need

Your organization might call these opportunities, problems, or business requirements. Once you're a project manager, you'll just call 'em your favorite project. (Your favorite project is always the one you're managing right now.) Why some projects get selected and others do not within an organization can be due to finances, the project owner, sponsor influence, legal requirements, or any number of reasons. The message to take away is that regardless of why a project gets selected you, the project manager, must have a charter for the project to be officially authorized. Charters should always include the following project information:

- Requirements for satisfaction, project stakeholder needs, wants, and expectations

- Business needs, a description of the project's product, or a mile-high view of the project's purpose
- The reason why the project was chartered
- The project manager and her level of autonomy
- Summary milestone schedule
- Stakeholder influences
- Functional organizations and how they'll be involved with the project
- Project constraints and assumptions (environment, external, and organizational)
- Business case for the project and the project's return on investment
- Summary project budget

Believe it or not, the project charter may be updated. For example, the summary project budget may be based on a simple rough order of magnitude estimate. As the project moves deeper into planning, the estimates become clearer and more precise. The more accurate estimate may cause the budget to grow, requiring the project charter to be modified to reflect the new information.

Preparing to Create the Project Charter

The project charter often comes from the project manager, so you'll need to know what goes into it, how it gets created, and then what you can do with your charter—especially for the Certified Associate in Project Management (CAPM) or Project Management Professional (PMP) examination. When preparing to create the project charter, you'll need four things, described in the following sections.

Contract Okay, I confess—you won't always need a contract in order to create a project charter, but it's the first input in the Project Management Body of Knowledge (PMBOK), so work with me for a moment. If you're working in an organization that performs projects for other entities, such as a consulting firm, architectural firm, or even an events planning company, you'll need a contract to make the project official. Chapter 12 explores contracting; but for now, know that you may need a contract if it's appropriate for your project.

Project Statement of Work (SOW) This document defines all the products and services that the project will provide. For a project completed internally, the SOW comes from the project sponsor and defines the business need, products, and services the project will create. If the project is to be completed for another organization, the customer should provide the performing organization with the SOW as part of their procurement package. For example, if your company were to receive a request for proposal (RFP) to create a new warehouse, the customer would include the SOW with the RFP so you could know what the proposal is to address. Every SOW should include:

- **Business need** Why the project needs to exist.

- **Product scope description** This document describes the product or service the project will create. Consider the RFP to create the new warehouse: the customer's RFP would detail the square footage, requirements of the warehouse, and other details that would allow your company to respond intelligently to their request. As you may have experienced, especially in the world of information technology, the product description is usually broad, vague, and dreamy in the early stages of a project. As the project moves through the planning phases, the details of the product scope become clearer.
- **Strategic plan** The strategic plan defines how the project will mesh with the organization's goals. This is a key input when an organization decides to do a project or not. Basically, you won't find a car manufacturer hosting projects to create chandeliers—it's just not within their strategic plan to undertake such a project.

Enterprise Environmental Factors The project charter also considers the organization where the project will take place and its culture, standards, regulations, and environment. You'll see enterprise environmental factors throughout the remainder of this book, and it's new to the third edition of the PMBOK. Just so you've got these fun things once and for all, here are the enterprise environmental factors you'll need to be familiar with:

- Organization's culture and structure.
- Industry standards and regulations.
- Organization's facilities and equipment (the general infrastructure of the company).
- Human resources and their talents and skills.
- Human resources administration.
- Work authorization system.
- Marketplace conditions.
- Stakeholders' tolerance for risk. (This is also known as the utility function.)
- Commercial databases for the organization's industry. (Think of cost-estimating databases for a builder or manufacturer.)
- Project management information system (PMIS). Think of—yes, I'll say it—Microsoft Project. Don't worry—you won't have to know any software vendors or their goods for the PMI exam. All of your favorite, or least favorite, project management software is just lumped into the generic term "project management information system."

Organizational Process Assets Anything that your organization has in its possession that can help your current project succeed is part of the organizational process assets. This also means that the policies, procedures, documentation of past projects, and plans are part of the organizational process assets. Project Management Institute (PMI) breaks down the organizational process assets into two big categories. Let's explore them in detail:

- Processes and procedures for project work:
    - Standard processes and procedures for getting project work done. Consider how purchase requests, team member acquisitions, the quality programs your projects subscribe to, checklists, and generally the way your company requires your projects to operate.
    - Guidelines, how your project team is to complete their work, proposal evaluations, and how you measure your project for performance.
    - Templates for project management.
    - How the project manager is allowed to tailor the project management processes to fit any given project.
- Communication requirements, archival, security requirements, and allowed modalities for communication:
    - How a project manager is to close a project.
    - Financial controls and procedures.
    - Issue and product defect management.
    - Change control procedures.
    - Risk management procedures.
    - Work authorization system processes.
    - Processes and procedures for contributing to and accessing a corporate knowledge base.
    - Process measurements.
    - Project files.
    - Historical information and lessons-learned documentation.
    - Issue and defect records of past projects and products.
    - Configuration management for versioning, baselines, company standards, procedures, and prior project documents. (Think of the versions of software, blueprints, and manuals.)
    - Financial databases.

Choosing a Project to Charter

Once the organization and the project manager are armed with these inputs, they're ready to go about creating the project charter. Preparing to create the charter is often trickier than actually writing it. However, before the project management team can actually create a charter, there needs to be a project. This means the organization, the project steering committee, or the project portfolio management team needs to choose a project to initiate.

Now, unless you work for an incredible organization and/or are extremely lucky, you've probably discovered that not every good project is allowed to be authorized through a charter. After all, most companies only have a limited amount of funds to invest in new projects. There are two approaches an organization takes to choose new projects—and no, they are not "heads or tails."

The first method is by using a mathematical model to determine the likelihood of success. These models include:

- Linear programming
- Nonlinear programming
- Dynamic programming
- Integer programming
- Multiobjective programming

Sounds like fun, doesn't it? Don't worry. You do not need to know how to perform any of the above math tricks for your CAPM or PMP examination. Just be topically aware of these and know that they are examples of geeky mathematical models.

EXAM TIP Mathematical models are also known as constrained optimization.

The second method, however, you will want to be a bit more familiar with. This project selection uses a benefits-comparison model to determine a project's success. Let's look at these in more detail in the following sections.

Murder Boards

Murder boards are committees full of folks that ask every conceivable negative question about the proposed project. Their goals are to expose strengths and weakness of the project—and kill the project if it's deemed unworthy for the organization to commit to. Not a pleasant decision-making process. You might also know murder boards by a slightly friendlier name: project steering committees or project selection committees.

Scoring Models

Scoring models (sometimes called weighted scoring models) are models that use a common set of values for all of the projects up for selection. For example, values can be profitability, complexity, customer demand, and so on. Each of these values has an assigned weight. Values of high importance have a high weight, while values of lesser importance have a lesser weight. The projects are measured against these values and assigned scores by how well they match the predefined values. The projects with higher scores take priority over projects with lesser scores. Figure 4-1 demonstrates the scoring model.

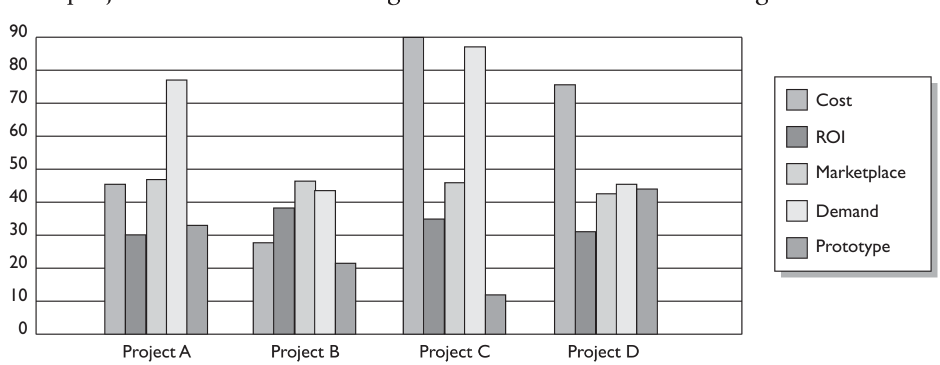


Figure 4-1 A scoring model bases project selection on predefined values.

Benefit/Cost Ratios

Just like they sound, benefit/cost ratio (BCR) models examine the cost-to-benefit ratio. A typical measure is the cost to complete the project and the cost of ongoing operations of the project product compared against the expected benefits of the project. For example, consider a project that will cost $575,000 to create a new product, market the product, and provide ongoing support for the product for one year. The expected gross return on the product, however, is $980,000 in year one. The benefit of completing the project is greater than the cost to create the product.

EXAM NOTE BCR statements can be written as ratios. For example, a BCR of 3:2 has three benefits to two costs—a good choice. A BCR of 1:3, however, is not a good choice. Pay special attention to which side of the ratio represents the cost; it should not be more than the benefit if you want the project to be selected.

Payback Period

How long does it take the project to "pay back" the associated costs? For example, the AXZ Project will cost the organization $500,000 to create over five years. The expected cash inflow (income) on the project deliverable, however, is $40,000 per quarter. From here, it's simple math: 500,000 divided by $40,000 is 12.5 quarters, or a little over three years to recoup the expenses.

This selection method, while one of the simplest, is also the weakest. Why? The cash inflows are not discounted against the time to begin creating the cash. This is the time value of money. The $40,000 per quarter five years from now is worth less than $40,000 in your pocket today. Remember when sodas were a nickel? It's the same idea—the soda hasn't gotten better, the nickel is just worth less today than it was way back then.

Considering the Discounted Cash Flow

Discounted cash flow accounts for the time value of money. If you were to borrow $100,000 for five years from your uncle, you'd be paying interest on the money, yes? (If not, you've got a great uncle.) If the $100,000 were invested for five years and managed to earn a whopping 6 percent interest per year, compounded annually, it'd be worth $133,822.60 at the end of five years. This is the future value of the money in today's terms.

The magic formula for future value is $FV = PV (1 + I)^n$, where:

- FV is future value
- PV is present value
- I is the interest rate
- N is the number of time periods (years, quarters, and so on)

Here's the formula with the $100,000 in action:

1. $FV = 100{,}000(1 + .06)^5$
2. $FV = 100{,}000(1.338226)$
3. $FV = 133{,}822.60$

The future value of the $100,000 five years from now is worth $133,822.60 today. So how does that help? Now we've got to calculate the discounted cash flow across all of the projects up for selection. The discounted cash flow is really just the inverse of the preceding formula. We're looking for the present value of future cash flows: $PV = FV \div (1 + I)^n$.

In other words, if a project says it'll be earning the organization $160,000 per year in five years, that's great, but what's $160,000 five years from now really worth today? This puts the amount of the cash flow in perspective with what the projections are in today's money. Let's plug it into the formula and find out (assuming the interest rate is still six percent):

1. $PV = FV \div (1 + I)^n$
2. $PV = 160{,}000 \div (1.338226)$
3. PV = $119,561

So…$160,000 in five years is really only worth $119,561 today. If we had four different projects of varying time to completion, cost, and project cash inflows at completion, we'd calculate the present value and choose the project with the best present value, as it'll likely be the best investment for the organization.

EXAM TIP You should be able to look at the present value of two proposed projects and make a decision as to which one should be green-lighted. The project with the highest present value is the best choice if that's the only factor you're presented with.

Calculating the Net Present Value

The net present value (NPV) is a somewhat complicated formula, but it allows you to predict a project's value more precisely than the lump-sum approach found with the PV formula. NPV evaluates the monies returned on a project for each time period the project lasts. In other words, a project may last five years, but there may be a return on investment (ROI) in each of the five years the project is in existence, not just at the end of the project.

For example, a retail company may be upgrading the facilities at each of their stores to make shopping and purchasing easier for their customers. The company has 1,000 stores. As each store makes the conversion to the new facility design, the project deliverables will begin, hopefully, generating cash flow as a result of the project deliverables. (Uh, we specifically want cash inflow from the new stores, not cash outflow. That's some nerdy accounting humor.) The project can begin earning money when the first store is completed with the conversion to the new facilities. The faster the project can be completed, the sooner the organization will see a complete ROI.

Here's how the NPV formula works:

1. Calculate the project's cash flow for time unit (typically quarters or years).
2. Calculate each time unit total into the present value.
3. Sum the present value of each time unit.
4. Subtract the investment for the project.
5. Take two aspirins.

6. Examine the NPV value. An NPV greater than one is good, and the project should be approved. An NPV less than one is bad, and the project should be rejected.

When comparing two projects, the one with the greater NPV is typically better, although projects with high returns (PVs) early in the project are better than those with low returns early in the project. Table 4-1 provides an example of an NPV calculation.

EXAM TIP You likely will not have to calculate NPV for your CAPM or PMP exam. I've included the whole scenario here to provide an understanding of the formula. Basically, better than one is good; less than one means your project is losing money.

Considering the Internal Rate of Return

The last benefit measurement method is the internal rate of return (IRR). The IRR is a complex formula to calculate when the present value of the cash inflow equals the original investment. Don't get too lost in this formula—it's a tricky business, and you won't need to know how to calculate the IRR for the exam. You will need to know, however, that when comparing multiple projects' IRRs, projects with high IRRs are better choices than projects with low IRRs. This makes sense. Would you like an investment with a high rate of return or a lower rate of return? As a general rule, an IRR greater than 1 is good.

EXAM TIP The formulas on the time value of money are important for project selection, but not so important to memorize for the exam. You'll need to be familiar with the formulas, what they do, and why organizations use them to select projects. Don't worry about memorizing them for the exam. You're more likely to experience these on the PMP exam than the CAPM exam.

Knowing the Project Management Methodology

Before the project management team can dive in and create the project charter, they also need to understand how their organization approaches project management in general. When I teach my project management seminars, I find that some companies

Time Period	Cash Flow	Present Value
1	15,000.00	14,150.94
2	25,000.00	22,249.91
3	17,000.00	14,273.53
4	25,000.00	19,802.34
5	18,000.00	13,450.65
Totals	$100,000.00	83,927.37
Investment		78,000.00
NPV		$5,927.37

Table 4-1 Net Present Value Calculation

have a formal, highly structured, rigid project management approach. Other companies are, well, loosey-goosey. Their approach can vary from project manager to project manager, and they don't mind.

Whatever methodology an organization has adapted, the project management team must understand how this affects the level of detail they'll need to provide in their project charter. The great thing about this point, in light of your exam, is that every company in the world can take a different project management methodology, so it's tough to ask questions about what's proper or not.

Creating the Charter—Finally

Now that the project management team is armed with all the inputs, has considered the project selection methodology, and understands the project management methodology in place in their organization, they're ready to create the project. There are two additional tools the project management team can use to create the charter and they're easy:

- **Project management information system** Remember the computer software that helps the project manager manage the project? That software can often help the project management team create the project charter as well.
- **Expert judgment** Experts within the organization or external experts, such as consultants, agencies, firms, or subject matter experts (SMEs), can help the project management team create all the needed elements for the charter.

The project charter, as a final reminder for your exam, is endorsed by an entity outside of the project boundaries. This person or entity has the power to authorize the project and grant the project manager the power to assign resources to the project work.

Developing the Preliminary Project Scope Statement (PMBOK, Section 4.2)

All projects need a project scope statement. This document defines what the project needs to accomplish in order for the project to be deemed complete. The project, in its infancy, is defined in the preliminary project scope statement. Like its name implies, this document is preliminary to the project work and much of the project planning. The project scope statement should always include:

- Project and product objectives
- Service requirements and characteristics
- Criteria for project acceptance
- Project boundaries
- Project requirements and deliverables
- Constraints and assumptions
- Initial project organization
- Milestones
- Initial work breakdown structure

- Order-of-magnitude cost estimate (this is your ballpark estimate)
- Configuration management requirements
- Approval requirements

This "baby scope statement" is based on the details the project sponsor provides the project management team. As you might guess, this information can be broad, sketchy, or even plain wrong. That's why this project scope statement is preliminary. Once the project team moves deeper into the planning process group, there'll be plenty of time for refining the project scope statement.

Developing the Project Management Plan (PMBOK, Section 4.3)

You wouldn't go about building a house, creating a new piece of software, or launching any project without a project plan, right? The project management plan, however, is more than how the work will be done: it's *how* the project will be done. That's right, the project management plan defines how the project is executed, monitored and controlled, and then closed. It's a plan on how to manage, coordinate, and integrate all the different knowledge areas and processes within a project. It's multifaceted. Figure 4-2 shows the process necessary before the project management plan can be developed. Think of all the things a project manager and the project team will decide within the project plan that need to be documented:

- Which project management processes and their level of implementation are appropriate for the project
- What tools and techniques will be used with which processes
- How the selected processes will be used to manage the project, including how the processes will interact as the project moves through its own phases
- How the project work will be completed
- How change control will happen

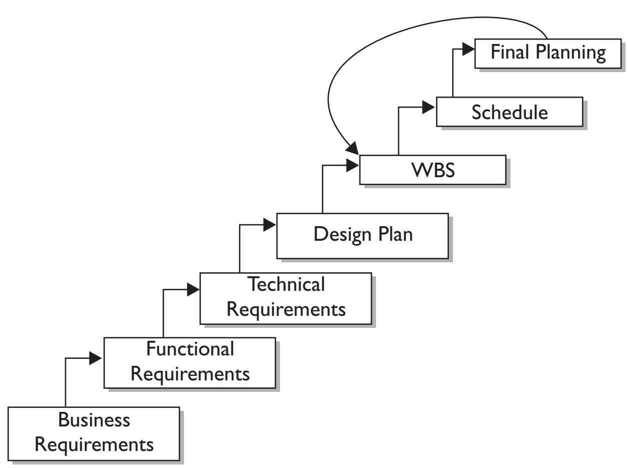


Figure 4-2 It's a logical approach to get to the project management planning phase.

- How configuration management will be performed
- The integrity of the project's baselines and how the measurements will be used to better manage the project
- Communication demand and techniques with the project stakeholders
- How the project phases will commence and proceed
- When and how management will review the project's performance

Creating the Project Management Plan

As the project completes project planning activities, the outputs will be assimilated into a collection of subsidiary project plans. The collection of these subsidiary project plans will address all of the previous points and help the project manager and the project team know where the project is going and how they will get there. Let's take a moment and look at each of the project management subsidiary plans the project management plan will include:

- **Project scope management plan** This defines how the project scope will be planned, managed, and controlled. This plan is covered in detail in Chapter 5.
- **Schedule management plan** This defines how the project schedule will be created and managed. The schedule management plan and its creation are covered in Chapter 6.
- **Cost management plan** This plan details how the project costs will be planned for, estimated, budgeted, and then monitored and controlled. Cost management is described in Chapter 7.
- **Quality management plan** Quality is expected on every project. This plan defines what quality means for the project, how the project will achieve quality, and how the project will map to organizational procedures pertaining to quality. Chapter 8 covers quality management in more detail.
- **Process improvement plan** Who wants an extra helping of waste in their project? This plan aims to eliminate non-value-added activity, eliminate waste, and determine how the project work, execution, and management can be made better. This plan is covered in Chapter 8.
- **Staffing management plan** This plan defines how project team members will be brought on to and released from the project team. It also defines team training, safety issues, and how the project's reward and recognition system will operate. Chapter 9 defines the staffing management plan in detail.
- **Communications management plan** This plan defines who will get what information, how will they receive it, and in what modality the communication will take place. Chapter 10 explains communication in more detail.
- **Risk management plan** Risk is an uncertain event or condition that may affect the project's outcome. The risk management plan defines how the project will manage risk. Chapter 11 includes a conversation on this plan.

- **Procurement management plan** The procurement management plan, defined in Chapter 12, controls how the project will be allowed to contract goods and services.

These subsidiary plans are directly related to the project management knowledge areas. Each plan can be adapted from previous projects or templates within the company that the performing organization has created as part of its organizational process assets. While the project management is, for the most part, a compilation of project plans, there are additional items included that you should know for your CAPM or PMP certification:

- **Milestone list** This list details the project's milestones and their attributes. It is used for several areas of project planning, but also helps determine how quickly the project may be ascertaining its objectives.
- **Resource calendar** Resources are people and things like equipment, rooms, and other facilities. This calendar defines when the resources are available to contribute to the project.
- **Schedule baseline** This is the planned start and finish of the project. The comparison of what was planned and was experienced is the schedule variance.
- **Cost baseline** This is the aggregated costs of all of the work packages within the work breakdown structure (WBS).
- **Quality baseline** This documents the quality objectives for the project, including the metrics for stakeholder acceptance of the project deliverable.
- **Risk register** The risk register is a centralized database consisting of the outcome of all the other risk management processes. Consider the outcome of risk identification, qualitative analysis, and quantitative analysis.

EXAM TIP You'll be seeing these documents throughout the remainder of this book. Basically, every knowledge area has one project management subsidiary plan, except for quality, which has two: the quality management plan and the process improvement plan.

Using the Project Management Information System

You already know that the PMIS is a software tool that helps the project management team plan, execute, monitor and control, and then close the project. The PMIS, contrary to what some managers want to believe, does not replace the project manager. Within the PMIS there are two important systems that you will need to know for your CAPM or PMP exam and the remainder of this book. Let's get these down now and be happy for the next eight chapters.

Configuration Management System

We all know that changes are likely to happen to the project scope. How these change requests are submitted, reviewed, their status tracked, and approved are part of the configuration management system. This system, established early in the project, defines how stakeholders are allowed to submit change requests, the conditions for approving a change request, and how approved change requests are validated in the project scope. Configuration management also is in charge of several activities:

- Documenting the functional and physical characteristics of a product or component
- Controlling changes to any of a product's physical characteristics
- Recording changes to the product's physical characteristics and the conditions surrounding the changes
- Contributing and supporting the audit of a product or component for quality

Change Control System

You'll be hearing an awful lot about change control throughout the remainder of this book. It's essential for a project to have an established change control system, or the project will be riddled with change requests. The change control system (CCS) communicates the process for controlling changes to the project deliverables. This system works with the configuration management system and seeks to control and document proposals to the project's product. Figure 4-3 demonstrates an example of a change control system.

NOTE I won't bash Microsoft Project—it's an excellent, excellent tool. However, some managers believe that if you have Microsoft Project installed on your PC, you should be able to manage a project without any flaws, questions, or issues. Ha! That's like saying that just because you have Microsoft Word installed you should be able to write a novel. Project management is more than a piece of software.

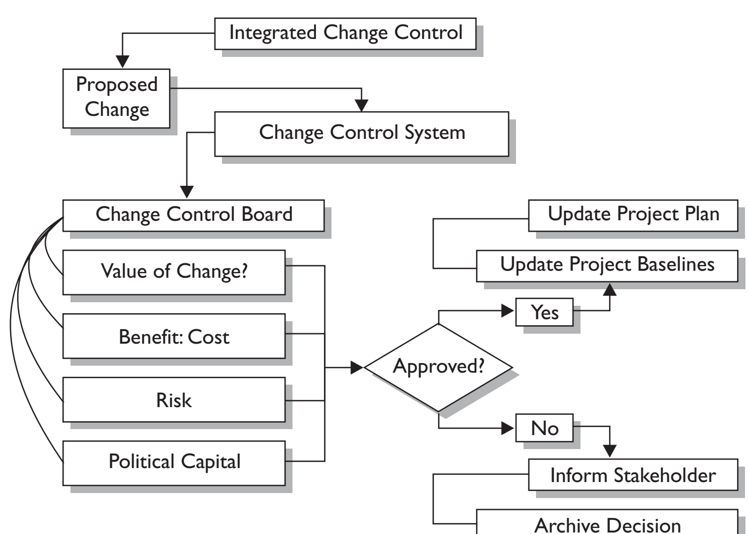


Figure 4-3 All change requests must be documented and pass through a change control system.

Executing the Project Plan (PMBOK, Section 4.4)

So you've got a project plan—great! Now the work of executing the project plan begins. The project manager and the project team will go about completing the promises made in the plan to deliver, document, measure, and complete the project work. The project plan will communicate to the project team, the stakeholders, management, and even vendors what work happens next, how it begins, and how it will be measured for quality and performance.

The product of the project is created during these execution processes. The largest percentage of the project budget will be spent now. The project manager and the project team must work together to orchestrate the timing and integration of all the project's moving parts. A flaw in one area of the execution can have ramifications in cost and additional risk, and can cause additional flaws in other areas of the project.

As the project work is implemented, the project manager refers to the project plan to ensure that the work is meeting the documented expectations, requirements, quality demands, target dates, and more. The completion of the work is measured and then compared against the cost, schedule, and scope baselines as documented in the project plan. Should there be—gasp!—discrepancies between the project work and the baselines, prompt and accurate reactions are needed to adjust the slipping components of the project. The execution of the project includes many activities:

- Doing the work to reach the project objectives
- Spending the project budget to reach the objectives (I can help!)
- Building, training, and developing the project team
- Getting quotes, bids, and proposals for project vendors
- Selecting the project sellers
- Purchasing, managing, and using the resources, materials, equipment, and facilities the project needs to reach its objectives
- Implementing the organization's mandated methods and standards for the project
- Managing and verifying the project deliverables
- Completing risk assessment, monitoring, and response
- Managing those pesky sellers
- Dovetailing the approved changes into the project
- Communicating with the project's stakeholders
- Gathering project data on cost, schedule, quality, and status to forecast where the project will be in the future
- Collecting and creating the lessons-learned documentation

Directing and managing the project also requires the project management team to respond to conditions within the project. Consider a new immediate risk that demands a response. A new condition warrants that the project management team plan and then directly confront the problem. There are three activities that also fall into executing the project plan:

- Apply corrective actions to bring future project performance back into alignment with the project plan.
- Apply preventive actions to avoid negative risks within the project.
- Apply defect repairs to fix flaws and problems identified through quality control.

Monitoring and Controlling the Project (PMBOK, Section 4.5)

As soon as a project begins, the project management monitoring and controlling processes also begin. These processes monitor all the other processes within the project to ensure that they are being done according to plan, according to the performing organization's practices, and to ensure that a limited amount of defects enters the project. The monitoring and controlling process group has several key activities:

- Collecting project statistics
- Measuring project performance
- Distributing project information
- Analyzing project trends and measurements to improve the project

Monitoring the Project

Monitoring and controlling the project is not a one-time or random event. It's important for the project management team to continue to monitor the project and not assume that all's well simply because the project work is being completed. A constant monitoring of the project confirms that the project work is being done properly and if the work is flawed that a response can be created. Monitoring and controlling is also concerned with its results. For example, a defect repair review follows a defect repair to ensure that it is accurate and that the project work may continue.

Monitoring and controlling the project work has seven activities:

- Comparing actual performance to what was promised in the project management plan
- Determining if corrective and preventive actions should be applied to the project
- Performing ongoing risk assessment, risk tracking, and analyzing the risk responses and their effectiveness on the identified risks
- Maintaining a project information base on the project's product throughout the project's life cycle
- Providing information for status updates, progress measurement, and project forecasting
- Forecasting cost and schedule information

- Monitoring the approved change requests as they are implemented into the project and tracking the rejected change requests and their associated documentation

Managing Integrated Change Control

Project managers must protect the project scope from changes. Management, team members, customers, and other stakeholders are going to want changes to the project deliverables. Changes to the product often stem from the customer. Changes may also stem from suggestions of the stakeholders—such as small, innocent changes that bloom into additional time and costs. Finally, changes may come from the project team. When it comes to integrated change control, the project manager must provide for:

- Identifying a change that is proposed or that has already occurred
- Influencing the stakeholders so that only approved changes are incorporated into the project work
- Reviewing and, when needed, approving change requests
- Managing changes by regulating the flow of change requests
- Reflecting the approved changes in the project's baselines: time, cost, scope, and quality
- Reviewing and approving corrective and preventive actions
- Considering the impact of a change request on the rest of the project, as well as considering all of the knowledge areas and the impact of a change on each one
- Documenting the change request and the impact it may have on the project
- Completing defect repair validation
- Continuing quality control

EXAM TIP Think of integrated change control as the domino effect. Any proposed changes to the project can have serious impacts on other areas of the project. Because of this, all of the project management knowledge areas have to be evaluated with each project change.

Reacting to Change

Every project needs a change control system to review, consider, track, and, if needed, approve the change requests. Rejected change requests should also be tracked and documented. Often, projects rely on a change control board (CCB) to evaluate the worthiness of a proposed change before it is approved. Whatever approach a project management team elects, or is required, to take when dealing with changes, the approach should be documented. The key stakeholders must all agree to abide by the rules of the change control system before the project work begins.

When changes are approved, the project manager must then update the project baselines, as changes will likely affect a combination of scope, cost, and time. The updated baselines allow the project to continue with the new changes fleshed in and provide for an accurate measurement of the project's performance.

This is an important concept: *update the project baselines*. Consider a project to which work has been added but for which the schedule baseline has not been updated. The project's end date will be sooner than what is possible because the project baseline does not reflect the additional work that should extend that date. In addition, a failure to revise the project baseline could skew reporting, variances, future project decisions—and even future projects.

EXAM TIP Undocumented change requests should not be implemented into the project.

Consider a project manager who does not update the project baseline after a change. The completion of the project goes into the archives and can serve as historical information for future projects. The historical information is skewed, as it does not accurately account for the added work and the projected end date or budget.

Remember our pal the configuration management system? It's a subcomponent of the PMIS and works with the change control system. It is within integrated change control that the configuration management system plays three vital roles, as explained in the following sections.

Configuration Identification

The configuration of the project's product or service must be accurately and completely defined. This includes the labeling of the components, how changes are made to the product, and the accountability of the changes. Specifically, accountability refers to the ownership of the change, the cost of the change, the schedule impacts, and the influence the product change has over the remainder of the product features and components. For example, a change to add a basement to a new home construction project would affect the project's baselines, the configuration of the product, and, depending on the project status when the change was approved, possibly other components of the house.

Configuration Status Accounting

Configuration management also includes the documentation of the product information so that the project management team can quickly and effectively manage the product. This process means organization of the product materials, details, and prior documentation. For example, a new home construction project would have blueprints, permits, field drawings, vendor and customer specifications, and more information that needs to be cataloged, managed, and quickly accessed throughout the project.

Configuration Verification and Auditing

Configuration management is concerned with the performance and functional attributes of the product. In the new home construction project, the role of configuration management is to ensure that the new home is built according to the configuration documentation. Variances between what was completed and what was planned would have to be reviewed and responded to via defect repair or corrective actions.

Closing the Project (PMBOK, Section 4.7)

Every project manager that I know loves to close a project. There's something rewarding about completing a project and then transferring the deliverable to the customer or project user. I've also learned from participant feedback in my PMP Boot Camp seminars that this topic is the category where they missed the most questions on their way to their PMP or CAPM certification. I believe it's because folks have a tendency to study in order of the phases: initiation, planning, monitoring and controlling, and then (finally) closing. I imagine they're winded by the time their studying efforts get to closing. With that in mind, give yourself a stretch, another sip of coffee, and really hone in on this closing discussion. I want you to pass your exam!

The closing process group may be applied to the end of a project or to the end of the project phase, in a multiphased project. Closing the project or phase means that the project manager confirms that all of the needed activities within the other processes groups have been completed and the project's deliverable may be handed over to the customer. If a project is terminated for any reason, the project manager should still close out the project to account for the work that has been performed on the project and to learn why the project may have failed.

NOTE Projects can be moving along swimmingly and still get terminated. Consider an organization's cash flow, the project's priority, or that the project deliverable may not be needed any longer. Just because a project was cancelled doesn't always mean the project was a failure.

Completing Administrative Closure

This is the guts of the closing process group. First, administrative closure documents everyone who is involved in the project closure: team members, vendors, management, the sponsor, and often the project customer. Part of this documentation defines each person's role and related responsibility to close out the project. Consider a large construction project. There are lots of people involved in the formal closing proceedings, so documentation explaining who'll be needed, what they'll be doing, and when they'll be doing it makes great sense for the project manager.

The second part of administrative closure collects all of the project records, the lessons learned, and communications for the project archives. Yes, archives; all project information should be archived—this becomes part of the organizational process assets. Administrative closure includes the examination and analysis of the project records and determines the success or failure of the project, as well as why the project succeeded or failed. This information helps future project managers.

The goal of project closure is to get formal acceptance of the project deliverables. Formal acceptance means that the project customer or sponsor agrees that the deliverable provided is in alignment with the project scope and that it is acceptable. A formal documentation of project acceptance is needed to confirm that the project deliverable has been transferred from the project manager to the recipient of the project.

Completing Contract Closure

Vendors like to get paid, but the project manager must confirm that everything the vendor promised has been delivered according to the contract between the vendor and the project manager's organization. Contract closure documents the completed contract and its outputs. This information is also stored as part of the project archives.

Above any other conversation, e-mail, or promises, the details of the project contract are paramount. The project manager consults the contract, not only to confirm that the vendor has lived by its obligations, but also to confirm that the project manager's organization has held up its part of the bargain. Sometimes, and they are not fun times, the vendor didn't live up to the agreement and the contract was cancelled. Contracts can be cancelled for any number of reasons: poor performance, schedule and/or cost overruns, quality issues, and more. Whatever the reason, the documentation surrounding the cancellation of the contract is included as part of the contract closure, and this information is also included in the project archives for future reference.

Chapter Summary

Project integration management is an ongoing process the project manager completes to ensure that the project moves from initiation to closure. It is the gears, guts, and grind of project management, the day-in, day-out business of completing the project work. Project integration management takes the project plans; coordinates the activities, project resources, constraints, and assumptions; and massages them into a working model. Once the model exists, it's up to the project management team to monitor and control the project from initiation to closure and assure that everything goes according to plan. And if not? Fix it.

Of course, project integration management isn't an automatic process; it requires you, the project manager, to negotiate, finesse, and adapt to project circumstances. It relies on general business skills (such as leadership), organizational skills, and communication to get all the parts of the project working together. Project integration management has seven events:

- **Developing the project charter** The project charter authorizes the project. It names the project manager and allows the project to commence. Projects are chartered for varying reasons: market demand, customer requests, to solve a problem, or even to address a social need. While the charter authorizes the project, it also defines the requirements for stakeholder satisfaction, the project purpose, and the project assumptions and constraints.
- **Developing the preliminary project scope statement** The preliminary project scope statement defines many things, chief among them: project objectives, deliverables, acceptance criteria, schedule milestones, the initial WBS, and the initial defined risks.
- **Developing the project plan** Project plan development is an iterative process that requires input from the project manager, the project team, the project customers, and other key stakeholders. It details how the project work will accomplish the project goals. The project is comprised of nine subsidiary plans and several other documents.

- **Directing and managing the project execution** Once the project management plan has been created, the project manager and the project team can implement the plan. Directing and managing the project plan creates the project deliverables for the project or phase. Corrective actions, preventive actions, and defect repair all happen through directing and managing the project execution.
- **Monitoring and controlling the project** This process group starts with the project's conception and finishes with the project completion. Its goal is to make certain that the project stays on track and finishes according to the project plan. Measurements for project performance, time, cost, and quality are implemented. If there are variances, responses to these will happen through preventive, corrective, or defect repair actions.
- **Managing integrated change control** Changes can kill a project. Change requests must be documented and sent through a formal change control system to determine their worthiness for implementation. Integrated change control manages changes across the entire project. Change requests are evaluated and considered for impacts on risk, costs, schedule, and scope. Not all change requests are approved—but all change requests must be documented.
- **Closing the project** Projects and phases are closed. Administrative closure confirms that all of the needed processes for each process group have been completed. Administrative closure also gathers all project records for archival purposes, including documentation of the project's success or failure. Contracts, when used, must also be closed after inspection of the contract deliverables. Contracts are always closed according to the agreed-upon terms.

Key Terms

Administrative closure The documentation of the closing process participants, their roles, responsibilities, and timings. The second part of administrative closure collects all of the project records, the lessons learned, and communications for the project archives.

Benefit/cost ratio (BCR) models This is an example of a benefits comparison model. It examines the cost-to-benefit ratio.

Change control board (CCB) A committee that evaluates the worthiness of a proposed change before it is approved.

Change control system (CCS) The change control system communicates the process for controlling changes to the project deliverables. This system works with the configuration management system and seeks to control and document proposals to the project's product.

Communications management plan This plan defines who will get what information, how will they receive it, and in what modality the communication will take place.

Configuration identification This includes the labeling of the components, how changes are made to the product, and the accountability of the changes.

Configuration management system This system defines how stakeholders are allowed to submit change requests, the conditions for approving a change request, and how approved change requests are validated in the project scope. Configuration management also documents the characteristics and functions of the project's products and any changes to a product's characteristics.

Configuration status accounting The organization of the product materials, details, and prior product documentation.

Configuration verification and auditing The scope verification and completeness auditing of project or phase deliverables to ensure that they are in alignment with the project plan.

Contract closure The formal verification of the contract's completeness by the vendor and the performing organization.

Cost baseline This is the aggregated costs of all of the work packages within the WBS.

Cost management plan This plan details how the project costs will be planned for, estimated, budgeted, and then monitored and controlled.

Enterprise environmental factors The culture, structure, standards, regulations, organizational logistics, and other organizational characteristics that influence how a project operates.

Future value A benefit comparison model to determine a future value of money. The formula to calculate future value is $FV = PV (1 + I)^n$, where PV is present value, I is the given interest rate, and n is the number of time periods.

Integrated change control A process to consider the impact of a proposed change on the project's knowledge areas.

Mathematical model A project selection method to determine the likelihood of success. These models include: linear programming, nonlinear programming, dynamic programming, integer programming, and multiobjective programming.

Milestone list This list details the project's milestones and their attributes.

Murder boards These are committees that ask every conceivable negative question about the proposed project. Their goals are to expose the project's strengths and weaknesses, and to kill the project if it's deemed unworthy for the organization to commit to. Also known as project steering committees or project selection committees.

Net present value Evaluates the monies returned on a project for each time period the project lasts.

Organizational process assets Anything that an organization has to help a current project succeed. Policies, procedures, documentation of past projects, and plans are part of the organizational process assets.

Payback period An estimate to predict how long it will take a project to pay back an organization for the project's investment of capital.

Preliminary project scope statement This document defines what the project needs to accomplish in order for the project to be deemed complete.

Present value A benefit comparison model to determine the present value of a future amount of money. The formula to calculate present value is $PV = FV \div (1 + I)^n$, where FV is future value, I is the given interest rate, and n is the number of time periods.

Process improvement plan This plan aims to eliminate non-value-added activity, eliminate waste, and determine how the project work, execution, and management can be made better.

Procurement management plan The procurement management plan controls how the project will be allowed to contract goods and services.

Project charter This document authorizes the project. The project charter is endorsed by an entity outside of the project boundaries.

Project management plan The documented approach of how a project will be planned, executed, monitored and controlled, and then closed. This document is a collection of subsidiary project management plans and related documents.

Project scope management plan Defines how the project scope will be planned, managed, and controlled.

Project statement of work (SOW) This document defines all the products and services the project will provide.

Quality baseline Documents the quality objectives for the project, including the metrics for stakeholder acceptance of the project deliverable.

Quality management plan This plan defines what quality means for the project, how the project will achieve quality, and how the project will map to organizational procedures pertaining to quality.

Resource calendar Resources are people and things like equipment, rooms, and other facilities. This calendar defines when the resources are available to contribute to the project.

Risk management plan Risk is an uncertain event or condition that may affect the project's outcome. The risk management plan defines how the project will manage risk.

Risk register The risk register is a centralized database consisting of the outcome of all the other risk management processes.

Schedule baseline This is the planned start and finish of the project. The comparison of what was planned and what was experienced is the schedule variance.

Schedule management plan Defines how the project schedule will be created and managed.

Scoring models These models use a common set of values for all of the projects up for selection. For example, values can be profitability, complexity, customer demand, and so on.

Staffing management plan This plan defines how project team members will be brought on to and released from the project team. It also defines team training, safety issues, and how the project's reward and recognition system will operate.

Questions

1. You are the project manager for a pharmaceutical company. You are currently working on a project for a new drug your company is creating. A recent change in a law governing drug testing will impact your project and change your project scope. The first thing you should do as project manager is:
   - A. Create a documented change request
   - B. Proceed as planned, as the project will be grandfathered beyond the new change in the law
   - C. Consult with the project stakeholders
   - D. Stop all project work until the issue is resolved
2. You are the project manager for the HALO Project. You and your project team are preparing the project plan. Of the following, which one is a project plan development constraint you and your team must consider?
   - A. The budget as assigned by management
   - B. Project plans from similar projects
   - C. Project plans from similar projects that have failed
   - D. Interviews with SMEs who have experience with the project work in your project plan
3. The primary purpose of your project management plan is:
   - A. To define the work to be completed to reach the project end date
   - B. To define the work needed in each phase of the project life cycle
   - C. To prevent any changes to the scope
   - D. To provide accurate communication for the project team, project sponsor, and stakeholders regarding how the project will be executed, controlled, and closed
4. Of the following, which one is an input to project plan development?
   - A. Assumptions
   - B. Project management processes
   - C. Earned Value Management
   - D. Business needs
5. Which one of the following is an example of defect repair review?
   - A. Adding labor to a project to reduce errors during the installation of hardware
   - B. Retraining the project team on how to install a new material so that all future work with the new materials is done correctly
   - C. Repairing an incorrectly installed door in a new home construction project
   - D. Inspecting work that has been corrected because it was done incorrectly the first time

PART II

6. You are the project manager of the NHG Project. You have had to terminate a contract with a vendor. What is this an example of?
   A. Special case of contract closure
   B. Mitigation
   C. Contract claim
   D. Scope closure
7. The project plan provides a baseline for several things. Which one of the following does the project plan not provide a baseline for?
   A. Scope
   B. Cost
   C. Schedule
   D. Control
8. You are the project manager for your organization. When it comes to integrated change control, you must ensure that which one of the following is present?
   A. Supporting detail for the change exists
   B. Approval of the change from the project team
   C. Approval of the change from a Subject Matter Expert
   D. Risk assessment for each proposed change
9. The project plan provides what in regard to project changes?
   A. A methodology to approve or decline changes
   B. A guide to all future project risk management decisions
   C. A vision of the project deliverables
   D. A fluid document that may be updated as needed based on the CCB
10. You are assisting the project manager for the DGF Project. This project is to design and implement a new application that will connect to a database server. Management has requested that you create a method to document technical direction on the project and any changes or enhancements to the technical attributes of the project deliverable. Which one of the following would satisfy management's request?
   A. Configuration management system
   B. Integrated change control
   C. Scope control
   D. Change management plan
11. Who directs the performance of the planned project activities?
   A. The project manager and the project management team
   B. The project team

C. The project sponsor

D. The role responsible for the activity

12. You have just informed your project team that each team member will be contributing to the lessons-learned documentation. Your team does not understand this approach and wants to know what the documentation will be used for. Which one of the following best describes the purpose of the lessons-learned documentation?

A. Offers proof of concept for management

B. Offers historical information for future projects

C. Offers evidence of project progression as reported by the project team

D. Offers input to team member evaluations at the project's conclusion

13. Which one of the following measures project performance?

A. WBS

B. Project plan

C. Earned value technique

D. Work authorization system

14. Configuration management is a process for applying technical and administrative direction and surveillance of the project implementation. Which activity is not included in configuration management?

A. Controlling changes to the project deliverables

B. A method to communicate changes to stakeholders

C. Automatic change request approvals

D. Identification of the functional and physical attributes of the project deliverables

15. All of the following are addressed in the project charter, except for which one?

A. Requirements to satisfy the project customer, project sponsor, and other stakeholders

B. Assigned project management and level of authority

C. Summary budget

D. Risk responses

16. Which one of the following is an example of a mathematical model?

A. Future value

B. Linear programming

C. Present value

D. Benefits-cost ratio

17. You and the project management team are creating a preliminary project scope statement. As part of this activity, which one of the following should be included in the preliminary project scope statement?
    - A. Risk responses
    - B. Organizational process assets
    - C. Project statement of work
    - D. Initial WBS
18. What is the purpose of the project management plan?
    - A. It defines the project manager and her level of authority on the project
    - B. It authorizes the project manager to assign resources to the project work
    - C. It defines how the project will be planned and executed
    - D. It defines how the project will be executed, monitored and controlled, and then closed
19. The project steering committee is considering which project they should invest capital in. Mary's project promises to be worth $175,000 in four years. The project steering committee is interested in Mary's project, but they would like to know the present value of the return if the interest rate is 6 percent. What is the present value of Mary's project?
    - A. $175,000
    - B. $139,000
    - C. $220,000
    - D. $43,750
20. You have just completed the project work and scope verification. You are ready, you believe, to commence administrative closure for your project. You realize that you need to do several things to complete the administrative closure process. Which one of the following is not part of the administrative closure process?
    - A. Transfer the project's product to operations
    - B. Obtain stakeholder approval of the project deliverables
    - C. Complete contract closure
    - D. Validate that completion and exit criteria have been completed

Answers

1. **A**. Change requests should first be documented in the project's change control system. B is incorrect because the new law will require changes to the project. C is incorrect because it may be inappropriate to consult with the project

stakeholders, especially on a large project. D is incorrect because we do not know the impact of the change and it may not justify halting the project work. For more information, see the PMBOK, Section 4.6.

2. **A**. A predetermined budget set by management is an example of a project constraint. B and C are examples of organizational process assets that the project manager will use as inputs to project management planning. D, interviews with subject matter experts, is an example of expert judgment, and is a tool and technique used in project management plan development. For more information, see the PMBOK, Sections 4.3, 4.3.1, and 4.3.2.3.
3. **D**. The primary purpose of the project management plan is to define how the project will proceed. A and B are incorrect choices, as these address only the project work. C is incorrect, as this answer only addresses the project's change control system. For more information, see the PMBOK, Section 4.3.
4. **B**. The selected project management processes need to be identified as part of the planning process. The project management processes are the 44 processes described in Chapter 3 and throughout the remainder of this book. A, C, and D are incorrect choices, as these are not inputs to the project plan development processes. For more information, see the PMBOK, Section 4.3.1.
5. **D**. Defect repair review is a review of the defect repair. A is an example of a preventive action. B is an example of a corrective action. C is an example of defect repair. For more information, see the PMBOK, Section 4.5.3.
6. **A**. Terminating a contract with a vendor is a special case of contract closure. Choices B, C, and D are not appropriate answers for this question. For more information, see the PMBOK, Section 4.7.
7. **D**. The project management plan provides baselines for time, cost, and scope. Control is a project activity and part of the monitoring and controlling process group. For more information, see the PMBOK, Sections 4.3, 4.5, and 4.6.
8. **D**. Change requests need to be researched, and their complete impact needs to be documented. Part of this documentation includes the risk assessment of the new change. A, B, and C are not requirements for change requests. For more information, see the PMBOK, Section 4.6.
9. **A**. The project management plan defines how changes will be monitored and controlled. B describes the risk management plan. C defines the project charter and project scope. D is an incorrect statement. For more information, see the PMBOK, Section 4.3.
10. **A**. The configuration management system documents all functional physical characteristics of the project's product. It also controls changes to the project's

product. B, C, and D are not correct answers. For more information, see the PMBOK, Section 4.3.2.2.

11. **A**. The project manager and the project management team direct the performance of the project activities. The project team, sponsor, and the roles do not direct performance. For more information, see the PMBOK, Section 4.4.
12. **B**. Lessons learned documentation serves as part of organizational process assets for future projects. A, the proof of concept, is not a PMI theme. C, project progress, is reported through status reports and performance measurements. D, team member performance, is built by performance, not lessons learned. For more information, see the PMBOK, Section 4.7.3.4.
13. **C**. The earned value technique, commonly called earned value management (EVM), measures project performance on several factors, including cost and schedule. A, the WBS, is a breakdown of the project scope. B, the project plan, defines how the project will be controlled, executed, and closed. D, the work authorization, allows work to progress within a project. For more information, see the PMBOK, Section 4.5.2.3.
14. **C**. Change requests should not be automatically approved. All documented change requests should flow through the change control system, be evaluated, and then a decision should be made. Choices A, B, and D are all part of configuration management. For more information, see the PMBOK, Section 4.6.
15. **D**. Risk responses are not addressed in the project charter. The project manager, the summary budget, and the requirements to satisfy the project customer are defined. For more information, see the PMBOK, Section 4.1.
16. **B**. Linear programming is an example of a mathematical model. Recall that mathematical models are also known as constrained optimization. Future value, present value, and a benefits-cost ratio are all examples of the benefits comparison model. For more information, see the PMBOK, Section 4.1.2.
17. **D**. The initial WBS is part of the preliminary project scope statement. Risk responses are part of the risk management plan, so A is incorrect. Organizational process assets are not included in the project scope statement, so B is incorrect, too. C, the project statement of work, is also not part of the project scope statement. For more information, see the PMBOK, Section 4.2.
18. **D**. The project management plan communicates how the project will be executed, monitored and controlled, and then closed. A and B both describe components of the project charter. C does not answer the question as completely as D. For more information, see the PMBOK, Section 4.3.
19. **B**. $139,000 is the present value of Mary's project. This is found through the following formula: future value divided by one plus the interest rate to the power of the time periods the project will last. This question would read

($175,000)/(1.26), as the interest rate provided was 6 percent. Choices A, C, and D are all incorrect calculations. For more information, see the PMBOK, Section 4.1.2.

20. **C**. Completing the contract closure procedure is part of closing the project, but it is not part of administrative closure. A, B, and D are incorrect choices, because these activities are part of administrative closure. For more information, see the PMBOK, Sections 4.7.3.1 and 4.7.3.2.

CHAPTER 5

Managing the Project Scope

In this chapter, you will
- Plan the project scope
- Create the project scope statement
- Create the work breakdown structure
- Verify the project scope
- Control the project scope

You're the project manager of a large, complex project. Everyone is in agreement that the project must be completed within one year, the budget is tight, and there's little room for error. One of your project team members, Tony, has taken it upon himself to incorporate "extras" into the project deliverable to make it snappier, better, and easier for the product customer to use. While his project additions are clever, they aren't in the project scope.

Tony argues how his creative additions don't cost the project anything extra and the customer will love what he's come up with. The trouble, for you, the customer, and Tony, is that the time he's spent changing the scope should be spent doing the things that are in the scope. In addition, the extras aren't in the scope, aren't managed and reviewed as change requests, and will likely be a surprise to the project customer. Not to mention the added risks, potential for defect, and the contempt for an established change control system.

VIDEO Managing the project scope.

Managing the project scope, according to the Project Management Body of Knowledge (PMBOK), is the project manager's job and ensures that all of the required work—and only the required work—is done to complete the project successfully. Project scope management doesn't permit Tony's, or anyone else's, additions. Scope management is agreeing on what's in the scope and then defending that agreement.

Planning the Project Scope (PMBOK, Section 5.1)

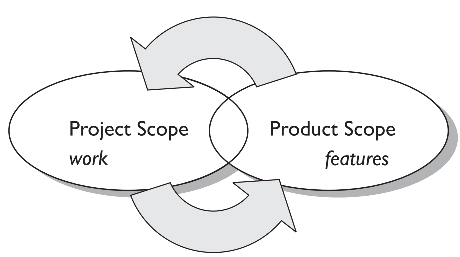
Building a skyscraper has to be one of the largest projects a project manager could manage. Think of all the different facets of the project: the art and design of the building, the structural requirements, the building codes, and the concern and interest of all the stakeholders within the project. The skyscraper would require months, if not years, of serious planning, tight change control, and incredible organization to complete. The scope of the skyscraper would be massive, and any change within the scope could have ramifications further down the blueprinted line.

Now imagine a project to build a barn. There would still be considerable planning, and the stakeholders of the barn might be concerned with its planning and construction, but probably not to the same depth as the skyscraper project. The priority and impact of each project is important to the key stakeholders of each, but no doubt the skyscraper has a much broader impact than a barn. My point? Larger projects require more detail when it comes to scope creation and planning. Lots more.

Let's define scope, er, scopes, before moving forward.

Project scope and product scope are different entities. Project scope deals with the required work to create the project deliverables. For instance, our projects to create a new barn and the new skyscraper would focus only on the work required to complete the projects, with the specific attributes, features, and characteristics called for by the project plan. The scope of the project is specific to the work required to complete the project objectives. The project scope focuses on what must be done to create the deliverable.

Product scope, on the other hand, refers to the attributes and characteristics of the deliverables the project is creating. As in the preceding barn and skyscraper projects, the product scope would define the features and attributes of the barn and skyscraper. In this instance, the project to create a barn would not include creating a flower garden, a wading pool, and the installation of a fence, just as the skyscraper project likely wouldn't include a neighboring park. There would be specific requirements regarding the features and characteristics of each project: the materials to be used, the dimensions of the space, the function of each building, and all the related details that make a skyscraper a skyscraper and a barn a barn. The product scope is what the customer of the project envisions.



The project scope and the product scope are bound to each other. The product scope constitutes the characteristics and features of the product that the project creates. The end result of the project is measured against the requirements for that product. The project scope is the work required to deliver the product. Throughout the project execution, the work is measured against the project plan to verify that the project is on track to fulfill the product scope. The product scope is measured against requirements, while the project scope is measured against the project plan.

EXAM TIP When it comes to project scope management, as is covered in the bulk of this chapter, focus on the work required to complete the project according to the project plan. The product scope, meanwhile, is specific to the deliverable of the project. Just remember, the exam will focus on project scope management. If you're stumped on a question, consider a huge project scope, like the skyscraper project.

Creating the Project Scope Management Plan

Once the project moves from the initiating processes into planning, one of the first plans to be created is the project scope management plan. This plan defines several things:

- How the project scope will be defined
- How the detailed project scope statement will be created
- How the work breakdown structure will be created
- How scope verification will happen at the end of each phase and at the end of the project
- How the project scope will be controlled

The project scope management plan is based first on the details of the project charter. Recall that the project charter authorizes the project within an organization and defines the general project boundaries and goals. Combined with the project scope statement, the project management team will also consider the preliminary project scope statement from our pals in the initiating process group. When the project management team is ready to begin creating the project scope management plan, they'll actually rely on five things as inputs to this project management process:

- Enterprise environmental factors.
- Organizational process assets.
- Project charter.
- Preliminary project scope statement.
- Project management plan. (This seems redundant, but because the scope management plan can be updated, this is an input of the plan that already exists.)

The project management team can use expert judgment to help them analyze these five inputs to create the best project scope management plan. Don't get too hyped over expert judgment; you'll see this term throughout the PMBOK and this book. Expert judgment is just an approach to use experts, people, and consultants (assuming they're truly experts—wink, wink) that have exceptional knowledge about the product the project will be creating. For example, in the skyscraper project, expert judgment could be world-renowned architects, city planners, union representatives, and more.

The project management team can also use templates, forms, and standards as part of the process to create the project scope management plan. If an organization is completing the same type of project over and over, there's no real benefit to starting from scratch each time. Instead, they'll logically use previous projects' plans, forms, work breakdown structures, and more as part of the current planning.

You now know that the project scope management plan will be used to define, verify, manage, and control the project scope. There are four more juicy facts you need to know about this hefty plan:

- The project scope management plan defines how the official project scope statement will be defined based on the preliminary project scope statement.
- The project scope management plan defines how the work breakdown structure (WBS) will be created, controlled, and approved. We'll talk about the WBS in more detail later in this chapter.
- The plan documents the process for scope verification. To clarify, scope verification is the inspection of the project's deliverables by the project customer. The goal of scope verification is to verify that the deliverables are in alignment with the project's goals and then formally accepted.
- The project scope management plan documents and defines how changes to the project scope will be managed and controlled. This is linked to our conversation in Chapter 4 on integrated change control. As a refresher, integrated change control acknowledges that a change in one knowledge area can affect all of the other knowledge areas.

The project scope management plan is a subsidiary of the project plan. This plan sets the tone for the remainder of the project. As you may have already guessed, the larger the project, the more important this plan is. As a general rule, larger projects require more detail.

Defining the Project Scope (PMBOK, Section 5.2)

A project manager and the project team can't plan how to complete the project until they know what it is and exactly what they are trying to complete. That's where the project scope statement is needed. Before the project management team can get to the good stuff of deciding how the project work will be done, they first must create the project scope statement.

When a project is first initiated, the focus is on what the project will deliver: the product scope. It's all dreamy and blue sky. Now that the project has moved into planning, things are tightened through the project scope statement. The project scope statement is built on the foundations defined in the project's initiation: major deliverables, preliminary project scope statement, constraints, and assumptions. In planning, more information about the exactness of the project's deliverables comes to light through planning, research, stakeholder analysis, and product analysis. The wants and needs of the stakeholders are considered, and eventually they evolve into the project requirements.

The project manager, the project team, and the key stakeholders need to work together to examine the project for additional constraints and assumptions so that the project can be planned completely. The key stakeholders are needed, because their insight into the project's deliverables can help the project manager and the project team define all that the project is to deliver. The key stakeholders help create the scope and agree on what's out of the project scope. For example, a project to build a Web site may include the layout, design, and database functionality—all within scope—but the photography needed for the Web site is out of scope. The photography activity may be in an entirely different project, so it's not relevant to the current scope definition.

In order to create the project scope, there are five inputs, as Figure 5-1 shows.

- Organizational process assets.
- Project charter.
- Preliminary project scope statement.
- Project scope management plan.
- Approved change requests. (Because scope definition takes place during the planning process, this is another example of how the iterations of planning can cause the scope to change. The first time through the creation of the detailed project scope statement, changes to the scope won't exist. Later in the project, change requests will likely cause the project management team to redefine and update the project scope statement.)

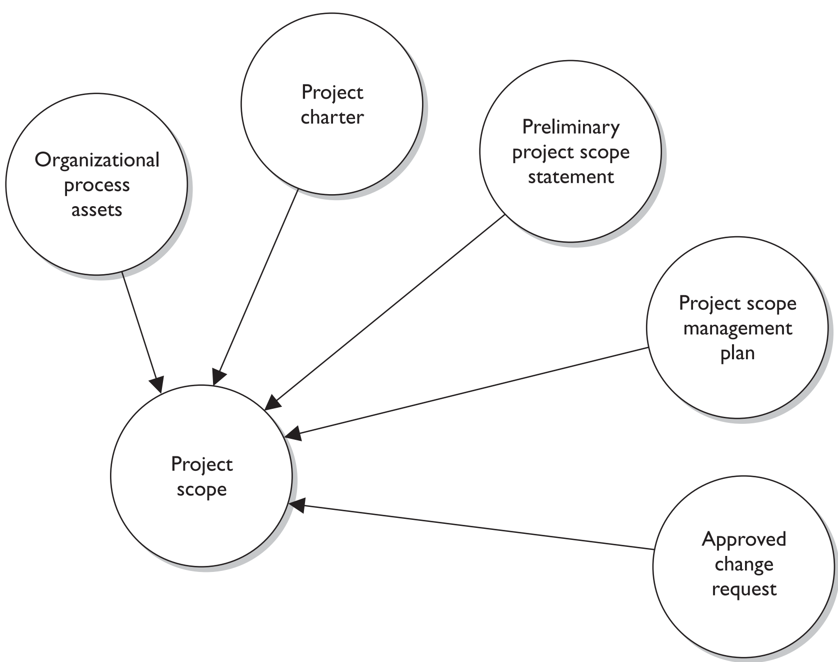


Figure 5-1 Several components are needed to create the project scope.

These five inputs help the project management team work together to define all of the project requirements. This isn't a quick or necessarily easy process, but it's vital to prepare an accurate and complete project scope statement, or the project will be haunted with errors and omissions.

EXAM TIP Projects fail in the beginning, not the end. A rushed scope definition will likely cause problems later on in the project. This is the stakeholders' opportunity to define all that they want in the scope. Changes to the scope are easy early in the project, but are much more difficult later in the project because of the work, time, and monies invested.

Using Product Analysis

If you were the project manager for a company that wanted to create a new camera, you might choose several of your competitors' cameras to study, experiment with, and improve upon. You'd compare the features and functions of the other cameras in light of the requirements and goals of your current project. Product analysis is the study of how a thing was made and how it works.

This approach to create the project scope statement is product analysis. Product analysis, however, is more than just analyzing a product. It focuses on how it works, the function of the product, and what's the most profitable approach to creating the project. There are seven flavors of product analysis. Don't be consumed with memorizing these approaches for your Certified Associate in Project Management (CAPM) or Project Management Professional (PMP) examination; just be topically aware of these product analysis methods.

Product Breakdown

This approach breaks down a product much like the project management team breaks down the project scope into a WBS. For example, a computer could be broken down into the physical components, such as the hard drive, processor, memory, network card, and so on. A product breakdown structure illustrates the hierarchical structure of the product.

Systems Analysis

This approach studies and analyzes a system, its components, and the relationship of the components within the system. For example, a manufacturing company's system for placing an order from a customer through delivery may have several steps, from sale to completion and interaction between departments on that journey. Systems analysis would study the relationship between each component and how the process could be improved, time reduced, or practically any variable within the system documented for additional study.

System Engineering

This project scope statement creation process studies how a system should work, designs and creates a system model, and then enacts the working system based on the project's goals and the customer's expectations. Systems engineering aims to balance the time and cost of the project in relation to the project's scope. A successfully designed system can be profitable, productive, and create quality that is acceptable with the project sponsor and the project customer.

Value Engineering

This project scope statement creation approach attempts to find the correct level of quality in relation to a reasonable budget for the project deliverable while still achieving an acceptable level of performance of the product. Basically, this approach wants the biggest bang for the project's buck—as long as the bang and the buck create a deliverable that performs as expected. Consider a home remodeling project: the home owner could choose silk drapes and gold doorknobs or wool drapes and brass doorknobs and get the same function. Their demand for a quality, grade, and function is in relation to how much capital they'd like to invest in their home project.

Value Analysis

Like value engineering, this approach examines the functions of the project's product in relation to the cost of the features and functions. This is where, to some extent, the grade of the product is in relationship to the cost of the product. Consider Microsoft Word's features and cost in relation to the features and cost of your computer's Notepad application. While the price range is broadly different, the functions associated with Word are far more powerful than those of Notepad.

Functional Analysis

This is the study of the functions within a system, project, or—what's more likely in the project scope statement—the product the project will be creating. Functional analysis studies the goals of the product, how the product will be used, and the expectations the customer has of the product once it leaves the project and moves into operations. Functional analysis may also consider the cost of the product in operations, which is known as life cycle costing.

Using Alternative Identification

Your customer wants you to install an e-mail system for their organization. They don't care which solution you and your project team come up with, as long as it's reliable, easy to manage, and provides a central calendaring system. If you're from the IT world, I imagine you immediately thought of several different approaches to solving this project for your customer. That's alternative identification at its root.

Alternative identification is more than just differing products that can solve the customer's problem. It's also examining what solution makes the most economical sense for the project and for the customer's ongoing support of the product once it's been created. In the e-mail system, the project manager, project team, and experts would need to examine how the customer will use all of the different aspects of the e-mail system, their long-term goals for the system, and what their budget for the project and any ongoing maintenance of the system would be.

To do alternative identification, the project management team will do research, brainstorming, and lateral thinking. Their focus is to identify all of the feasible alternatives to the project's deliverable or even components within the project. Alternative identification also broaches a quality topic: grade. Grade is the ranking of materials or service, such as first class versus coach or plywood versus oak wood. We'll see this again in Chapter 8.

Using Stakeholder Analysis

Stakeholder analysis is almost always involved when it comes to creating the project scope statement. It's all about the customer's demands, wishes, and goals for the project. The project management team interviews the stakeholders and categories, prioritizes, and documents what the customer wants and needs. This is fundamental to project management: You and the key stakeholders must be in agreement on what the project will create, or the project scope statement cannot be created and approved. Without an agreement of what the requirements for acceptance are, the project is moving towards inevitable failure.

Here's another gotcha with stakeholder analysis: If you can't quantify it, if you can't measure it, you can't create it. For example, a fast office network isn't quantified. Customer satisfaction isn't quantified. And happy, warm-fuzzy, and good aren't quantified. The project scope statement needs to define in exact terms the acceptable ranges for all of the project deliverables. Any project requirements must be quantifiable. Here's a general rule: if you can measure it, you can quantify it.

EXAM TIP A failure to quantify the project objectives is a risk that the project won't achieve the customer's expectations. After all, what's fast and good to you may mean something entirely different to the project customer.

Examining the Project Scope Statement

The project scope statement identifies all of the project's deliverables and defines the work required to create the deliverables. This document creates a common lexicon and understanding of what the project will deliver for all of the project stakeholders. The project scope statement clearly states the project's objectives and communicates the goals of the project so that all of the project team members, the project sponsor, and the key stakeholders are in agreement as to what the project will accomplish.

The project scope statement also guides the remainder of the project planning processes. Should changes be proposed to the project, the project scope statement helps determine if the proposed changes are within or are outside of the project's boundaries. A well-written scope can ward off change requests, while a loose, poorly written scope is often an invitation for change requests and additional work by the project team.

So what goes into a project scope statement? Glad you asked! There are a bunch of things, which the following sections explain.

Project Objectives

These are the measurable goals that determine a project's acceptability by the project customer and the overall success of the project. Objectives often include the cost, schedule, technical, and quality demands. The project objectives can have qualifiers, such as United States dollars, less than $4 million, or within 10 percent of the stated budget.

Product Scope Description

This is a narrative on what the project is creating as deliverables for the project customer. Early in the project, the product scope may be somewhat vague, but as the project scope is progressively elaborated, the product scope description may be updated to reflect its evolution and clarifications.

EXAM TIP Progressive elaboration is a Project Management Institute (PMI) term to describe an incremental process of redefining and clarifying any facet of a project. For example, a house project may start broad, as a three-bedroom, two-car garage home and then, through progressive elaboration, all of the details down to the kitchen sink and doorknobs are defined.

Project Requirements

These are the demands set by the customer, regulations, or the performing organization that must exist for the project deliverables to be acceptable. Requirements are often prioritized in a number of ways, from must have, should have, and would like to have. Basically, a project requirement is what determines the acceptance of the project completion. We've seen this already with scope verification.

Project Boundaries

A project boundary clearly states what is included with the project and what's excluded from it. This helps to eliminate assumptions between the project management team and the project customer. For example, a software programmer may create a new application for a customer as part of the project, but the distribution of the software to the customer's 10,000 computer workstations is defined as out of scope.

Project Deliverables

These are all the things that the project will create. Consider that the project deliverables are more than just the product, but also ancillary deliverables, such as project reports, communications, and lessons learned that the organization may use for future projects. The documentation and experience within the current project become part of the organizational process assets for future projects.

Product Acceptance Criteria

The project scope statement components work with the project requirements, but focus specifically on the product and what the conditions and processes are for formal acceptance of the product.

Project Constraints

A constraint is anything that limits the project manager's options. Consider a predetermined budget, deadline, resources, or materials the project manager must use within the project. If you're a project manager for an organization that does work for other organizations, your contract will likely have contractual constraints. While the project charter does list constraints, the constraints defined within the scope are generally more detailed, and often there are more constraints defined in the scope than in the charter.

Project Assumptions

A project assumption is anything that is held to be true but not proven to be true. Within the scope, the assumptions are defined, as is their impact on the project if an assumption proves to be false. For example, in construction, there are assumptions that the warmer seasons will be cooperative for outdoor work. No one can necessarily prove this, but it's believed to be true based on history. Should, however, the weather not cooperate, it could have huge impacts on the project.

Initial Project Organization

The project scope statement identifies the project team and the key stakeholders. In some organizations, especially on larger projects, the team organization and structure is documented as well.

Identified Risks

The project scope statement lists the risks within the project, both positive and negative. We'll talk all about risks in Chapter 11.

Scheduled Milestones

The project customer may have specific dates when phases of the project should be completed. These scheduled milestones are often treated as project constraints.

Fund Limitation

Unless you work for an amazing organization with loads of cash to spare, most projects have a determined budget in relation to the project scope. There may be a qualifier on this budget, such as plus or minus 10 percent, based on the type of cost estimate created. We'll talk about cost estimating in Chapter 7 (hold on to your wallet).

Cost Estimate

Got your wallet ready? Cost estimates, like the project scope statement, can evolve as more detail becomes available. Early in the project, you're usually forced to offer a rough order-of-magnitude estimate of the project's cost. Later, usually after the WBS has been created, you offer a tighter estimate, known as a definitive estimate. We'll cover estimating, as promised, in Chapter 7.

Project Configuration Management Requirements

This part of the project scope statement defines how configuration management and change control will perform within the project.

Project Specifications

This references the "spec" documents by which the project will abide. The easiest example of this is blueprints for a construction project.

Approval Requirements

This documents how the project will be approved. Items such as the project objectives, deliverables, and work are all considered.

Creating the Work Breakdown Structure (PMBOK, Section 5.3)

The WBS is all about the project deliverables. It's a breakdown of the project scope into hierarchical deliverables. The WBS takes the project scope and breaks it down into smaller, manageable chunks of deliverables. Each layer of the WBS breaks down the layer above it into smaller deliverables, until it arrives at the smallest item in the WBS, the work package.

Figure 5-2 is an example of a simple WBS. The house project has five major categories of deliverables: project management, paperwork, construction, interior design, and landscaping. Each of these first-tier deliverables can be broken down again. In Figure 5-2, the construction deliverable has been broken down to a second level consisting of the basement, first floor, and second floor. Each of these deliverables could be broken down again to another level, and so on. The smallest item in the WBS is called a work package, and these elements can be effective estimates for cost and time, monitored and controlled within the project.

So how deep must the project scope be broken down? There's no right answer, other than to the level of detail that's appropriate for the project priority, scope, and objectives. A guideline for WBS breakdown is the "8/80 Rule." This rule recommends that each work package equate to no more than 80 hours of labor and no less than eight hours of labor to create the deliverable. Of course, that's just a guideline, not a regulation. Some projects may call for work packages, such as a quality control result, that may take far less than eight hours. For your CAPM or PMP exam, know that the smallest element in the WBS is a work package and that it can be scheduled, estimated for costs, and then monitored and controlled.

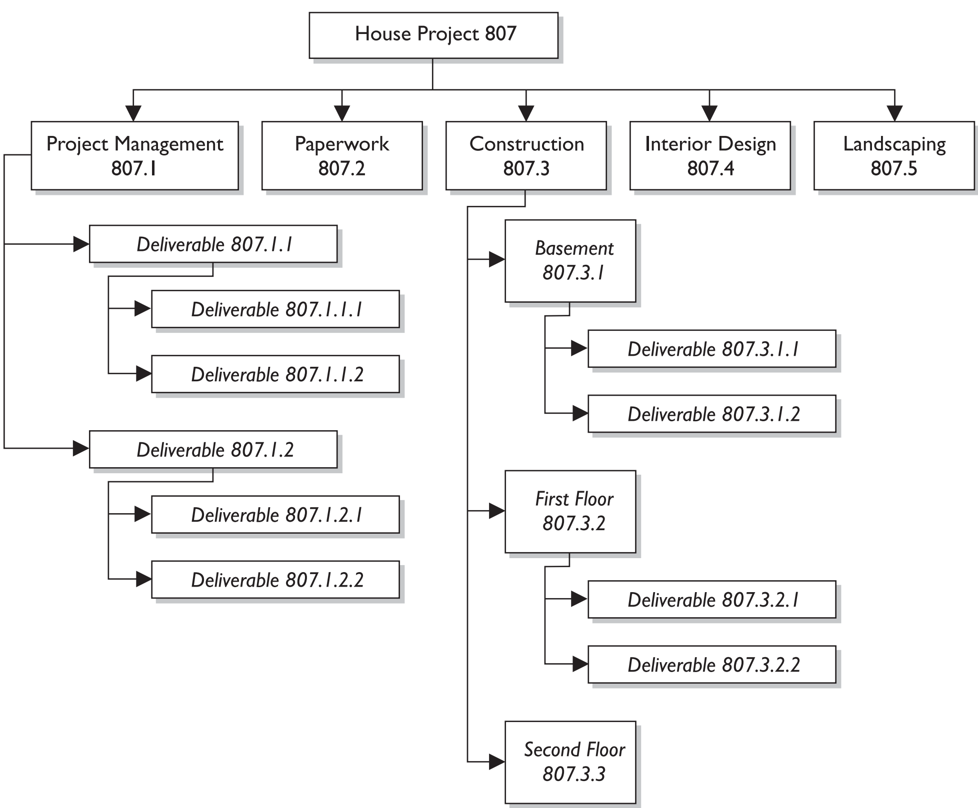


Figure 5-2 A WBS is the breakdown of a project scope.

EXAM TIP The WBS is primarily about things, not activities. The work package is just a label for the smallest deliverable within the WBS. PMI has lightened their stance on allowing appropriate activities, such as testing, into the WBS. For the most part, activities are in the activity list and are an output of the WBS and activity definition, not items within the WBS.

Using a WBS Template

If an organization is doing the same type of project work over and over, they likely wouldn't start a WBS from scratch every time. Instead, they'd use a previous, similar project as a template for the current one. This is ideal, as most projects within an organization have similar life cycles, deliverables, and milestones. A previous project's WBS makes an ideal template for the current project, provided they are similar enough. The project management team may still need to edit the template, but it's a huge timesaver in the long run.

Other organizations may use a template in the more traditional sense. Just like you may have a template for a newsletter, a report, or a memo, an organization could create a WBS template of pre-populated WBS deliverables. In Figure 5-2, I included the project management deliverables as part of the WBS. Project management deliverables could be a common component of every WBS an organization creates, so it'd be ideal to include these items in a standard WBS template for all project managers to use.

Breaking Down the Deliverables

Horrible joke warning: What's Beethoven doing now? Decomposing.

All right, so it's not the best joke in the world, but it's relevant. Like Beethoven, the project management team will first compose and then decompose. In project management, the project scope statement is first composed and then the scope is broken down (or decomposed) into the individual items that the project will create.

Some items in the WBS may not be available for decomposition because they're far off in the future. In these instances, the project management team will break down those items as more information regarding the deliverables becomes available. This is an example of rolling wave planning. Some projects may elect to create their WBS based on the phases within the project, rather than on the total deliverables of the project. Either approach is fine, but the following activities are required to break down the project scope into a WBS:

- Identify the project deliverables and related work.
- Form the WBS structure.
- Decompose the upper-tier deliverables into lower-tier deliverables.
- Create and assign WBS identification codes to the WBS packages. (This is called the code of accounts, and is a numbering system to identify each element within the WBS.)
- Confirm that the decomposition is appropriate for the type of project.

Creating the WBS Dictionary

Along with the WBS, there is a WBS dictionary that defines all of the characteristics of each element within the WBS. The primary documentation of the WBS dictionary is on the work package, the smallest item in the WBS, but upper-tier deliverables can also be documented. Each work package in the WBS is cross-referenced in this companion document and includes the following details where appropriate:

- Code of account identifier and charge number
- Work package description
- Statement of work
- Work package owner or responsible role
- Schedule milestones
- Contract information
- Quality requirements
- Technical references
- Associated activities and work packages
- Schedule
- Resources
- Cost

EXAM TIP Right from the PMBOK: "The approved detailed project scope statement and its associated WBS and WBS dictionary are the scope baseline for the project." You'll probably see that on an exam in your future.

Verifying the Project Scope (PMBOK, Section 5.4)

Imagine a project to create a full-color, slick catalog for an electronics manufacturer. The project manager has completed the initiation processes, moved through planning, and is now executing the project work. The only trouble is that the project manager and the experts on the project team aren't sharing the work progress with the customer. The work they are completing is not in alignment with the product description or the customer requirements.

The project team has created a trendy 1950s style catalog with funky green and orange colors, lots of beehive hairdo models, horn-rimmed glasses, and tongue-in-cheek jokes about "the future" of electronics. The manufacturer wants to demonstrate a professional, accessible, current look for its publications. What do you think will happen if the project manager presents the catalog with his spin rather than following the request of the customer?

Scope verification is the process of the project customer accepting the project deliverables. It happens either at the end of each project phase or as major deliverables are created. Scope verification ensures that the deliverables the project creates are in alignment with the project scope. It is concerned with the acceptance of the work. A related activity, quality control (QC), is concerned with the correctness of the work. Scope verification and QC happen in tandem, as the quality of the work contributes to scope verification. Poor quality will typically result in scope verification failure.

Should a project get cancelled before it has completed the scope, scope verification is measured against the deliverables to the point of the project cancellation. In other words, scope verification measures the completeness of the work up to the cancellation, not the work that was to be completed after project termination.

To complete scope verification, the work must be inspected. Inspection may require measuring, examining, and testing the product to prove that it meets the customer's requirements. Inspection usually requires the project manager and the customer to inspect the project work for verification, which, in turn, results in acceptance. Depending on the industry, inspections may also be known as:

- Reviews
- Product reviews
- Audits
- Walkthroughs

Assuming the scope has been verified, the customer accepts the deliverable. This is a formal process that requires signed documentation of the acceptance by the sponsor or customer. Scope verification can also happen at the end of each project phase or when major deliverables within the project are achieved. In these instances, scope verification may be conditional, based on the work results. When the scope is not verified, the project may undergo one of several actions. It may be cancelled and deemed a failure, sent through corrective actions, or put on hold while a decision is made based on the project or phase results.

EXAM TIP If a project scope has been completed, the project is complete. Resist the urge to do additional work once the project scope has been fulfilled. Also, be cautious of instances where the scope is fulfilled and the product description is exact but the customer is not happy with the product. Technically, for the exam, the project is complete even if the customer is not happy.

Controlling the Project Scope (PMBOK, Section 5.5)

Scope control is about protecting the project scope from change and, when change does happen, managing those changes. Ideally, all requested changes follow the scope change control system, which means that change requests must be documented. Those changes that sneak their way into the project scope are lumped into that project poison category of scope creep. Scope creep is, of course, bad, bad news.

Corrective actions—those steps taken to move the project back into alignment with the project scope—don't require formal change requests, because the project manager isn't changing the scope, but rather the work that's outside of the project scope. Corrective actions are a part of scope control because you're nudging, and sometimes shoving, work back into alignment with the project scope. The trouble with scope creep and corrective actions is that the project team is doing or fixing work that should never have entered the scope in the first place—and that means wasted time and dollars. That's one sure way for a project to be late and over budget.

Controlling the project scope is also concerned with "influencing the factors that create project scope changes." That's the PMBOK way of saying that the project manager must control the project team and the project stakeholders from doing anything, absolutely anything, that's outside of the project scope. It also means that the project management team should capture the customer's vision in planning before much of the project work begins. For example, it's always easier to make changes on a blueprint than in construction. Gathering all requirements and creating an accurate project scope statement can ward off changes during execution.

Using a Change Control System

While it's dreamy and ideal for requirements to be gathered completely before the work begins, change requests to the project work are still likely. Every project demands a change control system that defines and controls how changes to the project and to the product can be approved. The scope management plan defines the change control system, its procedure, and how the change decisions can be made—often with a fee just to entertain the change request. The change control system should be reviewed during the project kickoff meeting so that all of the stakeholders are aware of the process.

Change control is part of the project management information system to help control changes to the project scope. This helps automate the procedure, but doesn't necessarily make approving or denying change requests any easier. The change control system also considers integrated change control. Integrated change control examines the proposed change and how it affects all of the project's knowledge areas. For example:

- How does this change affect the project scope?
- What is the cost of the change?
- How does this change affect the project schedule?
- How does this change affect quality?
- What resources are needed or affected by the change?
- How does this change affect communications?
- What risks does this change present?
- Will procurement be affected by this change?

The change control system should do several things for the project management team:

- Document all change requests
- Track each change request
- Document approval levels required for a scope change
- Provide the status of each change request

Planning for Project Scope Changes

When a change is presented, part of considering the change involves additional planning. The project manager and the project team must reconvene to examine the change and how it may affect the project work and the knowledge areas discussed earlier. Changes are sometimes unapproved, such as when a project team member takes the initiative for a change and does not follow the change control procedures. In these instances, the project management team must consider the change and examine the variance to determine the response.

Consider a team member who moves the light fixtures in a kitchen construction project by two feet. The team member believes the kitchen would be better lit with the lights moved to their new position, but he didn't follow the change control process to make the change. Now there is a variance in the scope—a difference between what the specification documents called for and what the team member did. The project management team has to consider how to manage the variance. Should they redo the work or accept the change as the team member has done? If they redo the work, they may lose time and money, but they'll be in scope. If they leave the change as is, then they're out of scope.

Another consideration for all changes is the configuration management system. Configuration management documents all of the features and functions of the project's product. When a change is requested, the impact on the features and functions of the product is documented with the change request before the change is allowed to move through the integrated change control process. For example, a change to add French doors to a home construction project would need all of the features and functions of those French doors so that the true impact on the project's knowledge areas could be examined fully. Failure to accurately document the change can lead to assumptions proving false, new risks, schedule slippage, and financial costs within the project.

EXAM TIP Undocumented change requests should not be considered at all. Change requests must be documented according to the project scope management plan.

Approving a Change

It's a safe bet that changes to the project scope will happen during a project. Why do change requests happen? And which ones are most likely to be approved? Most change requests are a result of:

- **Value-added changes** These are changes that will reduce costs. (This is often due to technological advances made since the time the project scope was created.)
- **External events** These could be such things as new laws or industry requirements.
- **Errors or omissions** Ever hear this one: "Oops! We forgot to include this feature in the product description and WBS!" Errors and omissions can happen to both the project scope, which is the work to complete the project, and the product scope, which is the features and functions of the deliverable, and typically constitute an overlooked feature or requirement.

- **Risk response** A risk has been identified and changes to scope are needed to mitigate the risk.

When change requests are approved, the affects of that change should be documented throughout the project. The Iron Triangle of Project Management is a good example: If the project scope increases, then the project schedule and the project costs will likely need to be changed to reflect these changes. Here are all of the project components that will need to be updated to reflect any approved changes to the project:

- Project scope statement
- Work breakdown structure
- WBS dictionary
- Scope baseline
- Additional requested changes
- Organizational process assets
- Project management plan

Change requests must always follow the change control system, or they are considered out of scope. As the project manager and the project team discover and report changes that are out of scope, the project management team must deal with the changes to remove them through corrective actions or incorporate them through the change control process. Those changes that are incorporated into the project must still be documented and then reflected in the above project components. No changes sneak by!

Chapter Summary

Project scope management is the ability to complete all of the project's required work—and only the required work. This means no extras, no favors, and no cutting corners. The project scope is the focus of the project; it is the necessary work to complete the project. Project scope management is a tool the project manager uses to determine what work is in the project and what work is extraneous.

The project scope management plan will help the project management team determine how the project scope will be defined, how the WBS will be created, how the scope will be controlled throughout the remainder of the project, and how the scope will be verified by the project customer, both at the end of the project and at the end of each project phase. The project scope management plan makes the project team consider all of the knowledge areas and how they may be affected by changes to the project scope.

In order to determine what the project scope actually is, there's plenty of scope planning. The project manager and the project team must have a clear vision of the project, the business need for the project, the requirements, and the stakeholder expectations for the project. The end result of the scope planning processes is the project scope statement. The scope statement says, in no uncertain terms, what is within the project and what is not. This is a more detailed project scope statement than what's created during project initiation.

For your CAPM or PMP exam, focus on protecting the project scope. This includes finding the real purpose of the project so that the scope is in alignment with the identified need. Once the scope has been created, the project team, stakeholders, the project sponsor, and even the project manager should not change it, unless there is overwhelming evidence of why the scope needs to be changed. All changes should be documented and must follow the change control system as defined in the project scope management plan.

Key Terms

8/80 Rule A planning heuristic for creating the WBS. This rule states the work package in a WBS must take no more than 80 hours of labor to create and no less than eight hours of labor to create.

Alternative identification A scope definition process of finding alternative solutions for the project customer while considering the customer's satisfaction, the cost of the solution, and how the customer may use the product in operations.

Change control system Documented in the scope management plan, this system defines how changes to the project scope may be allowed.

Code of accounts A hierarchical numbering system for each item in the WBS. The PMBOK is a good example of a code of accounts, as each chapter and its subheadings follow a logical numbering scheme. For example, PMBOK 5.3.3.2 identifies an exact paragraph in the PMBOK.

Functional analysis This is the study of the functions within a system, project, or, what's more likely in the project scope statement, the product the project will be creating. Functional analysis studies the goals of the product, how the product will be used, and the expectations the customer has of the product once it leaves the project and moves into operations. Functional analysis may also consider the cost of the product in operations, which is known as life cycle costing.

Fund limitation Most projects have a determined budget in relation to the project scope. There may be a qualifier on this budget, such as plus or minus 10 percent based on the type of cost estimate created.

Initial project organization The project scope statement identifies the project team and the key stakeholders. In some organizations, especially on larger projects, the team organization and structure is also documented.

Product acceptance criteria This project scope statement component works with the project requirements, but focuses specifically on the product and what the conditions and processes are for formal acceptance of the product.

Product breakdown A scope definition technique that breaks down a product into a hierarchical structure, much like a WBS breaks down a project scope.

Product scope Defines the product or service that will come about as a result of completing the project.

Product scope description This is a narrative on what the project is creating as a deliverable for the project customer.

Project assumptions A project assumption is anything that is held to be true but not proven to be true.

Project boundaries A project boundary clearly states what is included with the project and what's excluded from the project. This helps to eliminate assumptions between the project management team and the project customer.

Project constraints A constraint is anything that limits the project manager's options. Consider a predetermined budget, deadline, resources, or materials the project manager must use within the project—these are all examples of project constraints.

Project objectives These are the measurable goals that determine a project's acceptability by the project customer and the overall success of the project. Objectives often include the cost, schedule, technical requirements, and quality demands.

Project requirements These are the demands set by the customer, regulations, or the performing organization that must exist for the project deliverables to be acceptable. Requirements are often prioritized in a number of ways, from must have, should have, and would like to have.

Project scope This defines all of the work, and only the required work, to complete the project objectives.

Project scope management plan This project management subsidiary plan controls how the scope will be defined, how the project scope statement will be created, how the WBS will be created, how scope verification will proceed, and how the project scope will be controlled throughout the project.

Schedule milestones The project customer may have specific dates when phases of the project should be completed. These milestones are often treated as project constraints.

Scope creep Undocumented, unapproved changes to the project scope.

Scope verification The formal inspection of the project deliverables, which leads to project acceptance.

Stakeholder analysis A scope definition process where the project management team interviews the stakeholders and categorizes, prioritizes, and documents what the project customer wants and needs. Stakeholder analysis demands quantification of stakeholder objectives; goals such as "good," "satisfaction," and "speedy" aren't quantifiable.

Systems engineering This project scope statement creation process studies how a system should work, designs and creates a system model, and then enacts the working system based on the project's goals and the customer's expectations. Systems engineering aims to balance the time and cost of the project in relation to the scope of the project.

Systems analysis A scope definition approach that studies and analyzes a system, its components, and the relationship of the components within the system.

Value analysis Like value engineering, this approach examines the functions of the project's product in relation to the cost of the features and functions. This is where, to some extent, the grade of the product is in relationship to the cost of the product.

Value engineering This project scope statement creation approach attempts to find the correct level of quality in relation to a reasonable budget for the project deliverable while still achieving an acceptable level of performance of the product.

WBS dictionary A WBS companion document that defines all of the characteristics of each element within the WBS.

WBS template A pre-populated WBS for repetitive projects. Previous projects' WBSs are often used as templates for current similar projects.

Work breakdown structure (WBS) A deliverables-orientated breakdown of the project scope.

Work package The smallest item in the WBS.

Questions

1. Which project management plan guides the creation of the detailed project scope statement?
   A. Charter
   B. Project management plan
   C. Project scope plan
   D. Project scope management plan
2. Which one of the following is not needed to define the project scope?
   A. Project charter
   B. Organizational process assets
   C. Risk management plan
   D. Preliminary project scope statement
3. You are the project manager of the BHY Project. Your project customer has demanded that the project be completed by December 1. December 1 is an example of which one of the following?
   A. Constraint
   B. Assumption
   C. Project boundary
   D. Product acceptance criteria
4. The lowest-level item in a WBS is called what?
   A. Deliverable
   B. Work package
   C. Activity
   D. Leaf object

5. You are working with the project team to create the WBS. There are some elements in the WBS that can't be broken down yet. You and the team elect to break down these items later in the project as more details become available. This approach to creating the WBS is also known as what?
   A. Decomposition
   B. 8/80 Rule
   C. Parkinson's law
   D. Rolling wave planning

6. Your WBS is numbered in a hierarchical fashion for easy identification and reference. This numbering scheme is called what?
   A. Code of accounts
   B. Chart of accounts
   C. WBS template
   D. WBS dictionary
7. Which two items are parts of the scope baseline for the project?
   A. Project scope management plan and the project charter
   B. Project scope management plan and the WBS
   C. WBS and WBS dictionary
   D. Time and cost baselines
8. Scope verification leads to what?
   A. Defect repair
   B. Formal acceptance of the complete project scope
   C. Rework
   D. Inspection
9. What is the only tool and technique used during scope verification?
   A. Inspection
   B. Quality control
   C. Stakeholder analysis
   D. Defect repair review
10. David, one of your project team members, has been making changes to his work, which, as a result, changes the project scope. David's changes are also known as what?
    A. Gold plating
    B. Scope control defect
    C. Scope creep
    D. Improvised scope composition

11. Which system defines how the project scope and the product scope can be changed?
   A. Project scope change control system
   B. Project integrated management system
   C. Project management information system
   D. Change control
12. A change has been approved in Marcy's project. All of the following must be updated to reflect the change, except for which one?
   A. Project scope statement
   B. WBS
   C. WBS dictionary
   D. Defect repair review
13. A project team member has, on his own initiative, added extra vents to an attic to increase air circulation. The project plan did not call for these extra vents, but the team member decided they were needed based on the geographical location of the house. The project team's experts concur with this decision. This is an example of:
   A. Cost control
   B. Ineffective change control
   C. Self-led teams
   D. Value-added change
14. Which of the following is an output of scope control?
   A. Workaround
   B. Recommended corrective action
   C. Transference
   D. Risk assessment
15. You are the project manager for the JHG Project. Your project is to create a new product for your industry. You have recently learned that your competitor is also working on a similar project, but their offering will include a computer-aided program and Web-based tools, which your project does not offer. You have implemented a change request to update your project accordingly. This is an example of which of the following?
   A. A change due to an error and omission in the initiation phase
   B. A change due to an external event
   C. A change due to an error or omission in the planning phase
   D. A change due to a legal issue
16. You are the project manager of a large project. Your project sponsor and management have approved you to outsource portions of the

project plan. What must be considered if a change request affects the procured work?

A. Project sponsor

B. Contractual agreement

C. Vendor(s)

D. Cause of the change request

17. A project team member has asked you what a scope statement is. Which of the following is a characteristic of a project scope statement?

A. Defines the scope baseline for the project

B. Defines the requirements for each project within the organization

C. Defines the roles and responsibilities of each project team member

D. Defines the project deliverables and the work needed to create those deliverables

18. One of the stakeholders of the project you are managing asks why you consider the project scope statement so important in your project management methodology. You answer her question with which of the following?

A. It is mandatory to consult the plan before authorizing any change.

B. Project managers must document any changes before approving or declining them.

C. The project scope helps the project manager determine if a change is within or without of scope.

D. The project plan and earned value management (EVM) work together to assess the risk involved with proposed changes.

19. You are the project manager for a large construction project. The architect has provided your project team with blueprints detailing the exact layout of the building your team will be creating. He insists that the team follow the blueprints as he's designed them. The blueprints are an example of which one of the following?

A. Project specifications

B. Approval requirements

C. Project constraints

D. Initially defined risks

20. Complete this sentence: Project scope management is primarily concerned with defining and controlling ________________________.

A. What is and is not included in the project

B. What is and is not included in the product

C. Changes to the project scope

D. Change to the configuration management system

Answers

1. **D**. The project scope management plan defines the creation of the detailed project scope statement. A, the charter, does include the preliminary project scope statement, but not the detailed one the project scope management plan defines. B, the project management plan, is a parent of the project scope management plan. C is not a valid plan, so this answer is incorrect. For more information, see the PMBOK, Section 5.1.3.1.
2. **C**. You won't need, or likely have at this point, the risk management plan to define the project scope. A, B, and D are incorrect statements, as you'll need the project charter, organizational process assets, and the preliminary project scope statement to define the project scope. For more information, see the PMBOK, Section 5.2.1
3. **A**. This is an example of a project constraint. B is incorrect, as this is a requirement, not an assumption. C is incorrect, as project boundaries define things that are within and without the project scope. D is incorrect, as product acceptance criteria is an example of functions and features the product must have to be acceptable to the customer. For more information, see the PMBOK, Section 5.2.3.1.
4. **B**. The smallest item in the WBS is called the work package. A, deliverable, may be true to a degree, but B is a more precise answer. C is incorrect, as activities are found in the activity list. D is an invalid WBS term. For more information, see the PMBOK, Section 5.3.2.2.
5. **D**. This is a clear example of rolling wave planning. A is incorrect, as decomposition describes the breakdown process of the project scope. B is incorrect, as the 8/80 rule defines the guideline for the amount of labor that should be related to each work package in the WBS. C, Parkinson's Law, is not relevant to this question. Parkinson's Law states that work will expand to fulfill the amount of time allotted to it. For more information, see the PMBOK, Section 5.3.2.2.
6. **A**. The WBS numbering scheme is called the code of accounts. B, chart of accounts, is a project management accounting system. C, a WBS template, can be a pre-populated WBS or a WBS from a previous project used to define the current project's WBS. D is incorrect, as the WBS dictionary defines the attributes of each WBS element. For more information, see the PMBOK, Section 5.3.3.
7. **C**. The WBS and the WBS dictionary are two of three components of the scope baseline. The approved detailed project scope statement is the third portion of the scope baseline. Choices A, B, and D are all incorrect, as they accurately define the scope baseline. For more information, see the PMBOK, Section 5.3.3.4.

8. **B**. Scope verification leads to one thing: formal acceptance of the complete project scope. A, C, and D are incorrect choices, as defect repair, rework, and inspection are not outputs of scope verification. For more information, see the PMBOK, Section 5.4.
9. **A**. Inspection is the only tool and technique used during scope verification. B, quality control, is tempting, but this is not a correct choice for scope verification. C and D are incorrect as well, as these two choices are not used during the scope verification process. For more information, see the PMBOK, Section 5.4.2.1.
10. **C**. Undocumented changes are examples of scope creep. A, gold plating, is when the project team adds changes to consume the project budget. B and D, scope control defect and improvised scope composition, are not valid change management terms. For more information, see the PMBOK, Section 5.5.
11. **A**. The only system that defines how project and product scope can be changed is the project scope change control system. B, the project integrated management system, is not a valid term. C, the project management information system, is the parent system of the project scope change control system. D, change control, is a process not a system. For more information, see the PMBOK, Section 5.5.
12. **D**. Defect repair and its review do not require a change request, so this choice is correct. Choices A, B, and C, the project scope statement, the WBS, and the WBS dictionary, do require updates when change requests are approved. For more information, see the PMBOK, Section 5.5.3.
13. **B**. Even though the change is agreed upon, this is an example of ineffective change control. The team member should follow the change control process as defined in the project scope management plan. Choices A, C, and D are incorrect choices. For more information, see the PMBOK, Section 5.5.2.
14. **B**. While corrective actions do not require change requests, they are an output of scope control. This is because the project team may be doing work outside of the project scope. Corrective action would stop the extraneous work and bring the project team member's actions back into the work within the project scope. A, C, and D are not outputs of scope control. For more information, see the PMBOK, Section 5.5.3.6.
15. **B**. This is a change due to an external event, the event being the product your competitor has in their project. This is not an example of an error or omission in the initiation phase, so A is incorrect. C is incorrect, as this is not an error or omission in the planning phase, but a response to a competitor. D is incorrect, as this is not a legal issue. For more information, see the PMBOK, Section 5.5.1.6 and Section 4.4.1.4.

16. **B**. If a change to the project scope affects the procured work, the project manager must consider the contract. This is because the change may affect the existing contract the project manager and the vendor have entered into. While the project sponsor and the vendor are likely to be involved with the change, the contractual agreements override all other internal systems. D, the cause of the change request, is not as relevant as the contract. For more information, see the PMBOK, Section 5.5.2.1.
17. **D**. The project scope statement defines the project deliverables and the associated work to create those deliverables. A is incorrect, as the project scope statement, the WBS, and the WBS template are considered to be project scope baseline. B is incorrect; the project scope statement does define the requirements for every project, but is project-specific. C is incorrect; the project scope statement does not define the roles and responsibilities of the project. For more information, see the PMBOK, Section 5.2.3.1.
18. **C**. The project scope statement can help the project management team determine if a proposed change is within or without the project boundaries. A, B, and D are correct statements, but they do not answer the question in regards to the importance of the project scope statement. For more information, see the PMBOK, Section 5.2.3.
19. **A**. Blueprints are an example of the project specifications. B is incorrect, as this is not an example of approval requirements. C is incorrect, as this is not an example of a constraint. D is also incorrect, as the blueprints are not examples of initially defined risks. For more information, see the PMBOK, Section 5.2.3.1.
20. **A**. Project scope management is primarily concerned with defining and controlling what is and is not included in the project. Choices B, C, and D are all incorrect statements. For more information, see the PMBOK, Chapter 5 Introduction.

CHAPTER 6

Managing Project Time

In this chapter, you will

- Define the project activities
- Sequence the project activities
- Estimate the resources for the defined activities
- Estimate how long the activities will take to complete
- Develop the project schedule
- Control the project schedule

Time has a funny way of slipping up on you—and then easing on by. As a project manager, you've got stakeholders, project team members, and management all worried about your project deliverables, how the project is moving forward, and when, oh when, the project will be done. You've also got vacations, sick days, demands from other project managers, and delays from vendors to deal with.

Management frets over how much a project will cost. Project customers fret over the deliverables the project will create. Everyone, as it turns out, frets over how long the project will take. Of course I'm talking about the triple constraints of project management: cost, scope, and time. If any one of these constraints is out of balance with the other angles, the project is likely not going to succeed. Time, as it happens, is often the toughest of the three angles to manage, because interruptions come from all sides of the project.

Your Project Management Institute (PMI) exam and this chapter will focus on six key project management activities within the confines of project time management. The activities within project time, like much of project management, are interdependent on one another and on other processes in the project management life cycle.

Of course, there's no time like the present, so let's get into project time management right now!

VIDEO Managing project time.

Defining the Project Activities (PMBOK, Section 6.1)

When a project is first initiated, project managers often drift immediately to the labor and activities that will be required to complete the project work. The trouble with moving right to the work that needs to be done to create the project scope is that the focus is on the labor and not on the scope first. In Chapter 5, I discussed the project scope and the work breakdown structure (WBS)—these are predecessors to defining the project activities. For your PMI examination, here's the sequence of events that the project manager should have in place to get to the work the project team will complete:

- Project scope statement
- Work breakdown structure
- WBS dictionary
- Work packages
- Schedule activities

The work package, the smallest item in the WBS, is broken down into schedule activities, which include the labor to create the things defined in the WBS. The WBS, of course, reflects the project scope statement. While the preceding list is the logical sequence of how the project management team will work together to create the activity list, there are actually six inputs to activity definition:

- Enterprise environmental factors
- Organizational process assets
- Project scope statement
- Work breakdown structure
- WBS dictionary
- Project management plan

These six inputs and the order of precedence mentioned earlier will help the project management define the activities needed to complete the project scope. We're still in the planning process group, so this process is iterative. Any changes to the project scope will likely cause the project management team to revisit these processes throughout the project.

Defining the Project Activities

You and your project team are armed with the six inputs I've listed previously and are ready to start defining the activities in order to create the project scope. Sounds like fun, huh? This process and its complexity will be in proportion to the size of the project scope. In other words, larger projects require more detail and more planning time, while smaller projects, like changing all the keyboards in your company, won't be all that special or too time-consuming to plan. My advice to you—the Certified Associate in Project Management (CAPM) or Project Management Professional (PMP) candidate—on your exam is to think of the largest project you can imaging, such as creating a skyscraper, and then you'll see the reason to use all or most of these project processes.

Let's take a look at the methods used to define the project activities, which the following sections explain in detail.

Decomposing the Work Packages

Yep, more decomposition. You know that the project scope is decomposed into deliverables and then those deliverables are continued to be decomposed into work packages. Work packages, of course, are the smallest item in the WBS. Now that you and your project team are focused on defining the project activities, you'll be breaking down the work packages into the labor needed to create each work package.

Some project managers follow a sequential pattern to this process. First, they'll decompose the project scope into first-tier deliverables, then decompose those project deliverables into second-tier deliverables, and so on, until they've created the work packages. Armed with the work packages, they'll decompose those into the schedule activities we're discussing here. Other project managers will decompose the project scope, then the work packages, and then create the schedule activities in one swoop.

Either approach, in fact, is just fine—even with our pals at PMI. Complete decomposition of the project scope down to the schedule activities is needed—how you get there doesn't matter. It only matters that all of the work packages are decomposed and that the project management team follows the internal policies and procedures (if they exist) to create the schedule activities.

EXAM TIP Use a logical approach to defining the activities: project scope statement, WBS, work packages, and then schedule activities.

Relying on Templates

Who wants to start a project from scratch when you've got an older, similar project just waiting to be manipulated? That older, similar project is a template. Sometimes, in the project management world, we think of a template as an empty shell with pre-populated fields and deliverables. In PMI's world, a template is an older, similar project that can be used and updated for the current project.

A project manager can use a standard activity list if the project work is similar to past projects. There's no real advantage to starting from scratch. Templates can include more than just the activity list, but also the resource skills, estimated hours of effort, risks, deliverables, and any relevant project work information.

EXAM TIP Think of templates as past project files that can be manipulated and used for the current project.

Using Rolling Wave Planning

Have you ever done "the wave" at a football game? You can see the wave moving towards you from across the stadium, and then you're in it, and then it surges past. Rolling wave in project management planning is iterations of planning the work and then doing the project work. Progressive elaboration, which you use to create the WBS and the WBS dictionary, is an example of rolling wave planning.

Rolling wave planning considers the big picture of what the project scope will create, but focuses on the short-term activities to move the project along. Figure 6-1 shows how a project to create a piece of software considers all of the project requirements for the deliverable, but focuses on the immediate activities necessary to complete a portion of the deliverable. Once that work is done, the project management team convenes and plans how to create the next portion of the project. The team plans, does the work, and then reconvenes for more planning.

EXAM TIP Rolling wave planning focuses on the immediate while considering the big picture of the project. Which is easier to plan and accomplish: what you must do this week or what you must do during a week a year from now?

Using Expert Judgment

Let's face facts. As a project manager, you aren't always the person who knows the most about the work that the project centers on. Using expert judgment is working smart, not hard. The project manager relies on the project team, subject matter experts, and consultants to help determine the work that needs to be completed to create the project scope. You'll see expert judgment throughout this book and the Project Management Body of Knowledge (PMBOK). It's simply leveraging other people's brainpower so that the project manager can make the best decisions with regard to the project.

Creating Planning Components

Sometimes, there just isn't enough information available in the WBS to determine what activities are needed in the activity list. For example, let's say you're building a new home for your customer. Your customer knows the dimensions of the kitchen, but doesn't know what type of appliances, cabinets, or even the tile that they want to put into their deluxe kitchen. This isn't a problem at the beginning of the project, as your construction team can get to work building the home, but there will come a date when the homeowners must make a decision on the materials and components they'll want in their schmancy kitchen.

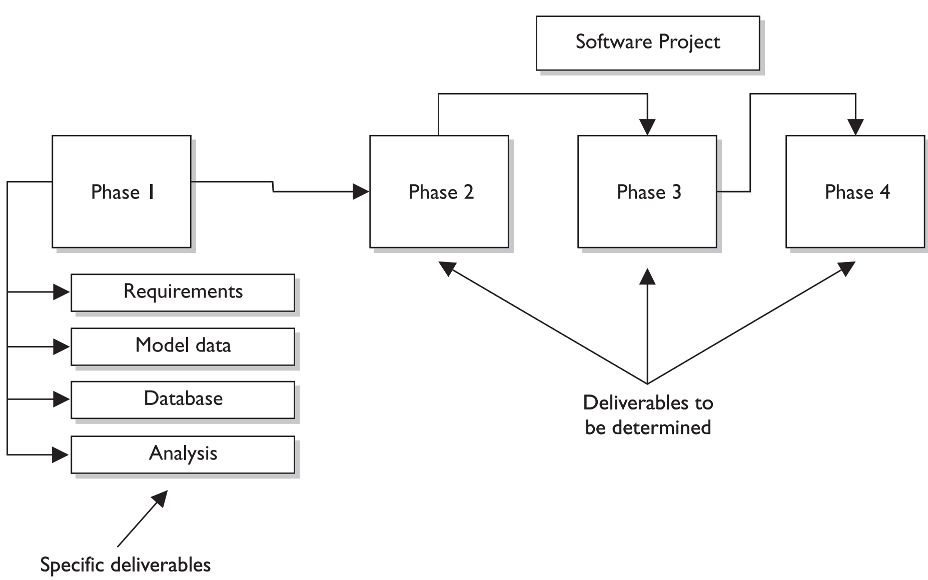


Figure 6-1 Rolling wave planning details the imminent work and keeps future work at the high level.

A project manager can use a control account to signal that the kitchen, in this instance, has not yet been fully defined. This management control point signifies that there are elements within this deliverable of the WBS that have not been planned. The kitchen may have a budget, but how the budget will be consumed isn't yet known, because the homeowners haven't decided where in the kitchen they'll spend their monies. The effort to create the deliverables in the kitchen may also fluctuate based on the type of materials and deliverables the homeowners elect to include in their kitchen.

Another planning component the project manager can use is a planning package within the WBS. A planning package comes below the control account in the WBS, but above the work packages. In our home construction project example, a control account could capture the kitchen, while planning packages could capture the cabinets; another could capture the appliances; and the third could capture the planning associated with the kitchen floor. We know these three things are needed in the kitchen (cabinets, appliances, and floor), but we don't know exactly what schedule activities are needed because not enough information is yet known.

Examining the Activity List

The primary output of decomposing the work is the activity list, which is a collection of all the work elements required to complete the project. The activity list is actually an extension of the WBS, and will serve as a fundamental tool in creating the project schedule. The activity list is needed to ensure that all the deliverables of the WBS are accounted for and that the necessary work is mapped to each work package.

The activity list also ensures that there is no extra work included in the project. Extra work costs time and money—and defeats the project scope. The WBS is comprised of all of the components the project will create, while the activities list is made up of all the work required to create the components within the WBS. In addition, the work on the activity list includes attributes of each identified activity. This ensures three things:

- That the team members are in agreement on what the work package accomplishes
- That the work supports and creates the WBS deliverables
- That the work is within the project scope

Documenting the Activity Attributes

Every activity in the activity list has attributes that must be documented. The documentation of the activities' characteristics will help with additional planning, risk identification, resource need, and more. Of course, the activities and depth of the attributes will vary by project discipline. For your PMI exam, here are some attributes you should consider:

- Activity identifier
- Activity codes
- Activity description
- Predecessor and successor activities
- Logical relationships
- Leads and lags

- Resource requirements
- Imposed dates
- Constraints and assumptions
- Responsibility of the project team member(s) completing the work
- Location of the work
- Type and amount of effort needed to complete the work

Updating the Work Breakdown Structure

When creating the activity list, the project team and the project manager may discover discrepancies or inadequacies in the existing WBS. Updates to the WBS allow the project manager to ensure that all the needed project deliverables are included in the WBS and then map the discovered deliverables to the identified work in the activity list.

In addition, the elements within the WBS may not be defined fully or correctly. During the decomposition of the work, elements of the WBS may need to be updated to reflect the proper description of the WBS elements. The descriptions should be complete and full and leave no room for ambiguity or misinterpretation. Finally, updates to the WBS may also include cost estimates to the discovered deliverables.

EXAM TIP Updates to the WBS are called *refinements*. As the project moves towards completion, refinements ensure that all of the deliverables are accounted for within the WBS. They may also call for, indirectly, updates to the activity list.

Sequencing the Project Work (PMBOK, Section 6.2)

Now that the activity list has been created, the activities must be arranged in a logical sequence. This process calls on the project manager and the project team to identify the logical relationships between activities, as well as the preferred relationship between those activities. This can be accomplished in a few different ways:

- **Computer-driven** There are many different scheduling and project management software packages available. These programs can help the project manager and the project team determine which actions need to happen in what order and with what level of discretion.
- **Manual process** In smaller projects, and on larger projects in the early phases, manual sequencing may be preferred. An advantage of manual sequencing is that it's easier to move around dependencies and activities than in some programs.
- **Blended approach** A combination of manual and computer-driven scheduling methods is fine. It's important to determine the finality of the activity sequence, however. Sometimes, a blended approach can be more complex than relying on just one or the other.

PART II

Considering the Inputs to Activity Sequencing

Figure 6-2 shows the complete process of activity sequencing. There are many approaches to completing activity sequencing. Perhaps the best approach, however, is activity sequencing that involves the entire project team and is not just a solo activity.

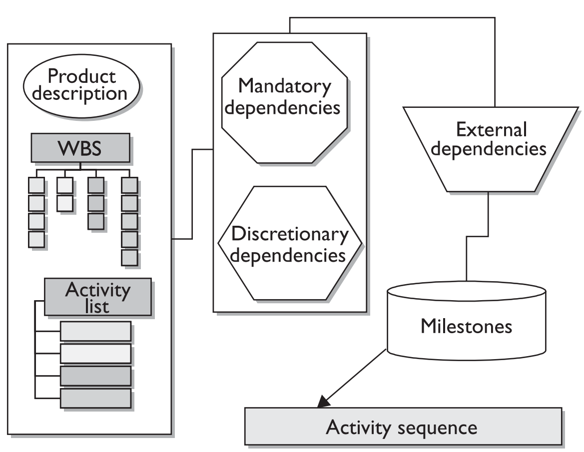
The project manager must rely on the project team and the inputs to activity sequencing:

- **The activity list** As just mentioned, this is the list of actions needed to complete the project deliverables.
- **The project scope statement** The scope statement is needed, since it may influence the sequence of events. For example, in construction, technology, or community planning (among other project types), the scope statement may include requirements, constraints, and assumptions that will logically affect the planning of activity sequencing.
- **Milestones** Milestones must be considered and evaluated when sequencing events to ensure that all of the work needed to complete the milestones is included.
- **Activity attributes** Each scheduled activity has attributes that need to be documented. For example, the successor and predecessor of each activity, the lead and lag information, and the person responsible for completing the activity should all be documented. This information is important when it comes to schedule development and project control.

Creating Network Diagrams

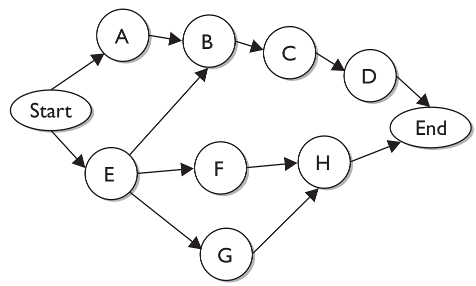
Network diagrams visualize the project work. A network diagram shows the relationship of the work activities and how they will progress from start to completion. Network diagrams can be extremely complex or easy to create and configure. Most network diagrams in today's project management environment use an approach called "activity-on-node" to illustrate the activities and the relationship between those activities. Older network diagramming methods used "activity-on-arrows" to represent the activities and their relationships.

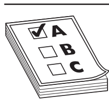
Figure 6-2 Activity sequencing relies on several inputs to create the schedule.



Using the Precedence Diagramming Method

The precedence diagramming method (PDM) is the most common method of arranging the project work visually. The PDM puts the activities in boxes, called nodes, and connects the boxes with arrows. The arrows represent the relationship and the dependencies of the work packages. The following illustration shows a simple network diagram using PDM.





EXAM TIP PDM is also known as AON—activity-on-node. It's the most common approach to network diagramming, since it's used by most project management information systems, but can also be done manually.

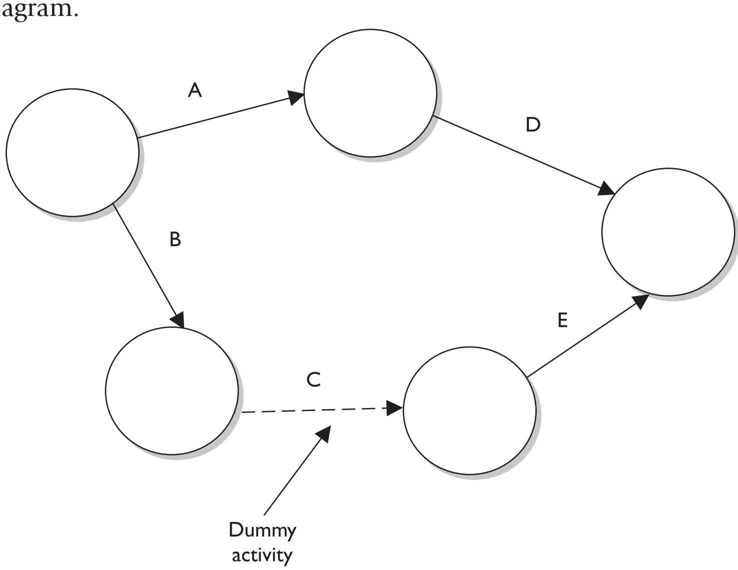
Relationships between activities in a PDM constitute one of four different types (as shown in Figure 6-3):

- **Finish-to-start (FS)** This relationship means that Task A must be completed before Task B can begin. This is the most common relationship. For example, the foundation must be set before the framing can begin.
- **Start-to-start (SS)** This relationship means that Task A must start before Task B can start. This relationship allows both activities to happen in tandem. For example, a crew of painters is painting a house. Task A is to scrape the flecking paint off the house, and Task B is to prime the house. The workers scraping the house must start before the other workers can begin priming the house. All of the scraping doesn't have to be completed before the priming can start, just some of it.
- **Finish-to-finish (FF)** This relationship means that Task A must be completed before Task B is completed. Ideally, the two tasks should finish at exactly the same time, but this is not always the case. For example, two teams of electricians may be working together to install new telephone cables throughout a building by Monday morning. Team A is pulling the cable to each office. Team B, meanwhile, is connecting the cables to wall jacks and connecting the telephones. Team A must pull the cable to the office so that Team B can complete their activity. The activities need to be complete at nearly the same time, by Monday morning, so that the new phones are functional.

- **Start-to-finish (SF)** This relationship is unusual and is rarely used. It requires that Task A start so that Task B may finish. Such relationships may be encountered in construction and manufacturing. It is also known as just-in-time (JIT) scheduling. An example is a construction of a shoe store. The end of the construction is soon, but an exact date is not known. The owner of the shoe store doesn't want to order the shoe inventory until the completion of the construction is nearly complete. The start of the construction tasks dictates when the inventory of the shoes is ordered.

Using the Arrow Diagramming Method

The arrow diagramming method (ADM) approach to activity sequencing uses arrows to represent the activities. The arrows are "connected" on nodes. ADM only uses finish-to-start relationships. In some instances, dummy activities are required to express the logical relationship between two activities. A dummy activity is illustrated with a dashed arrow between the nodes. The following illustration is a simple example of an ADM network diagram.



ADM is an example of "activity-on-arrow" (AOA) networks. This approach is not as popular as PDM, but may still be prevalent in some industries. ADM can be created manually or through a project management information system (PMIS).

Utilizing Network Templates

Just as a project manager can rely on WBS templates, there may be network templates available to streamline the planning process or to conform to a predetermined standard. Network templates can represent an entire project, if appropriate, although portions of a network template, such as the required project management activities, are common.

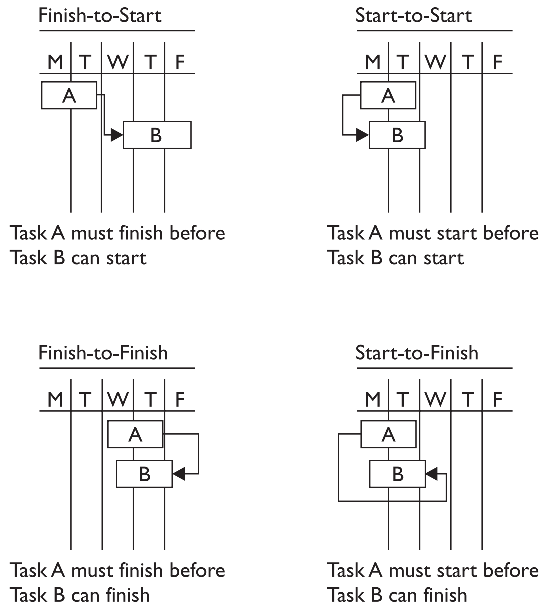


Figure 6-3 Task relationships can vary, but finish-to-start is the most common.

The portions of a network template are also known as subnets or fragnets. Subnets are often associated with repetitive actions within a network diagram. For example, each floor in a high-rise apartment building may undergo the same or similar actions during construction. Rather than complete the network diagram for each floor, a subnet can be implemented.

Determining the Activity Dependencies

The progression of the project is built on the sequence of activities. In other words, predecessor activities must be complete before successor activities can begin. The following are the dependencies you should know for your CAPM or PMP exam:

- **Mandatory dependencies** These dependencies are the natural order of activities. For example, you can't begin building your house until your foundation is in place. These relationships are called hard logic.
- **Discretionary dependencies** These dependencies are the preferred order of activities. Project managers should use these relationships at their discretion and document the logic behind the decision. Discretionary dependencies allow activities to happen in a preferred order because of best practices, conditions unique to the project work, or external events. For example, a painting project typically allows the primer and the paint to be applied within hours of each other. Due to the expected high humidity during the project, however, all of the building will be completely primed before the paint can be applied. These relationships are also known as soft logic, preferred logic, or preferential logic.
- **External dependencies** As the name implies, these are dependencies outside of the project's control. Examples include the delivery of equipment from a

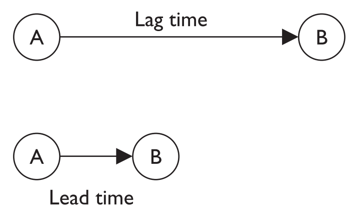
vendor; the deliverable of another project; or the decision of a committee, lawsuit, or expected new law.

Considering Leads and Lags

Leads and lags are values added to work packages to slightly alter the relationship between two or more work packages. For example, a finish-to-start relationship may exist between applying primer to a warehouse and applying the paint. The project manager in this scenario has decided to add one day of lead time to the work package painting the warehouse. Now the painting can begin one day before the priming is scheduled to end. Lead time is considered a negative value, because time is subtracted from the downstream activity to bring it closer to the start of the project.

Lag time is waiting time. Imagine a project to install wood floors in an office building. Currently, there is a finish-to-start relationship between staining the floors and adding a layer of shellac to seal them. The project manager has elected, because of the humidity in the building, to add two days of lag time to the downstream activity of sealing the floors. Now the shellac cannot be applied immediately after the stain, but must wait two additional days. Lag time is considered a positive value, since time is added to the project schedule.

The following illustration shows the difference between lead and lag times. Leads and lags must be considered in the project schedule, since an abundance of lag time can increase the project's duration. An abundance of lead time, while decreasing duration, may increase risks.



EXAM TIP Lead time is always "hurry-up time" and is negative time because the work is moving closer to the project start date. Lag time is always waiting time and is considered positive time because the project manager is adding time to the project schedule.

Estimating the Project Resources (PMBOK, Section 6.3)

Resources include materials, equipment, and people. After the project manager and the project team have worked together to determine the sequence of the activities, they now have to determine which resources are needed for each activities, as well as how much of each resource. As you can guess, resource estimating goes hand-in-hand with cost estimating (which we'll discuss in Chapter 7). After all, if you need a metric ton of pea gravel, that's a resource estimate, but someone's got to pay for that metric ton of pea gravel.

In order to estimate the demand for the project resources, you'll need several inputs:

- Enterprise environmental factors.
- Organizational process assets.
- Activity list.

- The attributes of each activity.
- The availability of the resources you'll need in the form of two calendars:
  - Resource calendars let you know when individual resources are available. This calendar tells you when Bob has scheduled a vacation, when a piece of equipment that your project needs is already scheduled for use, and even when facilities like meeting rooms are available.
  - Project calendars communicate when the project work may take place. For example, your project may allow work to happen between 6 a.m. and 6 p.m., Monday through Friday. Your project calendar will also identify any holidays when the project work won't happen.
- Project management plan.

Using Expert Judgment

The project manager and the project team have worked together to create the WBS, the activity list, and the sequence of activities, so it makes sense that they'll continue to work together to create the resource estimates. And they do. According to the PMBOK, the project management team may work with experts to help make the best decisions. This is using the old standby, "expert judgment," when the project manager relies on someone smarter to help make the best decision.

Identifying Alternatives

As the project management team determines what resources are needed, there will be plenty of opportunities to determine which solution is the best solution for the project. Whenever more than one solution is presented, this is called alternative identification. Alternative identification comes in many different flavors:

- Resources: employees or consultants, junior or senior engineers
- Tools and equipment: power tools or handheld tools, newer versus older machinery
- Types of materials: oak versus plywood
- Make or buy decisions: build our own software or buy a solution from a vendor

EXAM TIP Alternative identification is used throughout the PMBOK, so you'll likely see this term on the PMP exam. Whenever you have two feasible choices for a component in your project, you're working with alternative identification.

Relying on Published Estimating Data

If you are a project manager in construction, the cost of the labor you use, the materials you routinely work with, and seasonal factors you consider for each project typically vary, depending on what part of the country, or even the world, your project is operating within. Many companies provide estimating data on the resources your project can purchase based on the geographical locales the project takes place in, supply and demand, and the season of your purchases. Published estimating data helps the project management team determine an exact cost of the resources the project will utilize.

Using Bottom-Up Estimating

Every time I mention bottom-up estimating in one of my seminars, someone snickers and pantomimes drinking a shot of booze. Ha-ha.

Bottom-up estimating is the most accurate time and cost estimating approach a project manager can use. This estimating approach starts at "the bottom" of the project and considers every activity, its predecessor and successor activities, and the exact amount of resources needed to complete each activity. Bottom-up estimating accounts for all of the resources needed to complete all of the project work. While it is the most accurate estimating approach, it is also the most time-consuming.

EXAM TIP You'll see bottom-up estimating again in Chapter 7, which examines cost estimating. In order to complete bottom-up estimating, especially for costs, a WBS must be present. Bottom-up estimating for costs is also known as creating the definitive estimate.

Examining the Activity Resource Estimates

So what do you get when the project manager, the project team, and all your experts complete the activity resource process? You get the requirements for all the project resources. Not a trick question! The process allows the project manager, the project team, management, and your key stakeholders to see the needed resources to complete each work package in the WBS. Specifically, at the end of this process you'll have:

- **Resource requirements for each activity** You'll know what resources are needed, the assumption your project management team used to create the requirements, and the basis for each estimate.
- **Updates to the activity attributes** You may have errors and omissions, change requests, and discoveries about and around the activities that you're estimating. If the activities or their attributes change, you'll have to update your original activity list to reflect these changes.
- **Resource breakdown structure** This is a hierarchical breakdown of the project resources by category and resource type. For example, you could have a category of equipment, a category of human resources, and a category of materials. Within each category, you could identify the types of equipment your project will use, the types of human resources, and the types of materials.
- **Resource calendar updates** You know that the resource calendar identifies when the resources are working or idle. Updates to the calendar are based on the creation of the activity resource requirements. If change requests enter the project, the resource availability and demand may shift, which could affect the resource calendar.
- **Change requests** Resource estimating can cause change requests. All change requests must be documented and follow the integrated change control process (discussed in Chapter 4).

Estimating Activity Durations (PMBOK, Section 6.4)

How many times have you heard management ask, "Now how long will all of this take?" All the time, right? And maybe right after that: "How much will all of this cost?" We'll talk about cost estimates in Chapter 7. For now, let's talk about time.

The answer to the question "How long will it take?" depends on the accuracy of the estimates, the consistency of the work, and other variables within the project. The best a project manager can do is create honest estimates based on the information he's been provided. Until the schedule is finalized, no one will know the duration of the project.

The tasks are first identified, the sequencing of the activities takes place, resources are defined, and then durations are estimated. These activities are required to complete the project schedule and the estimated project duration. These four activities are iterated as more information comes available. If the proposed schedule is acceptable, the project can move forward. If the proposed schedule takes too long, the scheduler can use a few strategies to compress the project. We'll discuss the art of scheduling in a few moments.

Activity duration estimates, like the activity list and the WBS, don't come from the project manager—they come from the people completing the work. They may also undergo progressive elaboration. In this section, we'll examine the approach to completing activity duration estimates, the basis of estimates, and allow for activity list updates.

Considering the Activity Duration Estimating Inputs

The importance of accurate estimates is paramount. The activity estimates will be used to create the project schedule and predict when the project should end. Inaccurate estimates could cost the performing organization thousands of dollars in fines, missed opportunities, lost customers, or worse. To create accurate estimates, the project manager and the project team will rely on several inputs:

- **Activity lists** You know this, right? Activity lists are the work elements necessary to create the deliverables.
- **The project scope statement** Identification of the project constraints and assumptions is needed, since they may influence the estimates. The project scope statement provides this information.
- **Activity resource requirements** Activity resource requirements define the resources that are needed to complete a particular activity. For example, a project to build a home will require lots of different resources: plumbers, electricians, architects, framers, and landscapers. The project manager would not, however, assign all of the different resources to every task, but only to the tasks that the resource was qualified to complete. Remember that resources also include equipment and materials, so those are identified as part of the activity resource requirements as well.
- **Activity attributes** Effort is the amount of labor applied to a task. Duration, on the other hand, is how long the task is expected to take with the given amount of labor. For example, a task to unload a freight truck may take eight hours with two people assigned to the task. If the effort is increased by adding more labor to the

task (in this instance, more people), then the duration of the task is decreased. Some activities, however, have a fixed duration and are not affected by the amount of labor assigned to the task. For example, installing a piece of software on a computer will take the same amount of time if one computer administrator is completing the work or if two computer administrators are doing it.

- **Resource capabilities** The abilities of the project team members must be taken into account. Consider a task in an architectural firm. Reason says that if a senior architect is assigned to the task, he will be able to complete it faster than if a junior architect were assigned to the same job. Material resources can also influence activity time. Consider predrilled cabinets versus cabinets that require the carpenter to drill each cabinet as it's installed. The predrilled cabinets allow the job to be completed faster.
- **Organizational process assets** Okay, the big one here is historical information. Historical information is always an excellent source of information on activity duration estimates. It can come from several sources, such as the following:
  - Historical information can come from project files on other projects within the organization.
  - Commercial duration estimating databases can offer information on how long industry-specific activities should take. These databases should take into consideration the materials, the experience of the resources, and define the assumptions the predicted work duration is based upon.
  - Project team members may recollect information regarding the expected duration of activities. While these inputs are valuable, they are generally less valuable than documented sources, such as other project files or the commercial databases.
- **The project management plan** Specifically, the project manager and the project team must evaluate the risk register. We'll discuss risk in detail in Chapter 11. Risks, good or bad, can influence the estimated duration of activities. The risks on each activity should be identified, analyzed, and then predicted as to their probability and impact. If risk mitigation tasks are added to the schedule, the mitigation activities will need their duration estimated and then sequenced into the schedule in the proper order. The project activity cost estimates, if they exist yet, should also be referenced during activity duration estimates to determine the most cost-effective amount of labor or resources to apply to any given activity.

Using Analogous Estimating

Analogous estimating relies on historical information to predict what current activity durations should be. Analogous estimating is also known as top-down estimating and is a form of expert judgment. To use analogous estimating, activities from the historical project that are similar in nature are used to predict what similar activities in the current project will take place.

A project manager must consider if the work has ever been done before and, if so, what help the historical information provides. The project manager must consider the

PART II

resources, project team members, and equipment that completed the activities in the previous project compared to the resources available for the current project. Ideally, the activities should be more than similar; they should be identical. And the resources that completed the work in the past should be the same resources used in completing the current work. When the only source of activity duration estimates is the project team members, instead of expert judgment and historical information, your estimates will be uncertain and inherently risky.

EXAM TIP Analogous estimating uses historical information and is more reliable than predictions from the project team members.

Applying Parametric Estimates

Quantitatively based durations use mathematical formulas to predict how long an activity will take based on the "quantities" of work to be completed. For example, a commercial printer needs to print 100,000 brochures. The workers include two pressmen and two bindery experts to fold and package the brochures. Notice how the duration is how long the activity will take to complete, while the effort is the total number of hours (labor) invested because of the resources involved. The decomposed work, with quantitative factors, is shown in Table 6-1.

EXAM TIP Duration is how long an activity takes, while effort is the billable time for the labor to complete the activity. Consider an activity that is scheduled to last 40 hours. The project manager must consider the cost of the person's time assigned to complete the project work—for example, a senior full-time engineer versus a part-time person—at a lower cost. The senior engineer may be able to complete the activity in 40 consecutive work hours, but the cost of this employee's time may be more than the value of the activity. The part-time employee may be able to complete the task in two segments of 20 hours, but her time is billed at a substantially lower rate.

Creating a Three-Point Estimate

How confident can a project manager be when it comes to estimating? If the project work has been done before in past projects, then the level of confidence in the duration estimate is probably high. But if the work has never been done before, there are lots of unknowns—and with that comes risk. To mitigate the risk, the project manager can use a three-point estimate. A three-point estimate requires that for each activity, optimistic, most likely, and pessimistic estimates be created. Based on these three estimates, an average can be created to predict how long the activity should take (see Figure 6-4).

Workers	Units Per Hour	Duration for 100,000	Effort
Pressmen (two)	5,000	20 hours	40 hours
Bindery experts (two)	4,000	25 hours	50 hours
Totals		45 hours	90 hours

Table 6-1 Decomposed Work with Quantitative Factors

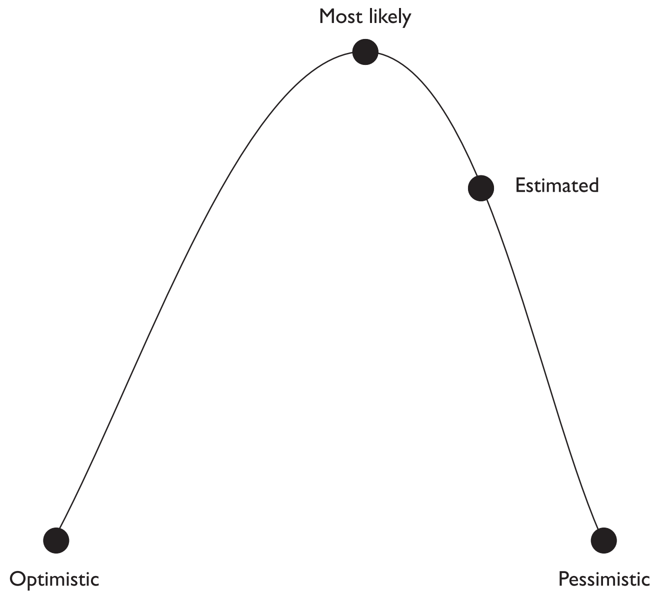


Figure 6-4 Three-point estimates use the formula (optimistic + most likely + pessimistic)/3 to predict an activity's duration.

EXAM TIP If you're thinking this sounds familiar to the Program Evaluation and Review Technique (PERT), you're correct. The *PMBOK Guide, Third Edition* dropped PERT and replaced it with this nomenclature. You should also note that PERT is rarely used in today's project management practices.

Factoring in Reserve Time

Parkinson's Law states: "Work expands so as to fill the time available for its completion." This little nugget of wisdom is oh-so-true. Consider a project team member who knows an activity should last 24 hours. The team member decides, in his own wisdom, to say that the activity will last 32 hours. These extra eight hours, he figures, will allow plenty of time for the work to be completed should any unforeseen incidents pop up. The trouble is, however, that the task will magically expand to require the complete 32 hours. Why does this happen? Consider the following:

- **Hidden time** Hidden time, the time factored in by the project team member, is secret. No one, especially the project manager, knows why the extra time has been factored into the activity. The team member can then "enjoy" the extra time to complete the task at his leisure.
- **Procrastination** Most people put off starting a task until the last possible minute. The trouble with bloated, hidden time is that people may wait through the additional time they've secretly factored into the activity. Unfortunately, if something does go awry in completing the activity, the work result is later than predicted.
- **Demands** Project team members may be assigned to multiple projects with multiple demands. The requirement to move from project to project can shift focus, result in a loss of concentration, and require additional ramp-up time as workers shift from activity to activity. The demand for multitasking allows project team members to take advantage of hidden time.

- **On schedule** Activities are typically completed on schedule or later, but rarely early. Users that have bloated the activity duration estimates may finish their task ahead of when they promised, but they have a tendency to hold on to those results until the activity's due date. This is because workers aren't usually rewarded for completing work early. In addition, workers don't want to reveal the inaccuracies in their time estimates. Workers may believe future estimates may be based on actual work durations rather than estimates, so they'll "sandbag" the results to protect themselves—and finish "on schedule."

So what's a project manager to do? First off, the project manager should strive to incorporate historical information and expert judgment to predicate accurate estimates. Second, the project manager should stress a genuine need for accurate duration estimates. Finally, the project manager can incorporate a reserve time.

A reserve time is a percentage of the project duration or a preset number of work periods, and is usually added to the end of the project schedule. Reserve time may also be added to individual activity durations based on risk or uncertainty in the activity duration. When activities are completed late, the additional time for the activity is subtracted from the reserve time. As the project moves forward, the reserve time can be reduced or eliminated as the project manager sees fit. Reserve time decisions should be documented.

Evaluating the Estimates

The end result of estimating activities provides three things:

- **Activity duration estimates** Activity duration estimates reflect how long each work package will take to complete. Duration estimates should include an acknowledgement of the range of variance. For example, an activity whose duration is expected to be one week may have a range of variance of one week plus or minus three days. This means that the work can take up to eight days or as little as two days, assuming a week is five days.
- **Basis of estimates** Any assumptions made during the activity estimating process should be identified. In addition, any historical information, subject matter experts, or commercial estimating databases that were used should also be documented for future reference.
- **Activity list updates** During the estimating process, there may be discoveries of missing activities within the activity list. The project manager should confirm that the new work packages are reflected in the activity list for the project.

Developing the Project Schedule (PMBOK, Section 6.5)

The project manager, the project team, and possibly even the key stakeholders, will examine the inputs previously discussed and apply the techniques discussed in this section to create a feasible schedule for the project. The point of the project schedule is to complete the project scope in the shortest amount of time possible without incurring exceptional costs, risks, or a loss of quality.

Creating the project schedule is part of the planning process group. It is calendar-based and relies on both the project network diagram and the accuracy of time estimates. When the project manager creates the project schedule, she'll also reference the risk register. The identified risks and their associated responses can affect the sequence of the project work and when the project work can take place. In addition, if a risk comes into fruition, the risk event may affect the scheduling of the resources and the project completion date.

Applying Mathematical Analysis

Mathematical analysis is the process of factoring theoretical early and late start dates and theoretical early and late finish dates for each activity within the project network diagram (PND). The early and late dates are not the expected schedule, but rather a potential schedule based on the project constraints, the likelihood of success, the availability of resources, and other constraints.

The most common approach to calculating when a project may finish is by using the critical path method. It uses a "forward" and "backward" pass to reveal which activities are considered critical. Activities on the critical path may not be delayed; otherwise, the project end date will be delayed. The critical path is the path with the longest duration to completion. Activities not on the critical path have some float (also called slack) that allows some amount of delay without delaying the project end date.

EXAM TIP The critical path is used to determine which activities have no float. You can also use the critical path to determine the earliest date for when the project may be completed. There can be more than one critical path in a project, and it's possible for the critical path to change.

Calculating Float in a PND

Float, or slack, is the amount of time a delayed task can postpone the project's completion. Technically, there are three different types of float:

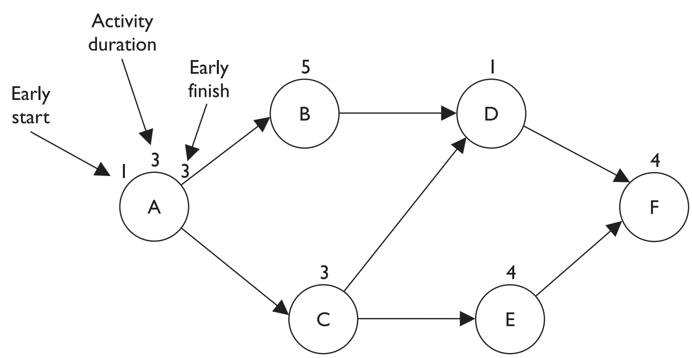
- **Free float** This is the total time a single activity can be delayed without affecting the early start of any successor activities.
- **Total float** This is the total time an activity can be delayed without affecting project completion.
- **Project float** This is the total time the project can be delayed without passing the customer-expected completion date.

Most project management software will automatically calculate float. On the CAPM or PMP exam, however, candidates will be expected to calculate float manually. Don't worry—it's not too tough. The following describes the process.

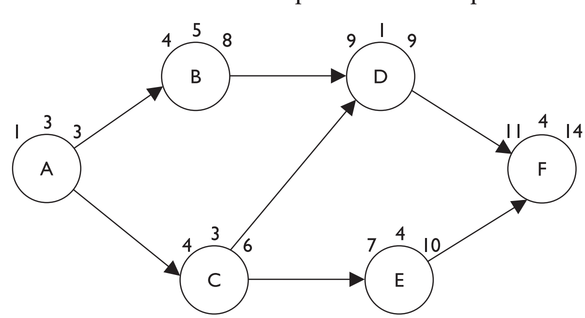
Examine the PND and find the critical path. The critical path is typically the path with the longest duration and will always have zero float. The critical path is technically found once you complete the forward and backward passes. Start with the forward pass. After the backward pass, you can identify the critical and near-critical paths, as well as float.

VIDEO How to calculate float.

1. The early start (ES) and early finish (EF) dates are calculated first by completing the forward pass. The ES of the first task is one. The EF for the first task is its ES, plus the task duration, minus one. Don't let the "minus one value" throw you. If Task A is scheduled to last three days, it would only take three days to complete the work, right? The ES is one, the duration is three, and the EF is three, because the activity would finish within three days, not four days. The following illustration shows the start of the forward pass.

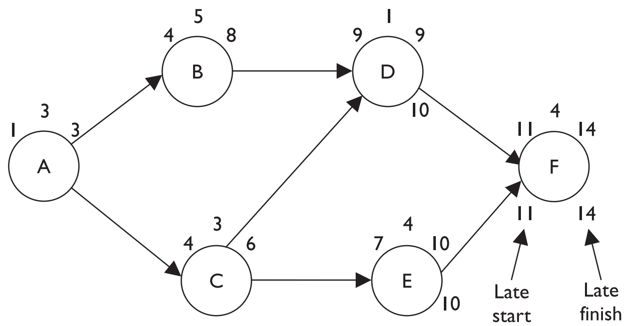


2. The ES of the next task(s) will be the EF for the previous activity, plus one. In other words, if Task A finishes on day eight, Task B will begin on day nine.
3. The EF for the next task(s) equals its ES plus the task duration, minus one. Sound familiar?
4. Now each task moves forward with the forward pass. Use caution when there are predecessor activities; the EF with the largest value is carried forward. The following illustration shows the completed forward pass.

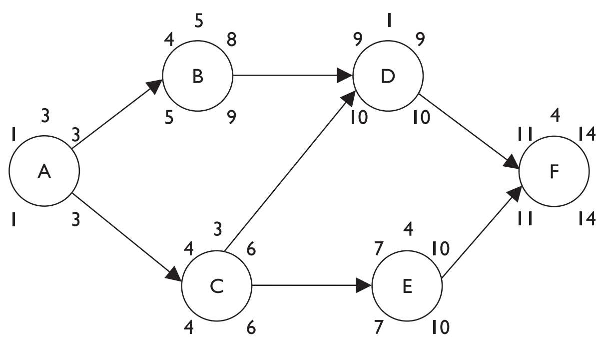


5. After the forward pass is completed, the backward pass starts at the end of the PND. The backward pass is concerned with the late finish (LF) and the late start (LS) of each activity. The LF for the last activity in the PND equals its EF value. The LS is calculated by subtracting the duration of the activity from its LF and then adding one. The one is added to accommodate the full day's work; it's just the opposite of subtracting the one day in the forward pass. Here's a tip: The last activity is on the critical path, so its LS will equal its ES.

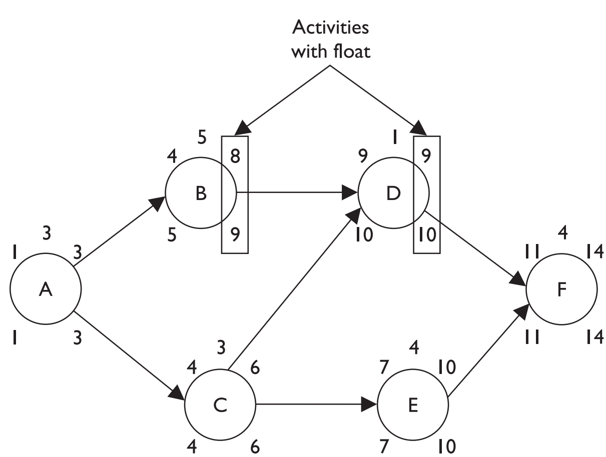
6. The next predecessor activity's LF equals the LS of the successor activity, minus one. In other words, if Task Z has an LS of 107, Task Y will have an LF of 106. The following illustration shows the process of the backward pass.



7. The LS is again calculated by subtracting the task's duration from the task's LF and then adding one. The following shows the completed backward pass.



8. To officially calculate float, the LS is subtracted from the ES and the LF is subtracted from the EF. Recall the total float is the amount of time a task can be delayed without affecting the project completion date. The next illustration shows the completed PND with the float exposed.



Encountering Scheduling on the CAPM or PMP Exam

Out here in the real world, where you and I work every day, we likely aren't calculating float manually. On your PMI exam, however, you'll need to be able to calculate float. Why? You're proving that you understand the theory and application of managing project time. On your regular gig, you'll use your project management software to do this magic for you. You'll encounter float, scheduling, and critical path activities on the exam. You should count these questions as "gimmies" if you remember a few important rules:

- Always draw out the network diagram presented on your scratch paper. It may be used in several questions.
- Know how to calculate float. (The complete process was shown earlier in the "Calculating Float in a PND" section.)
- You may encounter questions that ask on what day of the week a project will end if no weekends or holidays are worked. No problem. Add up the critical path, divide by 5 (Monday through Friday), and then figure out which day of the week the activity will end on.
- You may see something like Figure 6-5 when it comes to scheduling. When three numbers are presented, think three-point estimate. Optimistic is the smallest number and pessimistic is the largest, so most likely, it's somewhere between the two. When a number is positioned directly over the tasks, it is the task duration. When a number is positioned to the upper-right of a task, this represents the EF date.

Applying Duration Compression

Duration compression is also a mathematical approach to scheduling. The trick with duration compression, as its name implies, is calculating ways the project can get done sooner than expected. Consider a construction project. The project may be slated to last eight months, but due to the expected cold and nasty weather typical of month seven, the project manager needs to rearrange activities, where possible, to end the project as soon as possible.

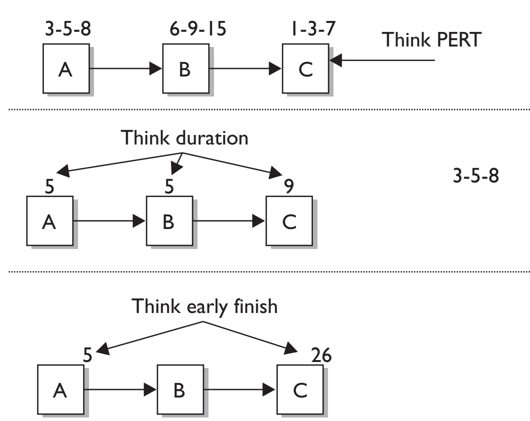


Figure 6-5 Scheduling follows many rules to arrive at a project completion date.

In some instances, the relationship between activities cannot be changed due to hard or soft logic. The relationships must remain as scheduled. Now consider the same construction company that is promised a bonus if they can complete the work by the end of month seven. Now there's incentive to complete the work, but there's also the fixed relationship between activities.

To apply duration compression, the performing organization can rely on two different methods. These methods can be used independently or together, and are applied to activities or to the entire project based on need, risk, and cost. The methods are as follows:

- **Crashing** This approach adds more resources to activities on the critical path to complete the project earlier. When crashing a project, costs are added as the labor expenses increase. Crashing doesn't always work. Consider activities that have a fixed duration and won't finish faster with additional resources. The project manager must also consider the expenses in relation to the gains of completing on time. For example, a construction company may have been promised a bonus to complete the work by a preset date, but the cost incurred to hit the targeted date is more than what the bonus offers.
- **Fast tracking** This method changes the relationship of activities. With fast tracking, activities that would normally be done in sequence are allowed to be done in parallel or with some overlap. Fast tracking can be accomplished by changing the relation of activities from FS to SS or by adding lead time to downstream activities. For example, a construction company could change the relationship between painting the rooms and installing the carpet by adding lead time to the carpet installation task. Before the change, all of the rooms had to be painted before the carpet installers could begin. With the added lead time, the carpet can be installed hours after a room is painted. However, fast tracking can increase risk and may cause rework in the project. Can't you just imagine those workers getting fresh paint on the new carpet?

EXAM TIP It's easy to remember the difference between these two actions. Crashing and cost both begin with C—we're adding resources, and too many people will "crash" into each other. Fast tracking is about speeding things up. However, haste makes waste, which can be risky.

Using a Project Simulation

Project simulations allow a project manager to examine the feasibility of the project schedule under different conditions, variables, and events. For example, the project manager can see what would happen to a project if activities were delayed, vendors missed shipment dates, or external events affected the project.

Simulations are often completed with the Monte Carlo analysis. The Monte Carlo analysis, named after the world-famous gambling city, predicts how scenarios may work out, given any number of variables. The process doesn't actually churn out a specific answer, but a range of possible answers. When Monte Carlo is applied to a schedule, it can examine, for example, the optimistic completion date, the pessimistic completion date, and the most likely completion date for each activity in the project.

As you can imagine in a typical network diagram, there are likely thousands, if not millions, of combinations of tasks that complete early, late, or as expected. Monte Carlo analysis shuffles these combinations, usually through computer software, and offers a range of possible end dates coupled with an expected probability for achieving each end date.

In other words, Monte Carlo analysis is an odds-maker. The project manager chooses, or is at least influenced by, the end date with the highest odds of completion in ratio to the demands for completion by an expected time. The project manager can then predict with some certainty that the project has an 85 percent chance of completion by a specific date.

EXAM TIP Monte Carlo analysis can be applied to more than just scheduling. It can also be applied to cost, project variables, and, most often, risk analysis.

Simulations also provide time to factor in "what-if" questions, worst-case scenarios, and potential disasters. The end result of simulations is to create responses to the feasible situations. Then, should the situations come into play, the project team is ready with a planned response.

Using Resource-Leveling Heuristics

First off, a heuristic is a fancy way of saying "rule of thumb." A resource-leveling heuristic is a method to flatten the schedule when resources are over-allocated. Resource leveling can be applied using different methods to accomplish different goals. One of the most common methods is to ensure that workers are not overextended on activities.

For example, Sarah is assigned to Task C and Task H, which are planned to happen concurrently. Sarah cannot be in two places at once, so resource leveling changes the timing of the activities so that Sarah can complete Task C and then move on to Task H. As expected, however, resource leveling often extends the project end date.

Another method for resource leveling is to take resources off of noncritical path activities and apply them to critical path activities to ensure that the project end date is met. This method takes advantage of available slack and balances the expected duration of the noncritical path with the expected duration of the critical path.

Resource leveling also provides for changing the project schedule to allow for long work hours to complete the project work, such as weekends, evenings, or even adding a second or third shift to bring the project back in alignment. Another approach, also part of resource leveling, is to change the resources, tools, or equipment used to complete the project work faster. For example, a project manager could request the printer to use a different, faster printing press to complete the printing activity than what was originally planned for. Of course, these approaches often increase cost.

Finally, some resources may be scarce to the project. Consider a highly skilled technician or consultant who is only available on a particular date to contribute to the project. These resources are scheduled from the project end date, rather than the start date. This is known as reverse resource allocation scheduling.

Using the Critical Chain Method

The critical chain method (CCM) aims to eliminate Parkinson's Law by eliminating bottlenecks that hold up project progression. In the critical chain method, deadlines associated with individual tasks are removed and the only date that matters is the promised due date of the project deliverable. CCM works to modify the project schedule based on the availability of project resources rather than the pure sequence of events, as in the critical path method.

CCM first requires the discovery of the critical path, but then applies available resources to determine the true resource-limited schedule. Based on the availability of resources to complete the project work, the critical path is often different than what it would have been using the pure critical path method.

CCM scheduling evaluates each activity's latest possible start and finish dates. This allows project managers to manage the buffer activity duration—that is, the activities that are not on the critical path—but their completion contributes to the start of critical path activities. In other words, the focus is on completing each activity in order to complete the entire project by the promised end date.

Using Project Management Software

When it comes to project management software, take your pick: The market is full of them. Project management applications are tools, not replacements, for the project management processes. Many of the software titles today automate the processes of scheduling, activity sequencing, work authorization, and other activities. The performing organization must weigh the cost of the PMIS against the benefits the project managers will actually see.

Relying on a Project Coding Structure

The coding structure identifies the work packages within the WBS and is then applied to the PND. This allows the project manager, the project team, experts, and even key stakeholders, to extract areas of the project to examine, evaluate, and inspect. For example, a project to create a catalog for a parts distributor may follow multiple paths to completion. Each path to completion has its own "family" of numbers that relate to each activity on the path, as outlined in Table 6-2.

Path	Coding for Path	Typical Activities
Artwork	4.2	Concept (4.2.1) Logos (4.2.2) Font design (4.2.3)
Photography	4.3	Product models (4.3.1) Airbrushing (4.3.2) Selection (4.3.3)
Content	4.4	Message (4.4.1) Copywriting (4.4.2) Editing (4.4.3) Rewrites (4.4.4)
Print	4.5	Signatures (4.5.1) Plates (4.5.2) Four-color printing (4.5.3)

Table 6-2 Possible Paths in Creating a Catalog

Path	Coding for Path	Typical Activities
Bind	4.6	Assembly (4.6.1) Bindery (4.6.2) Trimming (4.6.3) Shrink-wrap (4.6.4)
Distribution	4.7	Packaging (4.7.1) Labeling (4.7.2) Shipping (4.7.3)

Table 6-2 Possible Paths in Creating a Catalog *(continued)*

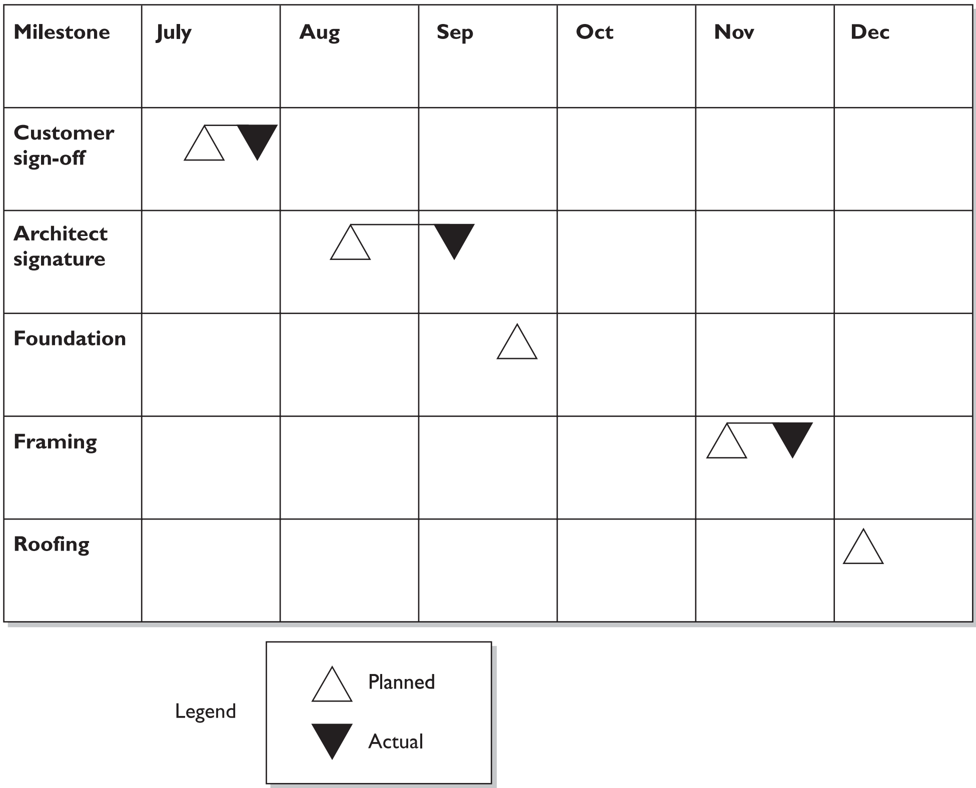
Considering the Outputs of Schedule Development

After all the challenges of examining, sequencing, and calculating the project activities, a working schedule is created. Schedule development, like most of project management's planning processes, moves through progressive elaboration. As the project moves forward, discoveries, risk events, or other conditions may require the project schedule to be adjusted. In this section, we'll discuss the project schedule and how it is managed.

Examining the Project Schedule

The project schedule includes, at a minimum, a date for when the project begins and a date when the project is expected to end. The project schedule is considered proposed until the resources needed to complete the project work are ascertained. In addition to the schedule, the project manager should include all of the supporting details. Project schedules can be presented in many different formats, such as:

- **Project network diagram** This illustrates the flow of work, the relationship between activities, the critical path, and the expected project end date. PNDs, when used as the project schedule, should have dates associated with each project activity to show when the activity is expected to start and end.
- **Bar charts** These show the start and end dates for the project and the activity duration against a calendar. They are easy to read. Scheduling bar charts are also called Gantt charts.
- **Milestone charts** These plot out the high-level deliverables and external interfaces, such as a customer walkthrough, against a calendar. Milestone charts are similar to a Gantt chart, but with less detail regarding individual activities. The following is an example of a milestone chart.



Utilizing the Schedule Management Plan

The schedule management plan is a subsidiary plan of the overall project plan. It is used to control changes to the schedule. A formal schedule management plan has procedures that control how changes to the project plan can be proposed, accounted for, and then implemented. An informal schedule management plan may consider changes on an instance-by-instance basis.

Updating the Resource Requirements

Due to resource leveling, additional resources may need to be added to the project. For example, a proposed leveling may extend the project beyond an acceptable completion date. To reach the project end date, the project manager elects to add additional resources to the critical path activities. The resources the project manager adds should be documented, the associated costs accounted for, and everything approved.

Controlling the Project Schedule (PMBOK, Section 6.6)

Schedule control is part of integrated change management, as discussed in Chapter 4. Throughout a typical project, events will happen that may require updates to the project schedule. Schedule control is concerned with three processes:

- The project manager works with the factors that can cause changes in the schedule in an effort to confirm that the changes are agreed upon. Factors can include project team members, stakeholders, management, customers, and project conditions.
- The project manager examines the work results and conditions to determine whether the schedule has changed.
- The project manager manages the actual change in the schedule.

Managing the Inputs to Schedule Control

Schedule control, the process of managing changes to the project schedule, is based on several inputs:

- The schedule management plan
- The schedule baseline
- Performance reports
- Change requests

Applying a Schedule Control System

A schedule control system is a formal approach to managing changes to the project schedule. It considers the conditions, reasons, requests, costs, and risks of making changes. It includes methods of tracking changes, approval levels based on thresholds, and the documentation of approved or declined changes. The schedule control system process is part of integrated change management.

Measuring Project Performance

Poor performance may result in schedule changes. Consider a project team that is completing a work on time, but all of the work results are unacceptable. The project team may be rushing through their assignments to meet their deadline. To compensate for this, the project may be changed to allow for additional quality inspections and more time for activity completion. Project performance is often based on earned value management, which we'll discuss in Chapter 10.

Examining the Schedule Variance

The project manager must actively monitor the variances between when activities are scheduled to end and when they actually end. An accumulation of differences between scheduled and actual dates may result in a schedule variance.

The project manager must also pay attention to the completion of activities on paths with float, not just the critical path. Consider a project that has eight different paths to completion. The project manager should first identify the critical path, but should also identify the float on each path. The paths should be arranged and monitored in a hierarchy from the path with smallest float to the path with the largest float. As activities are completed, the float of each path should be monitored to identify any paths that may be slipping from the scheduled end dates.

Updating the Project Schedule

So what happens when a schedule change occurs? The project manager must ensure that the project schedule is updated to reflect the change, document the change, and follow the guidelines within the schedule management plan. Any formal processes, such as notifying stakeholders or management, should be followed.

Revisions are a special type of project schedule change that cause the project start date and, more likely, the project end date to be changed. They typically stem from project scope changes. Because of the additional work the new scope requires, additional time is needed to complete the project.

Schedule delays, for whatever reason, may be so drastic that the entire project has to be rebaselined. Rebaselining is a worst-case scenario and should only be used when adjusting for drastic, long delays. When rebaselining happens, all of the historical information up to the point of the rebaseline is eliminated. Schedule revision is the preferred, and most common, approach to changing the project end date.

EXAM TIP You only want to rebaseline in extreme, drastic scenarios.

Applying Corrective Action

Corrective action is any method applied to bring the project schedule back into alignment with the original dates and goals for the project end date. Corrective actions are efforts to ensure that future performance meets the expected performance levels. It includes the following:

- Extraordinary measures to ensure that work packages complete as scheduled
- Extraordinary measures to ensure that work packages complete with as little delay as possible
- Root-cause analysis of schedule variances
- Implementing measures to recover from schedule delays

Chapter Summary

All projects take time—time to plan the project, do the work, control the work, and confirm that the work has been done according to plan. Of course, there are all those other things that eat into a project's schedule: change request reviews, corrective and preventive actions, defect repair, defect repair review, and scope verification. When a project manager first looks at planning the project work, she'll consider, along with her project team, all of the activities that will need to be completed based on the project's WBS.

Once all the project work has been identified and the activity list has been generated, it's time to put the activities into the order necessary to reach the project completion. This means the activity attributes are considered. Those activities that must happen in a particular order are using hard logic, while those activities that don't have to happen sequentially can use soft logic. The sequencing of the project activities happens with the project management team.

Putting the activities in the order in which they'll happen leads to the creation of a project network diagram. It's pretty. The PND most likely will be using the precedence diagramming method—that's where you can clearly identify the predecessors and successors within the project. The relationships between the activities signal the conditions that must be true to allow the work to progress.

Once the work has been organized and visualized, it's time to staff it. This is project resource estimating, which also contributes to the cost of the project. Resource utilization considers more than just the people that your project will need, but also the materials and equipment. This activity considers the quantity of resources the project demands and when the resources are available. This is tricky business in large projects, so rolling wave planning may be incorporated into the project.

Of course, management and the project's stakeholders will want to know how long the project work will take to complete. Now that the network diagram has been created and the resources have been identified, the project management team can have a more accurate estimate of the project's duration. The project manager can use the identified labor, which is common, or the project manager can rely on analogous estimating, which isn't as accurate as bottom-up estimating. In some instances, the project manager can also use parametric estimating to predict the project's duration.

As the project manager examines the network diagram, he'll want to find opportunities to shift resources and determine where delays will affect the project end date. Of course, I'm talking about the critical path—the path with no float and whose activities cannot, better not, be delayed, or the project end's date will go beyond what's been scheduled. Activities not on the critical path have float and can often be delayed if needed. You'll have a few questions on float, and I encourage you to watch the videos on the CD to nail down the float process.

A project manager must control the project schedule. Sometimes, this means compressing the project schedule. Recall that crashing adds people to the project work, but crashing adds cost. The project manager can only crash the project work if the activities are effort-driven. Activities that are of fixed duration, such as printing a million booklets, won't get down faster just because the project manager adds labor to the activities. Other activities can benefit from fast tracking; this approach allows phases to overlap, but increases the project risk.

Key Terms

Activity list The primary output of breaking down the WBS's work packages.

Alternative identification The identification of more than one solution. Consider roles, materials, tools, and approaches to the project work.

Analogous estimating A somewhat unreliable estimating approach that relies on historical information to predict what current activity durations should be. Analogous estimating is more reliable, however, than team member recollections. Analogous estimating is also known as top-down estimating, and is a form of expert judgment.

Bottom-up estimating The most accurate time and cost estimating approach a project manager can use. This estimating approach starts at "the bottom" of the project and considers every activity, its predecessor and successor activities, and the exact amount of resources needed to complete each activity.

Control account A WBS entry that considers the time, cost, and scope measurements for that deliverable within the WBS. The estimated performance is compared against the actual performance to measure overall performance for the deliverables within that control account. The specifics of a control account are documented in a control account plan.

Crashing A schedule compression approach that adds more resources to activities on the critical path to complete the project earlier. When crashing a project, costs are added, as the associated labor expenses increase.

Critical chain method A network analysis approach where the deadlines associated with individual tasks are removed and the only date that matters is the promised due date of the project deliverable. CCM works to modify the project schedule based on the availability of project resources rather than on the pure sequence of events, as in the critical path method.

Critical path The path in the project network diagram that cannot be delayed, or the project completion date will be late. There can be more than one critical path. Activities in the critical path have no float.

Discretionary dependencies These dependencies are the preferred order of activities. Project managers should use these relationships at their discretion and document the logic behind the decision. Discretionary dependencies allow activities to happen in a preferred order because of best practices, conditions unique to the project work, or external events.

Early finish The earliest a project activity can finish. Used in the forward pass procedure to discover the critical path and the project float.

Early start The earliest a project activity can begin. Used in the forward pass procedure to discover the critical path and the project float.

External dependencies As the name implies, these are dependencies outside of the project's control. Examples include the delivery of equipment from a vendor; the deliverable of another project; or the decision of a committee, lawsuit, or expected new law.

Fast tracking A schedule compression method that changes the relationship of activities. With fast tracking, activities that would normally be done in sequence are allowed to be done in parallel or with some overlap. Fast tracking can be accomplished by changing the relation of activities from FS to SS or by adding lead time to downstream activities. However, fast tracking does add risk to the project.

Finish-to-finish An activity relationship type that requires the current activity be finished before its successor can finish.

Finish-to-start An activity relationship type that requires the current activity be finished before its successor can start.

Fragnet A representation of a project network diagram that is often used for outsourced portions of a project, repetitive work within a project, or a subproject. Also called a subnet.

Free float This is the total time a single activity can be delayed without affecting the early start of any successor activities.

Hard logic Logic that describes activities that must happen in a particular order. For example, the dirt must be excavated before the foundation can be built. The foundation must be in place before the framing can begin.

Lag time Positive time that moves two or more activities farther apart.

Late finish The latest a project activity can finish. Used in the backward pass procedure to discover the critical path and the project float.

Late start The latest a project activity can begin. Used in the backward pass procedure to discover the critical path and the project float.

Lead time Negative time that brings two or more activities closer together.

Management reserve A percentage of the project duration to combat Parkinson's Law. When project activities become late, their lateness is subtracted from the management reserve.

Mandatory dependencies These dependencies are the natural order of activities. For example, you can't begin building your house until your foundation is in place. These relationships are called hard logic.

Monte Carlo analysis A project simulation approach named after the world-famous gambling city. This predicts how scenarios may work out, given any number of variables. The process doesn't actually churn out a specific answer, but a range of possible answers. When Monte Carlo analysis is applied to a schedule, it can examine, for example, the optimistic completion date, the pessimistic completion date, and the most likely completion date for each activity in the project and then predict a mean for the project schedule.

Parametric estimate A quantitatively based duration estimate that uses mathematical formulas to predict how long an activity will take based on the quantities of work to be completed.

Parkinson's Law A theory that states: "Work expands so as to fill the time available for its completion." It is considered with time estimating, because bloated or padded activity estimates will fill the amount of time allotted to the activity.

Planning package A WBS entry located below a control account and above the work packages. A planning package signifies that there is more planning that needs to be completed for this specific deliverable.

Precedence diagramming method A network diagram that shows activities in nodes and the relationship between each activity. Predecessors come before the current activity and successors come after the current activity.

Project calendars Calendars that identify when the project work will occur.

Project float This is the total time the project can be delayed without passing the customer-expected completion date.

Project network diagram A diagram that visualizes the flow of the project activities and their relationships to other project activities.

Refinement An update to the work breakdown structure.

Resource breakdown structure This is a hierarchical breakdown of the project resources by category and resource type. For example, you could have a category of equipment, a category of human resources, and a category of materials. Within each category, you could identify the types of equipment your project will use, the types of human resources, and the types of materials.

Resource calendars Calendars that identify when project resources are available for the project work.

Resource-leveling heuristic A method to flatten the schedule when resources are over-allocated. Resource leveling can be applied using different methods to accomplish different goals. One of the most common methods is to ensure that workers are not overextended on activities.

Rolling wave planning The imminent work is planned in detail, while the work in the future is planned at a high level. This is a form of progressive elaboration.

Soft logic The order of the activities doesn't necessarily have to happen in a specific order. For example, you could install the light fixtures first, then the carpet, and then paint the room. The project manager could use soft logic to change the order of the activities if he so desired.

Start-to-finish An activity relationship that requires an activity to start so that its successor can finish. This is the most unusual of all the activity relationship types.

Start-to-start An activity relationship type that requires the current activity to start before its successor can start.

Subnet A representation of a project network diagram that is often used for outsourced portions of projects, repetitive work within a project, or a subproject. Also called a fragnet.

Template A previous project that can be adapted for the current project.

Three-point estimate An estimating technique for each activity that requires optimistic, most likely, and pessimistic estimates to be created. Based on these three estimates, an average can be created to predict how long the activity should take.

Total float This is the total time an activity can be delayed without delaying project completion.

Work package The smallest item in the work breakdown structure.

Questions

1. You are the project manager of the HGF Project. You would like to use a portion of the activity list from the HGB Project, which is similar to your current project. The portion of the activity list from the HGB Project is best described as which one of the following?
   A. Rolling wave planning
   B. Analogous estimating
   C. Template
   D. Expert judgment
2. Which one of the following is the best example of rolling wave planning?
   A. Using expert judgment for the current project
   B. Using a portion of the activity list from a previous project
   C. Breaking down the project scope
   D. Planning the immediate portions of the project in detail and the future project portions at a higher level
3. You are working with your project team to break down the project work into activities. Which component in the WBS must be broken down to get to the schedule activities?
   A. Project scope
   B. Work packages
   C. Planning package
   D. Product scope
4. Which one of the following will not be included in the activity list created with the project management team?
   A. Activities that are not part of the project scope
   B. Quality control activities
   C. Activities to create the work packages
   D. Physical terms, such as linear feet of pipe to be installed
5. Mary has created an activity list with her project team. She has included activity attributes for each of the activities in her project's activity list. Of the following, which one is not an example of an activity attribute that Mary likely included?
   A. Scope verification processes
   B. Predecessor activities
   C. Leads and lags
   D. Geographic area where the work must take place
6. Your project team agrees that the server's operating system must first be installed before the application can be installed. This best describes which one of the following?

A. Hard logic

B. Soft logic

C. Start-to-start relationship

D. Finish-to-finish relationship

7. You are working with your project team to schedule activities for your construction project. You have scheduled the painting activity to be completed before the carpet installation activity may begin. The relationship between the painting activity and carpet installation activity can be best described as which one of the following?

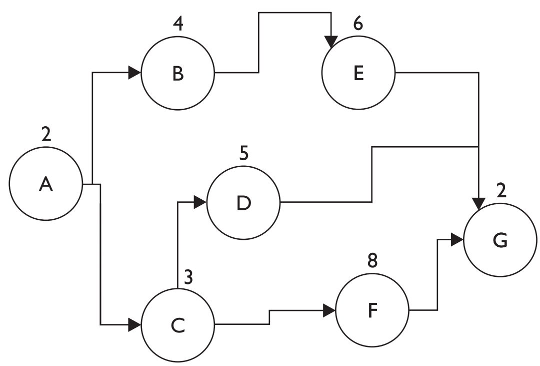
A. Lag

B. Lead

C. Finish-to-start

D. Start-to-finish

8. Examine the following illustration. How long will the project last?



A. 15 days

B. 12 days

C. 14 days

D. 41 days

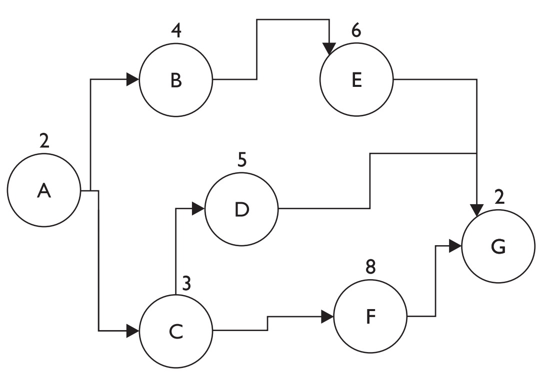
9. Examine the following illustration. If Activity B is delayed by two days, how late will the project be?

A. The project will not be late, as Activity B may use float.

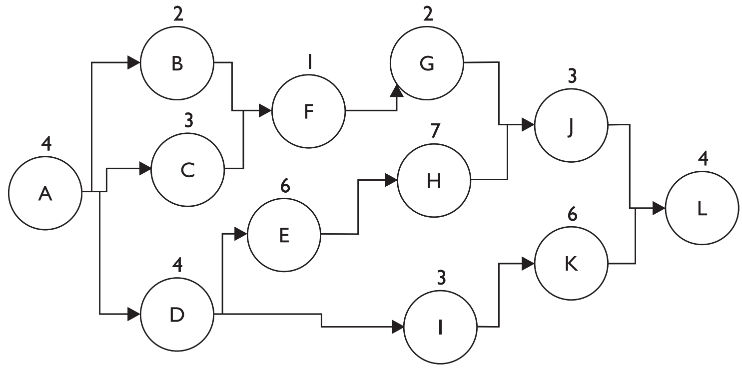
B. The project will be late by one day.

C. The project will be late by two days.

D. The project will be late by four days.



10. Examine the following illustration. Which path is the critical path?
  A. ABFGJL
  B. ACFGJL
  C. ADEHJL
  D. ADIKL



11. Consider a project that is to begin work on a Monday and a project team that will not work any weekends. The critical path of the project is 17 days. On what day of the week will the project be completed?
  A. Monday
  B. Tuesday
  C. Wednesday
  D. Thursday
12. Mike, a project manager in your company, is falling behind on the project schedule. He has elected to crash the project. What is crashing?
  A. Adding lag time between all project activities
  B. Adding lead time between all project activities
  C. Adding additional project resources to the project work
  D. Removing all unneeded project deliverables
13. Which estimating technique uses a similar project to predict how long the current project will take to complete?
  A. Analogous estimating
  B. Parametric estimating
  C. Organizational process assets
  D. Bottom-up estimating
14. You are using a three-point estimate for your project. Howard reports that his optimistic estimate is 16 hours, his most likely estimate is 24 hours, and the pessimistic estimate is 65 hours. What is the estimated duration for Howard's activity?
  A. You won't know until Howard actually does the work
  B. 105 hours

C. 24 hours
D. 35 hours

15. The framing activity cannot begin until the concrete has cured for 36 hours. The time between the concrete activity and the framing activity is best described as which one of the following?
A. Hard logic
B. Lag time
C. Lead time
D. Finish-to-start relationship

16. Which one of the following best describes the critical path?
A. It is always one path with no float.
B. It determines the earliest the project can finish.
C. It has the most activities.
D. It has the most important project activities.

17. Schedule control is part of which project management process?
A. Change control
B. Cost control
C. WBS refinements
D. Integrated change control

18. Which system can manage changes to the project schedule?
A. Change control system
B. Schedule change control system
C. Integrated change control
D. Change control board

19. Which schedule development tool does not consider the availability of the project resources only when the work may take place in the project?
A. Critical path method
B. Critical chain method
C. Schedule compression
D. Arrow on the node method

20. What happens when a project manager elects to crash a project?
A. The project will end early.
B. The project will end on time.
C. The project costs will increase.
D. The project team morale will decrease.

Answers

1. **C**. This is an example of using the previous project as a template. A, rolling wave planning, is incorrect, as rolling wave planning describes the detailed planning of the imminent project work, and the high-level planning of work is farther away in the project schedule. B is incorrect; analogous estimating describes the method of using a similar project to estimate the current project's time and/or cost estimate. D is incorrect, as expert judgment is using an expert to provide needed information for the current project. For more information, see the PMBOK, Section 6.1.2.2.
2. **D**. Rolling wave planning is the planning of the immediate portions of the project in detail and the future work at a higher level. A is incorrect, as expert judgment is using an expert to help the project manager make informed decisions within the project. B describes using a template for the current project. C is the process of creating the WBS by breaking down the project scope. For more information, see the PMBOK, Section 6.1.2.3.
3. **B**. The work packages are broken down into schedule activities. A, the project scope, is incorrect, as this is the root of the WBS. C, planning packages, is incorrect because the planning packages represent portions of the WBS where known work content does not have schedule activities. D is incorrect, as the product scope describes the thing or service the project will create. For more information, see the PMBOK, Section 6.1.2.1.
4. **A**. The activity list must not include any activities that are not part of the project scope. B, C, and D are all incorrect choices, as these activities and terms are included in the activity list. For more information, see the PMBOK, Section 6.1.3.1.
5. **A**. Scope verification leads to acceptance decisions with the project customer, but it is not part of the activity attributes. Choices B, C, and D are all part of the activity attributes that Mary may include. For more information, see the PMBOK, Section 6.1.3.1.
6. **A**. The operating system must be installed before the application, so this is an example of hard logic. B is incorrect, as soft logic describes a scenario in which the order of the activities can happen in any order. C and D are incorrect, as these activities cannot start at the same time nor may they finish at the same time. For more information, see the PMBOK, Section 6.2.2.4.
7. **C**. The painting activity must finish first and then the carpet installation activity can begin. A, lag, is incorrect, as this describes the waiting time between project activities. B, lead, is also incorrect, as this describes a schedule compression technique to move project activities closer together. D, start-to-finish, is a relationship between activities, typically used in just-in-time scheduling, but that is not what is described in this example. For more information, see the PMBOK, Section 6.2.2.1.

8. **A**. The project will last 15 days. The path ACFG is the critical path that will take 15 days to complete. B and C are both representative of paths that are less than the critical path, so these answers are incorrect. D, 41 days, is the sum of the amount of days of labor in the entire project, but it is not representative of the total amount of days to complete the project. For more information, see the PMBOK, Section 6.5.2.2.
9. **B**. If activity B is delayed by two days, the total duration of the project changes to 16 total days—one more day than the critical path will allow. A, C, and D are all incorrect calculations for this project. For more information, see the PMBOK, Section 6.5.2.2.
10. **C**. ADEHJL is the critical path, as this one takes the longest to complete. A, B, and D are examples of paths that have float, so they are not on the critical path. For more information, see the PMBOK, Section 6.5.2.2.
11. **B**. The project will complete on a Tuesday. This can be quickly determined by counting each set of Monday through Friday as five days. Three weeks allows the project to end on day 17, a Tuesday. Choices A, C, and D are incorrect. For more information, see the PMBOK, Section 6.5.2.2 and Section 6.4.3.1.
12. **C**. Crashing is when a project manager elects to add resources to the project work in an attempt to compress the project schedule. Crashing adds costs to the project. A would cause the project duration to increase. B, adding lead time, is an example of fast tracking. D is not a valid choice. For more information, see the PMBOK, Section 6.5.2.3.
13. **A**. Analogous estimating uses an analogy between similar projects to determine the current project's duration. B, parametric estimating, uses a parameter—such as 10 hours per unit installed—to predict the project's duration. C is not a valid answer. D, bottom-up estimating, accounts for every work package in the WBS and the total amount of time for each deliverable. It is the most reliable time-estimating technique, but also takes the longest to create. For more information, see the PMBOK, Section 6.4.2.2.
14. **D**. A three-point estimate takes the sum of the optimistic, pessimistic, and most likely estimates and divides by three. A is not a reflection of the estimated duration. B and C do not reflect the result of a three-point estimate. For more information, see the PMBOK, Section 6.4.2.4.
15. **B**. The framing activity cannot begin immediately after the concrete activity; there is waiting time, which is commonly known as lag time. A, hard logic, describes the order in which activities must happen; it does not describe the time between activities. C, lead time, would actually allow activities to overlap. D, finish-to-start, does describe the relationship between the concrete and the framing activities, but it does not answer the question. For more information, see the PMBOK, Section 6.2.2.5.

16. **B**. The critical path reveals the earliest that a project may finish. A is incorrect, because the project may have more than one critical path. C is incorrect, as the critical path may have fewer activities than other paths in the project but still take longer to complete. D is also incorrect, because the critical path does not reflect the importance of the path's activities, just their duration. For more information, see the PMBOK, Section 6.5.2.2.
17. **D**. Schedule control is part of the integrated change control process. A, B, and C are incorrect choices, as these do not completely answer the question. For more information, see the PMBOK, Section 6.6.1.4.
18. **B**. The only system that deals directly with schedule is in choice B, the schedule change control system. A is not a valid choice. C, integrated change control, actually describes a project process. D is a group of individuals that may determine scope changes and their affect on the project constraints. For more information, see the PMBOK, Section 6.6.1.4 and Section 6.6.2.2.
19. **A**. The critical path method only considers when the work may take place and not the availability of the resources. B, the critical chain method, does consider when the resources are available. C and D are not valid choices for this question. For more information, see the PMBOK, Section 6.6.1.4 and Section 6.5.2.2.
20. **C**. Crashing adds cost to the project because labor costs money. A and B are incorrect, because crashing a project does not necessarily ensure that the project will end early or on time. D is also incorrect, as there's no evidence that the team morale will decrease if the project manager elects to crash the project. For more information, see the PMBOK, Section 6.6.1.4 and Section 6.5.2.3.

CHAPTER 7

Managing Project Costs

In this chapter, you will
- Estimate the project costs
- Administer the project budget
- Manage project cost control
- Work with earned value management

Money. Cash. Greenbacks. Dead presidents. It's all the same thing when you get down to it: Projects require finances to get from start to completion, and it's often the project manager's job to estimate, control, and account for the finances a project demands. Projects consume the project budget during execution, when all of those project management plans we've discussed are put into action, and the project budget is monitored and controlled during, well, the monitoring and controlling processes.

What's that you say? You don't have any control over the monies your project requires? Management gives you a pre-determined budget, and it's up to you to make it all work out? Yikes! While this book centers on your Certified Associate in Project Management (CAPM) and Project Management Professional (PMP) examinations, that's always one of the scariest things I hear. Or is it? If management's decision is based on previous projects, business analysts' research, or should-cost estimates from experts, then it's not so scary. I'll give you this much: A pre-determined project budget is always a constraint and it's rarely fun for the project manager.

And what about those projects that don't have any monies assigned to the project work? You know…the projects where the project scope is just completed by the project team's time and there really aren't any materials or items to purchase. That's okay—there are still costs associated with the project, because someone, somewhere, is paying for the project team's time. Salaries can also be considered a project cost. After all, time is money.

VIDEO Using earned value management.

Finally—and here's the big whammy—it doesn't really matter where your project monies come from, whether you actually control them, and the processes your organization uses to spend them. Your Project Management Institute (PMI) exam makes you understand all of the appropriate processes and procedures of how projects are estimated, budgeted, and then financially controlled. And that's what we'll discuss in this chapter.

You know by now, I'm assuming, that there are 44 project management processes. Guess how many of them center on cost? Three: cost estimating, cost budgeting, and cost controlling. Isn't that reassuring? Your PMI exam will, no doubt, have questions on costs, but so much of the content of this chapter refers to your enterprise environmental factors. (Remember that term? It's how your company does business.) Your cost management plan defines and outlines your organization's and project's procedures for cost management and control. I'll not pass the buck anymore. Let's go through this chapter like a wad of cash at an all-night flea market.

Determining the Project Costs (PMBOK 7.1)

One of the first questions a project manager is likely to be asked when a project is launched is, "How much to finish?" That question can only be answered through progressive elaboration. In order to answer the question, the project manager, or the project estimator as the case may be, first needs to examine the costs of the resources needed to complete each activity in the project. Resources, of course, are people, but also things: equipment, material, training, even pizza if the project demands it.

On top of the cost of the resources, there's also all the variances that must be considered: project risks, fluctuations in the cost of materials, the appropriate human resources for each activity, and oddball elements, like shipping, insurance, inflation, and monies for testing and evaluations.

Estimates, as Figure 7-1 depicts, usually come in one of three flavors through a series of refinements. As more details are acquired as the project progresses, the estimates are refined. Industry guidelines and organizational policies may define how the estimates are refined.

- **Rough order of magnitude** This estimate is "rough" and is used during the initiating processes and in top-down estimates. The range of variance for the estimate can be from –25 percent to +75 percent.
- **Budget estimate** This estimate is also somewhat broad, and is used early in the planning processes and also in top-down estimates. The range of variance for the estimate can be from –10 percent to +25 percent.
- **Definitive estimate** This estimate type is one of the most accurate. It's used late in the planning processes, and is associated with bottom-up estimating. You need the work breakdown structure (WBS) in order to create the definitive estimate. The range of variance for the estimate can be from –5 percent to +10 percent.

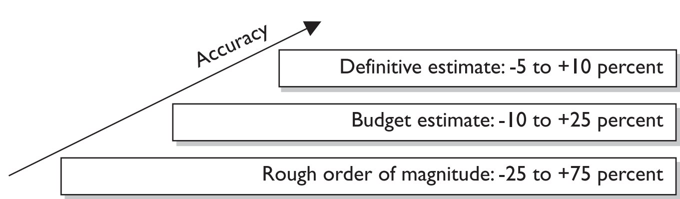


Figure 7-1 There are three generally accepted types of cost estimates.

While project managers typically think of project estimates as some unit of measure, such as dollars, euros, yen, or others, it's possible, and often feasible, to estimate project costs based on labor. Consider the amount of hours the project team must work on creating a new piece of software. You could even estimate based on the number of full-time employees assigned to the project for a given duration.

EXAM TIP If your organization doesn't use a cost estimator, the project manager and the project team work together to estimate the project costs.

Estimating the Project Costs

Assuming that the project manager and the project team are working together to create the cost estimates, there are many inputs to the cost estimating process. For your PMI exam, it'd behoove you to be familiar with these inputs, as these are often the supporting details for the cost estimate the project management team creates. Let's have a look, shall we?

Relying on Enterprise Environmental Factors

Every time I have to say or write "enterprise environmental factors," I cringe. It's just a fancypants way of saying how your organization runs shop. Within any organization, there are "factors" that affect the cost-estimating process. Surprise, surprise. There are two for your exam:

- **Marketplace conditions** When you have to buy materials and other resources, the marketplace dictates the price, what's available, and from whom will you purchase. We'll talk all about procurement in Chapter 12, but for now, there are three conditions that can affect the price of anything your project needs to purchase:
  - **Sole source** There's only one vendor that can provide what your project needs to purchase. Examples include a specific consultant, specialized service, or unique type of material.
  - **Single source** There are many vendors that can provide what your project needs to purchase, but you prefer to work with a specific vendor. They are your favorite.
  - **Oligopoly** This is a market condition in which the market is so tight, the actions of one vendor affect the actions of all the others. Can you think of any? How about the airline industry, the oil industry, or even training centers and consultants?
- **Commercial databases** One of my first consulting gigs was for a large commercial printer. We used a database based on the type of materials the job was to be printed on, the number of inks and varnish we wanted to use, and the printing press we'd use to predict how much the job would cost. That's a commercial database. Another accessible example is any price list your vendors may provide so that you can estimate accurately.

EXAM TIP Here's a goofy way to remember all the market conditions for your PMI exam. For a sole source, think of James Brown, the Godfather of Soul. There's only one James Brown, just as there's only one vendor. For a single source, think of all the single people in the world and how you only want to date your sweetie instead of all the others. With a single source, you consider all the different available vendors, but you have your favorite. And for oligopoly? It looks like "oil" which we know is a classic example of an oligopoly market. Hey! I warned you these were goofy.

Using Organizational Process Assets

Here's another term that makes my teeth hurt. Organizational process assets are just things your organization has learned, created, or purchased that can help the project management team manage a project better. When it comes to cost estimating, there are many assets an organization can use:

- **Cost estimating policies** An organization can, and often will, create a policy on how the project manager or the cost estimator is to create the project cost estimate. It's just their rule; got any of those where you work?
- **Cost estimating templates** In case you've not picked up on this yet, PMI and the Project Management Body of Knowledge (PMBOK) love templates. Templates in project management don't usually mean a shell like Microsoft Word thinks of templates. We're talking about using past similar projects to serve as a template for the current project.
- **Historical information** Beyond the specific costs of previous projects, historical information is just about anything that came before this project that can help the project manager and the project team create an accurate cost estimate.
- **Project files** Project archives and files from past projects can help with the cost estimate process. Specifically, the project manager is after the performance of past similar projects in areas of cost control, the cost of risks, and quality issues that could affect costs.
- **Project team knowledge** Your project team usually consists of the experts closest to the project work, and can be a valuable input to the project cost estimating process. Be forewarned—for the real world and your PMI exam, project team recollections are great, but aren't the most reliable input. In other words, Marty's war stories about how Project XYZ was a $14 billion over budget don't compare with historical information that says Project XYZ was $14 over budget.
- **Lessons learned** It's always good to rely on lessons learned as an input during planning. After all, it's better to learn from someone else's mistakes.

EXAM TIP Sometimes, an organization has two projects, or opportunities, and they can only choose one of the projects to complete. For example, Project A is worth $75,000 and Project B is worth $250,000. The organization will likely choose Project B because it is worth more and let Project A go because it is worth considerably less. *Opportunity costs* is a term to describe the total amount of the project that was let go in lieu of the project that was selected. In this instance, the opportunity cost is $75,000, the worth of Project A.

Relying on the Project Scope Statement

The project scope statement is also an input to the cost estimating process. What a surprise! The project scope statement is needed because it defines the business case for the project, the project justifications, and the project requirements—all things that'll cost cash in order to achieve. The project scope statement can help the project manager and the stakeholders negotiate the funding for the project based on what's already been agreed upon. In other words, the size of the budget has to be in proportion to the demands of the project scope statement.

While the project scope statement defines constraints, it also defines assumptions. In Chapter 11, which discusses risk management, we'll discuss how assumptions can become risks. Basically, if the assumptions in the project scope statement prove false, the project manager needs to assess what the financial impact may be.

Consider all of the elements in the project scope statement that can contribute to the project cost estimate:

- Contractual agreements
- Insurance
- Safety and health issues
- Environment expenses
- Security concerns
- Cost of intellectual rights
- Licenses and permits

Lastly, and this is perhaps one of the more important elements in the project scope statement, is the requirement for acceptance. The cost estimate must reflect the monies needed to ascertain the project customer's expectations. If the monies are not available to create all of the elements within the project scope, then the project scope must be trimmed to match the monies that are available or more cash needs to be dumped into the project.

Examining Other Cost Estimating Inputs

All right…I've covered the major inputs for cost estimating, but there are still some smaller, common sense inputs that the project manager or the cost estimator will need to rely upon to complete the cost estimating process. Don't worry—it's nothing you've not seen before, and it's all pretty straightforward:

- **Work breakdown structure** The WBS is needed to create a cost estimate, especially the definitive estimate, because it clearly defines all of the deliverables the project will create. Each of the work packages in the WBS will cost something in the way of materials, time, or often both. You'll see the WBS as a common theme in this chapter, because the monies you spend on a project are for the things you've promised in the WBS.
- **WBS dictionary** The WBS's pal, the WBS dictionary is needed because it includes all of the details and the associated work for each deliverable in the WBS. As a general rule, whenever you have the WBS involved, the WBS dictionary tags along.

- **Project management plan** The project management plan defines how the project will be executed and simultaneously monitored and controlled. Recall that the project management plan includes all of the subsidiary plans for the project—that's at least one for each project management knowledge area and quality process improvement plan. Because project management is integrative in nature, expenses from each knowledge area are considered inputs to the cost estimate. Specific contents of the project management plan to consider for the PMI examination include the following:
    - **Schedule management plan** The availability of resources, when the resources are to do the work, when capital expenses are to happen, and so on. The schedule management plan can also consider contracts with collective bargaining agreements (unions) and their timelines, seasonal cost of labor and materials, and any other timings that may affect the overall cost estimate.
    - **Staffing management plan** We've already determined that time is money, because the project pays for the labor to create the items promised in the project scope statement. The staffing management plan determines when project resources, specifically the people, are needed on the project team and the expenses to have those folks involved. Chapter 9 discusses the staffing management plan in more detail.
    - **Risk register** A risk is an uncertain event that may cost the project time, money, or both. The risk register is a central repository of the project's risks and the associated status of each risk event. Some risks the project team can buy their way out of, while other risks will cost the project if they come true. We'll discuss risks in detail in Chapter 11, but for now, know that the risk register is needed because the cost of the risk exposure helps the project management team create an accurate cost estimate.

EXAM TIP Risks may not always cost monies directly, but could affect the project schedule. Keep in mind, however, that this could, in turn, cause a rise in project costs because of vendor commitment, penalties for lateness, and added expenses with additional labor.

Estimating Project Costs

All of the cost inputs are needed so that the project cost estimator, likely the project management team, can create a reliable cost estimate. The estimates you'll want to know for the CAPM and PMP exam, and for your career, are reflective of the accuracy of the information the estimate is based upon. The more accurate the information, the better the cost estimate will be. Basically, all cost estimates move through progressive elaboration: As more details become available, the more accurate the cost estimate is likely to be. Let's examine the most common approaches to determining how much a project is likely to cost.

Using Analogous Estimating

Analogous estimating relies on historical information to predict the cost of the current project. It is also known as top-down estimating, and is the least reliable of all the cost estimating approaches. The process of analogous estimating uses the actual cost of a historical project as a basis for the current project. The cost of the historical project is applied to the cost of the current project, taking into account the scope and size of the current project, as well as other known variables.

Analogous estimating is considered a form of expert judgment. This estimating approach takes less time to complete than other estimating models, but is also less accurate. This top-down approach is good for fast estimates to get a general idea of what the project may cost. The trouble, or risk, with using an analogous estimate, however, is that the historical information that estimate is based upon must be accurate. For example, if I were to create a cost estimate for Project NBG based on a similar project Nancy did two years ago, I'd be assuming that Nancy kept accurate records and that her historical information is accurate. If it isn't, well, then my project costs are not going to be accurate and I'm going to be really mad at Nancy.

Determining the Cost of Resources

One of the project management plans needed for cost estimating was the staffing management plan, which defines all of the attributes of the project staff, including the personnel rates. Armed with this plan and a determination of what resources are needed to complete the project, the project manager can extrapolate what the cost of the human resource element of the project will likely be.

Resources include more than just the people doing the project work. The cost estimate must also reflect all of the equipment and materials that will be utilized to complete the work. In addition, the project manager must identify the quantity of the needed resources and when the resources are needed for the project. The identification of the resources, the needed quantity, and the schedule of the resources are directly linked to the expected cost of the project work.

There are four variations on project expenses to consider:

- **Direct costs** These costs are attributed directly to the project work and cannot be shared among projects (airfare, hotels, long distance phone charges, and so on).
- **Indirect costs** These costs are representative of more than one project (utilities for the performing organization, access to a training room, project management software license, and so on).
- **Variable costs** These costs vary, depending on the conditions applied in the project (the number of meeting participants, the supply and demand of materials, and so on).
- **Fixed costs** These costs remain constant throughout the life cycle of the project (the cost of a piece of rented equipment for the project, the cost of a consultant brought onto the project, and so on).

And yes, you can mix and match these terms. For example, you could have a variable cost based on shipping expenses that is also a direct cost for your project. Don't get too hung up on these cost types—just be topically familiar with them for your PMI exam.

Using Bottom-Up Estimating

Bottom-up estimating starts from zero, accounts for each component of the WBS, and arrives at a sum for the project. It is completed with the project team, and can be one of the most time-consuming methods used to predict project costs. While this method is more expensive, because of the time invested to create the estimate, it is also one of the most accurate. A fringe benefit of completing a bottom-up estimate is that the project team may buy into the project work since they see the cost and value of each cost within the project.

Using Parametric Estimating

That'll be $465 per metric ton.

You can buy our software for $765 per license.

How about $125 per network drop?

These are all examples of parameters that can be integrated into a parametric estimate. Parametric estimating uses a mathematical model based on known parameters to predict the cost of a project. The parameters in the model can vary based on the type of work being completed and can be measured by cost per cubic yard, cost per unit, and so on. A complex parameter can be cost per unit, with adjustment factors based on the conditions of the project. The adjustment factors may have several modifying factors, depending on additional conditions.

There are two types of parametric estimating:

- **Regression analysis** This is a statistical approach that predicts what future values may be based on historical values. Regression analysis creates quantitative predictions based on variables within one value to predict variables in another. This form of estimating relies solely on pure statistical math to reveal relationships between variables and to predict future values.
- **Learning curve** This approach is simple: The cost per unit decreases the more units workers complete, because workers learn as they complete the required work (see Figure 7-2). The more an individual completes an activity, the easier it is to complete. The estimate is considered parametric, since the formula is based on repetitive activities, such as wiring telephone jacks, painting hotel rooms, or other activities that are completed over and over within a project.

EXAM TIP Don't worry too much about regression analysis for the exam. Learning curve is the topic you're more likely to have questions on.

Using Good Old Project Management Software

Who's creating estimates with their abacus? Most organizations rely on software to help the project management team create an accurate cost estimate. While the CAPM and PMP examinations are vendor-neutral, a general knowledge of how computer software can assist the project manager is needed. Several different computer programs are available that can streamline project work estimates and increase their accuracy. These tools can include project management software, spreadsheet programs, and simulations.

Examining the Vendor Bids

Sometimes, it's just more cost-effective (and easier) to hire someone else to do the work. Other times, the project manager has no choice because the needed skill set doesn't exist within the organization. In either condition, the vendors' bids need to be

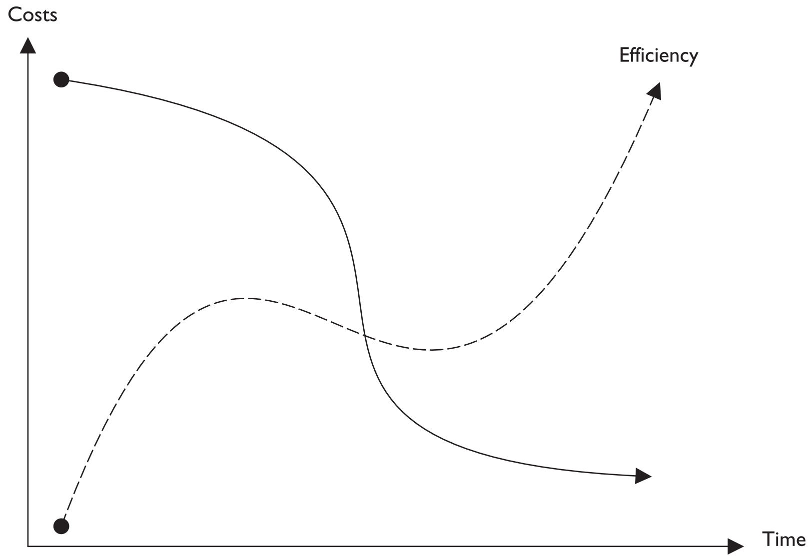


Figure 7-2 The learning curve affects the cost of efficiency.

analyzed to determine which vendor should be selected based on their ability to satisfy the project scope, the expected quality, and the cost of their services. We'll talk all about procurement in Chapter 12.

Creating a Reserve Analysis

Do you think it'll snow next December in Michigan? I do, too. But do we know on what exact date? That's a quick and easy example of a "known unknown." You know that something is likely to occur, but you just don't when or to what degree. Projects are full of known unknowns, and the most common deals with costs. Based on experience, the nature of the work, or fear, you suspect that some activities in your project will cost more than expected—that's a known unknown.

Rather than combating known unknowns by padding costs with extra monies, the PMBOK suggests that we create "contingency allowances" to account for these overruns in costs. The contingency allowances are used at the project manager's discretion to counteract cost overruns for schedule activities.

In Chapter 6, we discussed the concept of management reserve for time overruns. This is a related concept when it comes to the cost reserve for projects. This reserve is sometimes called contingency reserve, and is traditionally set aside for cost overruns due to risks that have affected the project's cost baseline. Contingency reserves can be managed in a number of different ways. The most common is to set aside an allotment of funds for the identified risks within the project. Another approach is to create a slush fund for the entire project for identified risks and known unknowns. The final approach is an allotment of funds for categories of components based on the WBS and the project schedule.

Considering the Cost of Quality

The cost of quality, which we'll discuss in Chapter 8, is a term that defines the monies the project must spend in order to reach the expected level of quality within a project. For example, if your project will use a new material that no one on the project team has ever worked with before, the project team will likely need training so that they can use it during the project execution. The training, as you can guess, costs something. That's an example of the cost of quality.

On the other side of the coin (cost pun intended, thank you), there's the cost of poor quality, sometimes called the cost of nonconformance to quality. These are the costs your project will pay if you don't adhere to quality the first time. In our example with the project team and the new materials, a failure to train the team on the new materials will mean that the team will likely not install the materials properly, take longer to use the materials, and may even waste materials. All of these negative conditions cost the project in time, money, team frustration, and even loss of sales.

Examining the Cost Estimate

Once all of the inputs have been evaluated and the estimate creation process is completed, you get, of course, the cost estimate. The estimate is the likely cost of the project—it's not a guarantee, so there is usually a modifier—sometimes called an acceptable range of variance. That's the plus/minus qualifier on the estimate, for example $450,000 +25,000 to -$13,000, based on whatever conditions are attached to the estimate. The cost estimate should, at the minimum, include the likely costs for all of the following:

- Labor
- Materials
- Equipment
- Services
- Facilities
- Information technology
- Special categories, such as inflation and contingency reserve

It's possible for a project to have other cost categories, such as consultants, outsourced solutions, and others, but the preceding list is the most common. Consider this list when studying to pass your exam.

Along with the cost estimate, the project management team includes the basis of the estimate. These are all the supporting details of how the estimate was created and why the confidence in the estimate exists at the level it does. Supporting details typically include all of the following:

- Description of the work to be completed in consideration of the cost estimate
- Explanation of how the estimate was created
- What assumptions were used during the estimate creation
- The constraints that the project management team had to consider when creating the cost estimate

A project's cost estimate may lead to some unpleasant news in the shape of change requests. I say "unpleasant," because changes are rarely enjoyable. Changes can affect the scope in two primary ways when it comes to cost:

- We don't have enough funds to match the cost estimate, so we'll need to trim the scope.
- We have more than enough funds to match the cost estimate, so let's add some stuff into the scope.

All change requests must be documented and fed through the integrated change control system, as discussed in Chapter 4. What the project manager wants to be leery of is gold plating. Gold plating is when the project manager, the project sponsor, or even a stakeholder adds in project extras to consume the entire project budget. It's essentially adding unneeded features to the product in order to use up all the funds allocated to the project. While this often happens in the final stages of a project, it can begin right here during the project cost estimating. Gold plating delivers more than what's needed and can create new risks, work, and contribute to a decline in team morale.

If changes are approved, then integrated change control is enacted and the project scope is updated and the WBS and WBS dictionary are updated, and so on, through all of the project management plans as needed. The cost management plan needs to be updated as well to reflect the costs of the changes and their impact on the project cost estimate.

Budgeting the Project (PMBOK, Section 7.2)

Now that the project estimate has been created, it's time to create the official cost budget. Cost budgeting is really cost aggregation, which means the project manager will be assigning specific dollar amounts for each of the scheduled activities or, more likely, for each of the work packages in the WBS. The aggregation of the work package cost equates to the summary budget for the entire project. This process creates the cost baseline, as Figure 7-3 shows.

Cost budgeting and cost estimates may go hand-in-hand, but estimating is completed before a budget is created—or assigned. Cost budgeting applies the cost estimates over time. This results in a time-phased estimate for cost, which allows an organization to predict cash flow, project return on investment, and forecasting. The difference between cost estimates and cost budgeting is that cost estimates show costs by category, whereas a cost budget shows costs across time.

Creating the Project Budget

Good news! Many of the tools and techniques used to create the project cost estimates are also used to create the project budget. The following is a quick listing of the tools you can expect to see on the CAPM and PMP exams:

- **Cost aggregation** Costs are parallel to each WBS work package. The costs of each work package are aggregated to their corresponding control accounts. Each control account is then aggregated to the sum of the project costs.
- **Reserve analysis** Cost reserves are for unknown unknowns within a project. The contingency reserve is not part of the project's cost baseline, but is included as part of the project budget.

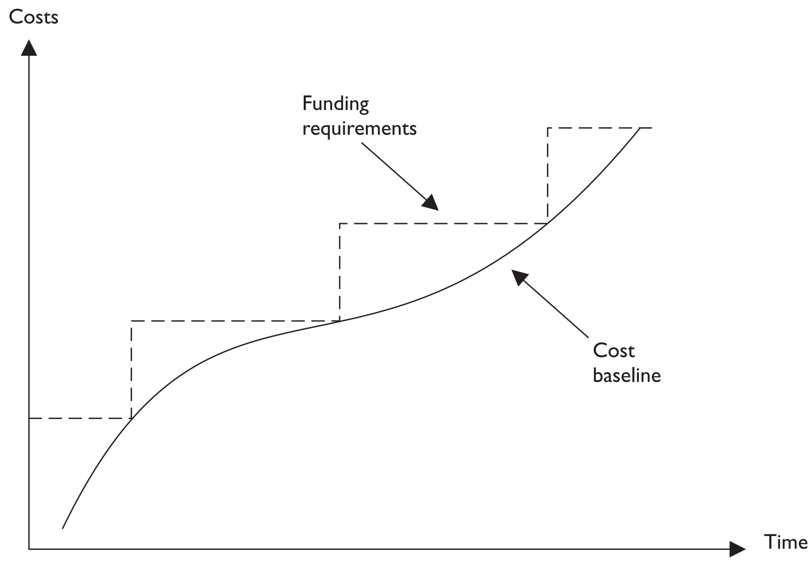


Figure 7-3 The cost baseline is how much the project will cost demonstrated on an S-curve.

- **Parametric estimating** This approach uses a parametric model to extrapolate what costs will be for a project (for example, cost per hour and cost per unit). It can include variables and points based on conditions.
- **Funding limit reconciliation** Organizations only have so much cash to allot to projects—and no, you can't have all the monies right now. Funding limit reconciliation is an organization's approach to managing cash flow against the project deliverables based on a schedule, milestone accomplishment, or data constraints. This helps an organization plan when monies will be devoted to a project rather than using all of the funds available at the start of a project. In other words, the monies for a project budget will become available based on dates and/or deliverables. If the project doesn't hit predetermined dates and products that were set as milestones, the additional funding becomes questionable.

Examining the Project Budget

Like most parts of the PMBOK, you don't get just one output after completing a process; you get several. Creating the project budget is no different, as there are four outputs to know for the PMI examination. The following sections look at these in detail.

Working with the Cost Baseline

The cost baseline, as shown in Figure 7-3, is actually a time-lapse exposure of when the project's monies are to be spent in relation to cumulative values of the work completed in the project. Most baselines are shown as an S-curve, where the project begins in the left and works its way to the upper-right corner. When the project begins, it's not worth much and usually not much has been spent. As the project moves towards completion, the monies for labor, materials, and other resources are consumed in relation to the work. In other words, the monies spent on the project over time will equate to the work the project is completing.

Some projects, especially projects that are of high priority or large, may have multiple cost baselines to track cost of labor, cost of materials, even the cost of internal resources compared to external resources. This is all fine and dandy, as long as the values in each of the baselines are maintained and consistent. It wouldn't do a project manager much good if the cost baseline for materials was updated regularly and the cost baseline for labor was politely ignored.

EXAM TIP Monies that have already been spent on a project are considered sunk into the project. These funds are called sunk costs—they're gone.

Determining the Project Funding Requirements

Projects demand a budget, but when the monies in the project are made available is dependent on the organization, the size of the project, and just plain old common sense. For example, if you were building a skyscraper that costs $850 million, you wouldn't need all of the funds on the first day of the project, but you would forecast when those monies would be needed. That's cash flow forecasting.

The funding of the project, based on the cost baseline and the expected project schedule, may happen incrementally or based on conditions within the project. Typically, the funding requirements have been incorporated into the cost baseline. The release of funds is treated like a step function, which is what it is. Each step of the project funding allows the project to move on to the next milestone, deliverable, or whatever "step" of the project the project manager and the stakeholders have agreed to.

The project funding requirements also account for the management contingency reserve amounts. This is a pool of funds for cost overruns. Typically, the management contingency reserve is allotted to the project in each step, though some organizations may elect to only disperse contingency funds on an as-needed basis—that's just part of organizational process assets.

To be crystal clear, the cost baseline is what the project should cost in an ideal perfect world. The management contingency reserve is the "filler" between the cost baseline and the maximum funding. In most cases, the management contingency reserve bridges the gap between the project cost baseline and the maximum funding to complete the project. Figure 7-4 demonstrates the management contingency reserve at a project's completion.

The Usual Suspects

There are two more outputs of the cost budgeting process. Care to guess which two? Here are the usual outputs:

- **Change requests** Did you guess this one? Just about any process in a project can generate a change request, and cost budgeting is no different. Of course, the change request must be documented and flow through the integrated change control system. There are no free rides, especially in cost management.
- **Cost management plan updates** If there's been a change request that is approved, you'll likely have to update the cost management plan. Fascinating.

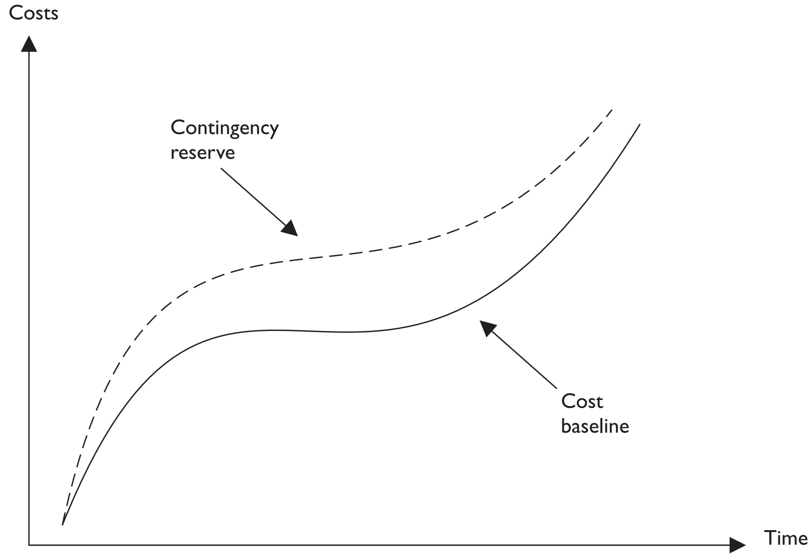


Figure 7-4 Contingency reserve provides funding for cost overruns.

Controlling Project Costs (PMBOK, Section 7.3)

Once a project has been funded, it's up to the project manager and the project team to work effectively and efficiently to control costs. This means doing the work right the first time.. It also means, and this is tricky, avoiding scope creep and undocumented changes, as well as getting rid of any non-value-added activities. Basically, if the project team is adding components or features that aren't called for in the project, they're wasting time and money.

Cost control focuses on controlling the ability of costs to change and on how the project management team may allow or prevent cost changes from happening. When a change does occur, the project manager must document the change and the reason why it occurred and, if necessary, create a variance report. Cost control is concerned with understanding why the cost variances, both good and bad, have occurred. The "why" behind the variances allows the project manager to make appropriate decisions on future project actions.

EXAM TIP Variance reports are sometimes called exception reports.

Ignoring the project cost variances may cause the project to suffer from budget shortages, additional risks, or scheduling problems. When cost variances happen, they must be examined, recorded, and investigated. Cost control allows the project manager to confront the problem, find a solution, and then act accordingly. Specifically, cost control focuses on:

- Controlling causes of change to ensure that the changes are actually needed
- Controlling and documenting changes to the cost baseline as they happen
- Controlling changes in the project and their influence on cost

- Performing cost monitoring to recognize and understand cost variances
- Recording appropriate cost changes in the cost baseline
- Preventing unauthorized changes to the cost baseline
- Communicating the cost changes to the proper stakeholders
- Working to bring and maintain costs within an acceptable range

Managing the Project Costs

Controlling the project costs is more than a philosophy—it's the project manager working with the project team, the stakeholders, and often management to ensure that costs don't creep into the project and then managing the cost increases as they happen. To implement cost control, the project manager must rely on several documents and processes:

- **Cost baseline** You know this one already. The cost baseline is the expected cost the project will incur and when those expenses will happen. This time-phased budget reflects the amount that will be spent throughout the project. Recall that the cost baseline is a tool used to measure project performance.
- **Project funding requirements** The funds for a project are not allotted all at once, but stair-stepped in alignment with project deliverables. Thus, as the project moves towards completion, additional funding is allotted. This allows for cash-flow forecasting. In other words, an organization doesn't have to have the project's entire budget allotted at the start of the project, but it can predict, based on expected income, that the budget will be available in incremental steps.
- **Performance reports** These reports focus on project cost performance, project scope, and planned performance versus actual performance. The reports may vary according to stakeholder needs. We'll discuss performance reporting in detail in Chapter 10 and everyone's favorite, earned value management, in just one moment.
- **Change requests** When changes to the project scope are requested, an analysis of the associated costs to complete the proposed change is required. In some instances, such as when removing a portion of the project deliverable, a change request may reduce the project cost. (I know, that's wishful thinking; but in PMI's world, it's possible.)
- **Cost management plan** The cost management plan dictates how cost variances will be managed. A variance is a difference between what was expected and was experienced. In some instances, the management contingency reserve allowance can "cover" the cost overruns. In other instances, depending on the reason why the overrun occurred, the funding may have to come from the project customer. Consider a customer who wanted the walls painted green and after the work was completed, changed his mind and wanted the walls orange. This cost overrun is due only to a change request and not a defect.

Creating a Cost Change Control System

Way, way back in Chapter 5, I discussed the scope change control system. Whenever some joker wants to add something to the project scope, or even take something out of our project scope, the scope change control system is engaged. Similarly, the cost change control system examines any changes associated with scope changes, the costs of materials, and the cost of any other resources you can imagine.

When a cost change enters the system, there is appropriate paperwork, a tracking system, and procedures the project manager must follow to obtain approval on the proposed change. Figure 7-5 demonstrates a typical workflow for cost change approval. If a change gets approved, the cost baseline is updated to reflect the approved changes. If a request gets denied, the denial must be documented for future potential reference. You don't want a stakeholder wondering why his or her change wasn't incorporated into the project scope at the end of the project without some documenting as to why.

EXAM TIP There are four specific change control systems in project management: scope change control system, schedule change control system, cost change control system, and the contract change control system.

Using Earned Value Management (PMBOK, Section 7.3.2)

When I teach a PMP Boot Camp, attendees snap to attention when it comes to earned value management and their exam. This topic is foreign to many folks, and they understandably want an in-depth explanation of this suite of mysterious formulas. Maybe you find yourself in that same position, so here's some good news: it's not that big of a deal. Relax—you can memorize these formulas, answer the exam questions correctly, and worry about tougher exam topics. I'll show you how.

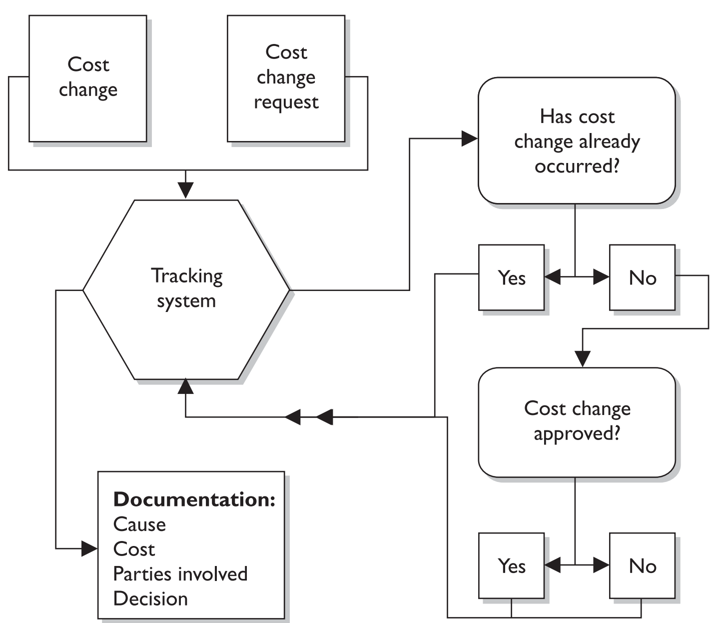


Figure 7-5 A cost change control system examines all cost changes.

First, earned value management (EVM) is the process of measuring the performance of project work against what was planned to identify variances, opportunities to improve the project, or just to check the project's health. EVM can help predict future variances and the final costs at completion. It is a system of mathematical formulas that compares work performed against work planned and measures the actual cost of the work your project has performed. EVM is an important part of cost control, since it allows a project manager to predict future variances from the expenses to date within the project.

Learning the Fundamentals

EVM, in regards to cost management, is concerned with the relationships between three formulas that reflect project performance. Figure 7-6 demonstrates the connection between the following EVM values:

- **Planned value (PV)** Planned value is the work scheduled and the budget authorized to accomplish that work. For example, if a project has a budget of $500,000 and month six represents 50 percent of the project work, the PV for that month is $250,000.
- **Earned value (EV)** Earned value is the physical work completed to date and the authorized budget for that work. For example, if your project has a budget of $500,000 and the work completed to date represents 45 percent of the entire project work, its earned value is $225,000. You can find EV by multiplying the percent complete times the project's budget at completion (BAC).
- **Actual cost (AC)** Actual cost is the actual amount of monies the project has required to date. In your project, your BAC, for example, is $500,000 and your earned value is $225,000. As it turns out, your project team had some waste, and you actually spent $232,000 in actual monies to reach the 25-percent-complete milestone. Your actual cost is $232,000.

That's the fundamentals of earned value management. All of our remaining formulas center on these simple formulas. Just remember that earned value is always the

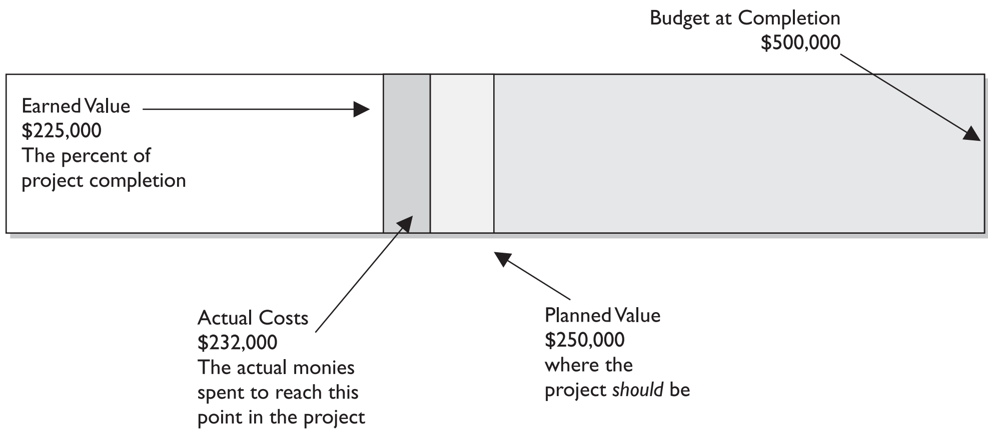


Figure 7-6 Earned value management shows project performance.

percent of work complete times the given budget at completion. On your PMI exam, you'll always be provided with the actual costs, which are the monies that have already been spent on the project. You'll have to do some math to find the planned value; it's the value where your project should be by a given time. The formula for planned value is the percentage of project completion based on where the project should be at a given time. For example, let's say you're supposed to be 80 percent complete by December 15. If your budget is $100,000, in this instance, your planned value is $80,000.

Finding the Project Variances

Out in the real world, I'm sure your projects are never late and never over budget (ha-ha—pretty funny, right?). For your exam you'll need to be able to find the cost and schedule variances for your project. I'll stay with the same $500,000 budget I've been working with in the previous examples and as demonstrated in Figure 7-7. Finding the variances helps the project manager and management determine a project's health, set goals for project improvement, and benchmark projects against each other based on the identified variances.

Finding the Cost Variance

Let's say your project has a BAC of $500,000 and you're 40 percent complete. You have spent, however, $234,000 in real monies. To find the cost variance, we'll find the earned value, which is 40 percent of the $500,000 budget. As Figure 7-7 shows, this is $200,000. In this example, you spent $234,000 in actual costs. The formula for finding the cost variance is earned value minus actual costs. In this instance, the cost variance is negative $34,000.

This means you've spent $34,000 dollars *more* than what the work you've done is worth. Of course, the $34,000 is in relation to the size of the project. On this project, that's a sizeable flaw, but on a billion-dollar project, $34,000 may not mean too much. On either project, a $34,000 cost variance would likely spur a cost variance report (sometimes called an exceptions report).

Finding the Schedule Variance

Can you guess how the schedule variance works? It's basically the same as cost variance, only this time, we're concerned with planned value instead of actual costs. Let's say your project with the $500,000 budget is supposed to be 45 percent complete by today, but

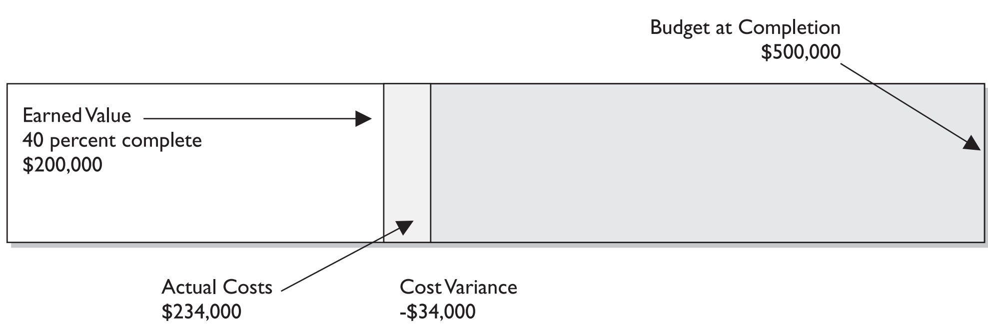


Figure 7-7 Cost variance is the difference between earned value and actual costs.

we know that you're only 40 percent complete. We've already found the earned value as $200,000 now for the planned value.

Recall that planned value, where you're supposed to be and what you're supposed to be worth, is planned completion times the BAC. In this example, it's 45 percent of the $500,000 BAC, which is $225,000. Uh-oh! You're behind schedule. The schedule variance formula, as Figure 7-8 demonstrates, is earned value minus the planned value. In this example, the schedule variance is $25,000.

Finding the Indexes

In mathematical terms, an index is an expression showing a ratio—and that's what we're doing with these indexes. Basically, an index in earned value management shows the health of the project's time and cost. The index, or ratio, is measured against one: The closer to one the index, the better the project is performing. As a rule, you definitely don't want to be less than one, as that's a poorly performing project. And, believe it or not, you don't want to be too far above one in your index, as this shows estimates that were bloated or way, way too pessimistic. Really.

Finding the Cost Performance Index

The cost performance index (CPI) measures the project based on its financial performance. It's an easy formula: earned value divided by actual costs, as Figure 7-9 demonstrates. Your project, in this example, has a budget of $500,000 and you're 40 percent complete with the project work. This is an earned value of how much? Yep. It's 40 percent of the $500,000, for an earned value of $200,000.

Your actual costs for this project to date (the cumulative costs) totals $234,000. Your PMI exam will always tell you your actual costs for each exam question. Let's finish the formula. To find the CPI, we divide the earned value by the actual costs, or $200,000 divided by $234,000. The CPI for this project is .85, which means that we're 85 percent on track financially, not too healthy for any project, regardless of its budget.

Another fun way to look at the .85 value is that you're actually losing 15 cents on every dollar you spend on the project. Yikes! That means for every dollar you spend for labor, you actually only get 85 cents worth. Not a good deal for the project manager. As you can guess, the closer to one, the better the project is performing.

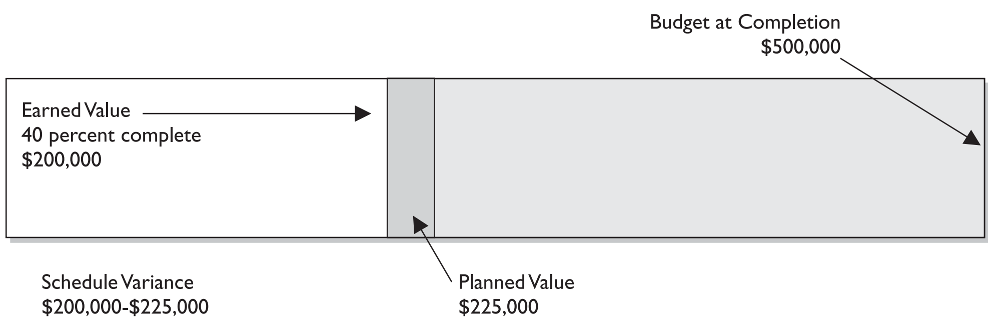


Figure 7-8 Schedule variance is the difference of earned value and planned value.

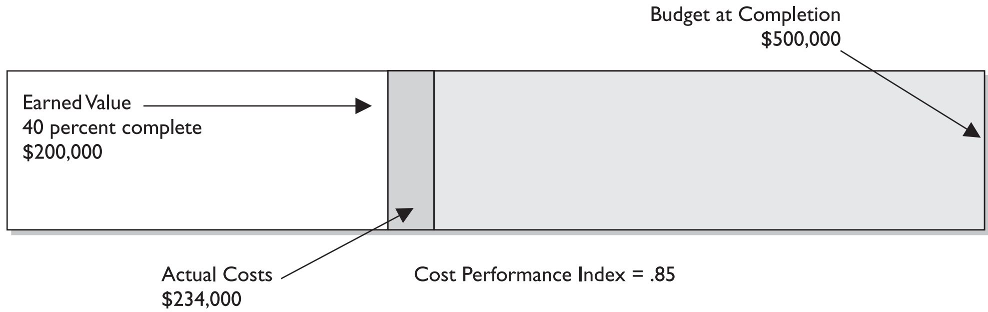


Figure 7-9 The CPI is found by dividing earned value by the actual costs.

Finding the Schedule Performance Index

The schedule performance index (SPI) measures the project schedule's overall health. The formula, as Figure 7-10 demonstrates, is earned value divided by planned value. In other words, you're trying to determine how closely your project work is being completed in relation to the project schedule you created. Let's try this formula out.

Your project with the $500,000 budget is 40 percent complete, for an earned value of $200,000, but you're supposed to be 45 percent complete by today. That's a planned value of $225,000. The SPI for this project at this point in time is determined by dividing the earned value of $200,000 by the planned value of $225,000, for an SPI of .88. This tells me that this project is 88 percent on schedule, or, if you're a pessimist, the project is 12 percent off track.

Predicting the Project's Future

Notice in the preceding paragraph I said, "at this point in time." That's because the project will, hopefully, continue to make progress and the planned value and earned value numbers will change. Naturally, as the project moves towards completion, the earned value amounts will increase and so will the planned value numbers. Typically, these indexes, both schedule and costs, are measured at milestones, and they allow the project management team to do some prognosticating as to where the project will likely end up by its completion. That's right—we can do some forecasting.

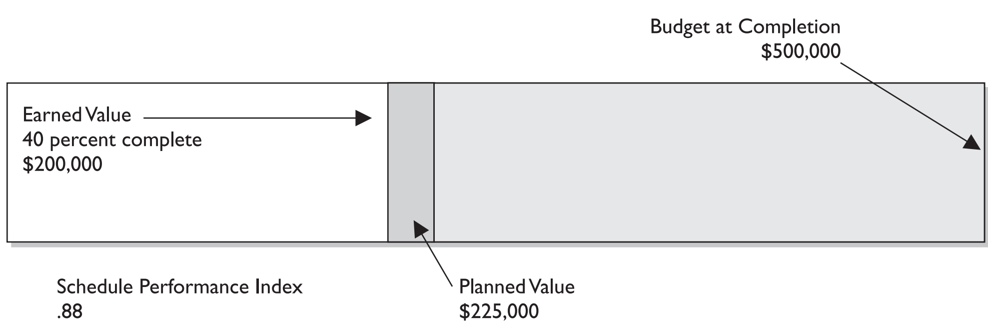


Figure 7-10 The SPI is found by dividing the earned value by the planned value.

EXAM TIP The forecasting formulas are swift and easy to calculate, but they're not really all that accurate. After all, you never really know how much a project will cost until you've completed all of the project work.

Finding the Estimate to Complete

So your project is in a pickle and management wants to know how much more this project is going to cost. They're after the estimate to complete (ETC) equation. There are three flavors of this formula, based on conditions within your project.

ETC Based on a New Estimate Sometimes you just have to accept the fact that all of the estimates up to this point are flawed and you need a new estimate. Imagine a project where the project manager and the project team estimate that the work will cost $150,000 in labor, but once they get into the project, they realize it'll actually cost $275,000 in labor because the work is much harder than they anticipated. That's a reason for the ETC on a new estimate.

ETC Based on Atypical Variances This formula, shown in Figure 7-11, is used when the project has experienced some wacky fluctuation in costs and the project manager doesn't believe the anomalies will continue within the project. For example, the cost of wood was estimated at $18 per sheet. Due to a hurricane in another part of the country, however, the cost of wood has changed to $25 per sheet. This fluctuation in the cost of materials has changed, but the project manager doesn't believe the cost change will affect the cost to deliver the other work packages in the WBS. Here's the formula for atypical variances: ETC=BAC-EV.

Let's say that this project has a BAC of $500,000 and is 40 percent complete. The earned value is $200,000, so our ETC formula would be ETC = $500,000-$200,000, for an ETC of $300,000. Obviously, this formula is shallow and won't be the best forecasting formula for every scenario. If the cost of the materials has changed drastically, a whole new estimate would be more appropriate.

ETC Based on Typical Variances Sometimes in a project, a variance appears and the project management team realizes that this is going to continue through the rest of the project. Figure 7-12 demonstrates the formula: ETC = (BAC-EV)/CPI. For example, consider a project to install 10,000 light fixtures throughout a university campus. You and the project team have estimated it'll take 12,000 hours of labor to install all of the lights, and your cost estimate is $54 per hour, which equates to $648,000 to complete all of the installations.

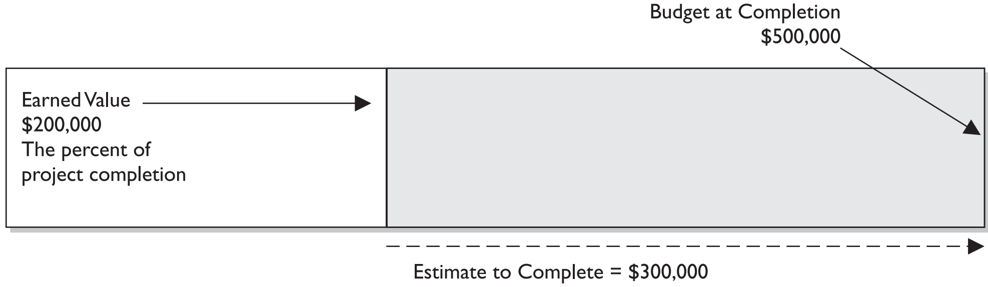


Figure 7-11 The estimate to complete can consider atypical variances.

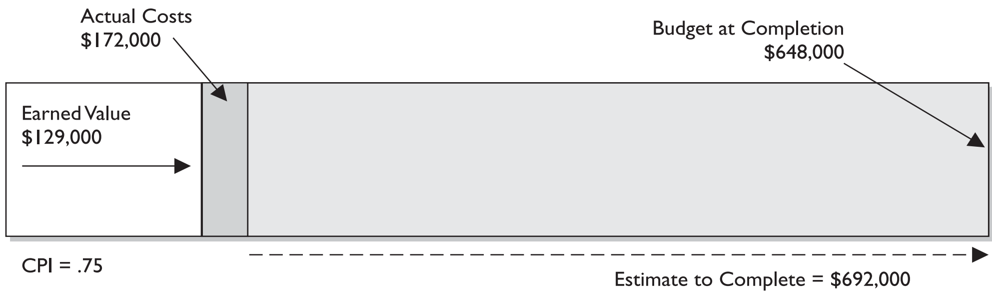


Figure 7-12 ETC may consider expected variances within a project.

As the project team begins work on the install, however, the time to install the light fixtures actually takes slightly longer than anticipated for each fixture. You realize that your duration estimate is flawed and will likely take the project team 16,000 hours of labor to install all of the lights.

The ETC in this formula requires that the project manager know the earned value and the cost performance index. Let's say that this project is 20 percent complete, so the EV is $129,600. As the work is taking longer to complete, the actual costs to reach the 20 percent mark turns out to be $172,000. The CPI is found by dividing the earned value, $129,600, by the actual costs of $172,000. The CPI for this project is .75.

Now let's try out ETC formula: (BAC-EV)/CPI, or ($648,000-$129,600)/.75, which equates to $691,200. That's $691,200 more than this project will need in its budget to complete the remainder of the project work. Yikes!

Finding the Estimate at Completion

One of the most fundamental forecasting formulas is the estimate at completion (EAC). This formula accounts for all those pennies you're losing on every dollar if your CPI is less than one. It's an opportunity for the project manager to say, "Hey! Based on our current project's health, this is where we're likely to end up at the end of the project. I'd better work on my resume." Let's take a look at these formulas.

EAC Using a New Estimate Just like the estimate to complete formulas, sometimes it's best just to create a whole new estimate. This approach with the EAC is pretty straightforward—it's the actual costs plus the estimate to complete. Let's say your project has a budget of $500,000 and you've already spent $187,000 of it. For whatever reason, you've determined that your estimate is no longer valid and your ETC for the project is actually going to be $420,000—that's how much you're going to need to finish the project work. The EAC, in this instance, is the actual costs of $187,000 plus your ETC of $420,000, or $607,000.

EAC with Atypical Variances Sometimes, there are anomalies within a project that can skew the project's estimate at completion. The formula for this scenario, as Figure 7-13 demonstrates, is the actual costs plus the budget at completion minus the earned value. Let's try it out. Your project has a BAC of $500,000 and the earned value is $100,000. However, you've spent $127,000 in actual costs. The EAC would be $127,000+$500,000-$100,000, or $527,000. That's your new estimate at completion for this project.

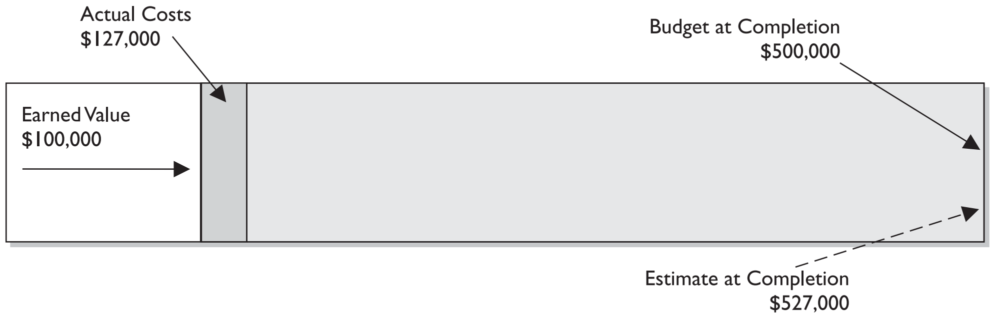


Figure 7-13 The EAC can also account for anomalies in a project's expenses.

EAC Using the CPI If a project has a CPI of .97, you could say the project is losing three pennies on every dollar. Those three pennies are going to add up over time. This approach is most often used when the project manager realizes that the cost variances are likely going to continue through the remainder of the project. This formula, as Figure 7-14 demonstrates, is EAC = AC+((BAC-EV)/CPI). Don't you just love nested formulas? Let's try this one out.

Your project has a BAC of $500,000 and your earned value is $150,000. Your actual costs for this project are $162,000. Your CPI is calculated as .93. The EAC would be $162,000+(($500,000-$150,000)/.93), or $538,344. Wasn't that fun?

EXAM TIP There won't be as many questions on these EVM formulas as you'd hope, but knowing these formulas can help you nail down the few questions you'll likely have.

Finding Big Variances

Two variances relate to the entire project, and they're both easy to learn. The first variance you don't really know until the project is 100 percent complete. This is the project variance, and it's simply BAC-AC. If your project had a budget of $500,000 and you spent $734,000 to get it all done, then the project variance is $500,000-$734,000, which equates, of course, to -$234,000.

The second variance is part of our forecasting model, and it predicts what the project variance will likely be. It's called the variance at completion (VAC), and the formula

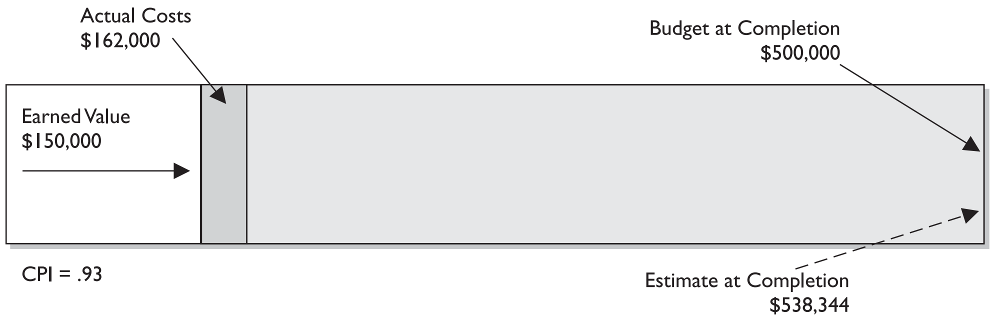


Figure 7-14 The EAC can also use the CPI as a modifier.

Name	Formula	Sample Mnemonic Device
Variance	VAR = BAC – AC	Victor
Earned Value	EV = % complete × BAC	Eats
Cost Variance	CV = EV – AC	Carl's
Schedule Variance	SV = EV – PV	Sugar
Cost Performance Index	CPI = EV/AC	Corn
Schedule Performance Index	SPI = EV/PV	S (This and the following two spell "SEE")
Estimate at Completion	EAC = BAC/CPI	E
Estimate to Complete	ETC = EAC – AC	E
Variance at Completion	VAC = BAC – EAC	Victor

Table 7-1 Simple Ways to Memorize EVM Formulas

is VAC=BAC-EAC. Let's say your project has a BAC of $500,000 and your EAC is predicted to be $538,344. The VAC is $500,000-$538,344, for a predicted variance of $38,344. Of course, this formula assumes that the rest of the project will run smoothly. In reality, where you and I hang out, the project's VAC could swing in either direction based on the project's overall performance.

Using Earned Value Management Variations

Like most things in project management, there's usually more than one way to do the same work. I'm happy to report that earned value management works the same way. The formulas I provided previously are accurate, somewhat reliable, and straight out of the PMBOK. However, there are some alternative formulas that you could use to save some of the headaches in memorizing these complex formulas, especially with the ETC and the EAC formulas.

Table 7-1 provides a quick reference for all of these nifty formulas and a mnemonic for memorizing the most common earned value formulas.

Chapter Summary

Projects require resources and time, both of which cost money. Projects are estimated, or predicted, on how much the project work will likely cost to complete. There are multiple flavors and approaches to project estimating. Project managers can use analogous estimating, parametric estimating, or, the most reliable, bottom-up estimating. Whatever estimating approach the project manager elects to use, the basis of the estimate should be documented should the estimate ever be called into question.

When a project manager creates the project estimate, he should also factor in a contingency reserve for project risks and cost overruns. Based on the enterprise environmental factors of an organization, and often the project priority, the process to create and receive the contingency reserve may fluctuate. The contingency reserve is not an allowance to be spent at the project manager's discretion, but more of a safety net should the project go awry. Variances covered by the contingency reserve can't be swept under the rug, but must be accounted for and hopefully learned from.

Cost budgeting is the aggregation of the costs to create the work packages in the WBS. Sometimes, cost budgeting refers to the cost aggregation as the "roll-up" of the costs associated with each work package. Cost budgeting effectively applies the cost estimates over time. Most project managers don't receive the entire project funding in one swoop, but rather in step functions over the life of the project.

Once the project moves from planning into execution, it also moves into monitoring and control. The project manager and the project team work together to control the project costs and monitor the performance of the project work. The most accessible method to monitor the project cost is through earned value management. Earned value management demonstrates the performance of the project and allows the project manager to forecast where the project is likely going to end up financially.

Key Terms

Actual cost (AC) The actual amount of monies the project has spent to date.

Analogous estimating An approach that relies on historical information to predict the cost of the current project. It is also known as top-down estimating, and is the least reliable of all the cost estimating approaches.

Bottom-up estimating An estimating approach that starts from zero, accounts for each component of the WBS, and arrives at a sum for the project. It is completed with the project team, and can be one of the most time-consuming and most reliable methods to predict project costs.

Budget estimate This estimate is also somewhat broad, and is used early in the planning processes and also in top-down estimates. The range of variance for the estimate can be from –10 percent to +25 percent.

Commercial database A cost estimating approach that uses a database, typically software-driven, to create the cost estimate for a project.

Contingency reserve This is a contingency allowance to account for overruns in costs. The contingency allowances are used at the project manager's discretion and with management's approval to counteract cost overruns for schedule activities.

Cost aggregation Costs are parallel to each WBS work package. The costs of each work package are aggregated to their corresponding control accounts. Each control account then is aggregated to the sum of the project costs.

Cost baseline A time-lapse exposure of when the project's monies are to be spent in relation to cumulative values of the work completed in the project.

Cost budgeting The cost aggregation achieved by assigning specific dollar amounts for each of the scheduled activities or, more likely, for each of the work packages in the WBS. Cost budgeting applies the cost estimates over time.

Cost change control system A system that examines any changes associated with scope changes, the costs of materials, and the cost of any other resources and the associated impact on the overall project cost.

Cost management plan The cost management plan dictates how cost variances will be managed.

Cost of poor quality The monies spent to recover from not adhering to the expected level of quality. Examples may include rework, defect repair, loss of life or limb because safety precautions were not taken, loss of sales, and loss of customers.

Cost of quality The monies spent to ascertain the expected level of quality within a project. Examples include training, testing, and safety precautions.

Cost performance index (CPI) Measures the project based on its financial performance. The formula is CPI = EV/AC.

Cost variance (CV) The difference of the earned value amount and the cumulative actual costs of the project. The formula is CV = EV-AC.

Definitive estimate This estimate type is one of the most accurate. It's used late in the planning processes and is associated with bottom-up estimating. You need the WBS in order to create the definitive estimate. The range of variance for the estimate can be from –5 percent to +10 percent.

Direct costs Costs are attributed directly to the project work and cannot be shared among projects (for example, airfare, hotels, long distance phone charges, and so on).

Earned value (EV) Earned value is the physical work completed to date and the authorized budget for that work. It is the percentage of the BAC that represents the actual work completed in the project.

Estimate at completion (EAC) These forecasting formulas predict the likely completed costs of the project based on current scenarios within the project.

Estimate to complete (ETC) An earned value management formula that predicts how much funding the project will require to be completed. There are three variations of this formula, based on conditions the project may be experiencing.

Fixed costs Costs that remain constant throughout the life of the project (the cost of a piece of rented equipment for the project, the cost of a consultant brought on to the project, and so on).

Funding limit reconciliation An organization's approach to managing cash flow against the project deliverables based on a schedule, milestone accomplishment, or data constraints.

Indirect costs These are costs that are representative of more than one project (for example, utilities for the performing organization, access to a training room, project management software license, and so on).

Known unknown An event that will likely happen within the project, but when it will happen and to what degree is unknown. These events, such as delays, are usually risk-related.

Learning curve An approach that assumes the cost per unit decreases the more units workers complete because workers learn as they complete the required work.

Oligopoly A market condition where the market is so tight that the actions of one vendor affect the actions of all the others.

Opportunity cost The total cost of the opportunity that is refused to realize an opposing opportunity.

Parametric estimating An approach using a parametric model to extrapolate what costs will be for a project (for example, cost per hour and cost per unit). It can include variables and points based on conditions.

Parametric estimating Uses a mathematical model based on known parameters to predict the cost of a project.

Planned value (PV) Planned value is the work scheduled and the budget authorized to accomplish that work. It is the percentage of the BAC that reflects where the project should be at this point in time.

Project variance The final variance, which is discovered only at the project's completion. The formula is VAR = BAC-AC.

Regression analysis This is a statistical approach to predicting what future values may be, based on historical values. Regression analysis creates quantitative predictions based on variables within one value to predict variables in another. This form of estimating relies solely on pure statistical math to reveal relationships between variables and to predict future values.

Reserve analysis Cost reserves are for unknown unknowns within a project. The contingency reserve is not part of the project's cost baseline, but is included as part of the project budget.

Rough order of magnitude This rough estimate is used during the initiating processes and in top-down estimates. The range of variance for the estimate can be from –25 percent to +75 percent.

Schedule performance index (SPI) Measures the project based on its schedule performance. The formula is SPI = EV/PV.

Schedule variance (SV) The difference between the earned value and the planned value. The formulas is SV = EV-PV.

Single source Many vendors can provide what your project needs to purchase, but you prefer to work with a specific vendor.

Sole source Only one vendor can provide what your project needs to purchase. Examples include a specific consultant, specialized service, or unique type of material.

Sunk costs Monies that have already been invested in a project.

Variable costs Costs that change based on the conditions applied in the project (the number of meeting participants, the supply and demand of materials, and so on).

Variance A variance is the difference between what was expected and what was experienced.

Variance at completion (VAC) A forecasting formula that predicts how much of a variance the project will likely have based on current conditions within the project. The formula is VAC = BAC-EAC.

Questions

1. You are using a previous similar project to predict the costs of the current project. Which of the following best describes analogous estimating?
   - **A.** Regression analysis
   - **B.** Bottom-up estimating
   - **C.** Organizational process assets
   - **D.** Enterprise environmental factors
2. You are the project manager for a new technology implementation project. Management has requested that your estimates be as exact as possible. Which one of the following methods of estimating will provide the most accurate estimate?
   - **A.** Top-down estimating
   - **B.** Top-down budgeting
   - **C.** Bottom-up estimating
   - **D.** Parametric estimating
3. What does the cost change control system do?
   - **A.** It defines the methods to change the cost baseline.
   - **B.** It defines the methods to create the cost baseline.
   - **C.** It evaluates changes to the project costs based on changes to the project scope.
   - **D.** This is not a valid change control system.
4. You have just started a project for a manufacturer. Project team members report they are 30 percent complete with the project. You have spent $25,000 of the project's $250,000 budget. What is the earned value for this project?
   - **A.** 10 percent
   - **B.** $75,000
   - **C.** $25,000
   - **D.** Not enough information to know

5. You and your project team are about to enter a meeting to determine project costs. You have elected to use bottom-up estimating and will base your estimate on the WBS. Which one of the following is not an attribute of bottom-up estimating?
   A. People doing the work create the estimates.
   B. It creates a more accurate estimate.
   C. It's more expensive to do than other methods.
   D. It's less expensive to do than other methods.
6. You are the project manager for a consulting company. Your company has two possible projects to manage, but they can only choose one. Project WQQ is worth $217,000, while Project LB is worth $229,000. Management elects to choose Project LB. The opportunity cost of this choice is which one of the following?
   A. $12,000
   B. $217,000
   C. $229,000
   D. Zero, as project LB is worth more than Project WQQ
7. You are the project manager for the CSR Training Project, and 21,000 customer service reps are invited to attend the training session. Attendance is optional. You have calculated the costs of the training facility, but the workbook expense depends on how many students register for the class. For every 5,000 workbooks created, the cost is reduced by a percentage of the original printing cost. The workbook expense is an example of which one of the following?
   A. Fixed costs
   B. Parametric costs
   C. Variable costs
   D. Indirect costs
8. You are the project manager of a construction project scheduled to last 24 months. You have elected to rent a piece of equipment for the project's duration, even though you will need the equipment only periodically throughout the project. The costs of the equipment rental per month are $890. This is an example of which of the following?
   A. Fixed costs
   B. Parametric costs
   C. Variable costs
   D. Indirect costs

9. You are the project manager of the BHG Project. Your BAC is $600,000. You have spent $270,000 of your budget. You are now 40 percent done with the project, though your plan called for you to be 45 percent done with the work by this time. What is your CPI?
   - A. 100
   - B. 89
   - C. .89
   - D. .79
10. Management has requested that you complete a definitive cost estimate for your current project. Which one of the following must exist in order to complete this estimate?
    - A. Project scope statement
    - B. Work breakdown structure
    - C. Project team
    - D. Expert judgment
11. You need to procure a highly specialized chemical for a research project. There is only one vendor available that provides the materials you need. This scenario is an example of what market condition?
    - A. Constraint
    - B. Single source
    - C. Sole source
    - D. Oligopoly
12. Of the following cost estimating inputs, which one is the least reliable?
    - A. Team member recollections
    - B. Historical information
    - C. Project files
    - D. Cost estimating templates
13. You can purchase pea gravel for your project at $437 per metric ton. You need four tons of the pea gravel, so you predict your costs will be $1,748. This is an example of which cost estimating approach?
    - A. Parametric
    - B. Analogous
    - C. Bottom-up
    - D. Top-down
14. Which one of the following is an example of resource cost rates that a project manager could use to predict the cost of the project?

A. Analogous estimating

B. Bottom-up estimating

C. Commercial database

D. Procurement bid analysis

15. You have created a cost estimate for a new project that you'll be managing in your organization. All of the following should be included in your cost estimate, except for which one?

A. Description of the schedule activity's project scope of work

B. Assumptions made

C. Constraints

D. Team members the project will utilize

16. Linda is the project manager of a construction project. The budget for her project is $275,000. The project team made a mistake early in the project that cost $34,000 in added materials. Linda does not believe the mistakes will likely happen again because the team is 30 percent complete with the project and things are once again going smoothly. Her sponsor wants to know how much more funding Linda will likely need on the project. What should Linda tell the sponsor?

A. $192,500

B. $241,000

C. $309,000

D. $275,000

17. A project had a budget of $750,000 and was completed on time. The project expenses, however, were 15 percent more than what the project called for. What is the earned value of this project?

A. It is impossible to know, as not enough information has been given.

B. $112,500

C. $637,500

D. $750,000

18. A project had a budget of $750,000 and was completed on time. The project expenses, however, were 15 percent more than what the project called for. What is the variance at completion for this project?

A. It is impossible to know, as not enough information has been given.

B. $112,500

C. $637,500

D. $750,000

19. Marty's project has a cost variance of \$44,000. He needs to complete what type of report?
    - A. Status report
    - B. Exceptions report
    - C. Forecast report
    - D. Lessons learned
20. You are a construction manager for a construction project. The project will be using a new material that the project team has never worked with before. You allot \$10,000 to train the project team on the new materials so that the project will operate smoothly. The \$10,000 for training is known as what?
    - A. Cost of quality
    - B. Cost of poor quality
    - C. Sunk costs
    - D. Contingency allowance

Answers

1. **C**. Analogous estimating is based on historical information, which is part of organizational process assets. A, regression analysis, is incorrect, as this choice describes the study of a project regressing so that it may move forward. B is incorrect, as this is the most reliable cost estimating technique and is based on the current project's WBS. D, enterprise environmental factors, is a term that describes the internal policies and procedures a project manager must follow within the project. For more information, see the PMBOK, Section 7.1.2.1.
2. **C**. Bottom-up estimating takes the longest to complete of all the estimating approaches, but it is also the most reliable approach. A, top-down estimating, is also known as analogous estimating, and it is not reliable. B, top-down budgeting, is not a valid term for this question. D, parametric estimating, is an approach that predicts the project costs based on a parameter, such as cost per hour, cost per unit, or cost per usage. For more information, see the PMBOK, Section 7.1.2.3.
3. **A**. The cost change control system defines how changes to the cost baseline may be approved. Choices B, C, and D are all invalid choices. For more information, see the PMBOK, Section 7.3.2.1.
4. **B**. Earned value is found by multiplying the percentage of the project that is completed by the project's budget at completion. In this instance, it's \$75,000. Choices A, C, and D are all incorrect. For more information, see the PMBOK, Section 7.3.2.2.
5. **D**. Bottom-up estimating is typically more expensive to do than other estimating approaches, because of the time required to create this type of estimate. A, B, and C are all accurate attributes of a bottom-up estimate. For more information, see the PMBOK, Section 7.1.2.3.

6. **B**. The opportunity cost is the amount of the project that the organization cannot do. A is incorrect, as the $12,000 represents the difference between the two projects. C, $229,000, is incorrect, as this is the amount of the LB project. D is incorrect because this is not an accurate statement. For more information, see the Exam Tip earlier in this chapter.
7. **C**. This is an example of a variable cost, since the cost of the training will fluctuate, based on the number of participants that choose to come to the project session. A is incorrect, as fixed costs do not vary. B is incorrect, as parametric costs can be identified as cost per unit. D is incorrect, as indirect costs are a way to describe costs that may be shared between projects. For more information, see the section "Determining the Cost of Resources" in this chapter.
8. **A**. This is an example of a fixed cost. The cost of the equipment will remain uniform, or fixed, throughout the duration of the project. B is incorrect, as parametric costs can be identified as cost per unit. C is incorrect, as the cost of the equipment does not fluctuate. D is incorrect, as indirect costs are a way to describe costs that may be shared between projects. For more information, see the section "Determining the Cost of Resources" earlier in this chapter.
9. **C**. The CPI is found by dividing the earned value by the actual costs. A is incorrect, as the project is not performing at 100 percent. B is incorrect, as "89" is not the same value of C. D is an incorrect calculation of the CPI. For more information, see the PMBOK, Section 7.3.2.2.
10. **B**. The WBS is needed in order to create a definitive cost estimate. This is the most accurate estimate type, but it also takes the longest to complete. Choices A, C, and D are all incorrect, as these items are not required to complete a definitive estimate. For more information, see the PMBOK, Section 7.1.2.
11. **C**. Sole source is the best choice, as it describes the marketplace condition in which only one vendor can provide the goods or services your project requires. A, constraint, is not a valid market condition. B, single source, describes the marketplace condition in which there are multiple vendors that can provide the goods or services your project demands, but you prefer to work with just one in particular. D, an oligopoly, is a market condition in which the actions of one vendor affect the actions of the other vendors. For more information, see the PMBOK, Section 7.1.1.1.
12. **A**. Team member recollections are the least reliable input to cost estimating. Choices B, C, and D are all valid inputs to the cost estimating process. For more information, see the PMBOK, Section 7.1.1.2.
13. **A**. The cost of the pea gravel is a parametric estimate. B, analogous, is not a correct choice, as no other project cost estimate is being referenced. C, bottom-up, is not described in this instance, as the WBS and each work package is not being estimated for cost. D, top-down estimating, is another name for A, analogous estimating, so this choice is invalid. For more information, see the PMBOK, Section 7.1.2.4.

14. **C**. Commercial databases often provide resource cost rates for project estimating, so this is the correct answer for this question. A, B, and D do not include resource cost rates, so these choices are all incorrect. For more information, see the PMBOK, Section 7.1.2.2.
15. **D**. The team members that the project manager will utilize are not included in the cost estimate. The project manager will include the project scope of work, the assumptions made, and the constraints considered when creating a cost estimate, so choices A, B, and C are incorrect answers. For more information, see the PMBOK, Section 7.1.3.2.
16. **A**. The formula for this instance, because the conditions experienced were atypical, is ETC = BAC-EV. The formula for Linda's project would be ETC = $275,000-$82,500. B, C, and D are all incorrect calculations of the estimate to complete the formula. For more information, see the PMBOK, Section 7.3.2.3.
17. **D**. The earned value is simply the percent complete times the BAC. In this instance, the project's budget was $750,000, and since the project is 100 percent complete, the answer is D. Choices A, B, and C are all incorrect. For more information, see the PMBOK, Section 7.3.2.
18. **B**. The formula for this problem is variance at completion minus the actual costs for the project. A, C, and D are all incorrect choices. For more information, see the PMBOK, Section 7.3.2.3.
19. **B**. Because Marty has a variance, he needs to complete a variance report. A variance report is also known as an exceptions report, so B is the best answer. A, status reports, are used to communicate the status of the project, not the variances. C is not a valid report type. D, lessons learned, is an ongoing project document, not a report type. For more information, see the PMBOK, Section 7.3.3.
20. **A**. Training for the project team is known as the cost of quality. B, the cost of poor quality, is incorrect because this would be the costs the project would incur if it did not ascertain the expected level of quality. Sunk costs describe the monies that have been spent on a project already, so C is not correct. D, contingency allowance, is an amount of fund allotted to cover cost overruns in a project. For more information, see the PMBOK, Section 7.1.2.8.

CHAPTER 8

Managing Project Quality

In this chapter, you will

- Plan for quality
- Work with quality assurance programs
- Perform quality control
- Recognize the quality control charts

What good does it do anyone if a project is launched and the monies and time are consumed by the project execution, but the quality of the project's deliverable is unacceptable? Imagine a project to build a new house, and at the project's completion, the house is tilting to one side, the windows all have cracks and holes in them, and the roof has obvious gaps for the rain and birds. This is not, I'm sure, what the homeowners had in mind.

Fortunately, in project management—in good project management—there are mechanisms in place to plan and implement quality throughout the project and not just as an afterthought. Project quality management is all about the project manager, the project team, and the performing organization working together to ensure that the project performs as the project plan calls for so that the project deliverable is in alignment with the project scope statement. Quality in a project is really all about creating a deliverable that satisfies the project requirements and is usable. It's about getting the project done and creating a deliverable that can actually be used by the project customer.

According to the American Society for Quality (ASQ), which the Project Management Body of Knowledge (PMBOK) quotes, "Quality is the degree to which a set of inherent characteristics fulfill requirements." Well, isn't that interesting? Let's go back in time. A project is launched and a project charter is issued to the project manager. Then the project manager and the project team create what document? The project scope statement. The project scope statement defines all of the requirements for the project, including what's in and what's out of scope. Quality is, therefore, satisfying everything that the project scope statement requires.

The PMBOK says that "stated and implied needs are the needs to developing project requirements." In the project scope statement, we define what the project will create, its requirements for acceptance, and the metrics to measure the project's success. In project quality management, we plan quality into the project, inspect the project and deliverables for the existence of quality, and then move towards the scope verification process, which confirms that you've created what your customer expected. Quality is about delivering on promises.

No discussion on quality is complete without a nod to our pal W. Edwards Deming. You likely won't need to know much about Deming for the exam, other than his famed Plan-Do-Check-Act cycle. (I highly recommend Mary B. Walton's book *The Deming Management Method* for the complete story of Deming—maybe after you pass your Project Management Institute [PMI] examination.) For your PMP and CAPM exams, know that Deming's philosophy on quality management considers customer satisfaction, prevention over inspection, a call for management responsibility, and a desire to do the work correctly the first time to be paramount.

VIDEO Examining quality control.

This chapter, I believe, is core to PMI's idea of project integration management. If quality suffers, then all of the knowledge areas are affected by the absence of quality. You can also see the effect on integration management if any of the other knowledge areas suffers in performance. Quality is directly affected by all of the other areas of project management, and there is equal impact on all the other knowledge areas if quality is missing. It's a busy, two-way street.

Planning for Quality (PMBOK, Section 8.1)

Quality planning is the process of first determining which quality standards are relevant to your project and then finding out the best methods of adhering to those quality standards. This is a great example of project integration management, which was referred to earlier. Quality planning is core to the planning process group, as each knowledge area has relevant standards that affect quality, and quality planning is integrated into each planning process.

In other words, if a project manager rushes through planning for each of the knowledge areas, then quality is likely to suffer. When change requests are proposed, the impact of each change request is considered on each of the knowledge areas. You already know that a change request could have a financial impact, a schedule impact, and more. Quality management asks: What impact does quality have on this proposed change, and what impact does this change have on the overall quality of the project?

Throughout the project planning, the focus is on reaching the project completion by satisfying the project requirements. Quality is fleshed into all of the project planning. The foundation of quality planning states that quality is planned into the project, not inspected in. In other words, by planning how to achieve the expected level of quality and then executing the project plan, it's easier, more cost effective, and less stressful for everyone involved than catching and fixing mistakes as the project moves towards completion. Like my dad used to say, "Do it right the first time."

There are just four inputs when planning for quality in a project, and you've seen them all before:

- **Enterprise environmental factors** You know that enterprise environmental factors are the policies and procedures your organization must adhere to. In particular, the enterprise environmental factors I'm discussing here are those mandates that affect the application area your project is dealing with. In other words, construction projects are going to have different codes and regulations to adhere to than a project to bake a million cookies.

- **Organizational process assets** These are the methods of operation your organization follows and the guidelines that are specific to your organization. Historical information, lessons learned, and guidelines within your organization are there for the project managers to rely on. Within the organization, a quality policy may have been issued by senior management for all projects to adhere to—this is part of organizational process assets. And what if a quality policy doesn't exist? It's up to the project management team to create one for their project.
- **Project scope statement** The project scope statement is needed because it defines all of the project requirements and the expectations of the project customer. By satisfying the requirements in the project scope statement, nothing less or more, quality can be achieved. The goal of project quality management is to satisfy the acceptance criteria for the project as defined in the project scope statement.
- **Project management plan** This shouldn't be a surprise. All of the subsidiary plans in the project plan are needed to see quality's impact on each knowledge area and vice versa.

Using Quality Planning Tools

There are several tools the project manager and the project team can use to plan for quality in the project. The goal of all of these tools is to plan quality into the project rather than attempt to inspect quality into the project. In other words, do the work right the first time. Let's take a look at these tools and how the project manager and the project team can use them to their benefit.

Using a Cost-Benefit Analysis

Ever go shopping and compare prices? For example, you might consider the cost of two cars in relation to features both cars provide. Or you might consider hiring a more experienced worker because he or she has some competencies that make the extra dollars worth the costs. Part of planning for quality is moving through this process of cost-benefits analysis.

Using a cost-benefits analysis is more than just considering how much for features and materials used in the project deliverable, although that is part of the process. Cost-benefits analysis also considers the cost of completing the project work and the best approach to achieving quality in the project in relation to the monies to complete the work. For example, you could always use senior engineers to complete even the most menial tasks, but that wouldn't be a good use of their time or of the monies to pay for the senior engineers' time. Figure 8-1 is an example of using a cost-benefits analysis.

Cost-benefits analysis is simply the study of the quality received in proportion to the cost to reach those quality expectations. The project management team must understand how much monies are appropriate to spend to reach satisfaction from the project customer. If the project spends too much to reach a level of quality that is far beyond what the customer expects, or wants, then that's waste. The same is true if the project team does less than the level of quality the customer expects and rework is needed.

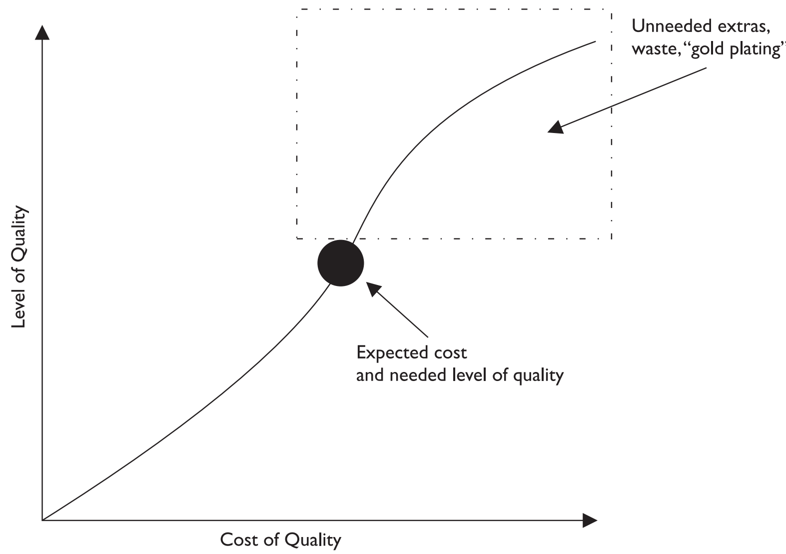


Figure 8-1 Quality should meet, not exceed, customer's expectations.

Benchmarking Performance

Benchmarking is simply comparing two similar things to measure which one performs best. For example, you could benchmark the same activities on two different computers, test-drive several different cars, or even benchmark an organization before and after a project. Benchmarking, in regards to quality planning, examines project practices against other projects to measure performance, and then selects the best practices for performance in the current project.

Using Design of Experiments

The design of experiments approach relies on statistical what-if scenarios to determine what variables within a project will result in the best outcome. This type of approach is most often used on the product of the project rather than the project itself. For example, a project team creating a new bicycle may experiment with the width of the tires, the weight of the frame, and the position of the handlebars in relation to the bike seat to determine the most comfortable ride at an acceptable cost to the consumer.

Although design of experiments is most often associated with product design, it can be applied to project management activities. For example, a project manager may evaluate the activities within a project and determine the time and cost of activities, depending on which employees are assigned to complete the work. A more experienced worker may cost the project more money on an hourly basis, but this individual is expected to complete the work in a third of the time that a less experienced worker would. This is design of experiments: experimenting with different variables to find the best solution at the best cost.

Design of experiments is also used as a method to identify which variables within a project or product are causing failures or unacceptable results. The goal of design of experiments is to isolate the root cause of an effect and then make adjustments to that cause to eliminate the unacceptable results.

Considering the Cost of Quality

The cost of quality (COQ) is a consideration of how much must be spent to achieve the expected level of quality within the project. There are two types of costs directly tied to quality:

- **Cost of quality** This is the cost associated with the monies spent to ascertain the expected level of quality. For example, training, safety issues, and purchasing the right equipment and materials all contribute to the expected levels of quality. This is sometimes called the cost of conformance to quality.
- **Cost of poor quality** This is the cost associated with not satisfying the cost expectations. For example, if the project manager does not train the project team, or if the correct materials are not used in the project implementation, quality will suffer and additional costs will be incurred to do the work over. Cost of poor quality can also result in rejected deliverables, loss of sales and customers, and, if safety concerns are not kept, there could be loss of life or limb.

Using Other Quality Planning Tools

There are lots of other tools and approaches the project manager can use to plan for quality within the project. The PMBOK just lumps these into one section (Section 8.1.2.5), so I recommend that you be aware of these tools, but don't invest too much time learning the ins and outs of each of these:

- Brainstorming
- Affinity diagrams
- Force field analysis
- Nominal group techniques
- Matrix diagrams
- Flowcharts
- Prioritization matrices

PART II

Creating the Quality Management Plan

The end result of the quality planning phase is to find a method to implement the quality policy. Because planning is iterative, the quality planning sessions often require several revisits to the quality planning processes. On longer projects, there may be scheduled quality planning sessions to compare the performance of the project in relation to the quality that was planned.

One of the major outputs of quality planning is the quality management plan. This document describes how the project manager and the project team will fulfill the quality policy. In an ISO 9000 environment, the quality management plan is referred to as the "project quality system." The quality management plan addresses the following three things about the project and the project work:

- **Quality control** Work results are monitored to see if they meet relevant quality standards. If the results do not meet the quality standards, the project manager applies root cause analysis to determine the cause of the poor performance and then eliminates the cause. Quality control is inspection-oriented.

- **Quality assurance** The overall performance is evaluated to ensure that the project meets the relevant quality standards. Quality assurance maps to an organization's quality policy and is typically a managerial process. Quality assurance is generally considered the work of applying the quality plan.
- **Quality improvement** The project performance is measured and evaluated, and corrective actions are applied to improve the product and the project. The improvements can be large or small, depending on the condition and the quality philosophy of the performing organization.

Establishing Quality Metrics

You need some quality metrics. If you don't measure, then your project cannot improve. Specifically, I'm talking about the quantifiable terms and values to measure a process, activity, or work result. An example of a quality metrics is an expected value for the required torque to tighten a bolt on a piece of equipment. By testing and measuring the torque, the operational definition would prove or disprove the quality of the product. Other examples can include hours of labor to complete a work package, required safety measures, cost per unit, and so on.

Operational definitions are clear, concise measurements. Designating that 95 percent of all customer service calls should be answered by a live person within 30 seconds is a metric. A statement that all calls should be answered in a timely manner is not.

Applying Checklists

Checklists are simple approaches to ensure that work is completed according to the quality policy. It's usually a list of activities that workers will check off as each task is completed. Checklists can be quick instructions of what needs to be done to clean a piece of equipment or questions that remind the employee to complete a task: "Did you turn off the printer before opening the cover?"

Creating the Process Improvement Plan

One of the goals of quality project management is continuous process improvement. The process improvement plan looks to improve the project, not just the end result of the project. Its aim is to identify and eliminate waste and non-value-added activity. Specifically, this plan aims to accomplish the following:

- Increase customer value by eliminating waste within the project
- Establish process boundaries
- Determine process configuration through a flowchart for evaluation and analysis in order to improve the project as a whole
- Process metrics within the project
- Establish targets for performance improvement

Updating the Baseline and the Project Management Plan

Just as there is a baseline for costs, schedule, and scope, there is also a baseline for quality. The quality baseline records and compares the quality objectives for the project. It's the measurement of the project performance and the quality of the project objectives. The variances show the project management team where the project should be improving.

The project management plan includes two plans that are outputs of quality planning: the quality management plan and the process improvement plan. Based on the outputs of quality management planning, the project plan can be updated to reflect how the expected level of quality will be achieved. As usual, changes to the project scope that change the project plan will also need to be examined for their impact on quality or the processes of the project. In addition, the project team's work to complete the changes may affect the quality of the deliverable.

Performing Quality Assurance (PMBOK, Section 8.2)

Quality assurance (QA) is the sum of the planning and the implementations of the plans the project manager, the project team, and management do to ensure that the project meets the demands of quality. QA is not something that is done only at the end of the project, but before and during the project as well.

In some organizations, the quality assurance department or another entity will complete the QA activities. QA is interested in finding any defects and then fixing the problems. There are many different approaches to QA, depending on the quality system the organization or project team has adapted. There are two types of QA:

- **Internal QA** Assurance provided to management and the project team
- **External QA** Assurance provided to the external customers of the project

Preparing for Quality Assurance

There are several inputs the project manager and the project team will need to prepare for QA:

- **The quality management plan** This plan defines how the project team will implement and fulfill the quality policy of the performing organization.
- **Quality metrics** Quality control tests will provide these measurements. The values must be quantifiable so that results may be measured, compared, and analyzed. In other words, "pretty close to on track" is not adequate; "95 percent pass rate" is more acceptable.
- **The process improvement plan** This plan aims to improve the project, not just the project's product.
- **Work performance information** This contains the results of the project work as needed, including technical performance measures, project status, information on what the project has created to date, corrective actions, and performance reports.
- **Approved change requests** Change requests that have been approved and fleshed into the project are needed, because their existence may bear on the content of the quality management plan, the quality of the project processes, and the project deliverable. All changes should be formally documented.

- **Results of quality control** The measures taken by the project manager and the project team to inspect the project deliverables' quality are fed back into the QA process.
- **Implemented actions** Any change requests, defect repairs, corrective actions, or preventive actions that have been taken in the project should be documented and submitted to the QA process.

Applying Quality Assurance

The QA department, management, or, in some instances, even the project manager can complete the requirements for QA. QA can be accomplished using the following tools, the same tools used during quality planning:

- Cost-benefit analysis
- Benchmarking
- Flowcharting
- Design of experiments
- Cost of quality

Completing a Quality Audit

Quality audits are about learning. The idea of a quality audit is to identify the lessons learned on the current project to determine how to make things better for this project—as well as for other projects within the organization. The idea is that Susan the project manager can learn from the implementations of Bob the project manager and vice versa.

Quality audits are formal reviews of what's been completed within a project, what worked, and what didn't work. The end result of the audit is improved performance for the current project, other projects, or the entire organization.

Quality audits can be scheduled at key intervals within a project or—surprise!—they can come without warning. The audit process can vary, depending on who is completing the audit: internal auditors or hired, third-party experts.

Improving the Project

The lone output of QA? Quality improvement. But it's not just the quality of the project's deliverables, but also of the process to complete the project work. This is process analysis, and it follows the guidelines of the process improvement plan. Process analysis is completed through any or all of the following measures:

- An examination of problems or constraints
- An analysis of the project for non-value-added activities
- Root cause analysis
- The creation of preventive actions for identified problems

Quality improvement requires action to improve the project's effectiveness. The actions to improve the effectiveness may have to be routed through the change control system, which means change requests, analysis of the costs and risks, and involvement from the change control board (CCB).

Performing Quality Control (PMBOK, Section 8.3)

This is the section of the project where the project manager and the project team have control and influence. QA, for the most part, is specific to your organization, and the project manager doesn't have much control over the QA processes—he just has to do them. Quality control (QC), on the other hand, is specific to the project manager, so there are lots of activities for the project manager to do.

EXAM TIP Pay close attention to the quality control mechanisms—there are things the project manager has control over in every project.

Quality control requires the project manager, or another qualified party, to monitor and measure project results to determine that they are up to the demands of the quality standards. If the results are unsatisfactory, root cause analysis follows the quality control processes. Root cause analysis is needed so that the project manager can determine the cause and apply corrective actions. On the whole, QC occurs throughout the life of a project, not just at its end.

QC is not only concerned with the product the project is creating, but also with the project management processes. QC measures performance, scheduling, and cost variances. The experience of the project should be of quality—not just the product the project creates. Consider a project manager who demands that the project team work extreme hours to meet an unrealistic deadline; team morale suffers and likely so does the project work the team is completing.

The project team should do the following to ensure competency in quality control:

- Conduct statistical quality control measures, such as sampling and probability
- Inspect the product to keep errors away from the customer
- Perform attribute sampling to measure conformance to quality on a per-unit basis
- Conduct variable sampling to measure the degree of conformance
- Study special causes to determine anomalies to quality
- Research random causes to determine expected variances of quality
- Check the tolerance range to determine if the results are within or without an acceptable level of quality
- Observe control limits to determine if the results are in or out of quality control

Preparing for Quality Control

Quality control relies on several inputs, such as the following:

- **The quality management plan** This defines how QA will be applied to the project, the expectations of quality control, and the organization's approach for continuous process improvement.

- **Work results** The results of both the project processes and the product results are needed to measure the results of the project team's work and compare it to the quality standards. The expected results of the product and the project can be measured from the project plan.
- **Quality metrics** The operational definitions that define the metrics for the project are needed so that QC can measure and react to the results of project performance.
- **Quality checklists** If the project is using checklists to ensure that project work is completed, copies of the checklists will be needed as part of quality control. The checklists can then serve as indicators of completed work, as well as expected results.
- **Approved change requests** Approved change requests have an effect on how the project work is scheduled and performed, which may affect the project's overall quality.

Inspecting Results

Although quality is planned into a project, not inspected in, inspections are needed to prove conformance to the requirements. An inspection can be done on the project as a whole, on a portion of the project work, on the project deliverable, or even on an individual activity. Inspections are also known as:

- Reviews
- Product reviews
- Audits
- Walkthroughs

Creating a Flow Chart

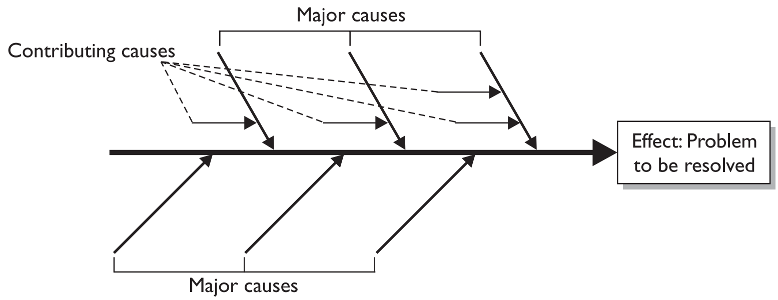
Technically, a flowchart is any diagram illustrating how components within a system are related. An organizational flowchart shows the bottom crew of operations up to the "little squirt" on top. A heating, ventilation, and air conditioning (HVAC) blueprint shows how the air flows through a building from the furnace to each room. Flowcharts show the relation between components, as well as help the project team determine where quality issues may be present and, once done, plan accordingly.

There are two types of flowcharts you'll need to be concerned with for these exams:

- **Cause-and-effect diagrams** These diagrams show the relation between the variables within a process and how those relations may contribute to inadequate quality. They can help organize both the process and team opinions, as well as generate discussion on finding a solution to ensure quality. Figure 8-2 is an example of a cause-and-effect diagram. These diagrams are also known as Ishikawa diagrams and fishbone diagrams.

EXAM TIP A cause-and-effect diagram is also called an Ishikawa diagram—same thing, just a fancier name.

Figure 8-2 Cause-and-effect diagrams show the relation of variables to a problem.



- **System or process flowcharts** These flowcharts illustrate the flow of a process through a system, such as a project change request through the change control system or work authorization through a quality control process. A process flowchart does not have to be limited to the project management activities. It could instead demonstrate how a manufacturer creates, packages, and ships the product to the customer, as seen in Figure 8-3.

Creating a Control Chart

Ever feel like your project is out of control? A control chart can prove it.

Control charts illustrate the performance of a project over time. They map the results of inspections against a chart, as seen in Figure 8-4. Control charts are typically used in projects or operations where there are repetitive activities—such as manufacturing, a series of tests, or help desks.

The outer limits of a control chart are set by the customer requirements. Within the customer requirements are the upper control limits (UCLs) and the lower control limits (LCLs). The UCL is typically set at +3 or +6 sigma, while the LCL is set at –3 or –6 sigma. Sigma results show the degree of correctness. Table 8-1 outlines the four sigma values representing normal distribution. You'll need to know these for the Project Management Professional (PMP) exam.

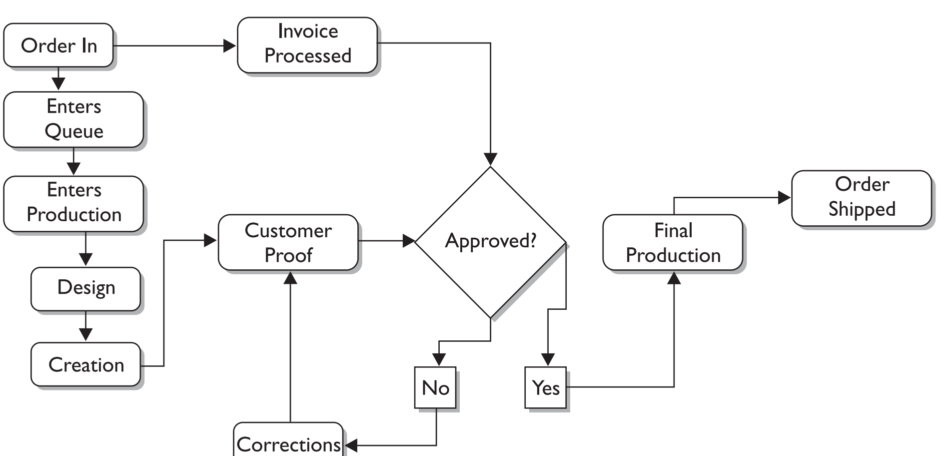


Figure 8-3 Flowcharts demonstrate how processes within a system are related.

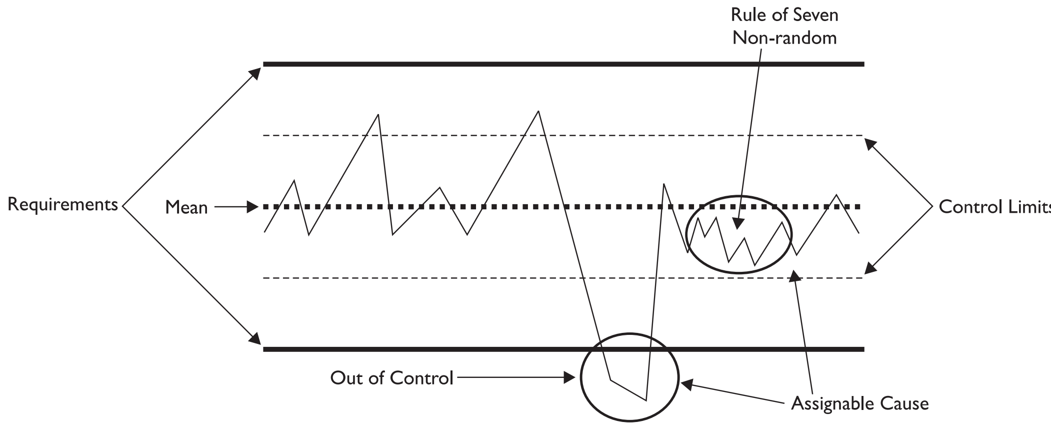


Figure 8-4 Control charts demonstrate the results of inspections.

So what happened to sigma four and five? Nothing. They're still there; it's just that the difference between three sigma at 99.73 and six sigma at 99.99 is so small that statisticians just jump to six sigma. The mean in a control chart represents the expected result, while the sigma values represent the expected spread of results based on the inspection. A true six sigma allows only two defects per million opportunities, and the percentage to represent that value is 99.99985 percent. For the exam, you can go with the 99.99 percent.

For example, if a manufacturer creates 1,000 units per hour and expects 50 units each hour to be defective, the mean would be 950 units. If the control limits were set at +/– three sigma, the results of testing would actually expect up to 953 correct units and down to 947 correct units.

Over time, the results of testing are plotted in the control chart. Whenever a result of testing is plotted beyond the upper or lower control values, it is considered to be "out of control." When a value is out of control, there is a reason why—it's called an assignable cause. Something caused the results to change for better or for worse, and the result must be investigated to understand the why behind the occurrence.

Another assignable cause is the Rule of Seven. The Rule of Seven states that whenever seven consecutive results are all on one side of the mean, this is an assignable cause. Thus, there's been some change that caused the results to shift to one side of the expected mean. Again, the cause must be investigated to determine why the change happened.

While control charts are easily associated with recurring activities, like manufacturing, they can also be applied to project management. Consider the number of expected change requests, delays within a project, and other recurring activities. A control chart can plot out these activities to measure performance, positive and negative results, and track corrective actions.

Table 8-1 The Four Sigma Values Representing Normal Distribution

Value	Percent Correct
+/– 1 sigma	68.26 percent
+/– 2 sigma	95.46 percent
+/– 3 sigma	99.73 percent
+/– 6 sigma	99.99 percent

PART II

Creating Pareto Diagrams

A Pareto diagram is somewhat related to Pareto's Law: 80 percent of the problems come from 20 percent of the issues. This is also known as the *80/20 Rule*. A Pareto diagram illustrates the problems by assigned cause from smallest to largest, as Figure 8-5 shows. The project team should first work on the larger problems and then move on to the smaller problems.

Creating a Histogram

A histogram is a bar chart showing the frequency of variables within a project. For example, a histogram could show which states have the most customers. Within project management, a common histogram is a resource histogram that shows the frequency of resources used on project work.

Creating a Run Chart

A run chart, as Figure 8-6 shows, is a line graph that shows the results of inspection in the order in which they've occurred. The goals of a run chart are to first demonstrate the results of a process over time and then use trend analysis to predict when certain trends may reemerge. Based on this information, an organization can work to prevent the negative trend or work to capitalize on an identified opportunity.

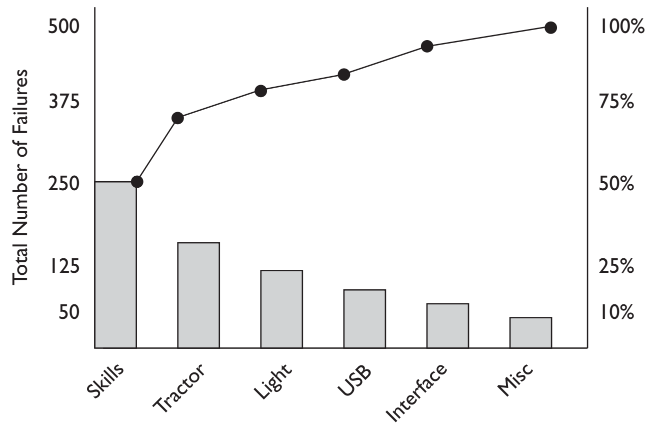
Creating a Scatter Diagram

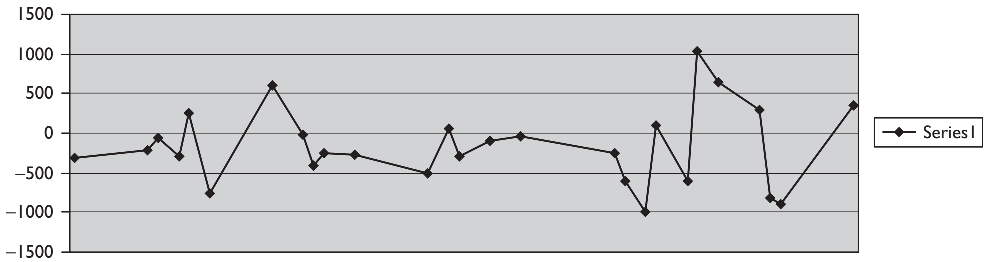
A scatter diagram is like a run chart, but it instead tracks the relationship between two variables. The two variables are considered related the closer they track against a diagonal line. For example, a project manager could track the performance of two team members, the time and cost, or even changes between functional managers and the project's schedule.

Completing a Statistical Sampling

Statistical sampling is the process of choosing a percentage of results at random. For example, a project creating a medical device may have 20 percent of all units randomly selected to check quality. This process must be completed on a consistent basis throughout the project, rather than on a sporadic schedule.

Figure 8-5
A Pareto diagram is a histogram that ranks the issues from largest to smallest.





	21-Au	28-Au	29-Au	31-Au	1-Se	3-Se	9-Se	12-Se	13-Se	14-Se	17-Se	24-Se	26-Se	27-Se	30-Se	3-Oc	12-Oc	13-Oc	15-Oc	16-Oc	19-Oc	20-Oc	22-Oc	26-Oc	27-Oc	28-Oc	4-No
Series1	-32	-21	-60	-30	255	-75	600	-10	-40	-26	-28	-50	60	-30	-10	-30	-26	-60	-10	100	-60	102	650	300	-82	-90	350

Figure 8-6 Run charts track the results of inspections over time.

Statistical sampling can reduce the costs of quality control, but mixed results can follow if an adequate testing plan and schedule are not followed. The science of statistical sampling (and its requirements to be effective) is an involved process. There are many books, seminars, and professionals devoted to the process. For the Certified Associate in Project Management (CAPM) and PMP exams, know that statistical sampling uses a percentage of the results to test for quality. This process can reduce quality control cost.

Revisiting Flowcharting

Flowcharting uses charts to illustrate how the different parts of a system operate. This is valuable in quality control, because the process can be evaluated and tested to determine where in the process quality begins to break down. Corrective actions can then be applied to the system to ensure that quality continues as planned—and as expected.

Applying Trend Analysis

Trend analysis is the science of taking past results to predict future performance. Sports announcers use trend analysis all the time: "The Cubs have never won in St. Louis on a Tuesday night in the month of July when the temperature at the top of the third inning was above 80 degrees."

The results of trend analysis allow the project manager to apply corrective action to intervene and prevent unacceptable outcomes. Trend analysis on a project requires adequate records to predict results and set current expectations. It can monitor the following:

- **Technical performance** Trends analysis can ask, "How many errors have been experienced up to this point in the project schedule, and how many additional errors were encountered?"
- **Cost and schedule performance** Trend analysis can ask, "How many activities were completed incorrectly, came in late, or had significant cost variances?"

Examining Quality Control Results

Quality control should, first and foremost, result in quality improvement. The project manager and project team, based on the results of the tools and techniques to implement quality control, apply corrective actions to prevent unacceptable quality and to improve the overall quality of the project management processes.

The corrective actions and the defect repairs the project manager and the project team want to incorporate into the project may require change requests and management approval. The value and importance of the change should be evident so that the improvement to quality is approved and folded into the project. In addition to quality improvement, there are other results of quality control:

- **Acceptance decisions** The work results are either accepted or rejected. Rejected items typically mean rework.
- **Rework** Nonconformance to quality results in rework. Rework costs time and money and contributes to projects being late, over budget, or both. It is always more cost-effective to do the work right the first time than to do it correct the second.
- **Completed checklists** If the project is using checklists to confirm the completion of work, then the completed checklists should become part of the project records. Some project managers require the project team member completing the checklists to initial them as whole and complete.
- **Process adjustments** When results of inspections indicate quality is out of control, then process adjustments may be needed to make immediate corrective actions or planned preventative actions to ensure that quality improves. Process adjustments, depending on their nature, may qualify for a change request and be funneled through the change control system as part of integration management.
- **Recommendations** The project manager and the project team can also make recommendations for additional defect repairs, preventative actions, corrective actions, and even additional change requests.

Chapter Summary

What good is a project deliverable if it doesn't work, is unacceptable, or is faulty? Project quality management ensures that the deliverables project teams create meet the expectations of the stakeholders. For your CAPM or PMP examination, quality means delivering the project at the exact level of the design specifications and of the project scope—no more, no less.

Grade and quality are two different things. Grade is the ranking assigned to different components that have the same functional purpose. For example, sheet metal may come in different grades based on what it is needed for. Another example is the grade of paper based on its thickness, ability to retain ink, and so on. Low quality is always a problem; low grade may not be.

Quality planning happens before project work begins, but also as work is completed. Quality planning can confirm the preexistence of quality or the need for quality improvements. Quality is planned into a project, not inspected in. However, quality control uses inspections to prove the existence of quality within a project deliverable.

The cost of quality is concerned with the monies invested in the project to ascertain the expected level of quality. Examples of these costs include training, safety measures, and quality management activities. The cost of nonconformance centers on the monies lost by not completing the project work correctly the first time. In addition, this fee includes the loss of sales, loss of customers, and downtime within the project.

Quality assurance is prevention-driven and is a management process. Quality control is inspection-driven and is a project process. On your PMI exam, keep those two thoughts separate and you'll be ahead of the game.

Key Terms

Benchmarking Comparing any two similar entities to measure their performance.

Cause-and-effect diagrams These diagrams show the relation between the variables within a process and how those relations may contribute to inadequate quality. They can help organize both the process and team opinions, as well as generate discussion on finding a solution to ensure quality.

Checklist A simple approach to ensure that work is completed according to the quality policy.

Control chart A quality control chart that maps the performance of project work overtime.

Cost of poor quality This is the cost associated with not satisfying the quality expectations. This is also known as the cost of nonconformance to quality.

Cost of quality This is the cost associated with the monies spent to ascertain the expected level of quality. This is also known as the cost of conformance to quality.

Cost-benefit analysis A process to study the tradeoffs between costs and the benefits realized from those costs.

Design of experiments An approach that relies on statistical scenarios to determine what variables within a project will result in the best outcome.

External QA Assurance provided to the external customers of the project.

Flowchart A diagram illustrating how components within a system are related. Flowcharts show the relation between components, as well as help the project team determine where quality issues may be present and, once done, plan accordingly.

Internal QA Assurance provided to management and the project team.

ISO The abbreviation for the International Organization for Standardization. ISO is Greek for equal, while "International Organization for Standardization" would be abbreviated differently in different language. The organization elected to use ISO for all languages.

Pareto diagram A histogram that illustrates categories of failure within a project.

Process improvement plan A project management subsidiary plan that aims to improve the project, not just the end result of the project. It strives to identify and eliminate waste and non-value-added activities.

Quality According to ASQ, it is the degree to which a set of inherent characteristics fulfills requirements.

Quality assurance A management process that defines the quality system or quality policy that a project must adhere to. QA aims to plan quality into the project rather than inspect quality into a deliverable.

Quality control An inspection-driven process that measures work results to confirm that the project is meeting the relevant quality standards.

Quality metrics The operational definitions that specify the measurements within a project and the expected targets for quality and performance.

Quality planning The process of first determining which quality standards are relevant to your project and then finding out the best methods of adhering to those quality standards.

Rule of Seven A component of a control chart that illustrates the results of seven measurements on one side of the mean, which is considered "out of control" in the project.

Run chart A quality control tool that shows the results of inspection in the order in which they've occurred. The goal of a run chart is to first demonstrate the results of a process over time and then use trend analysis to predict when certain trends may reemerge.

Scatter diagram A quality control tool that tracks the relationship between two variables over time. The two variables are considered related the closer they track against a diagonal line.

Statistical sampling A process of choosing a percentage of results at random. For example, a project creating a medical device may have 20 percent of all units randomly selected to check for quality.

System or process flowcharts These flowcharts illustrate the flow of a process through a system, such as a project change request through the change control system or work authorization through a quality control process.

Quality management plan This plan defines how the project team will implement and fulfill the quality policy of the performing organization.

Trend analysis The science of using past results to predict future performance.

Work performance information The results of the project work as needed. This includes technical performance measures, project status, information on what the project has created to date, corrective actions, and performance reports.

Questions

1. You are the project manager for the BBB Project. Stacy, a project team member, is confused about what QA is. Which of the following best describes QA?
   - **A.** QA is quality assurance for the overall project performance.
   - **B.** QA is quality acceptance according to scope verification.
   - **C.** QA is quality assurance for the project deliverable.
   - **D.** QA is quality assurance for the project stakeholders.

PART II

2. You are the project manager for the Photo Scanning Project. This project is similar to another project you have completed. Your project is to electronically store thousands of photos for your city's historical society. Quality is paramount on this project. Management approaches you and asks why you have devoted so much of the project time for planning. Your response is which of the following?
   A. This is a first-time, first-use project, so more time is needed for planning.
   B. Planning for a project of this size, with this amount of quality, is mandatory.
   C. Quality is planned into a project, not inspected in.
   D. Quality audits are part of the planning time.
3. You are the project manager for the Floor Installation Project. Today, you plan to meet with your project team to ensure that the project is completed with no deviations from the project requirements. This process is which of the following?
   A. Quality planning
   B. Quality management
   C. Quality control
   D. Quality assurance
4. You are the project manager for the ASE Project, which must map to industry standards in order to be accepted by the customer. You and your team have studied the requirements and have created a plan to implement the deliverables with the appropriate level of quality. What is this process called?
   A. Quality planning
   B. Quality management
   C. Quality control
   D. Quality assurance
5. A fishbone diagram is the same as a(n) ______________________ chart.
   A. Ishikawa
   B. Pareto
   C. Flow
   D. Control
6. Management has asked you to define the correlation between quality and the project scope. Which of the following is the best answer?
   A. The project scope includes metrics for quality.
   B. Quality metrics are applied to the project scope.
   C. Quality is the process of completing the scope to meet stated or implied needs.
   D. Quality is the process of evaluating the project scope to ensure that quality exists.
7. Which of the following is most true about quality?

A. It will cost more money to build quality into the project.

B. It will cost less money to build quality into the project process.

C. Quality is inspection-driven.

D. Quality is prevention-driven.

8. You are the project manager for the KOY Project, which requires quality that maps to federal guidelines. To ensure that you can meet these standards, you have elected to put the project team through training specific to the federal guidelines your project must adhere to. The costs of these classes can be assigned to which of the following?

A. The cost of doing business

B. Cost of quality

C. Cost of adherence

D. Cost of nonconformance

9. You are the project manager for the KOY Project, which requires quality that maps to federal guidelines. During a quality audit, you discover that a portion of the project work is faulty and must be done again. The requirement to do the work is an example of which of the following?

A. Cost of quality

B. Cost of adherence

C. Cost of nonconformance

D. The cost of doing business

10. You are the project manager of the JKL Project, which currently has some production flaws. Which analysis tool will allow you to determine the cause and effect of the production faults?

A. A flowchart

B. A Pareto diagram

C. An Ishikawa diagram

D. A control chart

11. Linda is the project manager of a manufacturing project. She and her project team are using design of experiments to look for ways to improve quality. Which of the following best describes design of experiments?

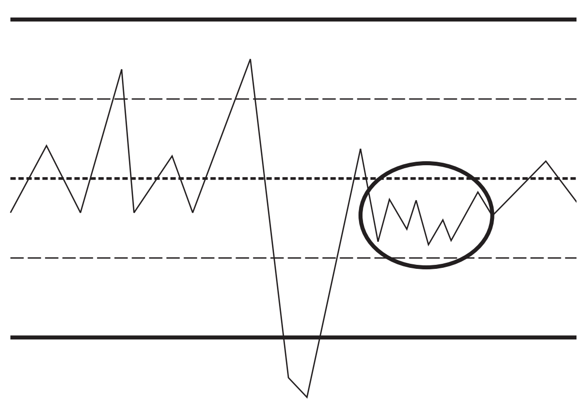
A. It allows the project manager to move the relationship of activities to complete the project work with the best resources available.

B. It allows the project manager to experiment with the project design to determine what variables are causing the flaws.

C. It allows the project manager to experiment with variables to attempt to improve quality.

D. It allows the project manager to experiment with the project design document to become more productive and to provide higher quality.

12. You are the project manager of the Global Upgrade Project. Your project team consists of 75 project team members around the world. Each team member will be upgrading a piece of equipment in many different facilities. Which of the following could you implement to ensure that project team members are completing all of the steps in the install procedure with quality?
    A. Checklists
    B. Work breakdown structure (WBS)
    C. Project network diagram (PND)
    D. The WBS dictionary
13. Mark is the project manager of the PMH Project. Quality audits of the deliverables show several problems. Management has asked Mark to create a chart showing the distribution of problems and their frequencies. Given this, management wants which of the following?
    A. A control chart
    B. An Ishikawa chart
    C. A Pareto diagram
    D. A flowchart
14. In the illustration, what does the circled area represent?



    A. Out-of-control data points
    B. In-control data points
    C. The Rule of Seven
    D. Standard deviation
15. You are an IT project manager and are working with the project team to determine the best computer system for the project. You and the project team decide to measure the performance of both systems to determine which one performs best. This is an example of which one of the following?
    A. Cost-benefit analysis
    B. Benchmarking
    C. Design of experiments
    D. Determining the cost of quality
16. A project manager has elected not to enforce safety measures on his construction project. One of the project team members has been injured

because of this oversight, and the job site is closed until an investigation into the lack of safety measures is completed. The project will now likely be late, be fined for the error, and will lose profitability with the customer. This is an example of which one of the following?

A. Risk

B. Trigger

C. Cost of poor quality

D. Cost of quality

17. Your organization uses total quality management as part of its quality assurance program. Maria, a leader in your organization's quality assurance program, informs you that she will be reviewing your project to determine if your project management activities comply with the total quality management program. This is an example of which one of the following?

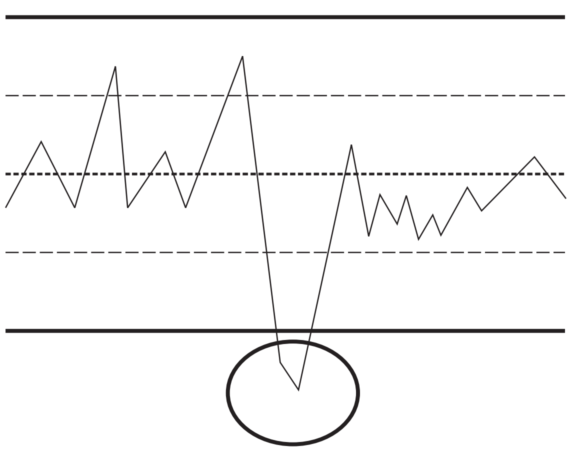
A. Process analysis

B. Quality control mechanism

C. Enterprise environmental factors

D. Quality audit

18. In the illustration, what does the circled area represent?



A. Out-of-control data points

B. In-control data points

C. The Rule of Seven

D. Standard deviation

19. You are the project manager for a plastics manufacturer. You would like to illustrate the categories of quality failure within your project so that you and your project team can attack the largest areas of failure first. This type of chart is known as which one of the following?

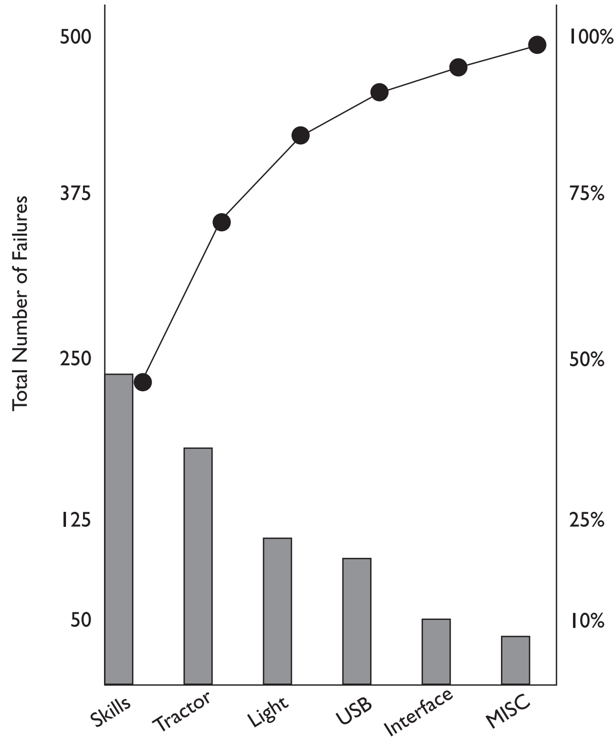
A. A control chart

B. An Ishikawa chart

C. A Pareto diagram

D. A flowchart

20. What is the following type of chart called?
    A. Pareto diagram
    B. Control diagram
    C. Fishbone diagram
    D. Ishikawa diagram



Answers

1. **A**. QA is concerned with overall project quality performance. B, C, and D are incorrect because they do not correctly explain quality assurance. For more information, see the PMBOK, Section 8.3.
2. **C**. Of all the choices presented, this is the best answer. Quality is planned into the project, and the planning requires time. A is incorrect because a project of this nature has been completed before. B is incorrect because there isn't enough information provided to determine what the quality demands of the project are. D is incorrect because quality audits are not part of the planning processes. For more information, see the introduction to Chapter 8 in the PMBOK.
3. **A**. Quality planning should be completed prior to the work beginning—and should thereafter be revisited as needed. B is incorrect, since quality management is not an applicable answer to the scenario. C and D are incorrect because QA and QC are part of quality management. For more information, see the PMBOK, Section 8.1.
4. **A**. Quality planning is the process of creating a plan to meet the requirements of quality. B, C, and D are incorrect because they do not explain the process in the question's scenario. For more information, see the PMBOK, Section 8.1.
5. **A.** A fishbone diagram is the same as an Ishikawa diagram. B, C, and D are incorrect. These charts and diagrams accomplish goals other than the cause-and-effect outcome of the Ishikawa. For more information, see the PMBOK, Section 8.3.2.1.
6. **C**. Quality, in regards to the project scope, is about completing the work as promised. A is incorrect because though the project scope will have requirements for acceptance, it may not have metrics for quality defined. B and D are also incorrect. For more information, see the introduction to Chapter 8 in the PMBOK.

7. **D**. Quality is prevention-driven. Quality wants to complete the work correctly the first time in order to prevent poor results, a loss of time, and a loss of funds. A and B are incorrect. There is no guarantee that a project will cost more or less depending on the amount of expected quality. Incidentally, lack of quality will likely cost more than quality planning because of the cost of nonconformance. C is incorrect because quality is planned into a project, not inspected in. For more information, see the introduction to Chapter 8 in the PMBOK.
8. **B**. Training to meet the quality expectations is attributed to the cost of quality. A, C, and D are incorrect because these choices do not describe training as a cost of quality. For more information, see the PMBOK, Section 8.1.2.4.
9. **C**. When project work results are faulty and must be done over, it is attributed to the cost of nonconformance to quality. A, B, and D are all incorrect. These values do not describe faulty work or the cost of nonconformance. For more information, see the PMBOK, Section 8.1.2.4.
10. **C**. The key words "cause and effect" equate to the Ishikawa diagram. A is incorrect. A flowchart will show how a process moves through the system, but not the cause and effect of the problems involved. B is incorrect as well. A Pareto chart maps out the causes and frequency of problems. D, a control chart, plots out the results of sampling, but it doesn't show the cause and effect of problems. For more information, see the PMBOK, Section 8.3.2.1.
11. **C**. Design of experiments uses experiments and "what-if" scenarios to determine what variables are affecting quality. A is incorrect because design of experiments, in regards to quality, is not interested in changing the relationship of activities to complete project work. B and D are also incorrect because design of experiments will not be changing project design to determine where flaws exist or to become more productive. For more information, see the PMBOK, Section 8.1.2.3.
12. **A**. Checklists are simple but effective quality management tools that the project manager can use to ensure that the project team is completing the required work. B, C, and D are all incorrect. The WBS, PND, and WBS dictionary are not tools the project team can necessarily use to prove they've completed required work. Checklists are the best approach for this scenario. For more information, see the PMBOK, Section 8.1.3.3.
13. **C**. Management wants Mark to create a Pareto diagram. Recall that a Pareto diagram maps out the causes of defects and illustrates their frequency. A is incorrect because a control chart does not identify the problems, only the relation of the results to the expected mean. B is incorrect because a cause-and-effect diagram does not map out the frequency of problems. D is also incorrect. Flowcharts show how a process moves through a system and how the components are related. For more information, see the PMBOK, Section 8.3.2.5.
14. **C**. The circled area shows seven consecutive sampling results, all on one side of the mean. This is known as the Rule of Seven, and is an assignable cause. A is incorrect. These values are in control. B is correct, but it does not fully answer the question as choice C does. D is incorrect, since standard deviation

PART II

is a predicted measure of the variance from the expected mean of a sampling. For more information, see the PMBOK, Section 8.3.2.2.

15. **B**. This is an example of benchmarking, as the project team is comparing one system to another. A, the cost-benefit analysis, would compare the costs and associated benefits of each system, rather than just how the two systems compare to each other. C, the design of experiments, is a method that determines which factors influence the variables of the project's deliverable. D is not a valid answer, as the cost of quality is the dollar amount the project must invest in order to achieve the expected level of quality. For more information, see the PMBOK, Section 8.1.2.

16. **C**. This is an example of the cost of poor quality. The project manager should have followed the safety measures for the job site, and costs associated with the safety measures are considered part of D, the cost of quality. A is incorrect because risk is inherent to application work, while the ramifications of not enforcing the safety measures is an example of the cost of poor quality. B, trigger, is a risk management term that references a condition or warning sign that a risk is coming into the project. For more information, see the PMBOK, Section 8.1.2.4.

17. **D**. This is an example of a quality audit to confirm that your project is adhering to the quality assurance program established within your organization. A and B are incorrect choices for this question. C, enterprise environmental factors, may be a valid characteristic of the total quality management program, but it is not the best answer for the question, which centers on the audit process rather than on how the audit will be performed. For more information, see the PMBOK, Section 8.2.2.2.

18. **A**. The circled area shows out-of-control data points. B is incorrect as in-control data points do not best answer the question. C is incorrect, as the Rule of Seven refers to seven consecutive measurements, all on one side of the mean. D is incorrect, since standard deviation is a predicted measure of the variance from the expected mean of a sampling. For more information, see the PMBOK, Section 8.3.2.2.

19. **C**. You want to create a Pareto diagram. A is incorrect because a control chart does not identify the problems, only the relation of the results to the expected mean. B is incorrect because a cause-and-effect diagram does not map out the frequency of problems. D is also incorrect. Flowcharts show how a process moves through a system and how the components are related. For more information, see the PMBOK, Section 8.3.2.5.

20. **A**. This is a Pareto chart. B is incorrect, as a control chart shows the results of measurements over time. C and D are both incorrect, as a fishbone diagram and an Ishikawa diagram are essentially the same type of chart. For more information, see the PMBOK, Section 8.3.2.3.

Managing Project Human Resources

In this chapter, you will
- Plan for human resources
- Acquire the project team
- Develop the project team
- Manage the project team

Your project relies on people to get the work done. Those people, your project team, look to you, the project manager, to provide leadership, direction, motivation, and your general management skills to help them know what their project assignments are, get their work done, and resolve issues and dilemmas within the project.

It's a blast! Okay, that's a bit of sarcasm. In reality, and on your Project Management Institute (PMI) examination, the resources involved with the project know what is expected of them by the project manager, management, and the stakeholders, and then they complete those expectations. And if they don't? Then it's up to the project manager, the functional managers, and even the other project team members to enforce the project's ground rules so that all team members work toward the requirements in the project scope statement.

VIDEO Exploring human resource theories.

The type of organizational structure, from functional to projectized, will also influence how the project manager may discipline, motivate, and manage the project team. In a functional environment, the project manager won't have much autonomy to discipline or offer rewards beyond what management has deemed appropriate. In a projectized structure, for example, the project manager has much more autonomy to both discipline and reward.

A subset of the project team is the project management team—you've seen this term already in this book. The project management team is the core group of project team members that help with the project management decision. Sometimes, this bunch of folks may also be called the core, executive, or leadership team. Your pal, the project sponsor, works directly with you, the project manager, and the project management team to help the team make the best decisions and to keep the project moving forward.

For your PMI examination, you'll need to know some vital facts about managing the project team. We'll cover these vital facts in this chapter.

Planning for Human Resources

Here we go again. Have you noticed that every knowledge area for your PMI examination starts with a planning process? Hmmm, I hope so. Planning is an iterative process that begins early in the project and continues through the project management life cycle. Planning for project human resources is vital to a successful project—after all, you've got to plan how the project work will be completed and which resources will complete that work.

When it comes to planning human resources, the project manager is aiming to plan for several facets of the project. Specifically, this planning process answers the following questions:

- What project roles are needed on the project?
- What is the responsibility of each role on the project?
- To whom does each role report?
- Will resources on the project be from inside or outside of the organization?
- How will project team members be acquired?
- How will project team members be released from the project?
- What training needs to be completed for the project team?
- What are the rewards and recognition systems the project may utilize?
- What are the compliance and safety issues that must be addressed?
- How will the usage of the team resources affect the operations of the organization?

Phew! That's a bunch of questions the project management team must answer during this portion of planning. The good news is that some of these questions can be answered when doing other project management planning exercises, such as time and cost estimating. All of the answers to these questions are documented in the staffing management plan. The staffing management plan is the primary output of the human resources planning process.

Relying on Enterprise Environmental Factors

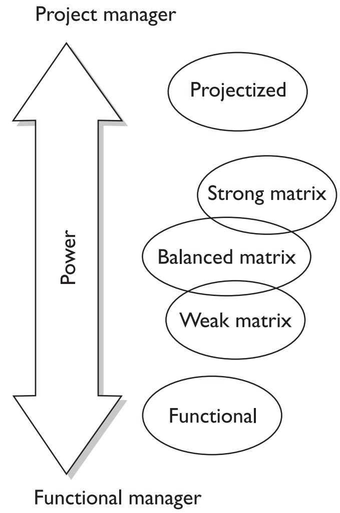
You've seen enterprise environmental factors over and over throughout this book and the Project Management Body of Knowledge (PMBOK). When it comes to relying on the good ol' enterprise environmental factors for human resource planning, the reliance is on how the organization identifies and utilizes roles and responsibilities and the interaction of the organization with the project management team. The project management team must consider five interfaces in its planning. These are organizational interfaces that the project team will likely have to interact with throughout the project:

- **Organizational** The project management team needs to identify which departments are going to be involved in the project. The team considers how the project will interact with these different departments and organizations, as well as what relationships exist between the departments, the project team, and management.
- **Technical** The project team identifies the disciplines and specialties that the project will require to complete the project scope statement. The technical interfaces are the resources that will be doing the project work. In that light, the project manager needs to examine what work needs to be completed, how the project moves from phase to phase, and even the nature of the work and how different disciplines may need to work together to allow the project to move forward.
- **Interpersonal** This organizational interface considers the formal and informal reporting relationships that may exist among the project team members. The interpersonal interface also considers the job descriptions of the project team members, existing reporting structures between supervisors and subordinates, and what, if any, existing relationships may affect the project work. This interface also considers any cultural or language differences among the project team that may need to be addressed.
- **Logistical** Have you ever worked with project team members that are located around the world? What about project team members who are within footsteps of each other? The logistical interface considers just that—the logistics of the project team and the stakeholders in relation to managing the project. The project manager must consider the geographical locales, the time zones, countries, and any other logistics that may affect the project.
- **Political** Uh-oh, here come the politics. This interface considers the hidden goals, personal agendas, and alliances among the project team and the stakeholders. Yep, politics is considered in project management and on the PMI examination.

While the interfaces mentioned previously should be considered during the human resource planning phase for every project, there are also constraints that could be introduced through these interfaces or as independent constraints. Recall that a constraint is anything that limits the project team's options. Here are three common constraints that may affect your human resources planning:

- **Organizational structure** The structure of the organization has a direct correlation to the amount of power a project manager has. Figure 9-1 provides a refresher on the organizational structures. For a more in-depth refresher, see Chapter 2.
- **Collective bargaining agreements** Contracts and agreements with unions or other employee groups may serve as constraints for the project.
- **Economic conditions** Your organization may be experiencing a hiring freeze, slashed the training budget, or even cut out most travel expenses. These cuts are all examples of economic conditions that can serve as constraints on your project.

Figure 9-1 The organizational structure affects the project manager's power.



EXAM TIP Contracts and grievances with unions are constraints. The unions, in and of themselves, are actually stakeholders.

Using the Organizational Process Assets

Many projects within any organization are similar to past projects. For example, an architecture firm designs buildings, an IT consultancy may design software or networks, and a manufacturer manufactures things. Within each of these disciplines, and countless others, there are projects that are similar to projects that have gone before. The past project records, lessons learned, and even past staffing management plans can be adapted for the current project. Organizational process assets provide two elements for human resources planning that you should know for your PMI exam:

- **Templates** Using past project records, including older staffing management plans as a base for the current project, is a great example of using past projects as templates for the current project—something the PMBOK loves to mention.
- **Checklists** Here's another theme throughout the PMBOK. Checklists, when it comes to planning for human resources, attempt to identify common elements within similar projects. Ideal things that a checklist can help the project management team identify include:
  - Roles and responsibilities
  - Competencies for the project work
  - Training programs
  - Team ground rules
  - Safety issues
  - Compliancy
  - Rewards and recognition considerations

Referencing the Project Management Plan

The project management plan has many things to consider when it comes to staffing the project. Let's take a quick peek at each subsidiary plan, elements within the project management plan, and how they may affect what resources the project manager will require on the project team. Here are the elements of the project management plan:

- **Project scope management plan** Defines how the project scope will be planned, managed, and controlled. This plan is considered, because the project team will be doing the work to create the things the scope promises.
- **Schedule management plan** Defines how the project schedule will be created and managed. The availability of and the demand for the project team are influenced by the schedule management plan.
- **Cost management plan** This plan details how the project costs will be planned for, estimated, budgeted, and then monitored and controlled. In most projects, the project manager will need to account for the cost of the project team and their contributions to the project work. In some instances, the cost is more related to the time the team member is utilized, rather than the actual salary of the project team member.
- **Quality management plan** Quality is expected on every project. This plan defines what quality means for the project, how the project will achieve quality, and how the project will map to organizational procedures pertaining to quality. The project team members will need to adhere to quality expectations, which may include training, team development, peer reviews, and inspections.
- **Process improvement plan** Who wants an extra helping of waste in their project? This plan aims to eliminate non-value-added activities; eliminate waste; and determine how the project work, execution, and management can be better executed and managed. The project manager wants the project team to get rid of non-value-added activities.
- **Staffing management plan** This plan defines how project team members will be brought on to and released from the project team. It also defines team training, safety issues, and how the project's reward and recognition system will operate. This plan is a work in process when planning begins, but updates to the plan may occur as the project management team revisits planning throughout the project.
- **Communications management plan** This plan defines who will get what information, how they will receive it, and in what modality the communication will take place. The project team will need to communicate with the project manager, the sponsor, stakeholders, vendors, and each other.
- **Risk management plan** Risk is an uncertain event or condition that may affect the project's outcome. Project team members will need to know what risks are within the project, which risk owners will be identified, and how risk responses will be planned and communicated.
- **Procurement management plan** The project may need to procure goods and services. The project team may need to interact with vendors, consultants,

and even internal stakeholders, such as a procurement office or purchasing department. This plan may also address how procured consultants will serve as project team members.

- **Milestone list** This list details the project's milestones and their attributes. The milestone list is used for several areas of project planning, but also helps determine how quickly the project may be achieving its objectives.
- **Resource calendar** Resources are people and things like equipment, rooms, and other facilities. This calendar defines when resources are available to contribute to the project.
- **Schedule baseline** This is the planned start and finish of the project. The comparison of what was planned and what was experienced is the schedule variance.
- **Cost baseline** This is the aggregated costs of all of the work packages within the WBS.
- **Quality baseline** This documents the quality objectives for the project, including the metrics for stakeholder acceptance of the project deliverable.
- **Risk register** The risk register is a centralized database consisting of the outcome of all the other risk management processes. Consider the outcome of risk identification, qualitative analysis, and quantitative analysis.

Charting the Human Resources

There are lots of charts that can help the project manager and the project management team determine what resources are needed, what responsibilities are within the project, reporting relationships, accountability concerns, and lots more. Your PMI examination will quiz you on these schmancy charts and how they're used. Don't worry—they're not difficult. Let's have a look.

Using a Hierarchical Chart

A hierarchical chart shows the relationship between superior and subordinate employees, groups, disciplines, even departments. You've already seen one hierarchical chart: the work breakdown structure. When it comes to human resource planning, there are five hierarchical charts to consider:

- **Organization chart** This traditional chart shows how the organization is broken down by departments and disciplines. It is sometimes called the organizational breakdown structure (OBS) and is arranged by departments, units, or teams. With regards to project management, an OBS can be used to show which project responsibilities are linked with which departments.
- **Resource breakdown structure (RBS)** This hierarchical chart can decompose the project by the types of resources it contains. For example, your project might be using mechanical engineers in several different deliverables throughout the project. The RBS would organize all of the usage of the mechanical engineers, as well as other resources, by their disciplines rather than by where the disciplines are being utilized. An RBS is an excellent tool for tracking resource utilization and resource costs.

- **Responsibility assignment matrix (RAM)** A RAM chart shows the correlation between project team members and the work they've been assigned to complete. A RAM chart doesn't necessarily have to be specific to individual team members; it can also be decomposed to project groups or units. Most often, however, RAM charts depict activities and individual workers.
- **RACI chart** A RACI chart is another matrix chart that only uses the activities of responsible, accountable, consult, and inform (hence, the acronym RACI). Technically, a RACI chart is a form of the responsibility assignment matrix, but I want to include it here as a separate entry. This chart, depicted in Figure 9-2, has gained some popularity in recent years, so I'd wager you'll see it on your PMI examination.
- **Text-oriented chart** A text-oriented chart is really more of a shopping list of what a team member is responsible for within the project. These listings define project responsibilities, reporting relationships, project authority, competencies, and qualifications. You might also know these as position descriptions or role-responsibility-authority forms.

Networking Human Resources

My buddy, Rick, and I do an exaggerated used car salesman thumbs-up whenever one of us mentions networking. We know networking works—it's a great way to meet new people, find new business, and make friends. Networking events, such as your PMI chapter meetings, luncheons, and just working a room, are all ways to help your project move forward by better understanding how your organization moves through political and interpersonal relationships.

	Project Team Member				
Activity	Steve	Martha	Sam	Liza	Mike
Foundation	A	R	A	I	C
Framing	I	A	A	I	C
Wiring	A	C	C	R	C
Testing	I	I	A	C	A

Figure 9-2 RACI charts show the relation between activities and project team members.

Basically, networking supports the old adage that people like to do business with people they like. If people don't know you, they won't get a chance to like you. Networking functions, especially those internal to your organization, are great methods to meet and greet and share news about your projects. The PMBOK advises that attending networking events on an ongoing basis is effective. Some project managers fall into the trap of networking only at the launch of a project. However, it's the steady networking that builds relationships.

Identifying the Roles and Responsibilities

Human resource planning accomplishes wonderful things. It communicates what resources the project will need, the roles and responsibilities the project team will play on the project, the structure of the project team, and more. One of the fundamental things that human resource planning does for the project is to identify the attributes of the project team. You'll need to know these four terms for your PMI examination:

- **Role** This person is responsible for a specific portion of the project. Roles are usually tied to job titles, such as network engineer, mechanical engineer, and electrician. It's what a person does.
- **Responsibility** A responsibility is the work that a role performs. More precisely, it's the work that a project team member is responsible for within the project.
- **Authority** Project team members may have authority over other project team members, have the ability to make decisions, and even sign approvals for project work and purchases. The authority level defines which project team member has what level of authority within the project.
- **Competency** This attribute defines what talents, skills, and capacities are needed to complete the project work. If there is a skill gap, then training, development, hiring, and even schedule and scope changes should be enacted.

Creating a Project Organization Chart

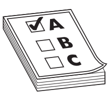
Another output of the human resource planning process for your project is a project organization chart. This chart, as its name implies, illustrates the organization of the project, the project team members, and all the associated reporting relationships. The level of detail of the project organization chart is relative to the size of the project team and the priority of the project. In other words, a massive international project with 3,000 project team members around the globe will likely have more detail than a 20-person project team to create a new piece of software.

Examining the Staffing Management Plan

Here's the meat of planning for project human resources: you and the project management team create the staffing management plan. This plan is a subsidiary plan of the project management plan and details all of the following concerns:

- **Staff acquisition** This portion of the project plan defines how the project team will be assembled. In some organizations, the project team is assigned to the project manager; in others, the project manager petitions for the project team members that he'd like on the project. This portion of the plan also defines how the organization's human resources department will interact with the project management team and if the project team will be all internal, all external, or a blend of resources. Staff acquisition concerns also deal with the geographical location of the project team members and the costs associated with acquiring team members with the appropriate expertise.

- **Timetable** In most projects, not all team members will be utilized on the project all of the time. A timetable can identify when project team members are needed on the project and when related activities, such as team acquisitions, can be scheduled. In some projects, a resource histogram, as Figure 9-3 shows, demonstrates when resources will be utilized across the project. Typically, each bar in the histogram represents a project team member, although some resource histograms can be created to show when a project unit or department is involved in the project.



EXAM TIP When an individual bar in a resource histogram extends beyond the maximum allowed hours, resource leveling is needed. Resource leveling lops off the exceeded labor amount and often causes the project duration to increase.

- **Release criteria** The staffing management plan defines the conditions and circumstances regarding when a project staff member may be released from the project team. This helps the project manager, functional managers, and other project managers plan for how they'll use the identified resource in future projects and operations.
- **Training needs** If the project team doesn't know how to complete the work within the project, the project manager must hire a contracted resource or train the project team. This section of the staffing management plan defines the need for training, the benefits of certification, and how the training can help the project—and often the organization—reach its goals.

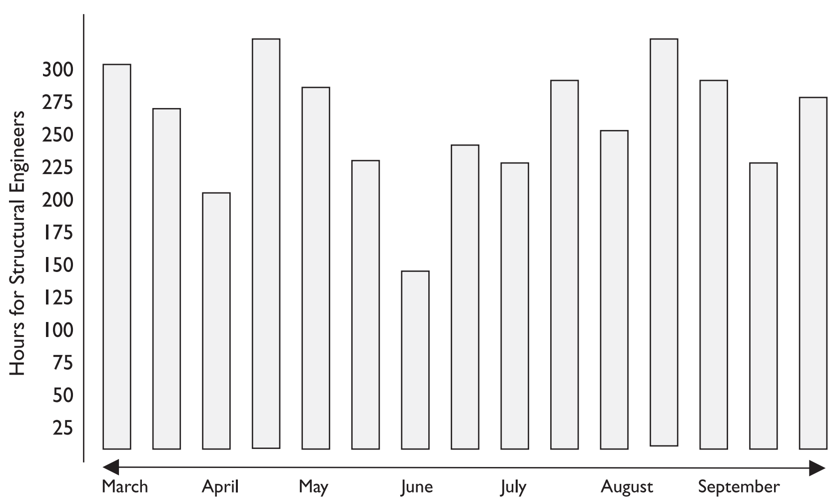


Figure 9-3 Resource histograms depict when project team resources are utilized.

- **Rewards and recognition** This is a key PMI point. A clearly defined system for rewards and recognition will reinforce the behavior the project manager wants from her project team. Rewards and recognition, however, must be based on conditions within a person's control. For example, if Bob is to be rewarded for managing costs within the project but Bob has no authority over the decisions that affect costs, he'll feel pretty insecure in his ability to realize the reward your project promises.

EXAM TIP Rewards and recognitions are part of team development.

- **Compliance issues** The staffing management plan also details how the project will adhere to government regulations, union contracts, and human resource practices your organization abides by.
- **Safety** Many projects must consider the safety of the project team. While safety for the project team is part of the cost of quality, as I discussed in Chapter 8, it's revisited here to reinforce the need for attention to safety issues. We'll see this issue again in Chapter 11 when we discuss risks and the project team.

Acquiring the Project Team (PMBOK, Section 9.2)

You need people to complete your project. But have you ever managed a project where the resources you wanted on the project were not available? Or have you managed a project where the resources you were assigned weren't the best resources to complete the project work? Staff acquisition is the process of getting the needed resources on the project team to complete the project work. It focuses on working within the policies and procedures of the performing organization to obtain the needed resources to complete the project work. Negotiation, communication, and political savvy are the keys to getting the desired resources on the project team.

Examining the Staffing Pool

Sometimes, the project manager doesn't have any say over the project team members that are assigned to the project team. In other instances, the project manager can influence the decision makers to get the best team members. This is part of enterprise environmental factors—how an organization operates. The project manager should always ask about the following things:

- **Experience** What is the experience of the project team member? Has he done similar work in the past? Has he done it well?
- **Interest level** Are the project team members interested in working on this project?
- **Characteristics** How will each individual team member work with other project team members?
- **Availability** Will the project team members desired for the project be available? Project managers should confer with functional managers on the availability of potential team members.

- **Knowledge** What is the competency and proficiency of the available project team members?

Negotiating for Resources

Most projects require the project manager to negotiate for resources. The project manager will likely have to negotiate with functional managers to obtain the needed resources to complete the project work. The functional managers and the project manager may struggle over an employee's time due to demands from ongoing operations, other projects, and desires to effectively use resources. In other instances, functional managers may want to assign under-utilized resources on projects in order to consume their otherwise idle employees' time.

Project managers may also have to negotiate with other project managers to share needed resources among projects. Scheduling the needed resources between the project teams will need to be coordinated so that both projects may complete successfully.

Working with Preassigned Staff

Project team members are often preassigned to a project for a number of reasons:

- Availability of the individual
- Promised as part of a competitive contract
- Required as part of the project charter for an internal project
- Opportunity for the staff member to complete on-the-job training

Whatever the reasoning behind the assignment of the staff to the project, the project manager should evaluate the project team for skill gaps, availability to complete the project work, and expectations of the project team members. The project manager must address any discrepancies between the requirements of the project work and the project team's ability to complete the work.

Procuring Staff

In some instances, the project manager may have no alternative but to procure the project team or individuals to complete the project work. I'll talk all about procurement in Chapter 12. With regard to project team procurement, reasons why the project manager can use this alternative include, but are not limited to, the following:

- The performing organization lacks the internal resources with the needed skills to complete the project work.
- The work is more cost-effective to procure.
- The project team members are present within the organization, but they are not available to the current project.
- The project team members are present within the organization, but they cannot complete the needed work due to other project assignments.

Assembling the Project Team

With the project team assembled, the project manager can continue planning, assigning activities, and managing the project progression. Project team members can be assigned to the project on a full- or part-time basis, depending on the project conditions. Once the project team is built, a project team directory should be assembled. The project team directory should include:

- The project team members' names
- Phone numbers
- E-mail addresses
- Mailing addresses, if the team is noncollocated
- Contact information for key stakeholders
- Any other relevant contact information for each team member, such as photos, Web addresses, and so on

Developing the Project Team (PMBOK, Section 9.3)

Developing the project team is met by enhancing the competencies of the individual project team members and promoting the interaction of all the project team members. Throughout the project, the project manager will have to work to develop the project team. The project manager may have to develop an individual team member's skills so that she can complete her assignments. The project manager will also have to work to develop the project team as a whole so that the team can work together to complete the project.

In matrix organizations, the project team members are accountable to the project manager and to their functional managers. Developing the project team can prove challenging, since the project team members may feel pulled between multiple bosses. The project manager must strive to involve and develop the project team members as individuals completing project work—and as team members completing the project objectives together.

Preparing for Team Development

Team development is a natural process, but it's also a process that the project manager can usher along. If you're the project manager and you want your team to work together, get along, and focus on completing the project rather than on who's really in charge of the project, you'll need these inputs:

- **Staff assignments** The assignments of the project team members define their skills, their needs for development, and their abilities to complete the project work as individuals and as part of the team.
- **Staffing management plan** Recall that the staffing management plan details how project team members will be brought on to the project and excused from it.
- **External feedback** When things are not well with project team members, stakeholders are often happy to tell the project manager. In some instances, the project manager must query stakeholders and organizational interfaces on the performance of the project team members.

- **Resource availability** You'll need to know when your project team members are available and when they're vacationing in the desert. This component also considers when project team members are on multiple projects within your organization and allows you to plan for when you'll utilize the project team members best.

Leading Project Team Development

Due to the temporary and short-term nature of projects, it can be tough for a group of strangers to form relationships and immediately create a successful project. Team development is the guidance, direction, and leadership the project manager offers to influence a project team.

Training the project team is one of the best team development exercises. The staffing management plan defines the need for training, and team development is the execution of that plan. In other words, if team members don't know how to do the project work, train them!

Another facet of team development is a focus on getting the project work completed. The project managers are the power on the project team. While there may be some resistance from the project team to cooperate with the project manager, complete assigned duties, or participate as requested, the project team should realize that the project manager is the project authority. There are five types of powers that the project manager yields:

- **Expert** The project manager's authority comes from both experience with the technology the project focuses on and from expertise managing projects.
- **Reward** The project manager has the authority to reward the project team.
- **Formal** The project manager has been assigned the role of project manager by senior management and is in charge of the project. This is also known as positional power.
- **Coercive** The project manager has the authority to discipline the project team members. This is also known as penalty power. When the team is afraid of the project manager, the project manager has coercive power.
- **Referent** The project team personally knows the project manager. Referent can also mean that the project manager refers to the person who assigned him the position; for example, "The CEO assigned me to this position, so we'll do it this way." This power can also mean the project team wants to work on the project or with the project manager due to the high priority and impact of the project.

Creating Team-Building Activities

Team-building activities are approaches to developing the team through facilitated events. The goal of team-building exercises is to allow the project team to learn about each other, rely on each other, and form cohesiveness among the project team members. Events can include:

- Involving the team during planning processes
- Defining rules for handling team disagreements

- Holding off-site activities
- Facilitating quick team-involvement activities
- Facilitating activities to improve interpersonal skills and form relationships

Establishing Project Ground Rules

Creating ground rules for the project team is part of team development. Ground rules establish the project expectations for the project team and define what is and is not acceptable behavior by all of the project team members, including the project manager. When all of the project team members agree to abide by the defined ground rules, misunderstandings diminish while productivity increases. Once ground rules are defined, it's the responsibility of all the project team members to enforce them.

EXAM TIP Ground rules are enforced by the project team, not the project manager. That's from the PMBOK, Section 9.3.2.4—there's an exam gotcha!

Managing a Collocated Project Team

The idea of placing all of the project team members in one geographical location is ideal for many project managers. In theory, having all of the project team members together allows the team members to quickly communicate, work with each other, and generally work better as a team. In reality, that's not always possible: Team members are spread around the globe, space isn't necessarily available in one locale, and all the other logistics that could prevent bringing all of the project team together in a project war room. (And yes, there's no fighting in the war room.)

Virtual teams, however, are more likely in today's world. Collaboration software, Internet tools, phone calls, and e-mails can help increase communications and the sense of a collocated team without the expense and improbability of a collocated team.

Relying on General Management Skills

A chunk of project management relies on general management skills. Specifically, the project manager relies on:

- **Leading** Good project managers master the art of establishing direction, aligning people, and motivating the project team to complete the project work.
- **Communicating** Good project managers are good communicators. Remember, half of communicating is listening.
- **Negotiating** Project managers will likely negotiate for scope, cost, terms, assignment, and resources.
- **Problem solving** Project managers must have the ability to confront and solve problems.
- **Influence** Project managers use their influence to get things done.

Rewarding the Project Team

When discussing human resource planning, I mentioned that you, the project manager, should create the rewards and recognition system. This system is part of team development and encourages the behavior you want from your project team—that is, the behavior that promotes the project to completion and meets the project scope statement. Performance appraisals tell the project manager, and sometimes functional management, which team members should be rewarded based on the confines of the reward system.

Obviously, positive behavior should be rewarded. If a project team member willingly agrees to work overtime to ensure that the project will hit its schedule objective, that should be rewarded or recognized by the project manager. However, if a project team member has to work overtime because he has wasted time or resources, a reward is not in order.

Win-lose awards, sometimes called zero-sum awards, should be avoided, as they can deteriorate the project team's cohesiveness. Any award where only some of the project team members can qualify shouldn't be given. I once worked on a project where the project manager awarded the software developer that accomplished the most code a bonus every month. Well, since I wasn't a software developer, I could never qualify for that bonus. (Thanks a lot, Ron! Ron was my boss then, and oh sweet printed vengeance now. Kidding…he dropped the bonus program when he saw the trouble with his plan.)

EXAM TIP Your reward and recognition system should also consider the cultural differences. The PMBOK acknowledges that creating team rewards in a culture that encourages individualism can be difficult. In other words, the reward system must mesh with the culture within which the project manager is operating.

Managing the Project Team (PMBOK, Section 9.4)

Now that the project manager has planned for the human resources and developed the project team, he can focus on managing the project team. This process involves tracking each team member's performance, offering feedback, taking care of project issues, and managing those pesky change requests that can affect the project team and its work. The staffing management plan may be updated based on lessons learned and changes within the team management process.

In a matrix environment, where the project team members are accountable to both the project manager and a functional manager, team management is tricky business. The project manager and the functional managers need to work together to communicate the utilization of the project team member in both operations and on the project. The project team's demand for dual reporting to the project manager and the functional manager also has to be considered—and is often the responsibility of the project manager rather than the functional manager or project team member.

Preparing for Team Management

Managing the project team is based on many conditions and scenarios within the project. Management of the project team is really about one thing: getting the project work done as promised in the project scope statement. There are many inputs to project team management:

- **Organizational process assets** Consider the organization's approach to rewarding employees for their work in a project. Organizational process assets in team management rely on dinners, certificates of appreciation, newsletters, and other methods to recognize a project team's hard work on a project.
- **Project staff assignments** The project manager and the project management team both need a listing of the project staff assignments to monitor and evaluate each project team member's project performance.
- **Project organizational charts** Remember these? These charts depict the reporting structure between and among project team members.
- **Staffing management plan** You know this plan, right? Just in case you forgot, it defines when project team members will complete their project work, the training needs for the project, certification requirements, and any labor compliance issues. It's the output of human resources planning.
- **Team performance assessment** You'll know if your project team is doing a good job or not, but you'll want to quantify their performance so that you can make recommendations where needed.
- **Work performance information** The project management team observes and records the work a project team member performs. This doesn't necessarily mean the project management team peers over the shoulder of the project team member, but rather observes the team member's participation in team activities, delivery on action items, and thoroughness in communication.
- **Performance reports** These are just reports about the project team's performance and how it meshes, or contradicts, what was promised in the project management plan.

All of these inputs feed directly into the actual process of managing the project team. The project manager and the project management team will use the evidence of these things to better manage the team in order to move the project towards completion.

Dealing with Team Disagreements

In most projects, there will be instances when the project team, management, and other stakeholders disagree on the progress, decisions, and proposed solutions within the project. It's essential for the project manager to keep calm, lead, and direct the parties to a sensible solution that's best for the project. Here are seven reasons for conflict, in order of most common to least common:

- Schedules
- Priorities
- Resources
- Technical beliefs
- Administrative policies and procedures

- Project costs
- Personalities

EXAM TIP You can expect questions on these areas of conflict on the exam. Don't be duped into thinking personality conflicts are the biggest problem with conflict resolution; they are the least important.

So what's a project manager to do with all the potential for strife in a project? There are five different approaches to conflict resolution:

- **Problem solving** This approach confronts the problem head-on and is the preferred method of conflict resolution. You may see this approach defined as "confronting" rather than problem solving. Problem solving calls for additional research to find the best solution for the problem, and should be a win-win solution. It should be used if there is time to work through and resolve the issue. It also serves to build relationships and trust.
- **Forcing** The person with the power makes the decision. The decision made may not be the best decision for the project, but it's fast. As expected, this autocratic approach does little for team development and is a win-lose solution. It should be used when the stakes are high and time is of the essence or if relationships are not important.
- **Compromising** This approach requires that both parties give up something. The decision made is a blend of both sides of the argument. Because neither party really wins, it is considered a lose-lose solution. The project manager can use this approach when the relationships are equal and no one can truly "win." This approach can also be used to avoid a fight.
- **Smoothing** This approach "smoothes" out the conflict by minimizing the perceived size of the problem. It is a temporary solution, but can calm team relations and boisterous discussions. Smoothing may be acceptable when time is of the essence or when any of the proposed solutions will not currently settle the problem. This can be considered a lose-lose situation as well, since no one really wins in the long run. The project manager can use smoothing to emphasize areas of agreement between disagreeing stakeholders and, thus, minimize areas of conflict. It's used to maintain relationships and when the issue is not critical.
- **Withdrawal** This conflict resolution has one side of the argument walking away from the problem, usually in disgust. The conflict is not resolved, and it is considered a yield-lose solution. The approach can be used, however, as a cooling-off period or when the issue is not critical.

Creating an Issue Log

It's okay to have issues within a project as long as the issues are recorded in the issue log. An issue, technically, is something that may be preventing the project team from reaching the project objectives. Typically, issues are identified and recorded in the issue log. Each issue is assigned to an owner, who needs to find a method that will resolve the issue by a given date. Each issue should also be identified as to its status and the possible resolution. Common issues listed in the PMBOK are:

- Differences of opinion
- Situations to be investigated
- Unanticipated responsibilities that need to be assigned to someone on the project team

Examining the Outputs of Team Management

Team management begins as soon as the project team comes together; it ends as soon as the project is closed. Throughout the project, there will be different conditions and scenarios that will affect how the project manager and the project management team will manage the project and the resources within it. There are six outputs of managing the project team:

- **Requested changes** Seems like just about everything can result in a change request, doesn't it? Changes to the project team can have ripple effects on the project scheduling, project cost, and even the project scope statement, so a change request is needed when these conditions are true.
- **Recommended corrective actions** These are actions to provide staffing changes, training, and even disciplinary actions. Other recommended corrective actions can include moving people to different assignments, outsourcing some of the project work, and replacing project team members who may have left the organization or project.
- **Recommended preventive actions** When the project management team identifies problems that could arise, they should make recommended preventive actions. This is true even in project human resource management. Preventive actions can include cross-training, role clarification, and even labor to ensure that all of the project work is completed as planned.
- **Inputs to performance appraisals** Project team members' performance is reviewed and tied to their overall performance on the project team. Performance appraisals can be in the form of the 360-degree appraisal, where a project team member is reviewed in all directions by the project team, the project manager, stakeholders, and even vendors, where appropriate.
- **Lessons learned** What the project management team learns in the project becomes part of organizational process assets for future projects. For example, lessons learned in human resources include:
  - Staffing management plan
  - Organizational charts
  - Position descriptions
  - Ground rules
  - Conflict management techniques

- Successful rewards and recognition approaches
- Procedures for virtual team management
- Negotiating techniques
- Training programs
- Successful team-building exercises
- Issues and solutions documented in the project log

- **Project management plan updates** Just like any other area of project management, if the project management plan needs to updated, it should be. Project management plan updates could be approved change requests, corrective actions, new project team member roles, and training decisions.

Relating to Organizational Theories (PMBOK, Section 9.1.2.3)

In the PMBOK, this is a minor section, with hints to these project management and human resource theories. On your exam, however, you can expect to see some of these topics there, so let's have a look at these theories in more detail.

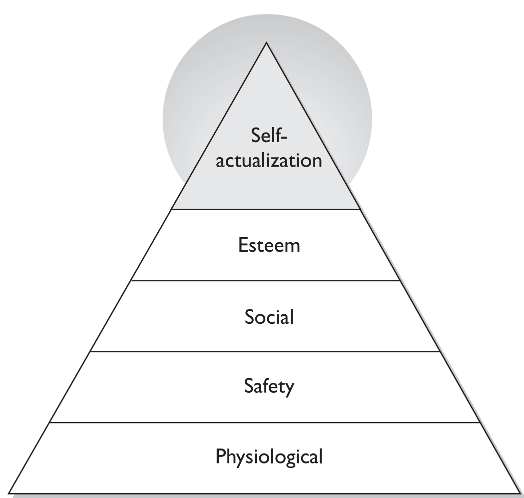
Maslow's Hierarchy of Needs

According to Abraham Maslow, people work to take care of a hierarchy of needs. The pinnacle of their needs is self-actualization. People want to contribute, prove their worth, and use their skills and abilities. Figure 9-4 shows the pyramid of needs that all people try to ascend by fulfilling each layer, one at a time.

Maslow's five layers of needs, from lowest to highest, are:

- **Physiological** People require these necessities to live: air, water, food, clothing, and shelter.

Figure 9-4 Maslow's theory states that people ultimately work for self-actualization.



- **Safety** People need safety and security; this can include stability in life, work, and culture.
- **Social** People are social creatures and need love, approval, and friends.
- **Esteem** People strive for the respect, appreciation, and approval of others.
- **Self-actualization** At the pinnacle of needs, people seek personal growth, knowledge, and fulfillment.

Herzberg's Theory of Motivation

According to Frederick Herzberg, a psychologist and authority on the motivation of work, there are two catalysts for success with people:

- **Hygiene agents** These elements are the expectations all workers have. They include job security, a paycheck, clean and safe working conditions, a sense of belonging, civil working relationships, and other basic attributes associated with employment.
- **Motivating agents** These are the elements that motivate people to excel. They include responsibility, appreciation of work, public recognition for a job well done, the chance to excel, education, and other opportunities associated with work aside from financial rewards.

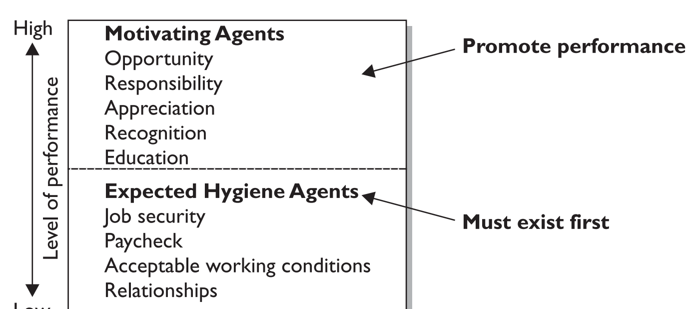
This theory says that the presence of hygiene factors will not motivate people to perform, as these are expected attributes. However, the absence of these elements will demotivate performance. For people to excel, the presence of motivating factors must exist. Figure 9-5 illustrates Herzberg's theory of motivation.

McGregor's Theory of X and Y

Douglas McGregor's theory states that, from their perspective, management believes there are two types of workers, good and bad, as seen in Figure 9-6. The theory goes on to state that management actually shifts from position to position, depending on the worker and the conditions that warrant the behavior of the manager:

- *X is bad.* These people need to be watched all the time, micromanaged, and cannot be trusted. X people avoid work, shun responsibility, and lack the aptitude to achieve.
- *Y is good.* These people are self-led, motivated, and can accomplish new tasks proactively.

Figure 9-5 Hygiene agents do nothing to motivate, but their absence will cause performance and morale to decline.



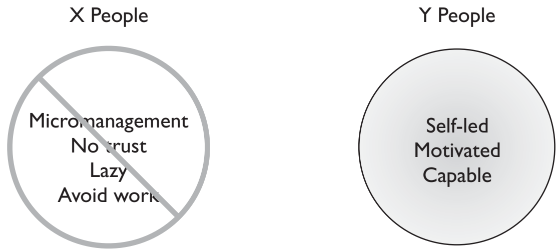


Figure 9-6 Management believes that "X" people are bad and "Y" people are good.

Ouchi's Theory Z

William Ouchi's theory is based on the participative management style of the Japanese. This theory states that workers are motivated by a sense of commitment, opportunity, and advancement. Workers in an organization subscribing to theory Z learn the business by moving up through the ranks of the company.

Ouchi's theory also credits the idea of "lifetime employment." Workers will stay with one company until they retire because they are dedicated to the company that is, in turn, dedicated to them.

EXAM TIP If you need a way to keep McGregor's X and Y and Ouchi's Z theories separate in your mind, think of this: X is bad; Y is good; Z is the best.

Expectancy Theory

Expectancy theory states that people will behave based on what they expect as a result of their behavior. In other words, people will work in relation to the expected reward of the work. If the attractiveness of the reward is desirable to the worker, she will work to receive it—people expect to be rewarded for their effort.

Chapter Summary

The project manager has to plan for the needed human resources in order to complete the project work. In addition, the project manager plans for how the human resources will be managed, trained, motivated, and led throughout the duration of the project. The project management team works to identify the roles within the project and their responsibilities, which are the activities to complete the project work. The key output of planning for human resources is the staffing management plan, which defines how the project team will be acquired, managed, trained, rewarded for the work, and then released from the project team. The staffing management plan also defines how the project management team will comply with government regulations and manage team safety concerns.

The project team is acquired just like the staffing management plan asks. The team, however, isn't always selected—it's often preassigned to the project. Sometimes, the project manager gets to negotiate with the functional managers and other project managers to get the best resources on the project as possible. When the resources aren't available inside the organization, the project manager often has to deal with contracted help, which means procurement.

Some teams all work together in one locale and might huddle in the project's war room. This idea of a collocated team supports ad-hoc conversations, team cohesiveness, and project performance. However, in many cases, the project team is not collocated and a virtual team is created. Virtual teams allow people with mobility handicaps, travel issues, and home office workers to be actively involved in the project.

Whatever conditions surround the project team, the project manager must work to develop it. Team development centers on building team cohesiveness through team-building exercises, training, and team involvement. One team development tool and technique is the creation of ground rules. Ground rules are created and agreed upon by the project team to promote performance within the project. Once ground rules are created, it's up to the project team to enforce them.

Through conversations, observations, performance appraisals, conflict management, and the issue log, the project manager will manage the project team. The goal of team management is getting the project done—it's all about results.

Human resource theories, such as Maslow's hierarchy of needs, McGregor's theory of X and Y, and Ouchi's theory Z, all seek to determine what motivates an employee to complete her project tasks. Project managers can use these theories to determine the best approach to motivate or inspire a project team member to elicit the behavior the project manager expects.

Key Terms

Authority power Project team members may have authority over other project team members, have the ability to make decisions, and even sign approvals for project work and purchases.

Coercive power The project manager has the authority to discipline the project team members. This is also known as penalty power.

Collective bargaining agreement constraints Contracts and agreements with unions or other employee groups may serve as constraints for the project.

Competency This attribute defines what talents, skills, and capacities are needed to complete the project work.

Compromising This approach requires that both parties give up something.

Expectancy theory This theory states that people will behave based on what they expect as a result of their behavior. In other words, people will work in relation to the expected reward.

Expert power The project manager's authority comes from both experiences with the technology the project focuses on and from expertise in managing projects.

Forcing power The person with the power makes the decision.

Formal power The project manager has been assigned the role of project manager by senior management and is in charge of the project.

Herzberg's theory of motivation Frederick Herzberg's theory of the motivating agents and hygiene agents that affect a person's willingness to excel in his career.

Hierarchical organizational chart A chart showing the relationship between superior and subordinate employees, groups, disciplines, and even departments.

Interpersonal interfaces This organizational interface considers the formal and informal reporting relationships that may exist among the project team members. The interpersonal interface also considers the job descriptions of the project team members, existing reporting structures between supervisors and subordinates, and existing relationships, if any, that may affect the project work. This interface also considers any cultural or language differences among the project team that may need to be addressed.

Issue log A logbook of the issues the project team has identified and dates as to when the issues must be resolved by. The issue log may also include team members or stakeholders who are responsible for finding a solution to the identified issues.

Logistical interfaces The logistics of the team locale, time zones, geographical boundaries, and travel requirements within a project.

Maslow's hierarchy of needs Abraham Maslow's theory of the five needs all humans have and work towards.

McGregor's theory of X and Y Douglas McGregor's theory that states management views workers in the Y category as competent and self-led and workers in the X category as incompetent and needing to be micromanaged.

Organization chart Traditional chart that depicts how the organization is broken down by department and disciplines. This chart is sometimes called the organizational breakdown structure (OBS) and is arranged by departments, units, or teams.

Organizational interfaces The project management team needs to identify which departments are going to be involved in the project.

Organizational structure constraint The structure of the organization has a direct correlation to the amount of power a project manager has within a project.

Ouchi's theory Z William Ouchi's theory is based on the participative management style of the Japanese. This theory states that workers are motivated by a sense of commitment, opportunity, and advancement.

Political interfaces The hidden goals, personal agendas, and alliances among the project team members and the stakeholders.

Problem solving This approach confronts the problem head-on and is the preferred method of conflict resolution.

RACI chart A RACI chart is a matrix chart that only uses the activities of responsible, accountable, consult, and inform.

Referent The project team personally knows the project manager. Referent can also mean that the project manager refers to the person who assigned him the position.

Resource breakdown structure (RBS) This hierarchical chart can decompose the project by the type of resources used throughout it.

Responsibility A responsibility is the work that a role performs.

Responsibility assignment matrix (RAM) A RAM chart shows the correlation between project team members and the work they've been assigned to complete.

Reward The project manager has the authority to reward the project team.

Role This person is responsible for a specific portion of the project. Roles are usually tied to job titles, such as network engineer, mechanical engineer, and electrician.

Smoothing This approach "smoothes" out the conflict by minimizing the perceived size of the problem. It is a temporary solution, but can calm team relations and boisterous discussions.

Staffing management plan A subsidiary plan of the project management plan that defines staff acquisition, timetables, release criteria, training needs, reward and recognition system, compliance issues, and safety concerns for the project.

Technical interfaces The project team identifies the disciplines and specialties that the project will require to complete the project scope statement. The technical interfaces are the resources that will be doing the project work.

Withdrawal This conflict resolution method sees one side of the argument walking away from the problem, usually in disgust.

Questions

1. You are the project manager for the JHG Project. This project requires coordination with the director of manufacturing, HR, the IT department, and the CIO. This is an example of what type of input to organizational planning?
   - **A.** Organizational interfaces
   - **B.** Technical interfaces
   - **C.** Interpersonal interfaces
   - **D.** Human resource coordination
2. Your project requires an electrician at month eight. This is an example of which of the following?
   - **A.** Organizational interfaces
   - **B.** Staffing requirements
   - **C.** Contractor requirements
   - **D.** Resource constraints
3. You are the project manager of the PUY Project. This project requires a chemical engineer for seven months of the project, although there are no available chemical engineers within your department. This is an example of which of the following?
   - **A.** Organizational interfaces
   - **B.** Staffing requirements

C. Contractor requirements

D. Resource constraints

4. You are the project manager in an organization with a weak matrix. Who will have the authority in your project?

   A. The project manager

   B. The customer

   C. Functional management

   D. The team leader

5. You are the project manager for the LMG Project. Your project will have several human resource issues that must be coordinated and approved by the union. Which of the following statements is correct about this scenario?

   A. The union is considered a resource constraint.

   B. The union is considered a management constraint.

   C. The union is considered a project stakeholder.

   D. The union is considered a project team member.

6. You are the project manager of the PLY Project. This project is similar to the ACT Project you have completed. What method can you use to expedite the process of organizational planning?

   A. Use the project plan of the ACT Project on the PLY Project.

   B. Use the roles and responsibilities defined in the ACT Project on the PLY Project.

   C. Use the project team structure of the ACT Project on the PLY Project.

   D. Use the project team of the ACT Project on the PLY Project.

7. Which of the following is an example of theory X?

   A. Self-led project teams

   B. Micromanagement

   C. Team members able to work on their own accord

   D. Earned value management

8. You are the project manager of the PLN Project. The team members are somewhat "afraid" of you as project manager because they see you as management. They know that a negative review from you about their project work will impact their yearly bonus. This is an example of which of the following?

   A. Formal power

   B. Coercive power

   C. Expert power

   D. Referent power

9. You are the project manager of the MMB Project. The president of the company has spoken to the project team and told them of the confidence and respect he has in you to lead the project to a successful completion. The project manager has what type of power on this project?
   - **A.** Formal power
   - **B.** Coercive power
   - **C.** Expert power
   - **D.** Halo power
10. Management has approached Tyler, one of your project team members. Tyler is a database administrator and developer whose work is always on time, accurate, and of quality. He also has a reputation of being a "good guy" and is well liked. Because of this, management has decided to move Tyler into the role of a project manager for a new database administration project. This is an example of which of the following?
    - **A.** Management by exception
    - **B.** The halo effect
    - **C.** Management by objectives
    - **D.** McGregor's theory of X and Y
11. Which problem-solving technique is the best for most project management situations?
    - **A.** Confronting
    - **B.** Compromising
    - **C.** Forcing
    - **D.** Avoiding
12. Harold is an outspoken project team member. All of the project team members respect Harold for his experience with the technology, but often, things have to go in Harold's favor or things do not go well. During a discussion on a solution, a project team member waves her arms and says, "Fine, Harold, do it your way." This is an example of which of the following?
    - **A.** A win-win solution
    - **B.** A leave-lose solution
    - **C.** A lose-lose solution
    - **D.** A yield-lose solution
13. You are the project manager for the GBK Project. This project affects a line of business, and the customer is anxious about the success of the project. Which of the following is likely *not* a top concern for the customer?
    - **A.** Project priorities
    - **B.** Schedule
    - **C.** Cost
    - **D.** Personality conflicts

14. Which theory believes that workers need to be involved with the management process?
    A. McGregor's theory of X and Y
    B. Ouchi's theory Z
    C. Herzberg's theory of motivation
    D. Expectancy theory
15. ____________________ states that as long as workers are rewarded they will remain productive.
    A. McGregor's theory of X and Y
    B. Ouchi's theory Z
    C. Herzberg's theory of motivation
    D. Expectancy theory
16. You are the project manager for Industrial Lights Project. You have been hired by your organization specifically because of your vast experience with the technology and with projects of this nature. The project team is aware of your experience. You likely have what type of power on this project?
    A. Formal power
    B. Coercive power
    C. Expert power
    D. Referent power
17. You are the project manager for GHB Project. You have served as a project manager for your organization for the past 10 years. Practically all of your projects come in on time and on budget. The project team has worked with you in the past, and they consider you to be an expert project manager. They also like working with you. Given all of this, you likely have what type of power on this project?
    A. Formal power
    B. Coercive power
    C. Expert power
    D. Referent power
18. Which of the following is an example of coercive power?
    A. A project manager who has lunch with the project team every Thursday
    B. A project manager who will openly punish any team member who is late with an activity
    C. A project manager who has worked with the technology on the project for several years
    D. A project manager who is friends with all of the project team members
19. Mike is the project manager for a project with a very tight schedule. The project is running late, and Mike feels that he does not have time to consider

all the possible solutions that two team members are in disagreement over. He quickly decides to go with the team member with the largest amount of seniority. This is an example of which of the following?

A. Problem solving

B. Compromising

C. Forcing

D. Withdrawal

20. You are a project manager in a projectized organization. Your job as a project manager can be described best by which of the following?

A. Full-time

B. Part-time

C. Expeditor

D. Coordinator

Answers

1. **A**. The reporting interfaces for this project—the director of manufacturing, HR, the IT department, and the CIO—are examples of the organizational interfaces. B is incorrect; technical interfaces are the technical gurus for the project, such as the engineers and designers. C, the interpersonal interfaces, is not the best choice because this relationship describes the different individuals working on the project. D, human resource coordination, is also incorrect. For more information, see the PMBOK, Section 9.1.1.
2. **B**. Because the project requires the electrician, a project role, this is a staffing requirement. A is incorrect because it does not accurately describe the situation. C is incorrect; contractor requirements would specify the procurement issues, the minimum qualifications for the electrician, and so on. D is incorrect. A resource constraint, while a tempting choice, deals more with the availability of the resource or the requirement to use the resource. For more information, see the PMBOK, Section 9.2.2.
3. **B**. The project needs the resource of the chemical engineer to be successful. When the project needs a resource, it is a staffing requirement. A, C, and D are all incorrect. This is not a situation describing an organizational interface or contractor requirements. Resource constraints might include a requirement to use a particular resource or that a resource must be available when certain project activities are happening. For more information, see the PMBOK, Section 9.2.2.
4. **C**. In a weak matrix structure, functional management will have more authority than the project manager. A, B, and D are all incorrect because these choices do not have as much authority on a project in a weak matrix environment as functional management will have. For more information, see the PMBOK, Section 9.1.1.1.
5. **C**. In this instance, the union is considered a project stakeholder because it has a vested interest in the project's outcome. A is incorrect because the union

is not a resource constraint; they are interested in the project management methodology and the project human resource management. B is incorrect; the union is the counterweight to the management of the organization, not to the project itself. D is also incorrect; the union is not a project team member. For more information, see the PMBOK, Section 9.1.1.1.

6. **B**. When projects are similar in nature, the project manager can use the roles and responsibilities defined in the historical project to guide the current project. A is incorrect; the entire project plan of the ACT Project is not needed. Even the roles and responsibilities matrix of the historical project may not be an exact fit for the current project. C is incorrect; copying the project team structure is not the best choice of all the answers presented. D is also incorrect because using the same project team may not be feasible at all. For more information, see the PMBOK, Section 9.1.1.2.
7. **B**. Theory X states that workers have an inherent dislike of work and will avoid it if possible. With regards to this theory, micromanagement is a method used to make certain workers complete their work. A and C are actually examples of McGregor's theory Y. D is incorrect because EVM is not directly related to McGregor's theory of X and Y. For more information, see the PMBOK, Section 9.1.2.3.
8. **B**. When the project team is afraid of the power the project manager yields, this is called coercive power. A, C, and D are incorrect because they describe assigned, referential, and technical power over the project, respectively. For more information, see the PMBOK, Section 9.4.2.
9. **A**. The company president has assigned you to the position of the project manager, so you have formal power. B is incorrect because coercive power is the fear associated with the project manager. C is incorrect because expert power is derived from the project manager's experience with the technology being implemented. D is also incorrect; halo power is not a viable answer to the question. For more information, see the PMBOK, Section 9.4.2.
10. **B**. The halo effect is the assumption that because the person is good at a technology, he would also be good at managing a project dealing with that said technology. A, C, and D are all incorrect because these do not describe the halo effect. For more information, see the PMBOK, Section 9.4.2.
11. **A**. Confronting is the best problem-solving technique because it meets the problem directly. B is incorrect; compromising requires both sides on an argument to give up something. C is incorrect; forcing requires the project manager to force a decision based on external inputs, such as seniority, experience, and so on. D is also incorrect; avoiding ignores the problem and does not solve it. For more information, see the PMBOK, Section 9.4.2.3.
12. **D**. When Harold always has to win an argument and team members begin to give in to Harold's demands simply to avoid the argument rather than finding an accurate solution, this is a yield-lose situation. A is incorrect because both parties do not win. B is incorrect because the project team member did not leave the conversation, but instead ended it. C is incorrect; a lose-lose is a compromise where both parties give up something. For more information, see the PMBOK, Section 9.4.2.3.

13. **D**. Personality conflicts are likely a concern for the customer, but are not as important as project priorities, schedule, and cost. The customer hired your company to solve the technical issues. A, B, and C are all incorrect because these are most likely the top issues for a company in a project of this magnitude. For more information, see the PMBOK, Section 9.4.2.3.
14. **B**. Ouchi's theory Z states that workers need to be involved with the management process. A is incorrect; McGregor's theory of X and Y believes that X workers don't want to work and need constant supervision; Z workers will work if the work is challenging, satisfying, and rewarding. C is incorrect; Herzberg's theory of motivation describes the type of people and what excites them to work. D, the expectancy theory, describes how people will work based on what they expect in return. For more information, see the PMBOK, Section 9.4.2.
15. **D**. The expectancy theory describes how people will work based on what they expect in return. If people are rewarded because of the work they complete, and they like the reward (payment), they will continue to work. A, B, and C are all incorrect because these theories do not accurately describe the scenario presented. For more information, see the PMBOK, Section 9.4.2.3.
16. **C**. You, the project manager, have expert power on this project because of your experience with the technology and with projects that are similar in nature. A, B, and D are all incorrect. These project management powers do not accurately describe the scenario. Formal power is appointed power. Coercive power describes fear of the project manager. Referent power describes power by association and personal knowledge. For more information, see the PMBOK, Section 9.4.2.
17. **D**. This is referent power because the project team knows the project manager personally. A and B are incorrect choices; these do not describe the scenario. C is incorrect; expert power does not deal with the ability to lead and complete a project, but it focuses on being an expert with the technology that the project deals with. For more information, see the PMBOK, Section 9.4.2.3.
18. **B**. Coercive power is the formal authority a project manager yields over the project team. A is incorrect; only referent power may come through lunch meetings. C is incorrect; experience is expert power. D is incorrect; interpersonal relationships are examples of referent power. For more information, see the PMBOK, Section 9.4.2.3.
19. **C**. Forcing happens when the project manager makes a decision based on factors that are not relevant to the problem. Just because a team member has more seniority does not mean this individual is correct. A, B, and D are incorrect choices. A, problem solving, is not described in the scenario. B, compromising, happens when both parties agree to give up something. D, withdrawal, happens when a party leaves the argument. For more information, see the PMBOK, Section 9.4.2.3.
20. **A**. Project managers are typically assigned to a project on a full-time basis in a projectized organization. B, C, and D do not accurately describe the work schedule of a project manager in a projectized environment. For more information, see the PMBOK, Section 9.1.1.1.

CHAPTER 10

Managing Project Communications

In this chapter, you will

- Plan for project communications
- Distribute the project information
- Report the project performance
- Manage the project stakeholders

In the movie *Cool Hand Luke*, the prison captain says, "What we got here is a failure to communicate." It's a famous line that has been repeated by musicians, politicians, and even muttered by project managers. Hopefully, when you, the project manager, quote this line, you aren't viewed as the prison captain by your project team.

The point is that most projects experience a breakdown in communications. It's been said that 90 percent of a project manager's time is spent communicating. If you think about it, this certainly makes sense. Your project plans all communicate what you're going to do. Your project reports and forms communicate what you are doing or have done. And all of your status meetings, ad-hoc meetings, and presentations are all examples of communicating.

VIDEO Learning the communications formula.

Managing project communications is all about the creation, collection, distribution, storage, and handy retrieval of project information. It's what the project manager does day in and day out. The project manager is at the hub of communications and works with the project team, the project stakeholders, the sponsor, the vendors, and often the public to send and receive communications about the project. It can be exhausting, as somebody always needs to tell you something or you need to tell somebody else something. The key, of course, is to plan how to communicate and then share that plan and expectations at the launch of the project.

This chapter discusses the four processes that project communication centers on. Of course, you'll also need to know these processes to pass your Project Management Institute (PMI) exam.

Examining the Communications Foundation (PMBOK, Section 10)

Communications is central to project management and, as part of integration management, works with and through all of the other knowledge areas. A poor job of communicating ensures that the other knowledge areas may also suffer. Integration management, which I discussed in Chapter 4, revisits us in this chapter, as communication is the monitor of the other knowledge areas and serves as the vehicle for reporting information on these other facets of project management.

Communication Factors

In the Project Management Body of Knowledge's (PMBOK) introduction to Chapter 10, some interesting tips and terms sneak into the chapter that you'll likely see on your PMI examination. The first foundation you've got to know in regards to project communications are some of the skills a project manager uses to communicate. Consider the following:

- **Sender-receiver models** These are feedback loops and barriers to communications. Your project status meeting is a great example of a feedback loop, as all of your project team members hear what the other team members say, offer feedback to the speaker, the speaker may respond, and on and on. Basically, a feedback loop is a conversation between one or more speakers centering on one specific topic. A barrier to communication is anything that prevents communication from occurring at optimum levels. For example, if you and I are on the same project team but we're mad at each other, we're not going to communicate effectively—if at all.
- **Choice of media** The best modality to use when communicating is the one that is relevant to the information that's being communicated. Some communications demand a formal report, whereas others only warrant a phone call, a face-to-face meeting, or a few sentences on a sticky note. The right media is dictated by what needs to be communicated.
- **Writing style** You don't have to be E.B. White to write effectively (look at me!). You should, however, be conscious of the message you want to communicate and choose the appropriate writing style.
- **Presentation techniques** Some people cannot stand to be in front of an audience, but as a project manager, they often find themselves having to present project news and status. The presentation techniques, such as confidence, body language, and visual aids, promote or distract from the message the presenter is offering to the audience.
- **Meeting management techniques** Ever attend a WOT meeting? That's a "waste of time" meeting. Meetings should have an agenda and order, and someone needs to keep the meeting minutes for the project.

Understanding the Communication Model

The second foundation that is tucked into the introduction of Chapter 10 of the PMBOK is the communication model. As you can see in Figure 10-1, the model demon-

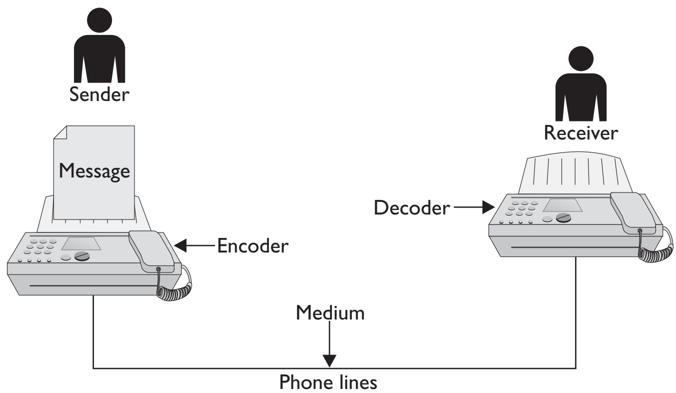


Figure 10-1 The communications model demonstrates the flow of communication.

strates how communication moves from one person to another. I like to think of each portion of the model as a fax machine to visualize all the components. Take a look:

- **Sender** This is the person who wants to send the message. Let's say I want to fax you a contract.
- **Encoder** This is the device that encodes the message to be sent. My fax machine is the encoder.
- **Medium** This is the device or technology that transports the message. The telephone line is the medium between our fax machines.
- **Decoder** This is the device that decodes the message as it is being received. Your fax machine is the decoder.
- **Receiver** This is the person who receives the message. You receive my fax, jot a note to me, and then send it back through your fax machine to mine. When you send the message back to me, the communication model is reversed.
- **Noise** Anything that interferes with or disrupts the message. It's possible that static on the phone line distorts the fax message between the two fax machines.

You'll likely see some of this business on your PMI exam. However, throughout this chapter, this model affects how communication happens between people.

Planning for Communications (PMBOK, Section 10.1)

As expected, effective communications begin with effective planning. The point of planning for communications is to determine and answer four fundamental project management questions:

- Who needs what information?
- When do they need the information?
- In what modality is the information needed?
- Who will provide the information?

Communication planning, although it comes late in this book and in the PMBOK, is actually done very early in the project planning processes. It's essential to answer the previous questions as early as possible, as their outcomes can affect the remainder of the project planning. Throughout the project, updates to communications planning are expected. Even the responses to the four project management communication questions can change as stakeholders, project team members, vendors, and other project interfaces change.

Preparing for Communications

The only output of the communications planning process is the communications management plan. This plan answers in detail the four questions previously mentioned and provides information on communication requirements, expectations, and timings. When the project management team begins to plan for communications in their project and answer those four essential questions, they've got four inputs they'll rely on, which the following sections describe.

Using Enterprise Environmental Factors

Much of the communications management processes are linked to the enterprise environmental factors. Enterprise environmental factors that affect project communications planning are:

- Organizational culture and structure
- Standards and regulations the project must comply with
- The logistics and organizational infrastructure
- The human resources the project will rely on and interact with
- The policies and procedures for personnel administration
- The project's work authorization system
- The marketplace conditions
- Stakeholder risk tolerances
- Commercial databases that the project may use for estimating
- Project management information system

Using Organizational Process Assets

The organizational process assets affect how the project manager, the project team, and the stakeholders will communicate within a project. The primary organizational process assets that affect communication are:

- Standards and policies unique to the organization
- Organizational guidelines, work instructions, and performance measurement criteria
- Organizational communication requirements for all projects considering required and approved technology, security issues, archiving, and allowed communication media
- Project closure requirements

- Financial controls and procedures
- Issue and defect management procedures for all projects
- Change control procedures
- Risk control procedures
- Work authorization systems
- Process measurement database
- Project file structure, organization, and retention
- Historical information and lessons learned requirements
- Issue and defect management databases
- Configuration management databases
- Project financial databases detailing labor hours, costs, budget issues, and cost overruns

Revisiting the Project Scope Statement

The project scope outlines all of the project work and only the project work. It also serves as a basis for all future project decisions and communicates for all of the project stakeholders what the project will and will not do. Recall that part of the scope creation, as I discussed way, way back in Chapter 5, is completing stakeholder analysis. I'll talk more about stakeholder analysis and managing the project stakeholders later in this chapter—both are key to project communications management.

Relying on the Project Management Plan

The project management plan is the collection of all those subsidiary plans and related documents, as well as communications to the stakeholders, the project team, management, vendors, the project sponsor, and you, the project manager. It illustrates what the project aims to do and how it will reach its objectives. The project plan is a communications device that can be updated as conditions in the project warrant.

The communications management plan also documents two components of just about every knowledge area. These two components you've seen over and over, so they shouldn't be a shock to you:

- **Constraints** Anything that limits the project management team's options. When it comes to communication constraints, geographical locales, incompatible communication software, or even limited communications technology can constrain the project team.
- **Assumptions** Anything that the project management team believes to be true but hasn't proven to be true. For example, the project management team may assume that all of the project team can be reached via cell phone, but, alas, there are parts of the world, as of this writing, that don't have a cell signal.

Identifying Communication Requirements

The project manager and the project team work together to identify who needs what information. In other words, the project management team needs to know what the requirements for successful communications are in order to plan on how to achieve those requirements.

Stakeholders will need different types of information, depending on their interest in the project and the priority of the project. The project manager will need to complete an analysis of the identified stakeholders to determine what information they actually need, as well as how often the information is needed.

There is no value in expending resources on generating information, reports, and analyses for stakeholders who have no interest in the information. An accurate assessment of stakeholders' needs for information is required early in the project planning processes. As a rule of thumb, provide information when its presence contributes to success or when a lack of information can contribute to failure.

The project manager and the project team can identify the demand for communications using the following:

- Organization charts
- The project structure within the performing organization
- Stakeholder responsibility relationships
- Departments and disciplines involved with the project work
- The number of individuals involved in the project and their locales
- Internal and external information needs
- Stakeholder information

On the Certified Associate in Project Management (CAPM) and Project Management Professional (PMP) exams, and in the real world, the project manager will need to identify the number of communication channels within a project. Here's a magic formula to calculate the number of communication channels: N (N – 1) / 2, where N represents the number of identified stakeholders. For example, if a project has 10 stakeholders, the formula would read 10 (10 – 1) / 2, for a total of 45 communication channels. Figure 10-2 illustrates the formula.

EXAM TIP Know this formula: N (N – 1) / 2, where N represents the number of stakeholders. It's easy, and you'll probably encounter it on the PMP exam.

Figure 10-2 Communication channels can be calculated using a simple formula.

Step 1
Know the formula.

$$\frac{N(N-1)}{2}$$

Step 2
Enter the values.

$$\frac{10(9)}{2}$$

Step 3
Get your answer.

$$\frac{90}{2} = 45$$

Exploring Communication Technologies

Let's face it: There are many different avenues a project manager and a project team can take to communicate. Project teams can effectively communicate through hallway meetings or formal project status meetings. Information can be transferred from stakeholder to stakeholder through anything from written notes to complex online databases and tracking systems.

As part of the communications planning, the project manager should identify all of the required and approved methods of communicating. Some projects may be highly sensitive and contain classified information that not all stakeholders are privy to, while other projects may contain information that's open for anyone to explore. Whatever the case, the project manager should identify what requirements exist, if any, for the communication modalities.

Communication modalities can also include meetings, reports, memos, e-mails, and so on. The project manager should identify the preferred methods of communicating based on the conditions of the message to be communicated. Consider the following, which may have an effect on the communication plan:

- **Urgency of the information** *When* the information is communicated can often be as important as *what's* being communicated. For some projects, information should be readily available, while other projects are less demanding.
- **Technology** Because of the demands of the project, technology changes may be needed to fulfill the project request. For example, the project may require an internal Web site that details project progress. If such a Web site does not exist, time and monies will need to be invested into this communication requirement.
- **Project staffing** The project manager should evaluate the abilities of the project team to determine if appropriate levels of competency exist to fulfill the communication requirements or if training will be required for the project team.
- **Project length** The length of the project can have an influence on the project technology. Advances in technology may replace a long-term project's communication model. A short-term project may not have the same technology requirements as a long-term project, but could, nevertheless, benefit from the successful model a larger project uses.
- **Project environment** How a team communicates often depends on its structure. Consider a collocated team versus a virtual team. Each type can be effective, but there will be differing communication demands for each type of team.

Creating the Communications Plan

Based on stakeholder analysis, the project manager and the project team can determine what communications are needed. There's no advantage to supplying stakeholders with information that isn't needed or desired, and the time spent creating and delivering such information is a waste of resources.

A communications management plan can organize and document the process, types, and expectations of communications. It provides the following:

- The stakeholder communications requirements in order to communicate the appropriate information as demanded by the stakeholders.
- Information on what is to be communicated. This plan includes the expected format, content, and detail—think project reports versus quick e-mail updates.
- Details on how needed information flows through the project to the correct individuals. The communication structure documents where the information will originate, to whom the information will be sent, and in what modality the information is acceptable.
- Appropriate methods for communicating include e-mails, memos, reports, and even press releases.
- Schedules of when the various types of communication should occur. Some communications, such as status meetings, should happen on a regular schedule, while other communications may be prompted by conditions within the project.
- Escalation processes and time frames for moving issues upwards in the organization when they can't be solved at lower levels.
- Methods to retrieve information as needed.
- Instructions on how the communications management plan can be updated as the project progresses.
- A project glossary.

The communications plan may also include information and guidelines for project status meetings, team meetings, e-meetings (that's electronic meetings, not meetings about the letter e), and even e-mail. Setting expectations for communications and meetings early in the project establishes guidelines for the project team and stakeholders.

Distributing Project Information (PMBOK, Section 10.2)

Now that the project's communication management plan has been created, it's time to execute it. Information distribution is the process of ensuring that the proper stakeholders get the appropriate information when and how they need it. Essentially, it's the implementation of the communications management plan. This plan details how the information is to be created and dispersed, and also how the dispersed information is archived.

Examining Communication Skills

Here's a news flash: Communication skills are used to send and receive information. Sounds easy, right? If communication is so easy, then why are there so many problems on projects stemming from misunderstandings, miscommunications, failures to communicate, and similar communication failings? Communication skills are part of the project manager's arsenal of general management skills—basically, it's delivering on the promise that the right stakeholders will get the right information at the right time.

General management skills, in regards to project communications, are also about managing stakeholder requirements.

In the communication model that your PMI exam will quiz you on, it's the sender's responsibility to make the message clear, complete, and concise so that the recipient can receive it. The sender must also confirm that the recipient truly understands the information. Have you ever been in a project team meeting where a team member implied he understood the message that was being sent, but it later proved that he really didn't understand what was being sent?

EXAM TIP Face-to-face meetings, like those in ad-hoc meetings, are ideal for project communications.

Communication happens when information is transferred from one party to another. Transmission of a message is just like a radio signal—it's transmitting, but there's no evidence that anyone is actually picking up on the signal. Along these same lines, the acknowledgement of a message means that the receiver has indeed received the message, but she may not necessarily agree with the message that has been sent.

Examining Communication Factors and Technologies

The most common type of communication between a sender and a receiver is verbal communication. When verbal communications are involved, the project manager should remember that half of communication is listening. This means that the project manager must confirm that the receiver understands the message being sent. The confirmation of the sent message can be seen in the recipient's body language, feedback, and verbal confirmation of the sent message. Five terms are used to describe the process of communicating:

- **Paralingual** The pitch, tone, and inflections in the sender's voice affect the message being sent.
- **Feedback** The sender confirms that the receiver understands the message by directly asking for a response, questions for clarification, or other confirmation of the sent message.
- **Active listening** The receiver confirms that the message is being received through feedback, questions, prompts for clarity, and other signs of confirmation.
- **Effective listening** The receiver is involved in the listening experience by paying attention to visual clues from the speaker and paralingual characteristics and also by asking relevant questions.
- **Nonverbal** Approximately 55 percent of communication is nonverbal. Facial expressions, hand gestures, and body language contribute to the message.

As pictured in Figure 10-3, the words in an oral message actually only account for 7 percent of the message. The tonality of the message accounts for 38 percent of the message. The remaining 55 percent is body language. A classic example involves a person talking to a dog. If the person has a friendly voice and posture, the dog will likely be receptive. However, if the person has a mean voice and guarded posture, the dog may feel threatened and on guard. When project managers talk with stakeholders, they must be aware of their body language and posture—not just the words they are communicating.

The medium in communication can help or hinder the message. For example, when a project manager talks to a stakeholder in person, the stakeholder has the advantage not only of hearing the message and tone, but also of seeing the body language. Remove body language from a conversation, and the message is interpreted by just the words and tonality. Always be aware of the downsides of various nondirect communication modalities: e-mail, reports, memos, and letters.

Creating Information Retrieval Systems

What good is information if no one can find it? An information retrieval system allows for fast and accurate access to project information. It can be a simple manual filing system, an advanced database of information storage, or a robust project management software suite. Whatever the approach, the information must be accessible, organized, and secure.

The project team, the project manager, the customer, and other stakeholders may need access to design specs, blueprints, plans, and other project information. A good information retrieval system is reliable, easy to navigate, and updated as new information becomes available.

Distributing Information

Throughout the project, the project manager, the project sponsor, the project team, and other stakeholders are going to need to supply information to one another. The methods for distributing information can vary, but the best modality is the one that's most appropriate to the information being conveyed. In other words, an e-mail may not be the correct format in which to share variance information regarding project costs.

Information can be distributed through some of the following methods, given project demands and available technology:

- Project meetings
- Hard-copy documentation
- Databases
- Faxes
- E-mail
- Telephone calls
- Videoconferences
- A project Web site

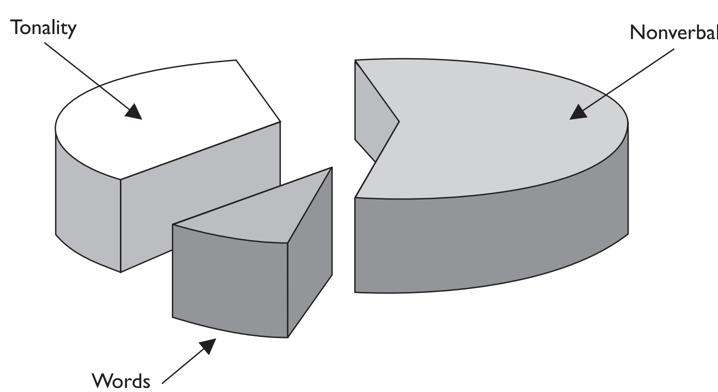


Figure 10-3 The words used in communication are only a small portion of a message.

Creating Lessons Learned

Do you ever wish you could travel back in time? With lessons learned, you almost can. The whole point of lessons learned is to improve future projects by sharing what was learned during the current project.

A lessons-learned session is completed with the project manager, the project team, and key stakeholders to identify lessons they've learned in the technical, managerial, and project processes. Think of it: You're helping other project managers in the future by documenting what works and what doesn't in your project.

Lessons learned should happen throughout the project, not just at the project's conclusion. As a project moves through each phase, project managers can use a lessons-learned session as a good team-building exercise. This means documenting and learning from what worked and what didn't within the project.

Examining the Results of Information Distribution

Information distribution results in the following:

- **Lessons learned** When lessons-learned sessions are completed, they're available to be used and applied. They are now part of the organizational process assets.
- **Project records** All project communications are also part of the organizational process assets. This includes e-mails, memos, letters, and faxes. In some instances, the project team can also contribute by keeping their records in a project notebook.
- **Project reports** Reports are formal communications on project activities, their status, and conditions. Management, customers, and policies within the performing organization may have differing requirements for when reports are required.
- **Project presentations** Presentations are useful in providing information to customers, management, the project team, and other stakeholders. The delivery and degree of formality of the presentation should be appropriate for the conditions and information being delivered within the project.
- **Feedback from stakeholders** Stakeholders are usually happy to offer their feedback on the project performance. Project managers should then document this feedback and apply it to improve the project's performance.
- **Stakeholder notifications** As the project rolls along, there undoubtedly will be notifications to the stakeholders about resolved issues, approved changes, and the overall health of the project. This information should be kept for future reference.

Reporting Project Performance (PMBOK, Section 10.3)

Throughout the project, customers and other stakeholders are going to need updates on the project performance. The work performance information—the status of what's been completed and what's left to do—is always at the heart of performance reporting. Stakeholders want to be kept abreast of how the project is performing.

Performance reporting is the process of collecting, organizing, and disseminating information on how project resources are being used to complete the project objectives. In other words, the people footing the bill and who are affected by the outcome of the project need some confirmation that things are going the way the project manager has promised.

Performance reporting covers more than just cost and schedule, although these are the most common concerns. Another huge issue is the influence of risks on the project's success. The project manager and the project team must continue to monitor and evaluate risks, including pending risks and their impact on the project's success.

Another major concern with reporting is the level of quality. No one will praise the project manager and the project team for completing the project on time and on budget if the quality of the work is unacceptable. In fact, the project could be declared a failure and cancelled as a result of poor quality, or the project team may be forced to redo the work, business could be lost, or individuals could even be harmed as a result of the poor quality of the project work.

Examining the Tools for Performance Reporting

You want, need, and are required to report performance on your project's status, time, cost variables, and more. You'll need some tools to get this job done quickly and correctly. You already know that the work performance information is one of the primary inputs to this process, but you'll need five tools that'll make this task even easier (and better). Here are the five reporting tools you need to know for the PMI exam:

- **Information presentation tools** You need some way to present your fantastic and not-so-fantastic news to management and other stakeholders. This tool is just any old software package that can incorporate some spreadsheet, presentation, and graphics abilities to present your overall project performance. (The exam will stay vendor-neutral, but for ease here, I'm going to say it: think Microsoft PowerPoint.)
- **Performance information gathering and compilation** You need a methodology to capture the project's health and status at any time. This system can be manual, which doesn't sound like much, nor is it very likely in today's push-button world. More likely, you'll pull this information from your project management information system. The specific information you're after is status, forecasting, performance, and project progress.
- **Status review meetings** You'll learn about the status of your project through many avenues, but the most common is through the project's status meetings. These regularly scheduled meetings measure what's been done, what's left to do, and the overall health of the project.
- **Time reporting systems** Remember Chapter 6 on time management? Good. The time reporting system is the collection of actual time spent completing project management and project tasks to complete the project scope statement.
- **Cost reporting systems** I know you remember Chapter 7. This system, like its time-based counterpart, is the system to record actual monies spent on the project. The difference, of course, between the actual and the estimate is a cost variance.

Reviewing Project Performance

The project manager will host performance review meetings to ascertain the progress and level of success the project team is having with the project work. Performance review meetings focus on the work that has been completed and how the work results are living up to the time and cost estimates. In addition, the project manager and the project team will evaluate the project scope to protect it from change and creep. The project manager and the project team will also examine quality and its effect on the project as a whole. Finally, the project manager must lead a discussion on pending or past risks and then determine any new risks, as well as the overall risk likelihood and its potential impact on the project's success.

Analyzing Project Variances

Performance review meetings are not the only tools the project manager uses to assess project performance. Prior to the performance reviews, or spurred by a performance review, the project manager needs to examine the time, scope, quality, and cost variances within the project. The project manager will examine the estimates supplied for the time and cost of activities and compare it to the time and cost actually experienced.

The goals of analyzing project variances include the following:

- Prevent future variances
- Determine the root cause of variances
- Determine if the variances are an anomaly or if the estimates were flawed
- Determine if the variances are within a predetermined acceptable range, such as -10 percent or +5 percent
- Determine if the variances can be expected on future project work

In addition to examining the time and cost variances, which are the most common, the project manager must examine any scope, resource, and quality variances. A change in the scope can skew time and cost predictions. A variance in resources, such as the expected performance by a given resource, can alter the project schedule and even the predicted costs of a project. Quality variances may result in rework, lost time, lost monies, and even the rejection of the project product.

EXAM TIP Performance reporting is often based on the results of earned value management (EVM). See Chapter 7 for detailed information on how to calculate EVM.

Examining the Results of Performance Reporting

The goal of performance reporting is to share information regarding the project's performance with the appropriate stakeholders. Of course, performance reporting is not something done only at the end of the project or after a project phase. Instead, it is done according to a regular schedule, as detailed in the communication plan or as project conditions warrant. Outputs of performance reporting include such things as:

- **Performance reports** These are the results and summation of the project performance analysis. The communications management plan will detail the type of report needed, based on the conditions within the project, the timing of the communication, and the demands of the project stakeholder.

- **Forecasting** Will the project end on schedule? Will the project be on budget? How much longer will it take to complete the project? And how much more money will this project need to finish? Earned value management can answer many of these questions for the project management team.
- **Change requests** Performance results may prompt change requests to some areas of the project. The change requests should flow into the change control system (CCS) for consideration and then be approved or denied.
- **Recommended corrective actions** Corrective actions center on bringing future project performance back in alignment with the project plan.

Managing Project Stakeholders (PMBOK, Section 10.4)

The project manager is responsible for managing stakeholders, who often require, or demand, attention from the project manager. Therefore, the project manager must make time to answer questions, get the stakeholders involved in the project, and, at a minimum, communicate the project's status. Stakeholder management is vital to a project's success for several reasons:

- It leads to resolving stakeholder issues.
- It promotes synergy.
- It limits disruptions during the project.
- It promotes project buy-in.
- It keeps the project on track.

Stakeholder management relies on the communication management plan to direct what needs to be communicated and when. The communications management plan will also define the goals and expectations of the stakeholders, which, in turn, will guide conversations between the project manager and the project stakeholders. The communications management and your organizational process assets are the only inputs to this process.

Communicating Effectively

The communications management plan defines what needs to be communicated to which stakeholders, when the communication is needed, and in what modality the information should be communicated. Armed with that information, the project management team needs to adapt their methodology for communication based on the stakeholder, the conditions in the project, or the news that's being presented.

Face-to-face meetings are, without a doubt, the most effective method to communicate and resolve issues with stakeholders. This gets back to the concept that 55 percent of all communication is nonverbal. That's why phone meetings, e-mails, and memos are considerably weak for communications. It's hard to read someone's reaction when you're in a phone conference. The project manager also needs to consider the paralingual impact of the conversation. Recall that paralingual is the tone and inflection of the speaker's voice that affects the speaker's message. Ever make a joke in an e-mail message and someone took it the wrong way?

Revisiting Issue Logs

An issue log is just that—a logbook full of project issues. Issues are documented, and their status is recorded and updated based on changes to the issues. Typically, issues don't evolve into projects or even project activities, but are recorded and considered to maintain good working relationships among the stakeholders and the project team. Ideally, an issue is assigned an owner and a target date for the issue to be resolved by. Unresolved issues can, of course, evolve into major conflicts and sources of project delays.

The project management team should be aware of pressing issues and work with the issue owners to ensure that they are resolved by the deadline. When an issue is resolved, the issue log should be updated with the resolution and its impact on the project, if any.

Chapter Summary

Communication is a project manager's most important skill. Project managers have to communicate with management, customers, the project team members, and the rest of the stakeholders involved with the project. The project manager's foundation is communication. Without effective communication, how will work get completed, progress reported, and information dispersed?

Communications planning centers on asking, "Who needs what information and when do they need it?" Consider all of the different channels for communication on any project. There are many different possibilities for information to be lost, messages to be skewed, and progress to be hindered. The formula for calculating the communication channels is $N(N - 1) / 2$, where N represents the number of stakeholders. As a general rule, larger projects require more detail—and detail means more planning for communications.

The communications management plan organizes and documents the communication processes, acceptable modalities for types of communication, and the stakeholder expectations for communication. The plan should detail how information is gathered, organized, accessed, and dispersed. The plan should also provide a schedule of expected communication based on a calendar schedule, such as project status meetings. Some communications are prompted by conditions within the project, such as cost variances, schedule variances, or other performance-related issues.

Key Terms

Acknowledgement The receiver signals that the message has been received; an acknowledgement shows receipt of the message, but not necessarily agreement with the message.

Active listening The receiver confirms that the message is being received through feedback, questions, prompts for clarity, and other signs of confirmation.

Choice of media The best modality to use when communicating that is relevant to the information being communicated.

Communication assumptions Anything that the project management team believes to be true but hasn't proven to be true. For example, the project management team may assume that all of the project team can be reached via cell phone, but parts of the world, as of this writing, don't have a cell signal.

Communication barrier Anything that prohibits communication from occurring.

Communication channels formula N (N – 1) / 2, where N represents the number of identified stakeholders. This formula reveals the total number of communication channels within a project.

Communication constraints Anything that limits the project management team's options. Geographical locales, incompatible communications software, and even limited communications technology are all examples of communication constraints.

Communications management plan A project management subsidiary plan that defines the stakeholders who need specific information, the person who will supply the information, the schedule for the information to be supplied, and the approved modality to provide the information.

Cost reporting system A system to record the actual costs of the project activities.

Decoder The device that decodes a message as it is being received.

Effective listening The receiver is involved in the listening experience by paying attention to visual clues from the speaker and paralingual characteristics and by asking relevant questions.

Encoder The device that encodes the message being sent.

Feedback The sender confirms that the receiver understands the message by directly asking for a response, questions for clarification, or other confirmation.

Information presentation tools A software package that allows the project management team to present the project's health through graphics, spreadsheets, and text. (Think of Microsoft Project.)

Information retrieval system A system to quickly and effectively store, archive, and access project information.

Lessons learned This is documentation of what did and did not work in the project implementation. Lessons-learned documentation is created throughout the project by the entire project team. When lessons-learned sessions are completed, they're available to be used and applied by the entire organization. They are now part of the organizational process assets.

Medium The device or technology that transports a message.

Noise Anything that interferes with or disrupts a message.

Nonverbal Facial expressions, hand gestures, and body language are nonverbal cues that contribute to a message. Approximately 55 percent of communication is nonverbal.

Paralingual The pitch, tone, and inflections in the sender's voice affecting the message being sent.

Performance report A report that depicts how well a project is performing. Often, the performance report is based on earned value management and may include cost or schedule variance reports.

Project presentations Presentations are useful in providing information to customers, management, the project team, and other stakeholders.

Project records All the business of the project communications are also part of the organizational process assets. This includes e-mails, memos, letters, and faxes.

Project reports Reports are formal communications on project activities, their status, and conditions.

Receiver The person who receives the message.

Sender The person who is sending the message.

Sender-receiver models Feedback loops and barriers to communications.

Stakeholder notifications Notices to the stakeholders about resolved issues, approved changes, and the overall health of the project.

Status review meeting A regularly scheduled meeting to discuss the status of the project and its progress towards completing the project scope statement.

Time reporting system A system to record the actual time to complete project activities.

Questions

1. Of the following, which one is an example of noise?
   A. Fax machine
   B. Ad-hoc conversations
   C. Contractual agreements
   D. Distance
2. You are the project manager for the JHG Project. Management has requested that you create a document detailing what information will be expected from stakeholders and to whom that information will be disseminated. Management is asking for which one of the following?
   A. The roles and responsibilities matrix
   B. The scope management plan
   C. The communications management plan
   D. The communications worksheet

3. Which of the following will help you, the project manager, complete the needed communications management plan by identifying the stakeholders' communication needs?
   A. Identification of all communication channels
   B. Formal documentation of all communication channels
   C. Formal documentation of all stakeholders
   D. Lessons learned from previous similar projects
4. You are the project manager for the JGI Project. You have 32 stakeholders on this project. How many communication channels do you have?
   A. Depends on the number of project team members
   B. 496
   C. 32
   D. 1
5. You are the project manager for the KLN Project. You had 19 stakeholders on this project and have added three team members to the project. How many more communication channels do you have now compared to before?
   A. 171
   B. 231
   C. 60
   D. 1
6. A memo has been sent to you, the project manager, the project team members, and the project customers from the project sponsor. In this instance, who is the encoder?
   A. Project sponsor
   B. Project manager
   C. Project team members
   D. Project customers
7. Which one of the following is an example of a project communication constraint?
   A. Ad-hoc conversations
   B. Demands for formal reports
   C. Stakeholder management
   D. Team members in different geographical locales
8. Project managers can present project information in many different ways. Which one of the following is not a method a project manager can use to present project performance?
   A. Histograms
   B. S-curves

C. Bar charts
D. RACI charts

9. Of the following, which term describes the pitch and tone of an individual's voice?
   A. Paralingual
   B. Feedback
   C. Effective listening
   D. Active listening

10. You are the project manager of the KMH Project. This project is slated to last eight years. You have just calculated EVM and have a cost variance (CV) of –$3,500, which is outside of the acceptable thresholds for your project. What type of report is needed for management?
   A. Progress report
   B. Forecast report
   C. Exception report
   D. Trends report

11. You are presenting your project performance to your key stakeholders. Several of the stakeholders are receiving phone calls during your presentation, and this is distracting from your message. This is an example of what?
   A. Noise
   B. Negative feedback
   C. Outside communications
   D. Message distracter

12. You are the project manager for the OOK Project. You will be hosting project meetings every week. Of the following, which one is not a valid rule for project meetings?
   A. Schedule recurring meetings as soon as possible
   B. Allow project meetings to last as long as needed
   C. Distribute meeting agendas prior to the meeting start
   D. Allow the project team to have input to the agenda

13. What percentage of a message is sent through nonverbal communications, such as facial expressions, hand gestures, and body language?
   A. Greater than 50 percent
   B. 30 to 40 percent
   C. 20 to 30 percent
   D. 10 to 20 percent

14. When does lessons-learned identification take place?
    A. At the end of the project
    B. At the end of each project phase
    C. Throughout the project life cycle
    D. Whenever a lesson has been learned
15. Why should a project team complete lessons-learned documentation?
    A. To ensure project closure
    B. To show management what they've accomplished on the project
    C. To show the project stakeholders what they've accomplished on the project
    D. To help future project teams complete their projects more accurately
16. You are the project manager for the PMU Project. Your project has 13 members. You have been informed that next week your project will receive the seven additional members you requested. How many channels of communication will you have next week?
    A. 1
    B. 78
    C. 190
    D. 201
17. Performance reporting should generally provide information on all of the following, except for which one?
    A. Scope
    B. Schedule
    C. Labor issues
    D. Quality
18. The process of sending information from the project manager to the project team is called what?
    A. Functioning
    B. Matrixing
    C. Blended communications
    D. Transmitting
19. George is the project manager of the 7YH Project. In this project, George considers the relation between himself and the customer to be of utmost importance. Which one of the following is a valid reason for George's belief in the importance of this relationship?
    A. The customer will complete George's performance evaluation. A poor communication model between George and the customer will affect his project bonus.

B. The customer is not familiar with project management. George must educate the customer about the process.

C. The customer is always right.

D. The communication between the customer and George can convey the project objectives more clearly than can the language in the project contract.

20. Which one of the following means that communications occur?

A. The transfer of knowledge

B. The outputting of knowledge

C. The presence of knowledge

D. The transmission of knowledge

Answers

1. **D**. Noise is anything that interferes with the transmission and understanding of the message. Distance is an example of noise. A, a fax machine, is an example of a decoder. B is incorrect; ad-hoc conversations are informal conversations. C, contractual agreements, are a type of formal communication. For more information, see the introduction to Chapter 10 in the PMBOK.
2. **C**. Management is requesting a communications management plan, which details the requirements and expectations for communicating information among the project stakeholders. A is incorrect, since a roles-and-responsibilities matrix depicts who does what and who makes which decisions. B, the scope management plan, is also incorrect because this plan explains how changes to the scope may be allowed, depending on the circumstances. D is not a valid choice for the question. For more information, see the PMBOK, Section 10.1.
3. **D**. Lessons learned and historical information from a previous project are ideal inputs to communications planning. A, B, and C are incorrect because these choices do not fully answer the question. Lessons learned from previous, similar projects are the best tool to identify stakeholders' requirements for communication. For more information, see the PMBOK, Section 10.1.1.2.
4. **B**. Using the formula N (N – 1) / 2, where N represents the number of stakeholders, gives us 496 communication channels. A, C, and D are incorrect. These values do not reflect the number of communication channels on the project. For more information, see the PMBOK, Section 10.1.2.1.
5. **C**. This is a tough question, but typical of the CAPM and PMP exams. The question asks how many more communication channels exist. You'll have to calculate the new value, which is 231, and then subtract the original value, which is 171, for a total of 60 new channels. A is incorrect. 171 is the original number of communication channels. B is incorrect because this value reflects the new number of communication channels. D is not a valid choice. For more information, see the PMBOK, Section 10.1.2.1.

6. **A**. The project sponsor is the source of the memo, since this is the sender of the message. B, C, and D are all recipients of the memo, not the sender, so they cannot be the source of the message. For more information, see the introduction to Chapter 10 in the PMBOK.
7. **D**. Team members that are not located physically close together can be a communications constraint, since it can be tougher to communicate when distance between team members exists. A, B, and C are all incorrect, since these are not project communications constraints. For more information, see the PMBOK, Section 10.1.1.4.
8. **D**. RACI charts do not show project performance, but accountability of the resources involved in the project. A, B, and C are incorrect, since these choices do present project performance. For more information, see the PMBOK, Section 10.3.3.1.
9. **A**. Paralingual is a term used to describe the pitch and tone of one's voice. B, feedback, is a request to confirm the information sent in the conversation. C, effective listening, is the ability to understand the message through what is said, facial expressions, gestures, tone, pitch, and so on. D, active listening, is the process of confirming what is understood and asking for clarification when needed. For more information, see the PMBOK, Section 10.2.2.1.
10. **C**. An exception report is typically completed when variances exceed a given limit. A is incorrect. Progress reports describe the progress of the project or phase. B is incorrect because this is not a valid answer. D, a trends report, is an analysis of project trends over time. For more information, see *threshold* in the PMBOK glossary.
11. **A**. Noise is the correct answer, since their phone calls are distracting from your message. B, C, and D are incorrect, as they do not answer the question. For more information, see the introduction to Chapter 10 in the PMBOK.
12. **B**. Project meetings should have a set time limit. A, C, and D are incorrect answers, although these are good attributes of project team meetings. For more information, see the introduction to Chapter 10 in the PMBOK.
13. **A**. Greater than 50 percent of a message is sent through nonverbal communications. B, C, and D are incorrect. For more information, see the introduction to Chapter 10 in the PMBOK and the section titled "Examining Communication Factors and Technologies" in this chapter.
14. **C**. Lessons learned takes place throughout the project life cycle, not just at the end of the project or its phases. A, B, and D are incorrect choices. For more information, see the PMBOK, Section 10.2.2.4.
15. **D**. Lessons-learned documentation helps future project teams complete their projects with more efficiency and effectiveness. A, B, and C are incorrect, since each statement does not reflect the intent of lessons-learned documentation: to help future project teams. For more information, see the PMBOK, Section 10.2.2.4.

16. **C**. The project currently has 13 team members, and next week, seven additional team members will come aboard, thus making a total of 20 team members. Using the formula N (N – 1) / 2, where N is the number of identified stakeholders, the communication channels equal 190. A, B, and D are all incorrect choices. For more information, see the PMBOK, Section 10.1.2.1.
17. **C**. Labor issues are not part of performance reporting. A, B, and D are all part of performance reporting. For more information, see the PMBOK, Section 10.3.
18. **D**. When information is sent, it is considered to be transmitted. A, B, and C are all incorrect choices. For more information, see the introduction to Chapter 10 in the PMBOK.
19. **D**. George and the customer's relationship can allow clearer communication on the project objectives than what may be expressed in the project contract. The contract should take precedence on any issues, but direct contact is often the best way to achieve clear and concise communication. A is an incorrect choice because the focus is on personal gain rather than the good of the project. B is incorrect, since the customer does not necessarily need to be educated about the project management process. C is incorrect because the customer is not always right—the contract will take precedence in any disagreements. For more information, see the PMBOK, Sections 10.4 and 12.5.
20. **A**. The transfer of knowledge is evidence that communication has occurred. B and C do not necessarily mean the knowledge has originated from the source and been transferred to the recipient. D is also incorrect because messages are transmitted, but knowledge is transferred. For more information, see the introduction to Chapter 10 in the PMBOK.

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CHAPTER 11

Managing Project Risks

In this chapter, you will

- Plan for risk management
- Identify project risks
- Complete qualitative risk analysis
- Complete quantitative risk analysis
- Plan the risk responses
- Monitor and control project risks

A project risk is an uncertain event or condition that can have a positive or negative impact on the project. That's correct—it's possible for a risk to have a positive impact. Technically, risk isn't a bad thing; it's the impact that can be painful, costly, or delay the project work. Most project managers look at risk the same way they'd look at leftover shrimp cocktail. Yuck. Some risks, though, are good for the project, and the project manager wants to accept them; others aren't so welcome.

Let's look at this from another point of view. Imagine a golfer teeing up. To the right of the tee box, there's a water hazard, but just beyond the water is the green. The golfer can either avoid the water and take longer to get to the green or try to shoot over the water and get on the green in fewer strokes. Driving up the fairway is the safer play, but cutting over the water will improve the golfer's score. The risk with the water hazard is that if he can't make the shot, then he's down a penalty stroke.

VIDEO Creating a risk matrix.

Risk, like the golfing scenario, must be in proportion to the reward the risk taker will realize as a result of taking the chance. The willingness to accept the risk is called the utility function. An experienced golfer may have a high utility function, so he's willing to accept the water hazard. A golf hack like me would likely have a low utility function and drive up the fairway away from the water.

It's true in project management, too. With some projects, you and your organization are willing to accept risks to realize rewards such as cost savings, time savings, or on-the-job training. On other projects—typically, those projects with high impact and high profile characteristics—you're not so willing to accept the risks. In this chapter we'll look at the six processes that dictate project risk management, and you'll have plenty of risk management questions on your Project Management Institute (PMI) exam.

The project management processes described here are presented in the most logical order. They are actually iterative processes through the project life cycle. Pay special attention to monitoring and controlling project risks, as new risks can creep into the project or be discovered as the project moves towards closure.

Planning for Risk Management (PMBOK, Section 11.1)

Risk management planning is not the identification of risks or even the response to known risks within a project. Risk management planning is how the project management team will complete the risk management activities within the project. These activities really set up the project to effectively manage the five other risk management activities.

By deciding the approach to each of the risk management activities before moving into them, the project management team can more effectively identify risks, complete risk analysis, and then plan risk responses. In addition, planning for risk management also allows the project management team to create a strategy for the ongoing identification and monitoring of existing risks within the project.

Preparing for Risk Management Planning

There are four inputs to risk management planning, although some are more important than others. It's essential for the project management team to understand the priority of the project, which shouldn't be too tough to do. Important projects, high-profile projects, or projects with hefty budgets are generally risk-adverse. Smaller projects are generally more willing to accept risks. You'll need the following to prepare for risk management:

- **Enterprise environmental factors** An organization's attitude towards risk may vary, as I mentioned, based on the type, size, and profile of the project.
- **Organizational process assets** An organization may have a predefined approach to risk management. If that's the case, the project management team uses the organization's approach and follows its established procedures. For example, an organization could define risk tolerance levels, risk categories, templates, roles and responsibilities, and more. A project team may also use other similar projects to guide the current risk management planning activities.
- **Project scope statement** The project scope is revisited throughout the project, as it defines all that's in scope and out of scope. The project scope statement also gives some insight into the priority and impact of the project, which can influence the risk management activities.
- **Project management plan** All of the subsidiary plans are needed as part of integration management. There may be risks lurking in any or all of the other project management plans. The project management team will examine the project for risks and the anticipated impact of the risks based on these other plans. I'll talk more about risk identification in a moment.

Completing Risk Management Planning

Planning for risk happens in—surprise, surprise!—planning meetings, where the project team develops the risk management plan and analyzes the inputs previously mentioned to make the best decisions for the current project. While the project team is the primary participant at the risk management planning meeting, the attendees may actually include the project manager, stakeholders, and other individuals within an organization that influence the risk management processes.

The purpose of these risk management meetings is to create the risk management plan and to define the cost and schedule for risk management activities. Let's face facts: It'll take time and monies for most projects to identify, test, and challenge the risks that may exist within the project. These initial meetings allow monies and time to be incorporated within the project. Risk responsibilities are also assigned in these meetings, as are the risk terminologies the project will use. Risk management planning also defines and tailors the following for the project:

- Risk templates the project should use
- Definitions and terms for risk levels
- Probability according to risk type
- Impact of the risks
- Guidelines for the risk and impact matrix to be used during risk analysis

Creating the Risk Management Plan

The whole point of risk management meetings and analysis is to create the risk management plan. This plan does not detail the planned responses to individual risks within the project—this is the purpose of the risk response plan. The risk management plan is responsible for determining how:

- Risks will be identified
- Quantitative analysis will be completed
- Qualitative analysis will be completed
- Risk response planning will happen
- Risks will be monitored
- Ongoing risk management activities will happen throughout the project's life cycle

Defining the Risk Management Methodology

The methodology is concerned with how the risk management processes will take place. It asks the following:

- What tools are available to use for risk management?
- What approaches are acceptable within the performing organization?
- What data sources can be accessed and used for risk management?
- What approach is best for the project type and the phase of the project?

- Which approach is most appropriate given the conditions of the project?
- How much flexibility is available for the project given the conditions, time frame, and the project budget?

Identifying Risk Roles and Responsibilities

The roles and responsibilities identify the groups and individuals that will participate in the leadership and support of each of the risk management activities within the project plan. In some instances, risk management teams outside of the project team may have a more realistic, unbiased approach to the risk identification, impact, and overall risk management needs than the actual project team does.

Creating a Risk Management Budget

Based on the size, impact, and priority of the project, a budget may need to be established for the project's risk management activities. This section of the risk management plan defines a cost estimate for the resources needed to complete risk management. These costs are rolled into the project's cost baseline. A project with high priority and no budget allotment for risk management activities may face uncertain times ahead.

Identifying the Risk Management Schedule

The risk management process needs a schedule to determine how often and when risk management activities should happen throughout the project. If risk management happens too late in the project, the project could be delayed because of the time needed to identify, assess, and respond to the risks. A realistic schedule should be developed early in the project to accommodate risks, risk analysis, and risk reaction.

Defining a Project's Risk Categories

Based on the nature of the work, there should be identified categories of risks within the project. Figure 11-1 depicts one approach to identifying risk categories by using a risk breakdown structure (RBS). Throughout the project, the risk categories should be revisited to update and reflect the current status of the project. If a similar risk management plan is available from a previous project, the project team may elect to use this plan as a template and tailor the risk categories accordingly. There are four major categories of risks:

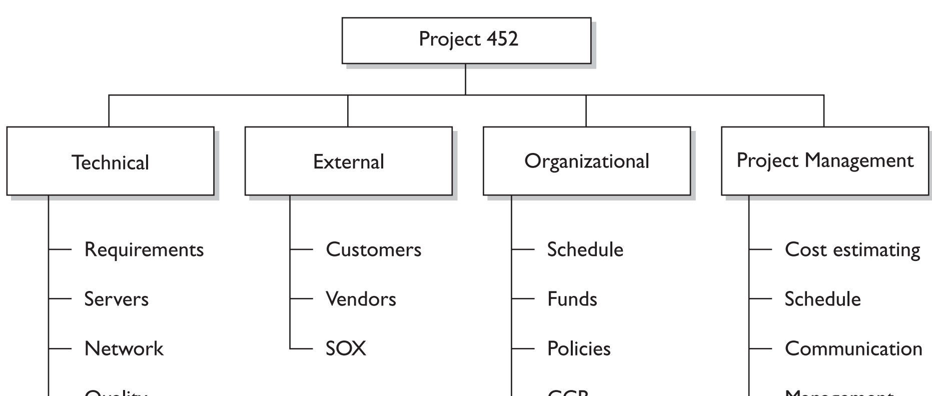


Figure 11-1 A risk breakdown structure can organize risks by categories.

- **Technical, quality, or performance risks** Technical risks are associated with new, unproven, or complex technologies being used on the project. Changes to the technology during the project implementation can also be a risk. Quality risks are the levels set for expectations of impractical quality and performance. Changes to industry standards during the project can also be lumped into this category of risks.
- **Project management risks** These risks deal with faults in the management of the project: the unsuccessful allocation of time, resources, and scheduling; unacceptable work results (low-quality work); and poor project management as a whole.
- **Organizational risks** The performing organization can contribute to the project's risks through unreasonable cost, time, and scope expectations; poor project prioritization; inadequate funding or the disruption of funding; and competition with other projects for internal resources.
- **External risks** These risks are outside of the project, but directly affect it—for example, legal issues, labor issues, a shift in project priorities, or weather. "Force majeure" risks can be scary, and usually call for disaster recovery rather than project management. These are risks caused by earthquakes, tornados, floods, civil unrest, and other disasters.

Identifying the Project Risks (PMBOK, Section 11.2)

Risk identification is the systematic process of combing through the project, the project plan, the work breakdown structure, and all supporting documentation to identify as many of the risks that may affect the project as possible. Remember, a risk is an uncertain event or condition that may affect the project's outcome. Risks can be positive or negative. In the big picture of risk identification, there are two categories of risks:

- **Pure risks** These risks have only a negative outcome. Examples include loss of life or limb, fire, theft, natural disasters, and the like.
- **Business risks** These risks may have a negative or a positive outcome. Examples include using a less experienced worker to complete a task, allowing phases or activities to overlap, or foregoing the expense of formal training for on-the-job education.

The initial risk identification meeting can be wild and unwieldy if the approach isn't structured. The project manager may elect to address risks by category, project phase, or the project life cycle. The goal of these meetings is to capture all of the risks so that the project management team can plan adequately for the risk responses. The participants of the risk identification meetings can include:

- Project manager
- Project team
- Risk management team (if one exists, of course)

- Subject matter experts
- Customers
- End users
- Other project managers
- Stakeholders
- Risk management experts

Risk identification is not a one-time event. The project manager should encourage the project team and these participants to continually be on the lookout for risk events as the project moves toward closure. The risk management plan also includes timings for iterations of risk identification and management. Risk identification is an iterative process, because new risks can creep into the project or existing risks may be identified later as more detail becomes available. You'll need five inputs to complete risk identification:

- **Enterprise environmental factors** When it comes to risk identification, having commercial databases, academic studies, benchmarking results, whitepapers, and other statistics and information related to your discipline is ideal.
- **Organizational process assets** If an organization has completed projects similar to the current project, there's no reason not to use the historical information to help the risk identification along.
- **Project scope statement** The project scope statement includes the assumptions that the project is based on. These assumptions are often sources of risk within the project.
- **Risk management plan** This lone output of risk management planning is needed during risk identification because the plan will identify the organization's and the project's proper approach for identifying risks within the project.
- **Project management plan** The project management plan is also needed, as there are likely risks lurking throughout the project. Consider schedules, costs, assumptions and constraints, quality issues, and all the other knowledge areas where risks may be hiding.

Finding Project Risks

Now the fun part of risk identification: Anything goes as long as it may be perceived as a risk. All of the risk identification participants should identify as many risks as possible, regardless of their perceived initial threat. I'm not really talking about sunspots and asteroid crashes here, but relevant risks should be recorded, regardless of their size and impact on the project. What begins as a small risk can bloom into something much larger as the project progresses.

Reviewing the Project Documentation

One of the first steps the risk identification participants can take is to review the project documentation. The project plan, scope, and other project files should be reviewed. Constraints and assumptions should be reviewed, considered, and analyzed for risks. This structure review takes a broad look at the project plan, the scope, and the activities defined within the project.

PART II

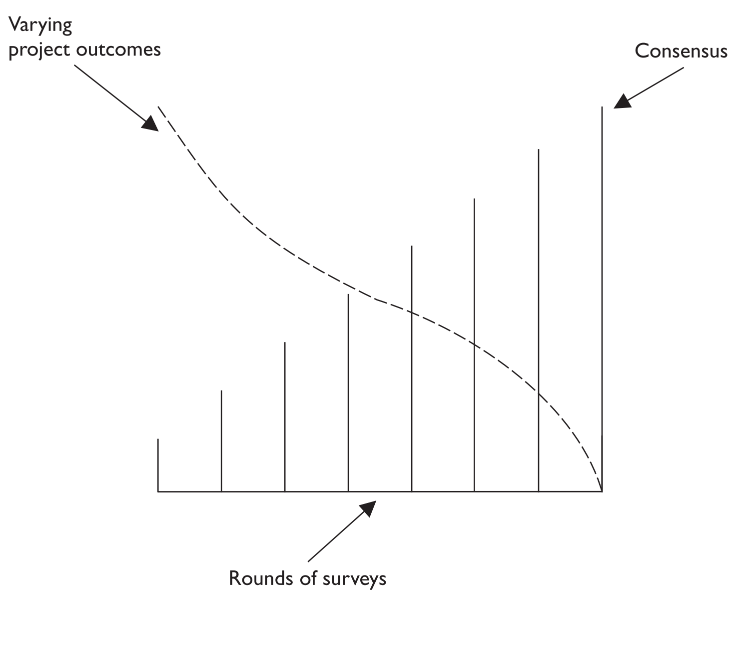
Relying on Risk Identification Methods

There are five methods the Project Management Body of Knowledge (PMBOK) dives into when it comes gathering project information regarding risks. You'll likely see these on your exam:

- **Brainstorming** Good old-fashioned brainstorming is the most common approach to risk identification. It's usually completed as a project team with subject matter experts to identify the risks within the project. The risks are identified in broad terms and posted, and then the risks' characteristics are detailed. Your pal, the risk breakdown structure, can help facilitate the brainstorming process. The identified risks are categorized and will pass through the qualitative and quantitative risk analyses later. I'll discuss those in just a few pages—no peeking!
- **Delphi Technique** The Delphi Technique, shown in Figure 11-2, is an anonymous method used to query experts about foreseeable risks within a project, phase, or component of a project. The results of the survey are analyzed by a third party, organized, and then circulated to the experts. There can be several rounds of anonymous discussion with the Delphi Technique without fear of backlash or offending other participants in the process. The Delphi Technique is completely anonymous, and the goal is to gain consensus on project risks within the project. The anonymous nature of the process ensures that no single expert's advice overtly influences the opinion of another participant.

  I often get asked why this approach is called the Delphi Technique. This approach was developed during the Cold War as a forecasting and consensus-building device. It's called the Delphi Technique after the "Oracle of the Delphi." Delphi is a Greek archeological site that, according to legend, is the center of the universe. However, as fascinating as Greek mythology is, there won't be any legends on your PMI examination. Sorry.

Figure 11-2 The Delphi Technique uses rounds of anonymous surveys to gain consensus.



- **Hosting interview sessions** Interviewing subject matter experts and project stakeholders is an excellent approach to identifying risks on the current project based on the interviewees' experiences. The people responsible for risk identification share the overall purpose of the project, the project's work breakdown structure (WBS), and, likely, the same assumptions as the interviewee.

  The interviewee, through questions and discussion, shares his insight on what risks he perceives within the project. The goal of the process is to learn from the expert what risks may be hidden within the project, what risks this person has encountered on similar work, and what insight the person has into the project work.
- **Root cause identification** Project managers and the project team often see the impact of a risk, but not always its cause. Root cause identification aims to find out why a risk event may be occurring, the causal factors creating the risk events, and then, eventually, how the events can be mitigated or eliminated.
- **Implementing SWOT analysis** SWOT stands for strengths, weaknesses, opportunities, and threats. SWOT analysis is the process of examining the project from the perspective of each characteristic. For example, a technology project may identify SWOT as:
  - **Strengths** The technology to be installed in the project has been installed by other large companies in our industry.
  - **Weaknesses** We have never installed this technology before.
  - **Opportunities** The new technology will allow us to reduce our cycle time for time-to-market on new products. Opportunities are things, conditions, or events that allow an organization to differentiate itself from competitors and improve its standing in the marketplace.
  - **Threats** The time to complete the training and simulation may overlap with product updates, new versions, and external changes to our technology portfolio.

Using Checklists

Checklists are a quick approach to risk identification. The lowest of the risk breakdown structures might serve as a checklist, for example. More likely, similar projects that have been completed in the past are going to have risk registers that the current risk identification process can benefit from. The PMBOK warns that while checklists can be created quickly and easily, it's impossible to build an exhaustive risk checklist.

EXAM TIP The danger in using or relying on risk identification checklists is that the risk identification participants don't consider risks that aren't on the checklists. Even for projects that have been completed over and over, based on the nature of the work, the project team must actively seek to identify risks that are outside of the organizational process assets checklists.

PART II

Examining the Assumptions

All projects have assumptions. Assumption analysis is the process of examining the assumptions to see what risks may stem from false assumptions. Examining assumptions is about finding the validity of the assumptions. For example, consider a project to install a new piece of software on every computer within an organization. The project team has made the assumption that all of the computers within the organization meet the minimum requirements to install the software. If this assumption were wrong, cost increases and schedule delays would occur.

Examining the assumptions also requires a review of assumptions across the whole project for consistency. For example, consider a project with an assumption that a senior employee will be needed throughout the entire project work; the cost estimate, however, has been billed at the rate of a junior employee.

Utilizing Diagramming Techniques

Several diagramming techniques can be utilized by the project team to identify risks:

- **Ishikawa** These cause-and-effect diagrams are also called fishbone diagrams, as seen in Figure 11-3. They are great for analyzing the root causes of risk factors within the project. The goal is to identify and treat the root of the problem, not the symptom.
- **Flow chart** System or process flow charts show the relationships between components and how the overall process works. These are useful for identifying risks between system components.

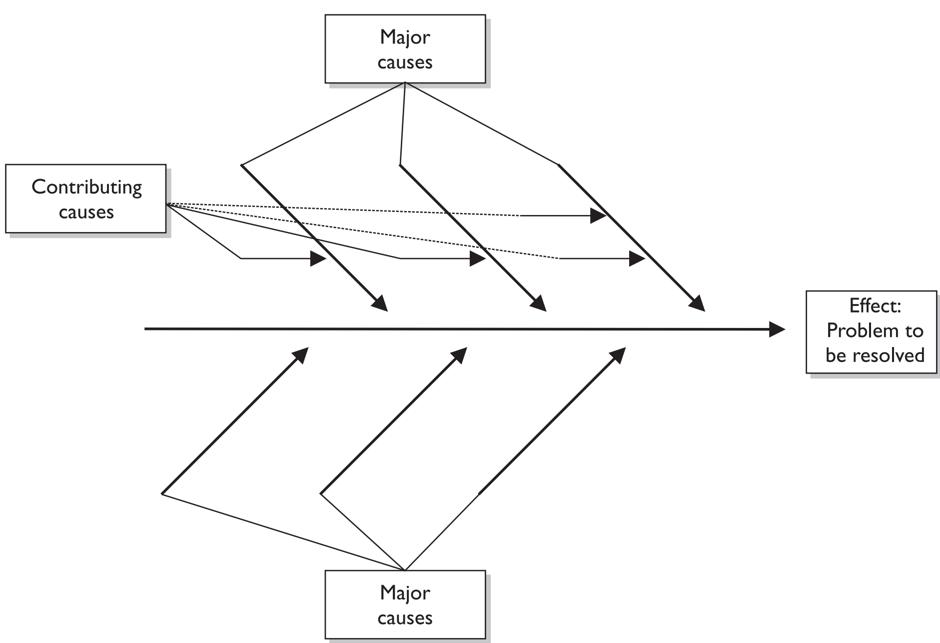


Figure 11-3 Ishikawa diagrams are also known as fishbone diagrams.

- **Influence** An influence diagram charts out a decision problem. It identifies all of the elements, variables, decisions, and objectives and also how each factor may influence another.

Creating a Risk Register

The only output of risk identification is the project's risk register. The risk register is a component of the project plan that contains all of the information related to the risk management activities. It's updated as risk management activities are conducted to reflect the status, progress, and nature of the project risks. The risk register includes the following:

- **Risks** Of course, the most obvious output of risk identification is the risk that has been successfully identified. Recall that a risk is an uncertain event or condition that could potentially have a positive or negative effect on the project's success.
- **Potential responses** During the initial risk identification process, there may be solutions and responses to identified risks. This is fine, as long as the responses are documented here. Along with the risk responses, the identification of risk triggers may also occur. Triggers are warning signs or symptoms that a risk has occurred or is about to occur. For example, should a vendor fail to complete her portion of the project as scheduled, the project completion may be delayed.
- **The root causes of risk** Risk identification can identify why risk conditions exist.
- **Updated risk categories** Risk identification may prompt the project team to identify new categories of risks. These new categories should be documented in the risk register, and if a risk breakdown structure is utilized, it will need to be updated as well.

Using Qualitative Risk Analysis (PMBOK, Section 11.3)

The first, and somewhat shallow, risk analysis is qualitative analysis. Qualitative risk analysis "qualifies" the risks that have been identified in the project. Specifically, qualitative risk analysis examines and prioritizes the risks based on their probability of occurring and the impact on the project if the risks do occur. Qualitative risk analysis is a broad approach to ranking risks by priority, which then guides the risk reaction process. The end result of qualitative risk analysis (once risks have been identified and prioritized) can either lead to more in-depth quantitative risk analysis or move directly into risk response planning.

The status of the project will also affect the process of qualitative risk analysis. Early in the project, there may be several risks that have not yet surfaced. Later in the project, new risks may become evident and need to pass through qualitative analysis. The status of the project is linked to the available time needed to analyze and study the risks. There may be more time early in the project, while a looming deadline near the project's end may create a sense of urgency to find a solution for the newly identified risks.

EXAM TIP When you think of "qualitative," think of qualifying. You are qualifying, or justifying, the seriousness of the risk for further analysis. Some Certified Associate in Project Management (CAPM) and Project Management Professional (PMP) candidates like to remember that qualitative is a list. The "L" in *qualitative* and *list* ties the two together.

Preparing for Qualitative Analysis

As with most of the project planning processes, the project management team is included in the rapid analysis of the project's risks. There are four inputs to qualitative analysis:

- **Organizational process assets** Past projects and lessons learned—the organization's historical information—are ideal resources for the qualitative risk analysis process. No need to reinvent the wheel.
- **Project scope statement** Consider an organization that does the same type of projects over and over, such as installing networks or constructing bridges. These repetitive projects have known risks and known risk responses. An organization that is attempting project work that it has never done before has more unknowns, which can represent risks in a project. The project scope statement can help identify a project's uniqueness. The project scope statement's assumptions and constraints can also be examined for risks.
- **Risk management plan** The risk management plan is the key input to qualitative risk analysis. The plan will dictate the process, the methodologies to be used, and the scoring model for identified risks. In addition to the risk management plan, the identified risks from the risk register, obviously, will be needed to perform an analysis. These are the risks that will be scored and ranked based on their probability and impact.
- **Risk register** This project-centric database of identified risks and their status is referenced to qualify risks.

Completing Qualitative Analysis

During the risk identification process, all possible risks are identified. Of course, not all risks are worth responding to, while others demand attention. Qualitative analysis is a subjective approach to organizing and prioritizing risks. Through a methodical and logical approach, the identified risks are rated according to probability and potential impact.

The outcome of the ranking determines four things:

- It identifies the risks that require additional analysis through quantitative risk analysis.
- It identifies the risks that may proceed directly to risk response planning.
- It identifies risks that are not critical, project-stopping risks, but that still must be documented.
- It prioritizes risks.

Applying Probability and Impact

The project risks are rated according to their probability and impact. Risk probability is the likelihood that a risk event may happen, while risk impact is the consequence that the result of the event will have on the project objectives. Two approaches exist to ranking risks:

- Cardinal scales identify the probability and impact on a numerical value, from .01 (very low) to 1.0 (certain).
- Ordinal scales identify and rank the risks from very high to very unlikely.

Creating a Probability-Impact Matrix

Each identified risk is fed into a probability-impact matrix, as seen in Figure 11-4. The matrix maps out the risk, its probability, and its possible impact. The risks with higher probability and impact are a more serious threat to the project objectives than risks with lower impact and consequences. The risks that are threats to the project require quantitative analysis to determine the root causes, the methods to control the risks, and effective risk management. We'll discuss quantitative risk management later in this chapter.

The project is best served when the probability scale and the impact scale are predefined prior to qualitative analysis. For example, the probability scale rates the likelihood of an individual risk happening and can be on a linear scale (.1, .3, .5, .7, .9) or the scale can be the ordinal scale. The scale, however, should be defined and agreed upon in the risk management plan. The impact scale, which measures the severity of the risk on the project's objectives, can also be ordinal or cardinal.

By identifying and assigning the scales to use prior to the process of qualitative analysis, all risks can be ranked by the system, including future identified risks. A shift in risk-rating methodologies mid-project can cause disagreements with regards to how the project risks should be handled.

A probability-impact matrix multiplies the value for the risk probability by the risk impact, giving a total risk score, as seen in Figure 11-5. The risk's scores can be cardinal, and then preset values can qualify the risk for a risk response. For example, an identified risk in a project is the possibility that the vendor may be late in delivering the hardware. The probability is rated at .9, but the impact of the risk on the project is rated

Figure 11-4 A probability-impact matrix measures the identified risks within the project.

Odds and impact

Risk	Probability	Impact	Risk Score
Data loss	Low	High	Moderate
Network speed	Moderate	Moderate	Moderate
Server downtime	High	Low	Moderate
E-mail service down	Low	Low	Low

Each identified risk

Subjective score

at .10. The risk score is calculated by multiplying the probability times the impact—in this case, resulting in a score of .09.

The scores within the probability-impact matrix can be referenced against the performing organization's policies for risk reaction. Based on the risk score, the performing organization can place the risk in differing categories to guide risk reaction. There are three common categories, based on an "RAG (Red, Amber, Green) Rating" risk score:

- **Red condition** High risk; these risk scores are high in impact and probability.
- **Amber condition (also called yellow condition)** These risks are somewhat high in impact and probability.
- **Green condition** Risks with a green label are generally fairly low in impact, probability, or both.

Relying on Data Precision

Here's the truth about qualitative risk analysis: It's easy, fast, cheap, and not very reliable. One of the toughest parts of qualitative risk analysis is the biased, subjective nature of the process. A project manager and the project team must question the reliability and reality of the data that leads to the ranking of the risks. For example, Susan may have great confidence in herself when it comes to working with new, unproven technologies. Based on this opinion, she petitions the probability of the work to be a very low score.

However, because she has no experience with the technology due to its newness, the probability of the risk of failure is actually very high. The biased opinion that Susan can complete the work with zero defects and problems is slightly skewed because she has never worked with the technology before. Obviously, a low-ranked score on a risk that should be ranked high can have detrimental effects on the project's success.

Data precision ranking takes into consideration the biased nature of the ranking, the accuracy of the data submitted, and the reliability of the nature submitted to examine the risk scores. Data precision ranking is concerned with the following:

- The level of understanding of the project risk
- The available data and information about the identified risk
- The quality of the data and information of the identified risk
- The reliability of the data about the identified risk

Figure 11-5 The results of a probability-impact matrix create the risk score.

Risk Scores					
Probability					
0.9	0.05	0.09	0.18	0.36	0.72
0.7	0.04	0.07	0.14	0.28	0.56
0.5	0.03	0.05	0.10	0.20	0.40
0.3	0.02	0.03	0.06	0.12	0.24
0.1	0.01	0.01	0.02	0.04	0.08
	0.05	0.10	0.20	0.40	0.80
	Impact				

Legend: Low, Moderate, High

Assessing the Risk Score

Once the qualitative risk assessment has been completed, you can step back, heave a sigh of relief, and then acknowledge that this process will need to be repeated throughout the project as new risks come into play. Risk assessment is an ongoing, iterative process that lasts throughout the project. Want some more sad news? The risk ratings in the qualitative risk matrix can change based on conditions in the project or as more information about the risks becomes available.

One nice thing about the qualitative risk analysis process is the ability to categorize risks. Remember the RBS? The qualitative risk analysis process may give you an opportunity to create new risk categories that you've identified or to reorganize the RBS. The goal of updating the RBS is to group risks by common categories to create better risk responses later on in the risk management processes.

Finally, assessing the risk score gives the project manager an opportunity to address near-term risks. Imminent risks are usually considered of higher urgency than future risks. Consider the risk ranking, the time needed for the risk response, and the conditions that indicate the risk is coming to fruition.

Updating the Risk Register

At the beginning of the qualitative risk analysis process, the risk register was fairly simple. The list of identified risks, some potential responses, and supporting detail for the risks are all that you'd likely find in that database. Now that more information has become available, the project manager and the project team can update the risk register accordingly.

As qualitative risk analysis happens throughout the project, new risks will be identified. The project manager should route the risks through the qualitative risk analysis process. The end results of qualitative risk analysis are all updated in the risk register:

- **Overall risk ranking of the project** This allows the project manager, management, customers, and other interested stakeholders to comprehend the risk, the nature of the risks, and the condition between the risk score and the likelihood of success for a project. The risk score can be compared to other projects to determine project selection, the placement of talent in a project, prioritization, the creation of a benefit-cost ratio, or even the cancellation of a project because it is deemed too risky.
- **Risk categories** Within the risk register, categories of risks should be created. The idea is that not only will related risks be lumped together, but also there may be some trend identification and root-cause analysis of identified risks. As risks are categorized, it should be easier to create risk responses as well.
- **Near-term risks** Qualitative analysis should also help the project team identify which risks required immediate or near-term risk responses. However, risks that are likely to happen later in the project can be acknowledged, allowing imminent risks to be managed first.
- **Risks requiring additional analysis** The risks categorized as high will likely need additional analysis, such as quantitative analysis. Some risks may demand

immediate risk management based on the nature of the risks and the status of the project.

- **Low-priority risk watchlist** Let's face it: not all risks need additional analysis. However, these low-priority risks should be identified and assigned to a watchlist for periodic monitoring.
- **Trends in qualitative analysis** As the project progresses and risk analysis is repeated, trends in the ranking and analysis of the risk may become apparent. These trends can allow the project manager and other risk experts to respond to the root cause and predicted trends to either eliminate or respond to the risks within the project.

Preparing for Quantitative Risk Analysis (PMBOK, Section 11.4)

Quantitative risk analysis attempts to numerically assess the probability and impact of the identified risks. It also creates an overall risk score for the project. This method is more in-depth than qualitative risk analysis and relies on several different tools to accomplish its goal.

Qualitative risk analysis typically precedes quantitative risk analysis. All or a portion of the identified risks in qualitative risk analysis can be examined in the quantitative analysis. The performing organization may have policies on the risk scores in qualitative analysis, which require the risks to advance to the quantitative analysis. The availability of time and budget may also be a factor in determining which risks should pass through quantitative analysis. Quantitative analysis is a more time-consuming process, and is, therefore, also more expensive. The goals of quantitative risk analysis are to:

- Quantify the cost and impact of the risk exposure
- Ascertain the likelihood of reaching project success
- Ascertain the likelihood of reaching a particular project objective
- Determine the risk exposure for the project
- Determine the likely amount of the contingency reserve needed for the project
- Determine the risks with the largest impact on the project
- Determine realistic time, cost, and scope targets

Interviewing Stakeholders and Experts

Interviews with stakeholders and subject matter experts can be one of the first tools to quantify the identified risks. These interviews can focus on worst-case, best-case, and most-likely scenarios if the goal of the quantitative analysis is to create a triangular distribution; most quantitative analysis, however, uses continuous probability distributions. Figure 11-6 shows five sample distributions: normal, triangular, uniform, beta, and lognormal.

Continuous probability distribution examines the probability of all possibilities within a given range. For each variable, the probability of a risk event and the

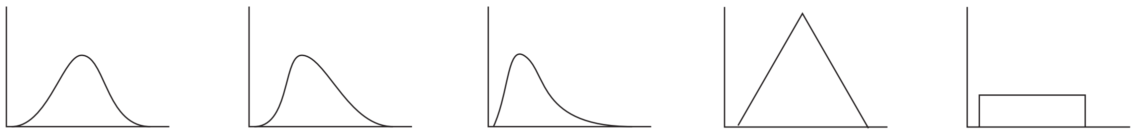


Figure 11-6 Risk distributions illustrate the likelihood and impact of an event within a project.

corresponding consequence of the event may vary. In other words, depending on whether the risk event occurs and how it happens, a reaction to the event may also occur. The distribution of the probabilities and impact includes:

- Uniform
- Normal
- Triangular
- Beta
- Lognormal

EXAM TIP It's doubtful you'll be tested on these risk distributions for the exam. The PMBOK mentions them only briefly, so you just need to be topically aware of them. Don't invest hours memorizing the subject.

Applying Sensitivity Analysis

Sensitivity analysis examines each risk to determine which one has the largest impact on the project's success. All other risks in the project are set at a baseline value and then compared against all of the other risks individually. The individual risk is then examined to see how it may affect the success of the project. The goal of sensitivity analysis is to determine which individual risks have the greatest impact on the project's success and then escalate the risk management processes based on these risk events. The tornado diagram is most likely to be used when completing sensitivity analysis.

Finding the Expected Monetary Value

The expected monetary value (EMV) of a project or event is based on the probability of outcomes that are uncertain. For example, one risk may cost the project an additional $10,000 if it occurs, but there's only a 20 percent chance of the event occurring. In its simplest form, the expected monetary value of this individual risk impact is, thus, $2,000. Project managers can also find the expected monetary value of a decision by creating a decision tree.

Table 11-1 is an example of a simple risk matrix that determines the expected monetary value for some sample risks. Note that the sum of the EMV reveals what the contingency reserve for these risks should be.

Using a Decision Tree

A decision tree is a method used to determine which of two or more decisions is the best one. For example, it can be used to determine buy-versus-build scenarios, lease-or-purchase equations, or whether to use in-house resources rather than outsourcing proj-

Risk	Probability	Impact	EMV
Data loss	.40	-$12,000	-$4,800
New regulation	.80	-$34,000	-$27,200
Vendor discount	.30	+$10,000	+$3,000
Hardware issue	.45	-$65,000	-$29,250
		Contingency reserve =	$58,250

Table 11-1 Creating the Contingency Reserve

ect work. The decision tree model examines the cost and benefits of each decision's outcome and weighs the probability of success for each of the decisions.

The purpose of the decision tree is to make a decision, calculate the value of that decision, or determine which decision costs the least. Follow Figure 11-7 through the various steps of the decision tree process.

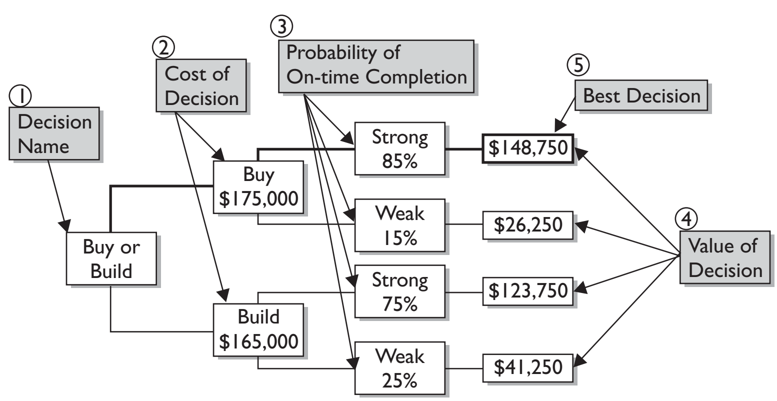
Completing a Decision Tree

As the project manager of the new GFB Project, you have to decide whether to create a new Web application in-house or send the project out to a developer. The developer you would use (if you were to outsource the work) quotes the project cost at $175,000. Based on previous work with this company, you are 85 percent certain they will finish the work on time.

Your in-house development team quotes the cost of the work as $165,000. Again, based on previous experience with your in-house developers, you feel 75 percent certain they can complete the work on time. Now let's apply what we know to a decision tree:

- Buy or build is simply the decision name.
- The cost of the decision if you "buy" the work outside of your company is $175,000. If you build the software in-house, the cost is $165,000.
- Based on your probability of completion by a given date, you apply the 85-percent certainty to the "strong" finish for the buy branch of the tree. Because you're 85 percent certain, you're also 15 percent uncertain; this value is assigned to the "weak" value on the buy branch. You complete the same process for the build branch of the tree.

Figure 11-7 Decision trees analyze the probability of events and calculate decision values.



- The value of the decision is the percentage of strong and weak applied to each branch of the tree.
- The best decision is based solely on the largest value of all possible decisions.

Using a Project Simulation

Project simulations allow the project team to play "what-if" games without affecting any areas of production. The Monte Carlo analysis (sometimes called the Monte Carlo technique) is the most common simulation. This technique got its name from Monte Carlo, Monaco (world-renowned for its slot machines, roulette wheels, and other games of pure chance). The Monte Carlo technique, typically completed using a computer software program, completely simulates a project, using values for all possible variables, to predict the most likely model.

Examining the Results of Quantitative Risk Analysis

Quantitative risk analysis is completed throughout the project as risks are identified and passed through qualitative analysis, as project conditions change, or on a preset schedule. The end result of quantitative risk analysis should be reflected in the risk register and includes the following:

- **Probabilistic analysis** The risks within the project allow the project manager or other experts to predict the likelihood of the project's success. The project may be altered by the response to certain risks; this response can increase cost and push back the project's completion date.
- **Probability of costs and schedule objectives** Based on the identified risks, their impact, and the probability of occurrence, forecasts for the project schedule and the project costs are created. The more negative the risks that occur within a project, the greater the chance of delays and increased costs.
- **A prioritized list of risks** This list of quantified risks demonstrates those with the highest potential for endangering the project's success. This list includes the risks that have the greatest opportunity to affect the project. Each risk is identified with its probability and impact.
- **Trends** As the project moves towards completion, quantitative risk analysis may be repeated over and over. In each round of analysis, trends in the identified risks may become visible. These trends can help the project team eliminate the root cause of the risk, reduce their probability, or control their impact.

Updating the Risk Register

You guessed it. After completing a round of quantitative risk analysis, the risk register needs to be updated to reflect all the new information the project manager has learned about the project and its risks. Here's what gets updated in the risk register:

- Probability of the project succeeding
- Probability of achieving the project's cost and time objectives

- Prioritized list of quantified risks
- Trends the project management team has discovered

The risk register and the risk information will be updated throughout the project. This is a PMI-ism—the risk register is part of the project management plan and has to be updated throughout the project.

Planning for Risk Responses (PMBOK, Section 11.5)

Risk response planning is all about options and actions. It focuses on how to decrease the possibility of risks from adversely affecting the project's objectives and also on how to increase the likelihood of positive risks that can aid the project. Risk response planning assigns responsibilities to people and groups close to the risk event. Risks will increase or decrease based on the effectiveness of risk response planning.

The responses to identified risks must be in balance with the risks themselves. The cost and time invested in a risk must be met with the gains from reducing the risk's impact and probability. In other words, a million-dollar solution for a hundred-dollar problem is unacceptable. The individuals who are assigned to the risk must have the authority to react to the project risk as planned. In most cases, several risk responses may be viable for the risk—the best choice for the identified risk must be documented, agreed upon, and then followed through should the risk come to fruition.

Preparing for Risk Responses

To successfully prepare for risk response, the project manager, project team, and appropriate stakeholders rely on several inputs—many of which stem from qualitative and quantitative risk analyses. The risk management plan is needed during the risk response planning, but the risk register is also needed to provide the following:

- A list of prioritized risks
- A risk ranking
- A prioritized list of quantified risks
- A probabilistic analysis of the project
- The probability of the project meeting the cost and schedule goals
- The list of potential responses decided upon when risks were first identified
- Any risk owners who have been identified
- A list of risks with common causal factors
- Trends from qualitative and quantitative analyses

Creating Risk Responses

There are several tools and techniques that the project team can employ to respond to risks. Each risk should be evaluated to determine which category of risk response is most appropriate. When a category has been selected, the response must then be developed, refined, documented, and readied for use, if needed. In addition, secondary responses may be selected for each risk. The purpose of risk response planning is to bring the overall risk of the project down to an acceptable level. In addition, risk response planning must address any risks that have unacceptably high scores.

Avoiding Negative Risks

Avoidance is simply avoiding the risk. This can be accomplished in many different ways, and generally happens early in the project, when any change will result in fewer consequences than later on in the project plan. Examples of avoidance include the following:

- Changing the project plan to eliminate the risk
- Clarifying project requirements to avoid discrepancies
- Hiring additional project team members who have experience with the technology that the project deals with
- Using a proven methodology rather than a new approach

Transferring Negative Risks

Transference is the process of transferring the risk (and the ownership of the risk) to a third party. The risk doesn't disappear—it just becomes someone else's problem. Transference of a risk usually costs a premium for the third party to own and manage. Common examples of risk transference include:

- Insurance
- Performance bonds
- Warrantees
- Guarantees
- Fixed-priced contracts

Mitigating Negative Risks

Mitigating risks is an effort to reduce the probability and/or impact of an identified risk in the project. Mitigation is done based on the logic before the risk happens. The cost and time to reduce or eliminate the risks is more cost effective than repairing the damage caused by the risk. The risk event may still happen, but hopefully the cost and impact of the risk will both be very low.

Mitigation plans can be created so that they are implemented should an identified risk cross a given threshold. For example, a manufacturing project may have a mitigation plan to reduce the number of units created per hour should the equipment's temperature cross a given threshold. The reduction is the number of units per hour that it may cost the project in time. In addition, the cost of extra labor to run the equipment longer because the machine is now operating at a slower pace may be attributed to the project. However, should the equipment fail, the project would have to replace the equipment and be delayed for weeks while awaiting repairs.

Examples of mitigation include:

- Adding activities to the project to reduce the risk probability or impact
- Simplifying the processes within the project

- Completing more tests on the project work before implementation
- Developing prototypes, simulations, and limited releases

Managing the Positive Risk and Opportunities

While most risks have a negative connotation, not all risks are bad. There are instances when a risk may create an opportunity that can help the project, other projects, or the organization as a whole. The type of risk and the organization's willingness to accept the risks will dictate the appropriate response.

Exploiting Positive Risks or Opportunities

When an organization would like to take advantage of a positive risk that will likely happen, it can exploit the risk. Positive risk exploitation can be realized by adding resources to finish faster than was originally planned, increasing quality to recognize sales and customer satisfaction, utilizing a better way of completing the project work, or any other method that creates the positive outcomes of the identified risk.

Sharing Positive Risks

The idea of sharing a positive risk really means sharing a mutually beneficial opportunity between two organizations or projects, or creating a risk-sharing partnership. When a project team can share the positive risk, ownership of the risk is given to the organization that can best capture its benefits.

Enhancing Positive Risks

This risk response seeks to modify the size of the identified opportunity. The goal is to strengthen the cause of the opportunity to ensure that the risk event does happen. Enhancing a project risk looks for solutions, triggers, or other drives to ensure that the risk does come to fruition so that the rewards of the risk can be realized by the performing organization.

Accepting the Risks

Risk acceptance is the process of simply accepting the risks because no other action is feasible or because the risks are deemed to be of small probability, impact, or both and that a formal response is not warranted. Passive acceptance requires no action; the project team deals with the risks as they happen. Active acceptance entails developing a contingency plan should the risk occur. Acceptance may be used for both positive and negative risks.

A contingency plan is a predefined set of actions the project team will take should certain events occur. Events that trigger the contingency plan should be tracked. A fallback plan is a reaction to a risk that has occurred when the primary response proves to be inadequate.

Updating the Risk Register

Are you noticing a theme here? Every time new information about the project's risks is learned, the risk register has to be updated. Since I'm dealing with risk responses in this section, the updates to the risk register are:

- Identified risks and how each one can threaten the project

- Risk owners and their responsibilities for the risk events
- Risk response strategies and the responses to risk events
- Symptoms and warning signs of risk
- Budget and schedule impact of the risk response activities
- Contingency reserves for time and costs
- Contingency plans and triggers to implement the plan
- Fallback plans
- Residual risks (these are risks that are expected to remain after a risk response)
- Secondary risks (these are new risks that are created as a result of a risk response)

Creating Contracts for Risk Response

When multiple entities are involved in a project, contractual agreements may be necessary to identify the responsible parties for identified risks. The contract may be needed for insurance purposes, customer acceptance, or the acknowledgement of responsibilities between the entities completing the project. Transference is an example of contractual agreements for the responsibility of risks within a project.

Justifying Risk Reduction

To reduce risk, additional time or monies are typically needed. The process and logic behind the strategies to reduce the risk should be evaluated to determine if the solution is worth the tradeoffs. For example, a risk may be eliminated by adding $7,500 to a project's budget. However, the likelihood of the risk occurring is relatively low. Should the risk happen, it would cost, at a minimum, $8,000 to correct and the project would be delayed by at least two weeks.

The cost of preventing the risk versus the cost of responding to it must be weighed and justified. If the risk is not eliminated with the $7,500 cost and the project moves forward as planned, it has, theoretically, saved $15,500 because the risk did not happen and the response to the risk did not need to happen.

However, if the risk does happen, the project will lose at least $8,000 and be delayed at least two weeks. The cost inherent in the project delay may be more expensive than the solution to the risk. The judgment of solving the risk to reduce the likelihood of delaying the project may be wiser than ignoring the risk and saving the cost by solving the risk problem.

Updating the Project Plan

The risk reactions, contingency plans, and fallback plans should all be documented and incorporated into the project plan—for example, updating the schedule, budget, and WBS to accommodate additional time, money, and activities for risk responses. The responses to the risks may change the original implementation of the project and should be updated to reflect the project plan and intent of the project team, management, and other stakeholders. A failure to update the project plan and the risk register may cause risk reactions to be missed—and skew performance measurements.

Monitoring and Controlling Project Risks (PMBOK, Section 11.6)

Risks must be actively monitored and new risks must be responded to as they are discovered. Risk monitoring and control is the process of monitoring identified risks for signs that they may be occurring, controlling identified risks with the agreed-upon responses, and looking for new risks that may creep into the project. Risk monitoring and control is also concerned with the documentation of the success or failure of risk response plans and keeping records of metrics that signal risks are occurring or disappearing from the project.

Risk monitoring and control is an active process that requires participation from the project manager, the project team, key stakeholders, and, in particular, risk owners within the project. As the project progresses, risk conditions may change and require new responses, additional planning, or the implementation of a contingency plan.

There are several goals to risk monitoring and control:

- Confirm that risk responses are implemented as planned
- Determine if risk responses are effective or if new responses are needed
- Determine the validity of the project assumptions
- Determine if risk exposure has changed, evolved, or declined due to trends in the project progression
- Monitor risk triggers
- Confirm that policies and procedures happen as planned
- Monitor the project for new risks

Preparing for Risk Monitoring and Control

A project manager's work is never done—at least, not until the project is closed. Risk monitoring and controlling is an active process. There are several inputs the project team and the project manager must rely on to effectively monitor and control risks:

- **The risk management plan** The risk management plan defines the organization's approach to risk management. It is not the strategy for specific risks within a project, but the overall strategy for risk analysis and planning.
- **The risk register** The risk register is the central repository for all project risk information. It includes the identified risks, the potential responses, the root causes of risks, and any identified categories of risk.
- **Scope changes** Change requests should be analyzed for their impact on the project and for any risks in the proposed change that could affect the project objectives, as well as any new risks the increased scope presents.
- **Work performance information** The results of project work can inform the project manager and the project team of new and pending risks. In addition, project team members may create reports to monitor or document risks. These reports are known as issue logs, action items, jeopardy warnings, and escalation notices.

- **Performance reports** The project performance focuses on the balance of the project schedule, costs, and scope. Should any of these factors suffer, new risks are likely to enter the project.

Monitoring and Controlling Risks

Risk monitoring and control happens throughout the project. These are not solitary activities that are completed once and never revisited. The project manager and the project team must actively monitor risks, respond with the agreed-upon actions, and scan the horizon for risks that have not been addressed. Risk monitoring and control is a recurring activity that requires input from all project participants.

Project risk should be on the agenda at every project team meeting. The periodic risk review is a regularly scheduled discussion throughout the project to ascertain the level of foreseeable risks, the success of risk responses in the project to date, and a review of pending risks. Based on circumstances within the project, risk rankings and prioritization may fluctuate. Changes to the project scope, team, or conditions may require qualitative and quantitative analyses.

Completing Risk Response Audits

You don't just assume your risk responses work—you have to test them. A risk response audit examines the planned risk responses, how well the planned actions work, and the effectiveness of the risk owners in implementing the risk responses. The audits happen throughout the project to measure the effectiveness of mitigating, transferring, and avoiding risks. The risk response audit should measure the effectiveness of the decision and its impact on time and cost. Of course, you'll update the risk register once the audit has been completed.

Analyzing Project Variances

A variance is the difference between what was planned and what was experienced. No one likes to hear that variances are in the project, but ignoring variances can only lead to more risks, more troubles, and more headaches. Cost variances can eat into the project budget, which in turn creates new risks, such as running out of cash, having to choose a lower grade of materials, or even removing deliverables from the scope. Cost variances can also force the project manager to have to ask for more funds, which is not a pleasant experience.

Schedule variances are just as deadly. Delays in the project work, vendor deliveries, and time estimates that were too optimistic can eat into the management reserve and consume the project's float. These risks can create new risks. Consider the risks inherent to the schedule variance responses:

- Crashing the project
- Fast-tracking the project
- Overworking the project team
- Rushing the project work
- Rushing through quality control and quality audits to regain time

Remember earned value analysis? Earned value analysis measures project performance. When project performance is waning, the project is likely missing targeted costs and schedule goals. The results of earned value analysis can signal that risks are happening within the project or that new risks may be developing.

For example, a schedule performance index (SPI) of .93 means the project is off schedule by 7 percent. A risk based on this value could mean that the project team is having difficulty completing the project work as planned. Additional work will continue to be late, the project will finish late, and quality may suffer as the team attempts to rush to complete assigned tasks.

Measuring Technical Performance

Throughout the project, the project team's technical competence with the technology being used in the project should increase. The level of technical achievement should be in proportion to the expected level of technical performance within the project. If the project team is not performing at a level of expected technical expertise, the project may suffer additional risks due to the discrepancy. Technical performance can be measured by the successful completion of activities throughout the project or project phases.

Examining the Results of Risk Monitoring and Control

Risk monitoring and control helps the project become more successful. Risk monitoring and control measures the planned responses to risks and creates reactions to unplanned risks. The outputs of risk monitoring and control also aim to help the project reach its objectives. Consider these outputs:

- **Risk register updates** As the project moves along and the project manager and the project team complete the risk assessments, audits, and risk reviews, they'll need to record their findings in the risk register. This update may include the reevaluation of the risk's impact, probability, and expected monetary value. For those risks that have passed in the project, the risk register should record what actually happened with the risk event and its impact on the project.
- **Change requests** Your favorite, I'm sure. As workarounds and contingency plans are used, they require changes to the project plan. Changes that occur as a result of the risks are completed through integrated change control. The changes are documented, approved, and incorporated into the project plan.
- **Recommended corrective actions** As risks come to fruition, corrective actions are needed to bypass them. The two types of corrective action are workarounds and contingency plans. Corrective actions are actions taken to bring the project back into compliance with the project plan.
- **Recommended preventive actions** Preventive actions are steps taken to bring the project back into alignment with the project management plan.
- **Risk response plan updates** As risks occur, the responses to them should be documented and updated in the risk response plan. Should risk rankings change during the project, the change in ranking, the logic behind the change, and the results of the risk rank change should be documented in the risk response plan. For the risks that do not occur, the risks should be documented and considered closed in the risk response plan.

- **Organizational process asset updates** The risks from the current project can help other project managers in the future. Therefore, the project manager must work to ensure that the current risks, their anticipated impact, and their actual impact are recorded. The current risk matrix, for example, can become a risk template for other projects in the future. This is true for just about any risk document—from risk responses to the risk breakdown structure, lessons learned, and checklists.
- **Project management plan updates** Some change requests and risk responses may require updates to the project management plan.

Chapter Summary

All projects have some level of risks—just how much the project's stakeholders are willing to accept varies by project and organization. The quantification of the stakeholders' tolerance for risk is called the utility function: the higher the project's importance, the lower the utility function. Low-priority projects are generally more likely to accept risks than those projects that have a big impact on your organization.

Recall that at the launch of the risk planning process, there's the creation of the risk management plan. This plan addresses how the project's risk management approach will be directed. This plan is not specific to the risks within the project, but creates the boundaries, expectations, and general rules for the risk management process. Once this plan is in place and everyone is in agreement to abide by it, the project-specific risk management activities can commence.

The first stop is all about risk identification. This isn't a private meeting—the project team, the project manager, the project sponsor, vendors, stakeholders, end users, even customers can participate if it's necessary. Any project-relevant risks are accepted. It's good to have a variety of participants, as their point of view can help identify risks that may have been overlooked otherwise.

As risks are identified, the project manager can use the Delphi Technique to build a consensus on which risks have the highest impact on the project. This anonymous approach allows participants to speak freely about the risks, unhindered by the opinions of other stakeholders. The comments on the identified risks are distributed to all of the participants, allowing participants to comment, concur, or dismiss opinions on the identified risks. Through rounds of discussion, a consensus on the risks is reached.

Then it's off to quantitative analysis, where the risks' probability and impact are quantified. Specifically, the risk exposure for the project is tied to a dollar amount. The risk exposure is offset by a contingency reserve. Should risk events happen, monies from the contingency reserve are used to counteract the risk events. Ongoing monitoring and controlling of the risk events and their impact is essential to effective risk management.

Involved with all of these processes is the risk register. It's the project's journal and database of risks, their status, their impact, and any supporting detail about the risk events. As more information is gathered about the risks, the project management team updates the risk register. As the project moves past risk events, their status and outcomes are updated in the risk register. The risk register is part of the project management plan and becomes, once the project closes, part of organizational process assets for future projects.

Key Terms

Acceptance A risk response appropriate for both positive and negative risks, but often used for smaller risks within a project.

Avoidance A risk response to avoid the risk; sometimes called a workaround.

Brainstorming The most common approach to risk identification; usually completed as a project team with subject matter experts to identify the risks within the project.

Business risks These risks may have negative or positive outcomes. Examples include using a less experienced worker to complete a task, allowing phases or activities to overlap, or foregoing the expense of formal training for on-the-job education.

Cardinal scales A ranking approach to identify the probability and impact on a numerical value, from .01 (very low) to 1.0 (certain).

Checklists A quick and cost-effective risk identification approach.

Data precision The consideration of the risk ranking scores that takes into account any bias, the accuracy of the data submitted, and the reliability of the nature submitted.

Decision tree A method to determine which of two or more decisions is the best one. The model examines the cost and benefits of each decision's outcome and weighs the probability of success for each of the decisions.

Delphi Technique An anonymous method of querying experts about foreseeable risks within a project, phase, or component of a project. The results of the survey are analyzed by a third party, organized, and then circulated to the experts. There can be several rounds of anonymous discussion with the Delphi Technique, without fear of backlash or offending other participants in the process. The goal is to gain consensus on project risks within the project.

Enhancing A risk response that attempts to enhance the conditions to ensure that a positive risk event will likely happen.

Expected monetary value (EMV) The monetary value of a risk exposure based on the risk's probability and impact in the risk matrix. This approach is typically used in quantitative risk analysis, as it quantifies the risk exposure.

Exploit A risk response that takes advantage of the positive risks within a project.

External risks These risks are outside of the project, but directly affect it—for example, legal issues, labor issues, a shift in project priorities, or weather. "Force majeure" risks call for disaster recovery rather than project management. These are risks caused by earthquakes, tornados, floods, civil unrest, and other disasters.

Flow charts System or process flow charts show the relationship between components and how the overall process works. These are useful for identifying risks between system components.

Influence diagrams An influence diagram charts out a decision problem. It identifies all of the elements, variables, decisions, and objectives and also how each factor may influence another.

Ishikawa diagrams These cause-and-effect diagrams are also called fishbone diagrams and are used to find the root cause of factors that are causing risks within the project.

Low-priority risk watchlist Low-priority risks are identified and assigned to a watchlist for periodic monitoring.

Mitigation A risk response effort to reduce the probability and/or impact of an identified risk in the project.

Monte Carlo technique A simulation technique that got its name from the casinos of Monte Carlo, Monaco. The simulation is completed using a computer software program that can simulate a project, using values for all possible variables, to predict the most likely model.

Ordinal scales A ranking approach that identifies and ranks the risks from very high to very unlikely or to some other ordinary value.

Organizational risks The performing organization can contribute to the project's risks through unreasonable cost, time, and scope expectations; poor project prioritization; inadequate funding or the disruption of funding; and competition with other projects for internal resources.

Probability and impact matrix A matrix that ranks the probability of a risk event occurring and its impact on the project if the event does happen; used in qualitative and quantitative risk analyses.

Project management risks These risks deal with faults in the management of the project: the unsuccessful allocation of time, resources, and scheduling; unacceptable work results; and poor project management.

Pure risks These risks have only a negative outcome. Examples include loss of life or limb, fire, theft, natural disasters, and the like.

Qualitative risk analysis This approach "qualifies" the risks that have been identified in the project. Specifically, qualitative risk analysis examines and prioritizes risks based on their probability of occurring and their impact on the project should they occur.

Quantitative risk analysis This approach attempts to numerically assess the probability and impact of the identified risks. It also creates an overall risk score for the project. This method is more in-depth than qualitative risk analysis and relies on several different tools to accomplish its goal.

RAG rating An ordinal scale that uses red, amber, and green to capture the probability, impact, and risk score. The first letter of red, amber, and green equate to "RAG" in the system.

Residual risks These are risks that are expected to remain after a risk response.

Risk A project risk is an uncertain event or condition that can have a positive or negative impact on the project.

Risk identification The systematic process of combing through the project, the project plan, the work breakdown structure, and all supporting documentation to identify as many risks that may affect the project as possible.

Risk management plan A project management subsidiary plan that defines how risks will be identified, analyzed, responded to, and monitored within the project. The plan also defines the iterative risk management process that the project is expected to adhere to.

Risk management planning The agreed-upon approach to the management of the project risk processes.

Risk owners The individuals or entities that are responsible for monitoring and responding to an identified risk within the project.

Risk register The risk register is a project plan component that contains all of the information related to the risk management activities. It's updated as risk management activities are conducted to reflect the status, progress, and nature of the project risks.

Risk response audit An audit to test the validity of the established risk responses.

Risk responsibilities The level of ownership an individual or entity has over a project risk.

Risk score The calculated score based on each risk's probability and impact. The approach can be used in both qualitative and quantitative risk matrixes.

Root cause identification Root cause identification aims to find out why a risk event may be occurring, the causal factors for the risk events, and then, eventually, how the events can be mitigated or eliminated.

Secondary risks New risks that are created as a result of a risk response.

Sensitivity analysis A quantitative risk analysis tool that examines each risk to determine which one has the largest impact on the project's success.

Sharing A risk response that shares the advantages of a positive risk within a project.

SWOT analysis SWOT analysis is the process of examining the project from the perspective of each characteristic: strengths, weaknesses, opportunities, and threats.

Technical, quality, or performance risks Technical risks are associated with new, unproven, or complex technologies being used on the project. Changes to the technology during the project implementation can also be a risk. Quality risks are the levels set for expectations of impractical quality and performance.

Transference A risk response that transfers the ownership of the risk to another party. Insurance, licensed contractors, or other project teams are good examples of transference. A fee and contractual relationships are typically involved with the transference of a risk.

Questions

1. When is it appropriate to accept a project risk?
   - **A.** It is never appropriate to accept a project risk.
   - **B.** All risks must be mitigated or transferred.
   - **C.** It is appropriate to accept a risk if the project team has never completed this type of project work before.
   - **D.** It is appropriate if the risk is in balance with the reward.

2. Frances is the project manager of the LKJ Project. Which of the following techniques will she use to create the risk management plan?
   A. Risk tolerance
   B. Status meetings
   C. Planning meetings
   D. Variance meetings
3. You are the project manager of the GHK Project. You and the manufacturer have agreed to substitute the type of plastic used in the product to a slightly thicker grade should there be more than 7 percent error in production. The thicker plastic will cost more and require the production to slow down, but the errors should diminish. This is an example of which of the following?
   A. Threshold
   B. Tracking
   C. Budgeting
   D. JIT manufacturing
4. An organization's risk tolerance is also known as what?
   A. The utility function
   B. Herzberg's theory of motivation
   C. Risk acceptance
   D. The risk-reward ratio
5. The customers of the project have requested additions to the project scope. The project manager notifies you that additional risk planning will need to be added to the project schedule. Why?
   A. The risk planning should always be the same amount of time as the activities required by the scope change.
   B. Risk planning should always occur whenever the scope is adjusted.
   C. Risk planning should only occur at the project manager's discretion.
   D. The project manager is incorrect. Risk planning does not need to happen at every change in the project.
6. Which one of the following best describes the risk register?
   A. It documents all of the outcomes of the other risk management processes.
   B. It's a document that contains the initial risk identification entries.
   C. It's a system that tracks all negative risks within a project.
   D. It's part of the project's project management information system (PMIS) for integrated change control.
7. ________________________ include(s) fire, theft, or injury, and offer(s) no chance for gain.
   A. Business risks

B. Pure risks

C. Risk acceptance

D. Life risks

8. Complete this sentence: A project risk is a(n)_______________________ occurrence that can affect the project for good or bad.

A. Known

B. Potential

C. Uncertain

D. Known unknown

9. When should risk identification happen?

A. As early as possible in the initiation process

B. As early as possible in the planning process

C. Throughout the product management life cycle

D. Throughout the project life cycle

10. You are the project manager of the KLJH Project. This project will last two years and has 30 stakeholders. How often should risk identification take place?

A. Once at the beginning of the project

B. Throughout the execution processes

C. Throughout the project

D. Once per project phase

11. Which one of the following is an acceptable tool for risk identification?

A. Decision tree analysis

B. Decomposition of the project scope

C. The Delphi Technique

D. Pareto charting

12. You are the project manager for a project that will create a new and improved Web site for your company. Currently, your company has over eight million users around the globe. You would like to poll experts within your organization with a simple, anonymous form asking about any foreseeable risks in the design, structure, and intent of the Web site. With the collected information, subsequent anonymous polls are submitted to the group of experts. This is an example of ______________________________.

A. Risk identification

B. A trigger

C. An anonymous trigger

D. The Delphi Technique

13. Which risk analysis technique provides the project manager with a risk ranking?
    A. Quantifiable
    B. Qualitative
    C. The utility function
    D. SWOT analysis
14. A table of risks, their probability, impact, and a number representing the overall risk score is called a ______________________________.
    A. Risk table
    B. Probability and impact matrix
    C. Quantitative matrix
    D. Qualitative matrix
15. You are presented with the following table:

Risk Event	Probability	Impact Cost/Benefit	EMV
1	.20	−4,000	
2	.50	5,000	
3	.45	–300	
4	.22	500	
5	.35	−4,500	

What is the EMV for Risk Event 3?
    A. $135
    B. –$300
    C. $45
    D. –$135
16. You are presented with the following table:

Risk Event	Probability	Impact Cost/Benefit	Ex$V
1	.35	−4,000	
2	.40	50,000	
3	.45	–300,000	
4	.30	50,000	
5	.35	−45,000	

Based on the preceding numbers, what is the amount needed for the contingency fund?
    A. Unknown with this information

B. 249,000

C. 117,150

D. 15,750

17. The water sanitation project manager has determined that the risks associated with handling certain chemicals are too high. He has decided to allow someone else to complete this portion of the project, and so has outsourced the handling and installation of the chemicals and filter equipment to an experienced contractor. This is an example of which of the following?

A. Avoidance

B. Acceptance

C. Mitigation

D. Transference

18. A project manager and the project team are actively monitoring the pressure gauge on a piece of equipment. Sarah, the engineer, recommends a series of steps to be implemented should the pressure rise above 80 percent. The 80 percent mark represents what?

A. An upper control limit

B. The threshold

C. Mitigation

D. A workaround

19. You are presented with the following table:

Risk Event	Probability	Impact Cost/Benefit	Ex$V
1	.20	–4,000	
2	.50	5,000	
3	.45	–300	
4	.22	500	
5	.35	–4,500	
6			

What would Risk Event 6 be based on the following information: Marty is 60 percent certain that he can get the facility needed for $45,000, which is $7,000 less than what was planned for.

A. .60, 45,000, 27,000

B. .60, 52,000, 31,200

C. .60, 7,000, 4,200

D. .60, –7,000, –4,200

20. Which of the following can determine multiple scenarios, given various risks and the probability of their impact?
    A. Decision tree
    B. Monte Carlo technique
    C. Pareto chart
    D. Gantt chart

Answers

1. **D**. Risks that are in balance with the reward are appropriate for acceptance. A, B, and C are all incorrect because these solutions are all false responses to risk management. For more information, see the introduction to Chapter 11 in the PMBOK.
2. **C**. Planning meetings are used to create the risk management plan. The project manager, project team leaders, key stakeholders, and other individuals with the power to make decisions regarding risk management attend the meetings. Choices A, B, and D are incorrect, since these choices do not fully answer the question.
3. **A**. An error value of 7 percent represents the threshold the project is allowed to operate under. Should the number of errors increase beyond 7 percent, the current plastic will be substituted. B is incorrect, since tracking is the documentation of a process through a system or workflow or the documentation of events through the process. C, budgeting, is also incorrect. D, JIT manufacturing, is a scheduling approach to ordering the materials only when they are needed in order to keep inventory costs down. For more information, see the PMBOK, Section 11.5.2.1.
4. **A**. The utility function describes a person's willingness to tolerate risk. B is incorrect. Herzberg's theory of motivation is a human resources theory that describes motivating agents for workers. C is also incorrect. Risk acceptance describes the action of allowing a risk to exist because it is deemed low in impact, low in probability, or both. D, the risk-reward ratio, is incorrect. This describes the potential reward for taking on a risk in the project.
5. **B**. When the scope has been changed, the project manager should require risk planning to analyze the additions for risks to the project's success. A is incorrect. The scope changes may not require the same amount of time as the activities needed to complete the project changes. C is incorrect because risk planning should not occur at the project manager's discretion. Instead, it should be based on evidence within the project and the policies adopted in the risk management plan. D is also incorrect. When changes are added to the project scope, risk planning should occur. For more information, see the PMBOK, Section 11.6.1.3.
6. **A**. The risk register documents all of the outcomes of the other risk management processes. B, C, and D are all incorrect definitions of the risk register. For more information, see the PMBOK, Section 11.2.3.1.

7. **B**. Pure risks are the risks that could threaten the safety of the individuals on the project. A is incorrect because business risks affect the financial gains or loss of a project. C and D are incorrect, since these terms are not relevant.
8. **C**. Risks are not planned; they are left to chance. The accommodation and the reaction to a risk can be planned, but the event itself is not planned. If risks could be planned, Las Vegas would be out of business. A, B, and D are all incorrect, since these terms do not accurately complete the sentence. For more information, see the introduction to Chapter 11 in the PMBOK.
9. **D**. Risk identification is an iterative process that happens throughout the project's life cycle. A and B are both incorrect because risk identification is not limited to any one process group. C is incorrect because risk identification happens, technically, throughout the project management life cycle, which is unique to each project, and not through the product management life cycle. For more information, see the PMBOK, Section 11.2.
10. **C**. Risk identification happens throughout the project. Recall that planning is iterative: As the project moves towards completion, new risks may surface that call for identification and planned responses. A is incorrect. Risk identification should happen throughout the project, not just at the beginning. B is incorrect because risk identification is part of planning. D is incorrect because the nature of the project phase may require and reveal more than one opportunity for risk identification. For more information, see the PMBOK, Section 11.2.
11. **C**. The Delphi Technique, an anonymous risk identification method, is the correct answer. A is incorrect. Decision tree analysis is appropriate for calculating the expected monetary value of a decision, but not risk identification. B is incorrect because the decomposition of the project scope will result in the WBS. D is incorrect. Creating a Pareto chart is part of quality control, not risk identification. For more information, see the PMBOK, Section 11.2.2.2.
12. **D**. An anonymous poll that allows experts to freely submit their opinion without fear of backlash is an example of the Delphi Technique. A, B, and C are incorrect. These choices do not accurately answer the question. For more information, see the PMBOK, Section 11.2.2.2.
13. **B**. The risk ranking is based on the very high, high, medium, low, and very low attributes of the identified risks. A is incorrect because it is not relevant to the question. This answer is quantifiable, not quantitative. C is incorrect. Utility function describes an organization's tolerance for risk. D, SWOT analysis, is part of risk identification. For more information, see the PMBOK, Sections 11.3.2.1 and 11.3.2.2.
14. **B**. A table of risks, their probability, and impact equate to a risk score in a risk matrix. A is incorrect, since it does not fully answer the question. C and D are incorrect because a risk matrix can be used in both quantitative and qualitative risk analyses. For more information, see the PMBOK, Section 11.3.2.2.
15. **D**. Risk Event 3 has a probability of 45 percent and an impact cost of –$300, which equates to –$135. A, B, and C are incorrect because their values are

wrong answers for the formula. For more information, see the PMBOK, Section 11.1.3.1.

16. **C**. The calculated amount for each of the risk events is shown in the following table:

Risk Event	Probability	Impact Cost/Benefit	Ex$V
1	0.35	–4,000	–1,400
2	0.4	50,000	20,000
3	0.45	–300,000	–135,000
4	0.3	50,000	15,000
5	0.35	–45,000	–15,750
			–117,150

A, B, and D are incorrect answers because they do not reflect the contingency amount needed for the project based on the preceding table. For more information, see the PMBOK, Section 11.1.3.1.

17. **D**. Because the risk is not eliminated but transferred to someone else or another entity, it is considered transference. A is incorrect because the risk still exists—it is just being handled by another entity. B is incorrect because the project manager has not accepted the risk, deciding instead to allow another entity to deal with it. C is incorrect. The risk has not been mitigated in the project. For more information, see the PMBOK, Section 11.5.2.1.

18. **B**. The 80 percent mark is a threshold. A is incorrect. An upper control limit is a boundary for quality in a control chart. C is incorrect. Mitigation is a planned response should a risk event happen. D is also incorrect. A workaround is an action to bypass the risk event. For more information, see the glossary in the PMBOK and also Section 11.5.

19. **C**. Marty is 60 percent certain that he can save the project $7,000. The $4,200 represents the 60 percent certainty of the savings. A, B, and D are all incorrect, since these values do not reflect the potential savings of the project. For more information, see the PMBOK, Section 11.1.3.1.

20. **B**. The Monte Carlo technique can reveal multiple scenarios and examine the risks and probability of impact. A, a decision tree, helps guide the decision-making process. C, a Pareto chart, helps identify the leading problems in a situation. D, a Gantt chart, compares the lengths of activities against a calendar in a bar chart format. For more information, see the PMBOK, Section 11.4.

CHAPTER 12

Introducing Project Procurement Management

In this chapter, you will
- Plan for project procurement
- Select the project vendors
- Create contracts for the project work
- Control and administer the contractual relationships
- Close out the contract with the project vendors

Projects routinely require procurements. Projects need materials, equipment, consultants, training, books, software, hardware, and lots of other stuff in order for the project to be successful. Project procurement management is the process of purchasing the products necessary to meet the needs of the project scope.

Procurement management also involves planning, requesting seller information, choosing a source, administering the contract, and closing out the contract. Procurement management, as far as your Certified Associate in Project Management (CAPM) and Project Management Professional (PMP) exams are considered, focuses on the practices from the buyer's point of view, not the seller's. Usually. Sometimes, you may be presented as the vendor that is completing a project for your customer, the buyer. You should also recognize that the seller can be seen as a contractor, subcontractor, vendor, or supplier. In whatever condition you're put into on your exam, always do what's "fair" for both parties and what's in the best interest of the project scope.

When buying anything from a vendor, the buyer needs a contract. A contract becomes a key input to many of the processes within the project. The contract, above anything else, specifies the rules and agreements for the project.

Here's a neat twist: When the seller is completing his or her obligations to supply a product, Project Management Institute (PMI) treats those obligations as a project. In other words, if ABC Electricians were wiring a building for your company, ABC Electricians would be the performing organization completing its own project. Your company becomes the customer of their project—and is, of course, a stakeholder in their project.

VIDEO Working with contract types.

In the scenarios described in this chapter, the seller will be outside of the performing organization. The buyer will be managing a project and procuring resources from a vendor. However, all of the details in this chapter can be applied to internal work orders, formal agreements, and contracts between organizational units within a single entity.

Planning for Procurement (PMBOK, Section 12.1)

Procurement planning is the process of identifying which part of the project should be procured from resources outside of the organization. Generally, procurement decisions are made early on in the planning processes. Procurement planning centers on four elements:

- Whether procurement is needed
- What to procure
- How much to procure
- When to procure

The project schedule is also taken into consideration when procurement decisions are made. Consider the lead time from when the purchase decision is made to when the purchase actually happens. And then consider the time from when the purchase happens to the time when the vendor actually delivers the goods or services. In light of the schedule, it's often more practical to just hire an expert to complete the work than to do the work in-house because of limited resources, the expertise of the internal resources, and the promised (or demanded) project completion date.

There are six inputs to the plan purchases and acquisitions processes—nothing new or alarming here:

- **Enterprise environmental factors** These are the conditions of the marketplace; the available products, services, and results; the availability of the things you'd like to purchase; and the terms and conditions of the purchase agreement. If your organization doesn't have a formal purchasing department, the project team has to step up and complete the project procurement activities.
- **Organizational process assets** When it comes to purchases, you likely have rules and procedures unique to your organization on how you can buy anything for your project. The internal rules in your organization police how the project manager may purchase, negotiate, agree to contractual obligations, and pay the vendor. (If you don't have these rules and policies in your organization, allow me to offer my services directly to you. Sign on the dotted line.)
- **Project scope statement** The project's scope statement serves as an input to making procurement decisions. Because the project scope statement defines the project work, and only the required work, to complete the project, it also defines the limitations of the project. Knowing the limits of what the project includes can help the project manager, the contract specialists, or other procurement professional determine what needs to be purchased and what does not.
- **Work breakdown structure (WBS)** Here's your buddy, the WBS, again. The WBS is needed during procurement decisions because it exposes all of the project deliverables and what needs to be purchased in order to create all of the promised deliverables.
- **WBS dictionary** If you're going to use the WBS, you might as well rely on the WBS dictionary, too. The WBS dictionary provides the full description of

the WBS deliverables. This can, of course, help the project manager and the project team determine exactly what needs to be procured and what does not.

- **Project management plan** The project management plan has lots of information for the project management team to consider when making purchase decisions. The subsidiary plans, scope management plan, the procurement management plan, quality management plan, and even the contract management plan can all help guide purchase decisions and requirements for vendors. Other project plan components that are likely referenced during the procurement planning process include the following:
  - **Risk register** In Chapter 11, we discussed the risk register: the centralized database of all project risks and their impact. The risk exposure, risk owners, and risk responses may all need to be considered for possible procurement decisions.
  - **Risk-related contractual agreements** Remember the risk response transference? It's where a risk is transferred to another party, usually for a fee. Transference often results in a contractual agreement between your organization and the vendor. Consider the risk of hiring an electrician to manage the electrical work within a project. The electrician owns the risk, and you'd have to pay him a fee for the services he'd provide.
  - **Activity resource requirements** Resources are people and things. A project manager may need to hire a consultant, a contractor, or a new employee to complete the project work. Resource requirements may also include tools, equipment, and materials. All of this costs—cha-ching!—money.
  - **Project schedule** The project schedule is considered for cash flow forecasting, the consideration of purchase decisions, and the timing for procurement processes.
  - **Activity cost estimates** Remember these from Chapter 7? You'll need your cost estimates to complete cost budgeting and to track your expenses for activities.
  - **Cost baseline** The cost baseline demonstrates the expected cost of the project and then the actual costs of the project. The difference between what was planned and what was expected is a variance.

Using the Procurement Planning Tools

Procurement planning should be done early in the planning processes, with certain exceptions. As needs arise, as project conditions change, or as other circumstances demand, procurement planning may be required throughout the project. Whenever procurement planning happens early in the project, as preferred, or later in the project, as needed, a logical approach to securing the proper resources is necessitated.

Determining to Make or Buy

The decision to make or buy a product is a fundamental aspect of project management. In some conditions, it is more cost-effective to buy; in others, it makes more sense to create an in-house solution. The make-or-buy analysis should be made in the initial scope definition to determine if the entire project should be completed in-house or procured. As the project evolves, additional make-or-buy decisions are often needed.

The initial costs of the solution for the in-house or procured product must be considered, but so, too, must the ongoing expenses of the solutions. For example, a company may elect to lease a piece of equipment. The ongoing expense of leasing the piece of equipment should be weighed against the expected ongoing expense of purchasing the equipment and the monthly costs to maintain, insure, and manage the equipment.

For example, Figure 12-1 shows the mathematical approach to determining whether it is better to create a software program in-house or buy one from a software company. The in-house solution will cost your company $25,000 to create your own software package and, based on historical information, another $2,500 per month to maintain it.

The development company has a solution that will cost your company $17,000 to purchase, but the development company requires a maintenance plan for each software program installed, which will cost your company $2,700 per month. The difference between making the software and buying it is $8,000. The difference between supporting the software the organization has made and allowing the external company to support their software is only $200 per month.

The $200 per month is divided into the difference between creating the software internally and buying it—which is $8,000 divided by $200, or 40 months. If the software is to be replaced within 40 months, the company should buy the software. If the software will not be replaced within 40 months, it should build the software.

There are multiple reasons why an organization may choose to make or buy. Table 12-1 provides some common reasons for making and buying.

EXAM TIP You may be presented with one or two questions on make-versus-buy analysis. In the preceding example, and on the exam, you won't be confronted with the tax benefits of make-versus-buy—although in your job as a project manager, you may be. For the exam, focus on determining which is the most cost-effective, fair solution.

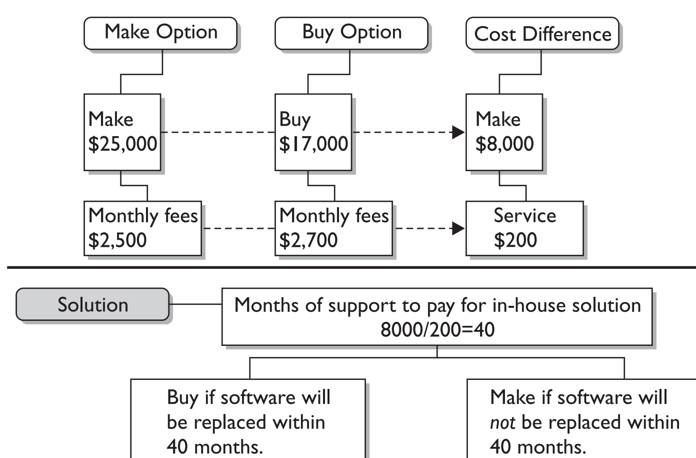


Figure 12-1 Project managers need to know the make-or-buy process.

Reasons to Make	Reasons to Buy
Less costly	Less costly
Can use in-house skills	In-house skills are not available or don't exist
Can control the work	Small volume of work
Can control intellectual property	More efficient
Learn new skills	Transfer risks
Available staff	Available vendor
Can focus on core project work	Allows project team to focus on other work items

Table 12-1 Common Reasons to Make or Buy Software

Using Expert Judgment

Procurement planning can rely on expert judgment. It may be beneficial to rely on the wisdom of others—whether those in the performing organization or subject matter experts—to determine the need for procurement. Expert judgment for procurement management planning can come from the following:

- Units or individuals within the performing organization
- Consultants and subject matter experts
- Professional, trade, or technical associations
- Industry groups

Determining the Contract Type

There are multiple types of contracts when it comes to procurement. The project work, the market, and the nature of the purchase determine the contract type. Here are some general rules that CAPM and PMP exam candidates, and project managers, should know:

- A contract is a formal agreement between the buyer and the seller. Contracts can be oral or written—although written is preferred.
- The United States backs all contracts through the court system.
- Contracts should clearly state all requirements for product acceptance.
- Any changes to the contract must be formally approved, controlled, and documented.
- A contract is not fulfilled until all of its requirements are met.
- Contracts can be used as a risk mitigation tool, as in transferring the risk. All contracts have some level of risk; depending on the contract type, the risk can be transferred to the seller. If a risk response strategy is to transfer, risks associated with procurement are considered secondary risks and must go through the risk management process.
- There are legal requirements governing contracts. In order for a contract to be valid, it must:
  - Contain an offer

- Have been accepted
- Provide for a consideration (payment)
- Be for a legal purpose
- Be executed by someone with capacity and authority

- The terms and conditions of the contract should define breaches, copyrights, intellectual rights, and *force majeure*.

EXAM TIP *Force majeure* is a powerful and unexpected event, such as a hurricane or other natural disaster.

Fixed-Price Contracts

These contracts must clearly define the requirements the vendor is to provide. These contracts may also provide incentives for meeting or exceeding contract requirements—such as meeting deadlines—and require the seller to assume the risk of cost overruns, as Figure 12-2 demonstrates.

Cost-Reimbursable Contracts

These contract types pay the seller for the product. In the payment to the seller, there is a profit margin—the difference between the actual costs of the product and the sales amount. The actual costs of the product fall into two categories:

- **Direct costs** Costs incurred by the project in order for the project to exist. Examples include equipment needed to complete the project work, salaries of the project team, and other expenses tied directly to the project's existence.
- **Indirect costs** Costs attributed to the cost of doing business. Examples include utilities, office space, and other overhead costs.

Cost-reimbursable contracts require the buyer to assume the risk of cost overruns. There are three types of cost-reimbursable contracts:

- Cost plus fixed fee

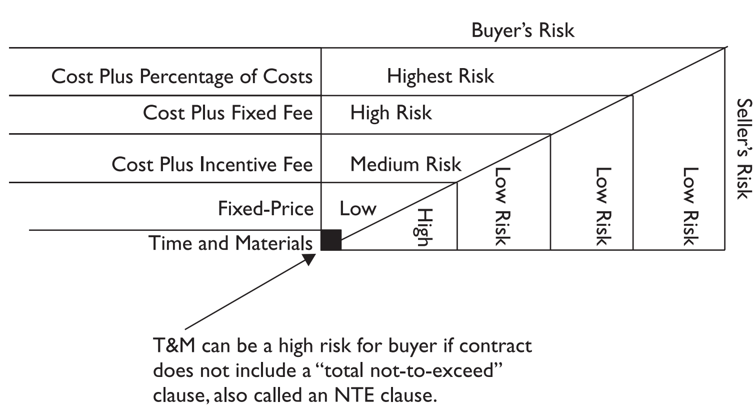


Figure 12-2 Fixed-price contracts transfer risk to the seller.

- Cost plus percentage of costs
- Cost plus incentive fee

NOTE Cost plus percentage of costs is not used often—and isn't allowed in many organizations. Don't plan on seeing this contract type on your exam.

Time and Materials Contracts

Time and materials (T&M) contracts are sometimes called unit price contracts. They are ideal for instances when an organization contracts out a small project or for instances when smaller amounts of work within a larger project are to be completed by a vendor. T&M contracts, however, can grow dangerously out of control as more work is assigned to the seller. While time and materials is an easy-to-create and administer-contract type, they can pose a threat to the buyer if a "not-to-exceed" clause is not included in the contract. A not-to-exceed clause states the maximum amount of monies the vendor can bill for the contracted work. Figure 12-3 is an example of how T&M contracts can pose a risk for the buyer.

Understanding Contract Types

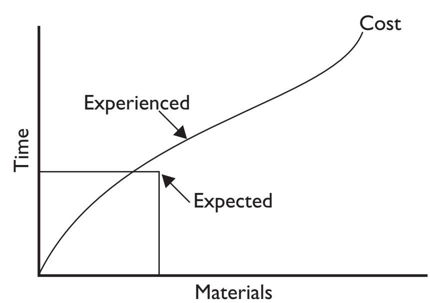
On the CAPM and PMP examinations, you can anticipate a few questions on contract types. Familiarize yourself with Table 2-2.

EXAM TIP The contractual relationship between the buyer and the seller is often considered confidential and secret. This relationship is known as privity.

Examining the Results of Procurement Planning

Procurement planning is a process that should happen early in the planning processes. The outputs of procurement planning allow the project manager and the project team to proceed with confidence in the procuring of products and services needed to successfully complete the project. If it is determined early in the project that there no need for procurements, then, obviously, the balance of the procurement processes is not necessary for the project.

Figure 12-3
Time and materials must have a not-to-exceed clause to protect the buyer.



Contract Type	Acronym	Attribute	Risk Issues
Cost Plus Fixed Fee	CPFF	Actual costs plus profit margin for seller.	Cost overruns represent risk to the buyer.
Cost Plus Percentage of Cost	CPPC	Actual costs plus profit margin for seller.	Cost overruns represent risk to the buyer. This is the most dangerous contract type for the buyer.
Cost Plus Incentive Fee	CPIF	Actual costs plus profit margin for seller.	Cost overruns represent risk to the buyer.
Fixed-Price	FP	Agreed price for contracted product. Can include incentives for the seller.	Seller assumes risk.
Lump-Sum	LS	Agreed price for contracted product. Can include incentives for the seller.	Seller assumes risk.
Firm Fixed-Price	FFP	Agreed price for contracted product.	Seller assumes risk.
Fixed-Price Incentive Fee	FPIF	Agreed price for contracted product. Can include incentives for the seller.	Seller assumes risk.
Time and Materials	T&M	Price assigned for the time and materials provided by the seller.	Contracts without "not-to-exceed" clauses can lead to cost overruns.
Unit Price	UP	Price assigned for a measurable unit of product or time. (For example, $130 for engineer's time on the project.)	Risk varies with the product. Time represents the biggest risk if the amount needed is not specified in the contract.

Table 12-2 Common Contract Types

Procurement Management Plan

This subsidiary project plan documents the decisions made in the procurement planning processes and specifies how the remaining procurement activities will be managed. The plan details the following:

- How vendors will be selected
- The type of contracts to be used
- The process of independent estimating
- The relationship between the project team and the procurement office within the performing organization (if one exists)
- The procurement forms, such as contracts, the project team is required to use
- How multiple vendors will be managed to supply their contracted product
- The coordination between sellers and the project team and among project activities, project reporting, scheduling, business operations, and other project concerns

Using the Contract Statement of Work

In the contract statement of work (often just called the SOW), the seller fully describes the work to be completed and/or the product to be supplied. The SOW becomes part of the contract between the buyer and the seller. It is typically created as part of the procurement planning process, and it allows the seller to determine if he or she can meet the written requirements of the SOW.

Particular industries have different assumptions about what constitutes an SOW. What one industry calls a SOW may be a statement of objectives (SOO) in another. An SOO is a document describing a problem to be solved by the seller.

EXAM TIP The SOW can be updated as the project moves through negotiations with the vendor or as more details about the purchase become available.

Miscellaneous Procurement Planning Business

You may have noticed that the Project Management Body of Knowledge (PMBOK) has a habit of little odds and ends that come out of the many planning processes. Procurement planning is no different. You know that one of the procurement planning tools is the make-or-buy decision process. The results of those decisions are documented, including the supporting detail of why the decision to make or buy was determined.

Another output of procurement planning is—surprise, surprise—change requests. During the procurement planning process, the vendor may offer some great ideas that cause change requests. Or the vendor's price is more than what was expected, so change requests are implemented. The point here is that through the procurement planning process, you, the project manager, may have changes that need to be entertained, and if approved, the integration management processes have to be enacted. Sounds like a fun time.

Planning for Contracting (PMBOK, Section 12.2)

Now that the project manager has made a decision on what needs to be procured, it's time to plan for the actual contracting. Plan contracting, as the PMBOK puts it, is the process of soliciting the vendors to respond to the requests to purchase goods or services. Yes, I said, "solicit." Gasp! You won't find the word solicit in the third edition of the PMBOK because that word could have a naughty meaning. Come on, we're all adults. We're just talking about buying goods and services—just not *that* service.

In order to plan for contracting, the project management team needs four things:

- **Procurement management plan** This subsidiary plan sets out the methodologies and expectations of procurement within the performing organization.
- **Contract statement of work** This document provides detailed information on what the seller will be providing for the performing organization. Recall that this document allows the seller to determine if he or she can provide the product and meet the requirements of the project team.

- **Make-or-buy decision** The make-or-buy decision tells the project manager what the conditions have to be to make or buy from a vendor.
- **Project management plan** Throughout the project management plan, there are planning outputs that affect the plan-contracting process. Consider the schedule, resource requirements, quality issues, and one of the most important topics: risk. When it comes to risk, consider the risk register and its information about each identified project risk and any transference risk response that will result in a risk-related contract.

Completing the Plan-Contracting Process

The plan-contracting process relies on the outputs of procurement planning. The procurement management plan will guide the process as the project team has planned, as the performing organization requires, or under the guidance of a procurement office within the performing organization. There are two primary tools used for plan contracting:

- **Standard forms** Within the performing organization, there may be different standardized forms for contracts, descriptions of procurement items, bid documents, and other procurement-related documents. The project manager also considers nondisclosure agreements, proposal evaluation checklists, and any standardized documents to aid in the procurement process.
- **Expert judgment** Expert judgment may be needed to review and help the project manager select the best source for the procured product.

Creating the Procurement Documents

The primary outputs of the plan-contracting process are the procurement documents. These documents guide the relationship between the buyer and the seller. Communication between the buyer and the seller should always be specific as to the requirements and expectations of the seller. In initial communications, especially when requesting a price or proposal, the buyer should include the contract statement of work, relevant specifications, and, if necessary, any nondisclosure agreements (NDAs). Requests from buyers to sellers should be specific enough to give the seller a clear idea of what the buyer is requesting, but general enough to allow the seller to provide viable alternatives.

Here are some specific documents the project manager—and the PMP and CAPM candidate—should be familiar with:

- **Invitation for bid (IFB)** From buyer to seller. Requests the seller to provide a price for the procured product or service.
- **Request for quote (RFQ)** From buyer to seller. Requests the seller to provide a price for the procured product or service.
- **Request for proposal (RFP)** From buyer to seller. Requests the seller to provide a proposal to complete the procured work or to provide the procured product.
- **Purchase order (PO)** A purchase order is a form of a unilateral contract that the buyer provides to the vendor which shows the purchase has been approved by the buyer's organization.
- **Bid** From seller to buyer. Price is the determining factor in the decision-making process.

- **Quotation** From seller to buyer. Price is the determining factor in the decision-making process.
- **Proposal** From seller to buyer. Other factors, such as skill sets, reputation, or ideas for the project solution; may be used in the decision-making process.

Creating Evaluation Criteria

Another output of the plan-contracting process is the evaluation criteria. This is used to rate and score proposals from the sellers. In some instances, such as with a bid or quote, the evaluation criteria are focused just on the price the seller offers. In other instances, such as a proposal, the evaluation criteria can be multiple values: experience, references, certifications, and more. The project management team can use any combination of the following questions to help determine which vendor should be selected to supply the project's procurement needs:

- Does the vendor understand the project needs?
- What's the overall cost of the project?
- What's the life cycle cost of the deliverable?
- Does the seller have the technical capability to complete the deliverable?
- What's the vendor's technical approach to the project's needs?
- What's the vendor's management approach to creating the deliverable?
- Does the seller have the financial backing to deliver as promised?
- Will the vendor have sustained capacity and interest in the project's deliverable for future assignments?
- What is the vendor's business model? Is it a small business, woman-owned, or disadvantaged business that may qualify for the contract as defined in some governmental agencies?
- Can the vendor provide references?
- Who retains the intellectual and proprietary property rights?

These questions—and others—can help the project management team make the best decision when it comes to choosing which vendor should support the project. For your PMP or CAPM exam, always choose the vendor that offers the best solution for the project.

Requesting Seller Responses (PMBOK, Section 12.3)

Once the plan-contracting process has been completed, the actual process of asking the sellers to participate can begin. Fortunately, the sellers, not the buyers, perform most of the activity in this process—usually at no additional cost to the project. The sellers are busy trying to win the business. There are three inputs to the request seller responses process:

- **Organizational process assets** Yes, you've seen organizational process assets throughout the project, but the specific asset you're considering is a history of qualified sellers. A list of qualified sellers (also preferred sellers or approved sellers) generally has contact information, history of past experience with the seller, and other pertinent information. In addition to the internal qualified seller list, there are other resources that can help determine which sellers may qualify for the proposed work: Internet resources, industry directories, trade associations, and so on.

- **Procurement management plan** This plan is needed because it directs the procurement processes. Go figure.
- **Procurement documents** These are created in plan-contracting processes. These are the invitations for bid (IFB), request for proposal (RFP), and request for quote (RFQ) documents.

Hosting a Bidder Conference

Buy some donuts and make the coffee—all your bidders are coming over! A bidder conference, also called a contractor conference or vendor conference, is a meeting with prospective sellers to ensure that all sellers have a clear understanding of the product or service to be procured and are all on equal footing. Bidder conferences allow sellers to query the buyer on the details of the project statement of work to help ensure that their proposals are adequate and appropriate for the proposed agreement. At this point of the process, all sellers are considered equal.

Advertising for Sellers

Have you ever opened your Sunday newspaper and checked out the classifieds? Chances are, you've seen classified ads announcing opportunities for organizations to bid on upcoming projects. That's the idea behind this tool and technique. These advertisements usually run in newspapers or trade journals specific to the industry of the organization. Some government agencies require advertisements inviting sellers to solicit the project work, attend a bidder conference, or present a proposal for the described work.

Creating a Qualified Sellers List

One of the inputs to this process is to rely on your organizational process assets' qualified sellers list. If the organization doesn't have such a list, the project management team can start creating one. The qualified sellers list can be created through trade magazines, interviews, the Internet, interviews with past customers, and even site visits. It's a bunch of fun!

Examining Vendor Responses

The procurement document package is a collection of documents prepared by the buyer and sent to each of the vendors that may participate in the procurement process. The procurement document package defines the requirements of the purchase, the specifications of the needs, and how the vendor should respond.

The end result of requesting a seller response is, as expected, a collection of proposals, bids, or quotations, depending on what the buyer asked for. These documents indicate the sellers' ability and preparedness to complete the project work. The proposals should be in alignment with the stated expectations of the buyer, and they may be presented orally, electronically, or in hard copy format. Of course, the relationship between the buyer and seller—and the type of information being shared—will determine which modality is the best choice of communication.

Selecting a Seller (PMBOK, Section 12.4)

Once the sellers have presented their proposals, bids, or quotes (depending on what the buyer requested), their documents are examined so that the project manager can select which sellers are the best choice for the project work. In many instances, price may be the predominant factor for choosing a particular seller—but not always. Other factors besides price may also be taken into consideration:

- The cost of an item may not reflect the true cost to the performing organization if the item cannot be delivered in a timely manner. If a seller promises to have a product on site by a specific date and fails to do so, the project can be delayed, costing the organization thousands—or more—in losses.
- Proposals can be separated into two categories: technical and commercial. The technical category describes the approach and methodology to complete the project work. The commercial category delves into the price to complete the project work. An evaluation takes into consideration both categories in order to determine the best choice for the project.
- Critical, high-priority projects may rely on multiple sellers to complete the project work. This redundancy can balance risk, cost, and opportunity among multiple vendors.

Choosing the Seller

For the performing organization to finalize the process of selecting a vendor, there must first be eligible sellers. Assuming there is more than one seller that can satisfy the demands of the project, there are seven tools and techniques the project manager can rely on:

- **Weighting system** A weighting system takes out the personal preferences of the decision-maker in the organization to ensure that the best seller is awarded the contract. A weighting system creates a matrix, as seen in Figure 12-4. Weights are assigned to the values of the proposals, and each proposal is scored. Because the weights are determined before reviewing the proposals, the process is guaranteed to be free of personal preferences and bias. The seller with the highest score is awarded the contract.
- **Independent estimates** These estimates are often referred to as "should cost" estimates. These estimates are created either by the performing organization or outside experts to predict what the cost of the procured product should be. If there is a significant difference between what the organization has predicted and what the sellers have proposed, either the statement of work was inadequate or the sellers have misunderstood the requirements.
- **Screening system** A screening system is a tool that filters or screens out vendors that don't qualify for the contract. For example, the project manager

Possible Score	20	20	15	10	10	5	20	100
Value	Experience	Certifications	Level IV Engineers	Security Clearance	Start Date	Waste Removal	Price	Total Score
ABC Constructions	15	20	7	10	10	5	12	79
Allen Builders	12	20	12	10	10	0	10	74
FRJ Construction	18	20	11	0	10	5	18	82
Howe & Who Construction	18	15	5	0	5	5	15	73
Martin & Martin	9	20	13	10	5	0	18	65
Ralph Engineers	15	8	8	0	10	5	17	73

Figure 12-4 A weighting system scores values to the seller's ability to deliver goods or services.

could say that only vendors that have built eight bridges in the state of Utah can qualify for the contract. Sellers that don't meet the requirements are removed from the selection process, and their proposals are not considered.

- **Contract negotiation** The performing organization creates an offer, and the seller considers the offer. The contract negotiation process is an activity to create a fair price for the work the seller is to complete. The performing organization and the seller must be in agreement on the expectations, requirements, authorities, terms, technical and business management approaches, price—and any other pertinent factors covered within and by the contract—prior to signing the contract.
- **Seller rating systems** Seller rating systems are used by organizations to rate prior experience with each vendor that it has worked with in the past. The seller rating system can track performance, quality ratings, delivery, and even contract compliance. The project manager of the current project can reference this internal seller rating system to determine the expectations of working with a vendor based on the vendor's past performance.
- **Expert judgment** Sometimes, the project manager isn't the best person to make a decision as to which vendor should be selected. Consider very large projects, like building a new skyscraper. The project manager likely wouldn't be the only person involved in making the procurement decision, but rather a team comprised of different experts would contribute to the decision.
- **Proposal evaluation techniques** This big bucket of tools and techniques can include objective and subjective considerations from experts within the organization, weighting systems, multiple reviewers, scoring systems, screening systems—just about any source selection technique that the project management team feels like using. The point is that there are many different approaches to compare and contrast proposals, so the project management team should use all of the appropriate techniques available to make the best decision for the good of the project.

Examining the Results of Seller Selection

The primary output, other than the selected seller, of the selecting seller process is a contract between the buyer and the seller. A contract is a legally binding agreement between the buyer and seller in which the seller provides the described product and the buyer pays for the product. Contracts are known by many names:

- Agreement
- Subcontract
- Purchase order
- Memorandum of understanding

EXAM TIP A letter of intent is not a contract, but a letter the buyer is intending to create a contractual relationship with the seller. A letter contract is a contract that may be used when the work is needed to start immediately. A letter contract is often considered a "stop-gap" solution in procurement.

Contracts have to be signed by a person with the power to authorize the requirements and payment specified in the contract. This role is called the delegation of procurement authority. Whether this person is the project manager depends on the procurement policies of the performing organization.

In some organizations, all contracts flow through centralized contracting. Centralized contracting requires all contracts for all projects to be approved through a central unit within the performing organization. Other organizations use a decentralized contracting approach, which assigns a contract administrator or contract officer to the project.

There are four other outputs of the seller selection process that PMP and CAPM candidates should be familiar with:

- **Contract management plan** When dealing with large, wieldy contracts, a new subsidiary plan may need to be created. This subsidiary plan, the contract management plan, defines how the contract will be administered through the duration of the project.
- **Resource availability** The demand and availability of resources related to the contracted decision should be documented. This documentation includes when resources are active in the project and when they're not needed and can be utilized elsewhere.
- **Procurement management plan updates** The contract may cause integration management to kick in. Changes to the procurement process, or changes to the procured item itself, may cause ripples in the procurement management plan, which means updates.
- **Change requests** We all know that change requests are likely to happen, and when dealing with procurement management, it's no different. Change requests are fed into the change control system, considered through integration change control, and, if approved, are then reflected in the time, cost, and scope baselines. Nothing new or surprising here.

Performing Contract Administration (PMBOK, Section 12.5)

Contract administration is the process of ensuring that both the buyer and the seller live up to the agreements in the contract. The project manager and the contract administrator must work together to make certain the seller meets its obligations, just as the vendor will ensure that the buyer lives up its agreements as well. If either party does not fulfill its contractual requirements, legal remedies may ultimately be pursued.

EXAM TIP Because of the legalities associated with the contract, contract administration is often handled as an operation of the organization rather than as part of project management.

Another aspect of contract administration, especially on larger projects with multiple sellers providing various products, is the coordination between the contractors. The project manager or contract officer schedules and confirms the performance of the sellers so that the deliverables, schedule, and performance of a contractor do not infringe or adversely affect the performance of another contractor.

Within the contract, there must be the terms for payment. Typically, the performance and progress of the contractor is directly linked to payments it receives. The project manager must track performance and quality to approve or decline payment as needed. The contract should define the metrics for acceptance to avoid disagreements on performance.

Completing Contract Administration

The actual process of completing contract administration relies heavily on communication between the project manager, the contract officer, and the seller. The communications plan may have considerations for how and when the communication between the buyer and seller should take place and what the purpose of the communication should be. There are several tools and techniques to assist the project management team with the contract administration process:

- **Contract change control system** The contract change control system defines the procedures for how the contract may be changed. The process for changing the contract includes the forms, documented communications, tracking, conditions within the project, business, or marketplace that justify the needed change, dispute resolution procedures, and the procedures for getting the changes approved within the performing organization. The system is part of integrated change control.
- **Performance reporting** Performance reporting is the communication between the project manager and management on how the seller is performing under the guidelines in the contract. This is part of communications and should be documented within the communications management plan. The buyer has to confirm that the vendor is living up to the terms of the contract.
- **Inspections and audits** If you hired an architect to build your dream home, would you wait until the house is completely built before inspecting the work? Of course not. You'd have to, and likely want to, perform periodic inspections, audits, and walk-throughs of the home as it's under construction. The same is true in project management: The buyer completes inspections and audits to confirm that the seller is abiding by the contracted requirements for the project.

- **Payment system** Sellers like to be paid when they have completed their obligations. How the sellers are paid is controlled by the payment system, which includes interaction of the project manager and the accounts payable department. The performing organization may have strict guidelines for how payment requests are submitted and approved and how payments are completed. On larger projects, the project management team may have specific procedures for submitting the payment requests.
- **Claims administration** Uh-oh! Claims are disagreements between the buyer and the seller usually centering on a change, who did the change, and even if a change has occurred. Claims are also called disputes and appeals, and are monitored and controlled through the project in accordance with the contract terms. The contract can, and usually does, determine the path to resolution, which may include arbitration or litigation to resolve the claims between the buyer and seller. No fun.
- **Records management system** Guess what this system does. Yep. It records and organizes all of the documentation of the contract, the related communications, the work results, and performance of the vendor. The records management system is part of the project management information system.
- **Information technology** Who's administering a contract manually? Information technology (IT) can help the project manager, the project management team, and the vendor efficiently abide by the terms of the contract and keep the project moving forward. For example, IT can help the project manager build the information recorded in the records management system.
- **Buyer-conducted performance reviews** The buyer has to confirm that the seller is living up to the terms of the contract. Specifically, the buyer reviews the quality of what the vendor has created, the cost of what's been created, and if the vendor is on schedule. All of these items are documented in the terms of the contract—no fudging from the vendors is allowed.

Reviewing the Results of Contract Administration

Contract administration calls for communication between the seller and buyer, the project manager and the vendor, and the stakeholders. There must be significant documentation of the agreement that both the buyer and the seller agree to before the procured work begins. Once the procured work, service, or product has been delivered from the seller to the buyer, there must be agreement that the delivery is in alignment with the original agreement. There are five outputs of the contract administration process:

- **Contract documentation** All of the contract documentation, including the contract, schedules, approved and declined contract changes, technical documentations, and any other contract-related paperwork is included as part of the contract documentation.
- **Contract change requests** Both approved and declined changes are documented as to their cost, time, and effect on the project and the procured work. Changes that are approved require updates to the project plan, subsidiary

plans, and possibly to other project documentation. Recall that integration and the contract change control system are invoked for proposed changes that affect the contracted work.

- **Recommended corrective actions** The buyer may make recommended corrective actions for the seller to bring the seller's performance into alignment with the project scope and the contracted requirements.
- **Organizational process asset updates** Consider the correspondence between the project manager and the seller, the seller's payment requests, and the seller's performance review. These documents all become part of organizational process assets for future reference.
- **Project management plan updates** The contract administration process may cause the project management plan to be updated. Specifically, the procurement management plan and the contract management plan may need to be revised.

Performing Contract Closure (PMBOK, Section 12.6)

Contract closure is analogous to administrative closure. Its purpose is to confirm that the obligations of the contract were met as expected. The project manager, the customer, key stakeholders, and, in some instances, the seller may finalize product verification together to confirm that the contract has been completed.

Contract closure can also be linked to administrative closure, because it is the process of confirming that the work was finished. In instances where the contract was terminated, contract closure is reviewed and the project is considered closed because of the termination. The project records should be updated to reflect the contract closure and the acceptance of the work or product.

Auditing the Procurement Process

The successes and failures within the procurement process of the project are reviewed from the procurement planning stage through to contract administration. The intent of the audit is to learn what worked and what didn't during the procurement processes. This knowledge can then be applied to other areas within the current project and to other projects within the performing organization.

Completing Contract Closure

Once the deliverables have been accepted and the contract has been closed, it's essential to collect all of the contract information and record it in the contract file. A contract file is a complete indexed set of records of the procurement process and is incorporated into the administrative closure process. These records include financial information as well as information on the performance and acceptance of the procured work.

Assuming the procured work is acceptable and meets the requirements of the contract, the contract can be closed. The formal closure of a project comes in a written notice from the contract officer to the seller. The notice informs the seller that the work is acceptable and that the contract is considered closed. The formal closure process may vary, according to the size of the project. The requirements for contract closure should be documented within the contract.

Chapter Summary

Projects can buy or build as much as they need to be successful. Part of the procurement process is making the decision of what needs to be procured. The WBS and the project scope can help the project management team determine what things or services need to be procured in order for the project to be completed. Once the decision of what needs to be procured is made, the project manager can, often with the help of expert judgment, query the vendors for bids, quotes, or proposals based on the details of the project manager's SOW.

Vendors may need to attend a bidder conference in order to get clarification on the SOW—plus, it helps to chat with the project manager to get a clear understanding of what the project calls for. Vendors will then provide their quotes, bids, or proposals, according to what the project manager has requested. And then they'll hope they win the gig.

Once the project manager's organization has made the decision as to what vendor will be providing the service, the contract is issued. Now both parties have to live up to the terms and conditions of the contract. Of course, if there are issues that escalate during contract administration, there can be—gulp!—claims between the buyer and seller.

The project manager and the vendor should work together for the best interest of the project. During contract closure, the buyer inspects the project work and confirms that the vendor delivered and performed according to the contract terms. And then everyone lives happily ever after.

Key Terms

Bid From seller to buyer. Price is the determining factor in the decision-making process.

Bidder conference A meeting of all the project's potential vendors to clarify the contract statement work and the details of the contracted work.

Claims These are disagreements between the buyer and the seller, usually centering on a change, who did the change, and even if a change has occurred. Claims are also called disputes and appeals, and are monitored and controlled through the project in accordance with the contract terms.

Contract A contract is a formal agreement between the buyer and the seller. Contracts can be oral or written—though written is preferred.

Contract change control system This defines the procedures for how the contract may be changed. The process for changing the contract includes the forms; documented communications; tracking; conditions within the project, business, or marketplace that justify the needed change; dispute resolution procedures; and the procedures for getting the changes approved within the performing organization.

Contract statement of work (SOW) This document requires that the seller fully describe the work to be completed and/or the product to be supplied. The SOW becomes part of the contract between the buyer and the seller.

Cost plus fixed fee contract A contract that requires the buyer to pay for the cost of the goods and services procured plus a fixed fee for the contracted work. The buyer assumes the risk of a cost overrun.

Cost plus incentive fee A contract type that requires the buyer to pay a cost for the procured work, plus an incentive fee, or a bonus, for the work if terms and conditions are met.

Cost plus percentage of costs A contract that requires the buyer to pay for the costs of the goods and services procured plus a percentage of the costs. The buyer assumes all of the risks for cost overruns.

Direct costs These are costs incurred by the project in order for the project to exist. Examples include equipment needed to complete the project work, salaries of the project team, and other expenses tied directly to the project's existence.

Fixed-price contracts Also known as firm fixed-price and lump-sum contracts, these are agreements that define a total price for the product the seller is to provide.

Force majeure An "act of God" that may have a negative impact on the project; consider fire, hurricanes, tornados, and earthquakes.

Independent estimates These estimates are often referred to as "should cost" estimates. They are created by the performing organization or outside experts to predict what the cost of the procured product should be.

Indirect costs These are costs attributed to the cost of doing business. Examples include utilities, office space, and other overhead costs.

Invitation for bid (IFB) From buyer to seller. Requests the seller to provide a price for the procured product or service.

Letter contract A letter contract allows the vendor to begin working on the project immediately. It is often used as a stop-gap solution.

Letter of intent A letter of intent is not a contract, but a letter stating that the buyer is intending to create a contractual relationship with the seller.

Make-or-buy decision A process in which the project management team determines the cost effectiveness, benefits, and feasibility of making a product or buying it from a vendor.

Privity The contractual relationship between the buyer and the seller is often considered confidential and secret.

Procurement management plan A project management subsidiary plan that documents the decisions made in the procurement planning processes.

Procurement planning A process to identify which parts of the project warrant procurement from a vendor by the buyer.

Proposal A document the seller provides to the buyer. The proposal includes more than just a fee for the proposed work; it also includes information on the vendor's skills, the vendor's reputations, and ideas on how the vendor can complete the contracted work for the buyer.

Purchase order (PO) A purchase order is a form of a unilateral contract that the buyer provides to the vendor showing that the purchase has been approved by the buyer's organization.

Quotation From seller to buyer. Price is the determining factor in the decision-making process.

Request for proposal (RFP) From buyer to seller. Requests the seller to provide a proposal to complete the procured work or to provide the procured product.

Request for quote (RFQ) From buyer to seller. Requests the seller to provide a price for the procured product or service.

Risk-related contractual agreements When the project management team decides to use transference to respond to a risk, a risk-related contractual agreement is created between the buyer and the seller.

Screening system A tool that filters or screens out vendors that don't qualify for the contract.

Seller rating systems These are used by organizations to rate prior experience with each vendor that it has worked with in the past. The seller rating system can track performance, quality ratings, delivery, and even contract compliance.

Time and materials contract A contract type in which the buyer pays for the time and materials for the procured work. This is a simple contract, usually for smaller procurement conditions. These contract types require a not-to-exceed clause, or the buyer assumes the risk for cost overruns.

Weighting system This takes out the personal preferences of the decision-maker in the organization to ensure that the best seller is awarded the contract. Weights are assigned to the values of the proposals, and each proposal is scored.

Case Study

Litke Greenhouse and Nursery: Procurement Processes

Litke Greenhouse and Nursery is Knoxville, Tennessee's agricultural supplier. They specialize in commercial and home-based plants, ranging from orchids and roses to dogwood and jasmine trees. Ros Litke, owner, sponsored a project to create a year-round garden and showcase that would serve multiple purposes:

- A greenhouse that could hold plants
- An educational facility for classes and seminars
- A marketing piece that could gain national attention
- A tourist destination for gardeners, photographers, and local residents

The project scope called for the design and installation of a large greenhouse like no other facility in the Southeast. The greenhouse simulates a lush Smoky Mountain cove with adult trees, younger saplings, indigenous plants, a water feature with rainbow trout, and a limited amount of birds. The project was dubbed "Snapshot of East Tennessee" because it reflected the ideal East Tennessee environment.

Planning for Procurement

Ros Litke, the project sponsor, named Jen Stein as the project manager and Ty Koenig as the project manager assistant. When Jen, Ty, and the project team planned this project, they identified which deliverables in the WBS they would be able to feasibly create in-house and which items needed to be procured. The internal team was qualified to complete the placement of the plants, design of the garden environment, and installation of the water feature. The deliverables in the WBS that required procurement included:

- Architectural design and construction of the greenhouse
- Fish and wildlife for the greenhouse
- Marketing process to inform the public of the final product

The project team, Jen, and Ty determined that Litke Greenhouse and Nursery would need to procure these resources because the internal talent did not have the skill sets to complete the required work. In addition, the fish and birds needed for the project would need to come from a supplier. While Litke Greenhouse and Nursery does have a full-time marketing manager, it was determined that this individual, Jeff Honeycutt, did not have the time to dedicate to the complete campaign. In addition, Jeff did not have the skill set to create the desired Web site to promote the new space. Jeff Honeycutt was, however, involved with selecting the vendor for the marketing campaign.

As there were multiple items to procure, different procurement items were created.

Procuring the Architectural Design

The vision of the finished project was discussed in detail with Ros Litke, Jen Stein, and Ty Koenig. The details of the facility were documented and mapped to a statement of work. The statement of work defined the design of the architectural plans according to the specifications of Litke Greenhouse and Nursery.

With the SOW created, Jen created a request for proposal that she submitted to five selected architectural and construction organizations.

Procuring the Wildlife

Based on the planned space of the facility, it was determined that eight birds and 144 rainbow trout would need to be procured. Jen created a request for quote for this procurement, because price was the only determining factor in the selection. The RFQ was sent to five suppliers of the birds and fish.

Procuring the Marketing

Jeff Honeycutt, the full-time marketing pro at Litke Greenhouse and Nursery, worked with Jen and Ty to define the SOW for the marketing. Because of the nature of the work to be procured, an RFP was created. Jeff wanted a marketing company to see the whole vision of the project, and then share that vision with the public.

Hosting a Bidder Conference

Jen and Ty agreed to meet with each of the proposed bidders to discuss the RFP, the project, and to answer any questions the bidders may have. The conferences were held on a preset date, as detailed in the RFP, and each bidder had the opportunity to schedule a 40-minute session with Jen and Ty. This allowed the vendor to clarify any issues and to gather as much detail as possible to create the proposal that he or she believed would be most valuable to the buyer.

A bidder conference was allowed for both the architectural and the marketing procurement processes. During the marketing bidder conferences, Jen and Ty relied on Jeff's marketing experience to help lead the conversation and to answer vendor questions.

A bidder conference was not needed for the procurement of the fish and birds. Jen and Ty did allow the bidders to call them to clarify any questions on the procured items. Only one bidder for the wildlife called with a question: "How many female rainbow trout would the project require?"

Selecting a Vendor

Jen and Ty read each of the proposals and bids supplied by the sellers. The bid for the wildlife was the easiest decision to make because it was driven solely by price. While all of the bidders that supplied a quote for the wildlife were close, Jen and Ty selected the vendor with the lowest price. All of the vendors guaranteed their fish and fowl to be healthy and disease-free.

The architectural selection process was not as clear because of the proposals involved. Ty assisted Jen in creating evaluation criteria to compare and contrast each proposal. Proposals were ranked according to the following specifications:

- Qualifications and experience of each firm
- Ability to address all issues in the provided statement of work
- Ability to fulfill the design and construction based on the determined timeline
- New ideas presented within the proposal
- Price

Based on this ranking of information, Jen selected an architectural firm to design and build the facility. Jen and Ty followed a similar approach in selecting the marketing vendor, but also involved Jeff Honeycutt to make the best decision.

Negotiating the Contract

After selecting the vendors for each of the items that needed procurement, Jen worked with the vendors to negotiate the contract. Each contract was relative to the type of work or item to be procured. For example, the architectural firm initially wanted a cost plus percentage of costs contract. This would have caused the final price for the project to fluctuate based on the costs of the materials throughout the project.

Jen negotiated with the seller to use a fixed-price and incentive fee contract for the project. This contract ensured that the vendor would receive a guaranteed fee for the project work, but also created an opportunity to gain a bonus if the contracted work was completed ahead of schedule.

The contracted work for the marketing was assigned to a time and materials contract. This contract type allowed the selected marketing firm to bill for time invested in the project's marketing creation, the Web site, and marketing literature. The contract did, however, include a not-to-exceed fee for the entire project work. Jen and the seller agreed that reports on the expense of the work would be provided every two weeks. This would allow Jen to track the marketing expenses against the deliverables the seller was creating.

Questions

1. Which of the following may be used as a risk mitigation tool?
   - A. Vendor proposal
   - B. Contract
   - C. Quotation
   - D. Project requirements
2. You are the project manager for the 89A Project. You have created a contract for your customer. The contract must have what two things?
   - A. Offer and consideration
   - B. Signatures and the stamp of a notary public
   - C. Value and worth of the procured item
   - D. Start date and acceptance of start date
3. The project scope statement can help a project manager create procurement details. Which one of the following best describes this process?
   - A. The project scope statement defines the contracted work.
   - B. The project scope statement defines the requirements for the contract work.
   - C. The project scope statement defines the contracted work, which must support the requirements of the project customer.
   - D. Both parties must have and retain their own copy of the product description.
4. Yolanda has outsourced a portion of a project to a vendor. The vendor has discovered some issues that will influence the cost and schedule of its portion of the project. How must the agreement be updated?
   - A. As a new contract signed by Yolanda and the vendor.
   - B. As directed by the contract change control system.
   - C. As a memo and SOW signed by Yolanda and the vendor.
   - D. Project management contracts have clauses that allow vendors to adjust their work according to unknowns.
5. The United States backs all contracts through which of the following?

A. Federal law
B. State law
C. Court system
D. Lawyers

6. Terry is the project manager of the MVB Project. She needs to purchase a piece of equipment for her project. The accounting department has informed Terry that she needs a unilateral form of contract. Accounting is referring to which of the following?
   A. SOW
   B. Legally binding contract
   C. Purchase order
   D. Invoice from the vendor

7. The purpose of a contract is to distribute between the buyer and seller a reasonable amount of what?
   A. Responsibility
   B. Risk
   C. Reward
   D. Accountability

8. Privity is what?
   A. Relationship between the project manager and a known vendor
   B. Relationship between the project manager and an unknown vendor
   C. Contractual, confidential information between customer and vendor
   D. Professional information regarding the sale between customer and vendor

9. Sammy is the project manager of the DSA Project. He is considering proposals and contracts presented by vendors for a portion of the project work. Of the following, which contract is least risky to the DSA Project from Sammy's perspective?
   A. Cost plus fixed fee
   B. Cost plus percentage of cost
   C. Cost plus incentive fee
   D. Fixed-price

10. In the following contract types, which one requires the seller to assume the risk of cost overruns?
   A. Cost plus fixed fee
   B. Cost plus incentive fee
   C. Lump-sum
   D. Time and materials

11. Benji is the project manager of the PLP Project. He has hired an independent contractor for a portion of the project work. The contractor is billing the project $120 per hour plus materials. This is an example of what?
    - **A.** Cost plus fixed fee
    - **B.** Time and materials
    - **C.** Unit-price
    - **D.** Lump-sum
12. Mary is the project manager of the JHG Project. She has created a contract statement of work (SOW) for a vendor. All of the following contribute to the creation of the contract statement of work, except for which one?
    - **A.** Project scope statement
    - **B.** Work breakdown structure (WBS)
    - **C.** Risk register
    - **D.** WBS dictionary
13. You are the project manager for a software development project for an accounting system that will operate over the Internet. Based on your research, you have discovered that it will cost you $25,000 to write your own code. Once the code is written, you estimate you'll spend $3,000 per month updating the software with client information, government regulations, and maintenance.

    A vendor has proposed to write the code for your company and charge a fee based on the number of clients using the program every month. The vendor will charge you $5 per month per user of the Web-based accounting system. You will have roughly 1,200 clients using the system per month. However, you'll need an in-house accountant to manage the time and billing of the system, so this will cost you an extra $1,200 per month.

    How many months will you have to use the system before it is better to write your own code than to hire the vendor?
    - **A.** 3 months
    - **B.** 4 months
    - **C.** 6 months
    - **D.** 15 months
14. Henry has sent the ABN Contracting Company a letter of intent. This means what?
    - **A.** Henry intends to sue the ABN Contracting Company.
    - **B.** Henry intends to buy from the ABN Contracting Company.
    - **C.** Henry intends to bid on a job from the ABN Contracting Company.
    - **D.** Henry intends to fire the ABN Contracting Company.

15. Martha is the project manager of the MNB Project. She wants a vendor to offer her one price to do all of the detailed work. Martha is looking for which type of document?
    A. Request for proposal
    B. Request for information
    C. Proposal
    D. Invitation for bid
16. Which one of the following is true about procurement documents?
    A. They offer no room for bidders to suggest changes.
    B. They ensure receipt of complete proposals.
    C. They inform the performing organization why the bid is being created.
    D. The project manager creates and selects the bid.
17. In what process group does the select seller process happen?
    A. Initiating
    B. Planning
    C. Executing
    D. Closing
18. You have an emergency on your project. You have hired a vendor who is to start work immediately. What contract is needed now?
    A. T&M
    B. Fixed-price
    C. Letter contract
    D. Incentive contract
19. You are the project manager for a seller and are managing another company's project. Things have gone well on the project, and the work is nearly complete. There is still a significant amount of funds in the project budget. The buyer's representative approaches you and asks that you complete some optional requirements to use up the remaining budget. You should do what?
    A. Negotiate a change in the contract to take on the additional work.
    B. Complete a contract change for the additional work.
    C. Gain the approval of the project stakeholder for the requested work.
    D. Deny the change because it was not in the original contract.
20. A tornado has wrecked your construction project. The tornado is known as what?
    A. Force majeure
    B. Risk transference
    C. Direct costs
    D. Unknown unknown

Answers

1. **B**. Contracts can be used as a risk mitigation tool. Procurement of risky activities is known as transference; the risk does not disappear, but the responsibility for the risk is transferred to the vendor. A, C, and D are all incorrect. A vendor proposal, a quotation, and project requirements do nothing to serve as a risk mitigation tool. For more information, see the PMBOK, Section 12.2.1.4.
2. **A**. Of all choices presented, A is the best choice. Contracts have an offer and a consideration. B is incorrect, as not all contracts demand signatures and notary public involvement. C is incorrect; a contract may not explicitly determine what the value and worth of the procured product or service is. D is also incorrect; a contract may specify a start date, but the acceptance of the start date is vague and not needed for all contracts. For more information, see the PMBOK, Section 12.4.3.2.
3. **C**. The project scope statement defines the details and requirements for acceptance of the project, serves as a valuable input to the process of determining what needs to be procured, and defines what the end result will be. When dealing with vendors to procure a portion of the project, the procured work must support the requirements of the project's customer. A is incorrect because the project scope statement defines the project as a whole, not just the contracted work, which may be just a portion of the project. B is incorrect; the project scope statement does not define the requirements for the contract work. D is also incorrect; the vendor likely will not have a copy of the product description. For more information, see the PMBOK, Section 12.1.1.3.
4. **B**. This is the best answer of all the choices presented. The contract change control system will determine the best route to incorporate the change. A, while feasible, is not the best answer to the question. A new contract does not update the original agreement and may cause delays, as the contract may have to be resubmitted, reapproved, and so on. C and D are not viable answers. For more information, see the PMBOK, Section 12.5.2.1.
5. **C**. All contracts in the United States are backed by the U.S. court systems. A, B, and D are not correct answers. For more information, see the PMBOK, Section 12.4.3.2.
6. **C**. A purchase order is an example of a unilateral contract. A, B, and D are all incorrect choices. An SOW is a statement of work. A legally binding contract does not fully answer the question. D, an invoice from the vendor, is not what the purchasing department is requesting. For more information, see the PMBOK, Section 12.1.2.3.
7. **B**. A fair contract shares a reasonable amount of risk between the buyer and the seller. A is incorrect; a contract may transfer the majority of the responsibility to the vendor. C is incorrect; the reward is not an appropriate answer to the question. D is also incorrect; the accountability of the services contracted to the vendor is not shared between the buyer and the seller. For more information, see the PMBOK, Section 12.1.2.3.

8. **C**. Privity is a confidential agreement between the buyer and seller. A, B, and D are incorrect choices, as these do not fully answer the question.
9. **D**. A fixed-price contract contains the least amount of risk for a project. The seller assumes all of the risk. A, B, and C are incorrect because these contract types carry the risk of cost overruns being assumed by the buyer. For more information, see the PMBOK, Section 12.1.2.3.
10. **C**. A lump-sum contract provides a fixed fee to complete the contract; the seller absorbs any cost overruns. A and B are incorrect because these contracts require the seller to carry the risk of cost overruns. D is incorrect, because a time and materials contract requires the buyer to pay for cost overruns on the materials and the time invested in the project work. For more information, see the PMBOK, Section 12.1.2.3.
11. **B**. The contractor's rate of $120 per hour plus the cost of the materials is an example of a time and materials contract. A is incorrect; a cost plus fixed fee contract charges the cost of the materials, plus a fixed fee, for the installation or work to complete the contract. C is incorrect; a unit price contract has a set price for each unit installed on the project. D is also incorrect, as a lump-sum contract does not break down the time and materials. For more information, see the PMBOK, Section 12.1.2.3.
12. **C**. The risk register is not an input to the contract statement of work. Only A, B, and D are inputs for the contract statement of work. For more information, see the PMBOK, Section 12.1.3.2.
13. **C**. The monies invested in the vendor's solution would have paid for your own code in six months. This is calculated by finding your cash outlay for the two solutions: $25,000 for your own code creation; zero cash outlay for the vendor's solution. The monthly cost to maintain your own code is $3,000. The monthly cost of the vendor's solution is $7,200. Subtract your cost of $3,000 from the vendor's cost of $7,200 and this equals $4,200. Divide this number into the cash outlay of $25,000 to create your own code, and you'll come up with 5.95 months. Of all the choices presented, C, 6 months, is the best choice. A, B, and D are all incorrect, as they do not answer the question. For more information, see the PMBOK, Section 12.1.2.1.
14. **B**. Henry intends to buy from the ABN Contracting Company. A, C, and D are all incorrect; these choices do not adequately describe the purpose of the letter of intent.
15. **D**. An invitation for bid is a request for a sealed document that lists the seller's firm price to complete the detailed work. A and B, request for proposal and request for information, are documents from the buyer to the seller requesting information on completing the work. C, a proposal, does not list the price to complete the work, but instead offers solutions to the buyer for completing the project needs. For more information, see the PMBOK, Section 12.2.2.1.
16. **B**. Procurement documents detail the requirements for the work to ensure complete proposals from sellers. A is incorrect; procurement documents allow input from the seller to suggest alternative ways to complete the project

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work. C is incorrect; informing the performing organization as to why the bid is being created is not the purpose of the procurement documents. D is not realistic. For more information, see the PMBOK, Section 12.2.3.1.

17. **C**. The select seller process happens during the execution process group. A, B, and D are all incorrect, as these process groups do not include source selection. For more information, see the PMBOK, Sections 12.4 and 3.2.3.7.
18. **C**. For immediate work, a letter contract may suffice. The intent of the letter contract is to allow the vendor to get to work immediately to solve the project problem. A, B, and D are all incorrect; these contracts may require additional time to create and approve. When time is of the essence, a letter contract is acceptable.
19. **C**. Any additional work is a change in the project scope. Changes to the project scope should be approved by the mechanisms in the contract change control system. The stakeholder needs to approve the changes to the project scope. A, B, and D are not realistic expectations of the project. This question borders on the PMP Code of Professional Conduct. Typically, when a project scope has been fulfilled, the project work is done. The difference in this situation is that the additional tasks are optional requirements for the project scope. For more information, see the PMBOK, Section 12.5.2.1.
20. **A**. Force majeure, sometimes called "an act of God," is a natural disaster that can wreck a project. B, risk transference, is incorrect, as this describes the response to the risk, not the tornado itself. C, direct cost, describes costs that cannot be shared with other organizations but that are attributed directly to your project. D, an unknown unknown, does not fully describe the tornado as choice A does, so this choice is also incorrect. For more information, see the PMBOK, Section 12.2.1.4.

CHAPTER 13

PMP Code of Professional Conduct

In this chapter, you will

- Learn the PMP Code of Conduct
- Understand how a project manager should behave
- Represent PMI as a PMP or CAPM
- Agree to live according to the PMP Code of Conduct (forever and ever)

The PMP Code of Professional Conduct is the authoritative guide on how the project management professional (PMP) should act as a professional and how the PMP should behave with customers and the public in general. The PMP exam candidate will be tested on the knowledge of the PMP Code of Professional Conduct.

The code, while only one page in length, covers a broad array of do's and don'ts for the PMP. Essentially, the PMP and certified associate in project management (CAPM) should always take the high road. There should be no room for misconceptions, errors in judgment, or actions that could be interpreted as conflicts of interest, shady, or just plain wrong.

Whenever the project manager is considering doing something that could be seen as wrong, just remember, "When in doubt, don't." The full PMP code of conduct is available through the Project Management Institute (PMI) Web site at: www.pmi.org/prod/groups/public/documents/info/pdc_pmpcodeofconduct.pdf.

The PMP and the CAPM exams cover more than just the PMP Code of Professional Conduct in regards to professional responsibility. Many of these topics have been covered in communications and human resources. The five areas of professional responsibility are:

- Ensuring integrity
- Contributing to the knowledge base
- Applying professional knowledge
- Balancing stakeholder interests
- Respecting differences

VIDEO Adhering to the Code of Conduct.

Understanding Your Responsibilities to the Profession

The project manager must adhere to a high set of principles, rules, and policies. This includes the organizational rules and policies, the certification process, and the advancement of the profession. On the PMP exam, always choose the answer that best supports the project management profession and the higher set of principles the PMP and CAPM are expected to adhere to.

Complying with Rules and Policies

Honesty is expected in all areas regarding the PMP examination process, including:

- Exam applications must be honest and reflect actual education and work experience.
- Test items, questions, answers, and scenarios are not to be shared with other PMP candidates.
- PMP renewal information must reflect an honest assessment of education and experience.
- Continuing education information must be honest and accurate; continuing education reporting must reflect actual courses completed.

The project manager should report violations of the PMP code when clear and factual evidence exists of the code being violated. Based on the scenario, the reporting may be to PMI, to the performing organization's management, or to the proper law enforcement authorities.

The PMP and CAPM must disclose to clients and customers scenarios where the project manager may be perceived as having an unfair advantage, a conflict of interest, or where he or she may profit from conditions within the project. Any appearances of impropriety must be avoided and disclosed.

Applying Honesty to the Profession

The PMP and CAPM candidates are expected, at all times, to provide honesty in experience documentation, advertisement of skills, and performance of services. The project manager must, of course, adhere to and abide by all applicable laws governing the project work. In addition, the ethical standards within the trade or industry should be adhered to.

EXAM TIP Industry standards are recommendations for how the work and practice should be followed. Regulations are requirements for how the work and practice must be followed. A project manager must know the difference.

Advancing the Profession

PMPs and CAPMs must respect and recognize the intellectual work and property of others. A project manager can't claim others' work as his own. He must give credit where credit is due. Work, research, and development sources must be documented and acknowledged by the project manager relying on others' work.

Another method of advancing the project management profession is to distribute the PMP Code of Professional Conduct to other PMP and CAPM candidates.

Understanding Your Responsibilities to the Customer and the Public

The project manager also has a responsibility to the customer of the project and the public. Projects that affect internal customers are expected to meet requirements, standards, and fulfill the business need of the performing organization. Essentially, the project manager is working for the customer.

Projects that serve a community and citizens have a responsibility that is somewhat tied to public service. The project manager is held accountable for the work completed for the public—and for the transactions, quality of work, and the ethics enforced in the project.

Enforcing Project Management Truth and Honesty

PMPs and CAPMs must represent themselves and their projects truthfully to the general public. This includes statements made in advertising, press releases, and in public forums. When project managers are involved in the creation of estimates, truth is also expected. The project manager must provide accurate estimates on time, cost, services to be provided, and realistic outcomes of the project work.

When a project is assigned to a CAPM or PMP, the project manager has the responsibility to meet the project scope as expected by the customer. PMPs and CAPMs work for the customer and must strive for customer satisfaction while fulfilling the project objectives. As part of the project implementation, the project manager keeps confidential information confidential. There is an obligation to the customer to maintain privacy, confidentiality, and nondisclosure of sensitive information.

Eliminating Inappropriate Actions

PMPs and CAPMs must avoid conflicts of interest and scenarios where conflicts of interest could seem apparent, opportunistic, or questionable to the customer or other stakeholders. In addition, the project manager must not accept any inappropriate gifts; inappropriate payments; or any other compensation for favors, project management work, or influence of a project. The exception to this rule is when the laws or customs of the country where the project is being performed call for gifts to the project manager. However, PMPs and CAPMs should be aware of what gifts are acceptable and appropriate within the country where the project is taking place. Lavish gifts outside of the norm should be refused.

Summing Up the Code

The PMP Code of Professional Conduct and the professional conduct of a project manager account for a big chunk of questions on the PMP and CAPM examination. To answer these questions correctly, always take the "ethical high road." The questions concerning ethics, conflict of interest, and personal gain are representative of the types of situations project managers can find themselves in on a regular basis. For the PMP and

CAPM exams—and in daily practice—follow the Code of Professional Conduct, and you'll do fine.

A project manager must follow the laws he or she is governed by. This means knowing the difference between optional standards and the required regulations. Next, the project manager must follow the policies of the organization he or she is employed by. This means that if the project manager's company has a policy against a certain condition—no matter how small or innocent it may seem—the policy must be followed first. Finally, the project manager must avoid conflicts of interest and appearances of impropriety.

When a project manager is completing projects in another country, the project manager must be respectful of the laws, people, culture, and values of the country the work is taking place in. Project managers must not succumb to ethnocentrism—the act of believing that their own culture is better than anyone else's. The project manager must work to understand the culture, traditions, and expectations of the people he is working with in the foreign countries while still complying with the policies of his organization.

Key Terms

Confidentiality The privacy allotted to customers and stakeholders regarding the terms, conditions, and circumstances within a project.

Conflict of interest An ethical dilemma in which a project manager could affect a project decision for personal gain rather than doing what's in the best interest of the project.

PMP Code of Professional Conduct A PMI-endorsed code that PMP and CAPM candidates are expected to abide by in their career and role as a project manager.

Questions

1. You are the project manager of the JKN Project. The project customer has requested that you inflate your cost estimates by 25 percent. He reports that his management always reduces the cost of the estimates, so this is the only method to get the monies needed to complete the project. Which of the following is the best response to this situation?

   A. Do as the customer asked to ensure that the project requirements can be met by adding the increase as a contingency reserve.

   B. Do as the customer asked to ensure that the project requirements can be met by adding the increase across each task.

   C. Do as the customer asked by creating an estimate for the customer's management and another for the actual project implementation.

   D. Complete an accurate estimate of the project. In addition, create a risk assessment on why the project budget would be inadequate.

2. You are the project manager for the BNH Project. This project takes place in a different county than where you are from. The project leader from this country presents a team of workers that are only from his family. What should you do?
   A. Reject the team leader's recommendations and assemble your own project team.
   B. Review the résumé and qualifications of the proposed project team before approving the team.
   C. Determine if the country's traditions include hiring from the immediate family before hiring from outside the family.
   D. Replace the project leader with an impartial project leader.
3. You are about to begin negotiations on a new project that is to take place in another country. Which of the following should be your guide on what business practices are allowed and discouraged?
   A. The project charter
   B. The project plan
   C. Company policies and procedures
   D. The PMP Code of Conduct
4. One of your project team members reports that he sold pieces of equipment because he needed to pay for his daughter's school tuition. He says that he has paid back the money by working overtime without reporting the hours worked so that his theft remains private. What should you do?
   A. Fire the project team member.
   B. Report the team member to his manager.
   C. Suggest that the team member report his action to human resources.
   D. Tell the team member you're disappointed in what he did and advise him not to do something like this again.
5. You are the project manager of the SUN Project. Your organization is a functional environment, and you do not get along well with the functional manager leading the project. You are in disagreement with the manager on how the project should proceed, the timings of the activities, the suggested schedule, and the expected quality of the work. The manager has requested that you get to work on several of the activities on the critical path even though you and she have not solved the issues concerning the project. What should you do?
   A. Go to senior management and voice your concerns.
   B. Complete the activities as requested.
   C. Ask to be taken off of the project.
   D. Refuse to begin activities on the project until the issues are resolved.

6. PMI has contacted you regarding an ethics violation of a PMP candidate. The question is in regards to a friend that said he worked as a project manager under your guidance. You know this is not true, but to save a friendship, you avoid talking with PMI. This is a violation of what?
   - **A.** The PMP code to cooperate on ethics violations investigations
   - **B.** The PMP code to report accurate information
   - **C.** The PMP code to report any PMP violations
   - **D.** Law concerning ethical practices
7. You are the project manager for the Log Cabin Project. One of your vendors is completing a large portion of the project. You have heard a rumor that the vendor is losing many of its workers due to labor issues. In light of this information, what should you do?
   - **A.** Stop work with the vendor until the labor issues are resolved.
   - **B.** Communicate with the vendor regarding the rumor.
   - **C.** Look to secure another vendor to replace the current one.
   - **D.** Negotiate with the labor union to secure the workers on your project.
8. You are the project manager for the PMH Project. Three vendors have submitted cost estimates for the project. One of the estimates is significantly higher than similar project work in the past. In this scenario, you should do what?
   - **A.** Ask the other vendors about the higher estimate from the third vendor.
   - **B.** Use the cost estimates from the historical information.
   - **C.** Take the high cost to the vendor to discuss the discrepancy before reviewing the issue with the other vendors.
   - **D.** Ask the vendor that supplied the high estimate for information on how the estimate was prepared.
9. You are the project manager of the LKH Project. This project must be completed within six months. The project is two months into the schedule and is starting to slip. As of now, the project is one week behind schedule. Based on your findings, you believe that you can make some corrective actions and recover the lost time over the next month to get the project back on schedule. Management, however, requires weekly status reports on cost and schedule. What should you do?
   - **A.** Report that the project is one week behind schedule, but will finish on schedule based on cited corrective actions.
   - **B.** Report that the project is on schedule and will finish on schedule.
   - **C.** Report that the project is off schedule by a few days, but will finish on schedule.
   - **D.** Report that the project is running late.
10. As a contracted project manager, you have been assigned a project with a budget of $1.5 million. The project is scheduled to last seven months, but

your most recent earned value management (EVM) report shows that the project will finish ahead of schedule by nearly six weeks. If this happens, you will lose $175,000 in billable time. What should you do?

A. Bill for the entire $1.5 million, since this was the approved budget.

B. Bill for the $1.5 million by adding additional work at the end of the project.

C. Report to the customer the project status and completion date.

D. Report to the customer the project status and completion date, and ask if they'd like to add any additional features to account for the monies not spent.

11. You are the project manager of the PMH Project. You have been contracted to design the placement of several pieces of manufacturing equipment. You have completed the project scope and are ready to pass the work over to the installer. The installer begins to schedule you to help with the installation of the manufacturing equipment. You should do what?

A. Help the installer place the equipment according to the design documents.

B. Help the installer place the equipment as the customer sees fit.

C. Refuse to help the installer, since the project scope has been completed.

D. Help the installer place the equipment, but insist that the quality control be governed by your design specifications.

12. You are the project manager of the 12BA Project. You have completed the project according to the design documents and have met the project scope. The customer agrees that the design document requirements have been met; however, the customer is not pleased with the project deliverables and is demanding additional adjustments be made to complete the project. What is the best way to continue?

A. Complete the work as the customer has requested.

B. Complete the work at 1.5 times the billable rate.

C. Do nothing. The project scope is completed.

D. Do nothing. Management from the performing organization and the customer's organization will need to determine why the project failed before adding work.

13. You are the project manager of the AAA Project. Due to the nature of the project, much of the work will require overtime between Christmas and New Year's Day. Many of the project team members, however, have requested vacation during that week. What is the best way to continue?

A. Refuse all vacation requests and require all team members to work.

B. Only allow vacation requests for those team members who are not needed during that week.

C. Divide tasks equally among the team members so that each works the same amount of time.

D. Allow team members to volunteer for the overtime work.

14. You are a project manager for your organization. Your project is to install several devices for one of your company's clients. The client has requested that you complete a few small tasks that are not in the project scope. To maintain the relationship with the client, you oblige her request and complete the work without informing your company. This is an example of what?
    A. Effective expert judgment
    B. Failure to satisfy the scope of professional services
    C. Contract change control
    D. Integrated change control
15. You are completing a project for a customer in another country. One of the customs in this country is to honor the project manager of a successful project with a gift. Your company, however, does not allow project managers to accept gifts from any entity worth more than $50. At the completion of the project, the customer presents you with a new car in a public ceremony. What should you do?
    A. Accept the car, since it is a custom of the country; to refuse it would be an insult to your hosts.
    B. Refuse to accept the car, since it would result in a conflict with your organization's policy on gifts.
    C. Accept the car and then return it, in private, to the customer.
    D. Accept the car and then donate the car to a charity in the customer's name.
16. You have a project team member who is sabotaging your project because he does not agree with it. What should you do?
    A. Fire the project team member.
    B. Present the problem to management.
    C. Present the problem to management with a solution to remove the team member from the project.
    D. Present the problem to management with a demand to fire the project team member.
17. You are the project manager of a project in Asia. You discover that the project leader has hired family members for several lucrative contracts on the project. What should you consider?
    A. Cultural issues
    B. Ethical issues
    C. Organizational issues
    D. Political issues
18. Of the following, which one achieves customer satisfaction?
    A. Completing the project requirements
    B. Maintaining the project cost

C. Maintaining the project schedule

D. Completing the project with the defined quality metrics

19. A PMP has been assigned to manage a project in a foreign country. The disorientation the PMP will likely experience as he gets acclimated to the country is known as what?

A. The Sapir-Whorf hypothesis

B. Time dimension

C. Ethnocentrism

D. Culture shock

20. You are the project manager for an information technology project. It has come to your attention that a technical problem has stopped the project work. How should you proceed?

A. Measure the project performance to date and account for the cost of the technical problem.

B. Rebaseline the project performance to account for the technical problem.

C. Work with the project team to develop alternative solutions to the technical problem.

D. Outsource the technical problem to a vendor.

Answers

1. **D**. It would be inappropriate to bloat the project costs by 25 percent. A risk assessment describing how the project may fail if the budget is not accurate is most appropriate. A, B, and C are all incorrect, since these choices are ethically wrong. The PMP should always provide honest estimates of the project work.

2. **C**. You should first confirm what the local practices and customs call for regarding hiring family members before others. A and D are incorrect, since they do not consider the qualifications of the project team leader and the project team. In addition, they do not take into account local customs. B is incorrect as well; although it does ponder the qualifications of the project team, it does not consider the local customs.

3. **C**. The company polices and procedures should guide the project manager and the decision he makes in the foreign country. A and B are incorrect, since these documents are essential but usually do not reference allowed business practices. D is incorrect; while the PMP harbors crucial information, the company's policies and procedures are most specific to the project work and requirements.

4. **B**. This situation calls for the project team member to be reported to his manager for disciplinary action. A is inappropriate because the project manager may not have the authority to fire the project team member. C

is inappropriate because the project manager must take action to bring the situation to management's attention. D is also inappropriate, since there are no formal discipline actions taken to address the problem.

5. **B**. The project manager must respect the delegation of the functional manager. A, C, and D are all inappropriate actions, since they do not complete the assigned work the functional manager has delegated to the project manager.
6. **A**. By avoiding the conversation with PMI regarding your friend's ethics violation, you are, yourself, violating the PMP code to cooperate with PMI. B, C, and D are incorrect answers, since they do not fully answer the question.
7. **B**. The project manager should confront the problem by talking with the vendor about the rumor. A is incorrect and would delay the project and possibly cause future problems. C is incorrect and may violate the contract between the buyer and seller. D is also incorrect—the agreement is between the vendor and the performing organization, not the labor union.
8. **D**. Most likely, the vendor did not understand the project work to be procured, so the estimate is skewed. A clear statement of work is needed for the vendors to provide accurate estimates. A, B, and C are all inappropriate actions, since they discuss another vendor's estimate. This information should be kept confidential between the buyer and seller. In some government projects, the winning bid may be required to be released.
9. **A**. The project manager should report an honest assessment of the project, with actions on how he plans to correct the problem. B is incorrect because it does not provide an honest answer to management. C is also incorrect because it does not provide an honest answer to management. D is incorrect because it does not provide a solution to the problem.
10. **C**. Honest and accurate assessment of the project work is always required. A and B are incorrect because these actions do not reflect an honest assessment of the work. D is incorrect because it offers gold plating and recommends additional changes that were not part of the original project scope. In addition, because this is a contracted relationship, the additional work may not be covered within the original project contract and may result in legal issues.
11. **C**. When the project scope is completed, the contract is fulfilled and the project is done. Any new work items should not be sent through. In this instance, the contract change control system or a new contract should be created. A, B, and D are incorrect because these choices are outside of the scope and have not been covered in the contract.
12. **C**. When the project scope has been completed, the project is completed. Any additional work, without a contract change or new contract, would be dishonest and would betray the customer or the project manager's company. A and B are both incorrect; additional work is not covered in the current contract. D is incorrect because the project did not fail—the deliverables met the requirements of the project scope and the design document.

13. **D** is the best choice for this scenario, because it allows the project team to be self-led and is sensitive to the needs of the project team. A, B, and C are all autocratic responses to the problem, and while the results may seem fair, D is the best choice.
14. **B**. When the project manager completes activities outside of the contract and does not inform the performing organization, it is essentially the same as stealing. The PMP must be held accountable for all the time invested in a project. A is incorrect; this is not expert judgment. C is incorrect because the contract has not been changed or attempted to be changed. D is also incorrect; the changes the project manager completed for the customer were not sent through any change control system, but were completed without documentation or reporting.
15. **B** is the best answer. Although this solution may seem extreme, to accept the car in public would give the impression that the project manager has defied company policy. In addition, accepting the car would appear to be a conflict of interest for the project manager. A, C, and D are all incorrect. Accepting the car, even with the intention of returning it or donating it to charity, would be in conflict with the company's policies regarding the acceptance of gifts.
16. **C**. The project team member that is causing the problems should be presented to management, with a solution to remove the project team member from the project. Remember, whenever the project manager must present a problem to management, he should also present a solution to the problem. A is incorrect because it likely is not the project manager's role to fire the project team member. B is incorrect because it does not address a solution for the problem. D is incorrect because the project manager's focus should be on the success of the project. By recommending that the project team member be removed from the project, the problem is solved from the project manager's point of view. Management, however, may come to the decision on their own accord to dismiss the individual from the company altogether. In addition, a recommendation from the project manager to fire someone may be outside the boundary of human resources' procedure for employee termination.
17. **A**. The project manager should first determine what the country's customs and culture call for when hiring relatives. It may be a preferred practice in the country to work with qualified relatives first before hiring other individuals to complete the project work. B, C, and D are not the best choice in this scenario. They may be followed up by first examining the cultural issues within the country.
18. **A**. The largest factor when it comes to customer satisfaction is the ability to complete the project requirements. B, C, and D are incorrect because achieving these factors, while good, is not as complete as achieving the project requirements, which may include the cost, schedule, and quality expectations.
19. **D**. Culture shock is the typical disorientation a person feels when visiting a foreign country. A is incorrect; the Sapir-Whorf hypothesis is a theory

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that believes an individual can understand a culture by understanding its language. B is incorrect; time dimension is the local culture's general practice for respecting time and punctuality. C is incorrect; ethnocentrism is a person's belief that his or her own culture is the best and that all other cultures should be measured against it.

20. **C**. When problems arise that stop project tasks, the project manager should work with the team to uncover viable alternative solutions. A and B do nothing to find a solution to the problem, so they are incorrect. D is incorrect, since the solution for the problem has not necessarily been addressed. The end result of C, to find an alternative solution, may be D, but outsourcing the problem to a vendor should not be the first choice in this scenario.

PART III

Appendixes

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APPENDIX A

Project Management Documents

Projects are full of plans, reports, and other documents. Having a clear understanding of each of the document types and why they may, or may not, be needed in a project can help you answer exam questions correctly. What follows is every document type and its Project Management Body of Knowledge (PMBOK) reference.

Activity cost estimate supporting detail This is the collection of documents that detail how the project's cost estimate was created. The supporting detail should include the following (for more information, see the PMBOK, Section 7.1.3.2):

- The scope of the work that the estimate is based on
- The basis for the estimate
- Documentation of the assumptions used in the estimate creation
- Documentation of the constraints used in the estimate creation
- The range of possible estimates, such as the +/- percentage of dollar amount

Activity duration estimate An estimate of the likely time it will take to complete the project, a phase, or individual activities within the project. For more information, see the PMBOK, Section 6.4.3.1.

Activity list The collection of schedule activities is called the activity list. For more information, see the PMBOK, Section 6.1.3.1.

Analogous estimate An estimate based on a previous similar project to predict the current project's time or cost expectations. For more information, see the PMBOK, Sections 6.4.2.2 and 7.1.2.1.

Arrow diagramming method A network diagram where the arrows represent the activities in the project and the diagram's nodes show the dependencies of the activities. This network diagramming approach only uses the finish-to-start relationship between activities. Should two activities need to happen in tandem, a "dummy activity" is added to the network diagram and is illustrated by a dashed line. For more information, see the PMBOK, Section 6.2.2.2.

Bar charts A histogram that typically depicts the project activities and their associated start and end dates. For more information, see the PMBOK, Section 6.5.3.1

Bill of materials (BOM) Defines the materials and products needed to create the items defined in the corresponding work breakdown structure (WBS). The BOM is arranged in sync with the hierarchy of the deliverables in the WBS. For more information, see the PMBOK, Section 5.3.3.2.

Business case A business case is often needed for the project charter to justify the project's existence. For more information, see the PMBOK, Section 4.1.

Cause-and-effect diagrams Also known as Ishikawa diagrams and fishbone diagrams. These illustrate how potential problems within a project may contribute to failure or errors within the project. For more information, see the PMBOK, Section 8.3.2.1.

Change requests A documented request to change the project's scope is managed through the project's integrated change control process. For more information, see the PMBOK, Section 4.4.3.2.

Claim A documented disagreement between the buyer and the seller. Claims are often settled through negotiations, mediation, or in the courts, depending on the terms of the contract. For more information, see the PMBOK, Section 12.5.2.6.

Communications management plan This subsidiary plan defines who needs what information, when the information is needed, the frequency of the communication, and the accepted modalities for the communication needs. For more information, see the PMBOK, Section 10.1.3.1.

Contract A legal relationship between the buyer and the seller that describes the work to be completed, the fee for performing the work, a schedule for completing the work, and acceptance criteria to deem the contract complete. If a project is being completed by one organization for another organization, there is typically a contractual relationship between the seller and the customer. Contracts may be inputs for the project charter. For more information, see the PMBOK, Sections 4.1.1 and 12.4.3.2.

Contract management plan A plan that is used for significant purchases. This plan directs the acquisition and adherence of both the buyer and the seller to the terms of the contract. For more information, see the PMBOK, Section 12.4.3.3.

Contract statement of work This document defines the product and services that are being procured to satisfy portions of the project scope statement. For more information, see the PMBOK, Section 12.1.3.2.

Control charts This quality-control tool illustrates the stability of a process and allows the project management team to determine if the process may have trends and predictability. For more information, see the PMBOK, Section 8.3.2.2.

Cost baseline A time-phased budget that tracks the planned project expenses against the predicted project expenses. This document is used to measure, monitor, and control project costs in conjunction with the cost management plan. For more information, see the PMBOK, Section 7.2.3.1.

Cost management plan A project management subsidiary plan that defines the structure for estimating, budgeting, and controlling project costs. For more information, see the introduction to Chapter 7 in the PMBOK and Section 7.1.3.4.

Cost plus fee or cost plus percentage of costs A contract in which the buyer pays the seller a fee for the contract work or deliverable plus an additional fee based on the percentage of the total costs for the goods or service provided. For more information, see the PMBOK, Section 12.1.2.3.

Cost plus fixed fee A contract in which the buyer pays the seller the costs of the materials and/or labor to complete the contract work or deliverable plus a predetermined fee. For more information, see the PMBOK, Section 12.1.2.3.

Cost plus incentive fee A contract in which the buyer pays the seller the costs of the materials and labor plus an incentive bonus for reaching objectives set by the buyer. Incentives are typically based on reaching schedule objectives. For more information, see the PMBOK, Section 12.1.2.3.

Decision tree A diagram that identifies and evaluates each available outcome of a decision and the decision's implication, consideration of each choice, and the value of each decision. For more information, see the PMBOK, Section 11.4.2.2.

Defect repair requests Requests to repair defects within the project deliverables. For more information, see the PMBOK, Section 4.4.

Fishbone diagrams Also known as cause-and-effect diagrams and Ishikawa diagrams. These illustrate how potential problems within a project may contribute to failure or errors within the project. For more information, see the PMBOK, Section 8.3.2.1.

Fixed-price or lump-sum contract A contract that defines the total price for the work or product the organization agrees to purchase. For more information, see the PMBOK, Section 12.1.2.3.

Flowchart A flowchart is a visual representation of a process through a system. For more information, see the PMBOK, Section 8.3.2.3.

Formal acceptance documentation A document that formally records that the project customer and/or sponsor has accepted the project deliverables. For more information, see the PMBOK, Section 4.7.3.4.

Histogram A bar chart that shows the distribution of values. For more information, see the PMBOK, Section 8.3.2.4.

Historical information Past project documentation and lessons-learned documents are often used as inputs and references for current projects. Current project documentation and lessons-learned documentation become historical information for future projects within an organization. For more information, see the PMBOK, Section 4.7.3.4.

Independent estimate Also known as a third-party estimate and should-cost estimate, this document serves as a mean for estimates provided by potential vendors to complete the work the contract calls for. An independent estimate is often created by a third party for the performing organization for a fee. For more information, see the PMBOK, Section 12.4.2.2.

Influence diagram A chart that shows the relationships between and among causal factors, events, situations, and other project conditions. For more information, see the PMBOK, Section 11.2.2.5.

Invitation for bid A document inviting a prospective vendor to bid on the contents of the contract statement of work. This is a price-based decision model. For more information, see the PMBOK, Section 12.2.3.1.

Ishikawa diagrams Also known as cause-and-effect diagrams and fishbone diagrams. These illustrate how potential problems within a project may contribute to failure or errors within the project. For more information, see the PMBOK, Section 8.3.2.1.

Issue log A document or database that records the issue, the issue owner(s), and a date by which the issued must be resolved. For more information, see the PMBOK, Section 9.4.2.4.

Lessons-learned documentation The results of quality control and other types of lessons learned are documented and become part of organizational process assets. Lessons-learned documentation is created throughout the project's life cycle. For more information, see the PMBOK, Section 8.3.3.8.

Milestone chart A chart that depicts the promised milestone completion and the actual milestone completion dates. For more information, see the PMBOK, Section 6.5.3.1.

Milestone list The documented collection of the project milestones and their attributes, deadlines, and requirements. The milestone list is part of the overall project management plan. For more information, see the PMBOK, Section 6.1.3.3.

Nondisclosure agreement A procurement document that requires the vendor to not disclose information about the contract to anyone within or without of the performing organization. For more information, see the PMBOK, Section 12.2.2.1.

Organizational breakdown structure There can be two versions of this document. First, there's the decomposition of the project's hierarchy of organizations, departments, and disciplines related to the work packages in the WBS. This document helps the project management team determine which disciplines or departments are responsible for which work packages as identified in the WBS. For more information, see the PMBOK, Section 5.3.3.2. Second, this could depict the organization's departments, teams, functional departments, and business units. For more information, see the PMBOK, Section 9.1.2.1.

Parametric estimate An estimate based on a parameter, such as a cost per metric ton or number of hours to complete a repetitive activity. For more information, see the PMBOK, Sections 6.4.2.3 and 7.1.2.4.

Pareto chart A histogram that shows the categories of failure within a project. A Pareto chart ranks the failures from largest to smallest, which then allows the project management team to attack the largest problems within the project. Pareto charts are based on Pareto's law, which states that 80 percent of the problems are related to 20 percent of the causes. For more information, see the PMBOK, Section 8.3.2.5.

Performance reports The project's communications management plan defines the expectations and frequency of the project's performance reports. Performance reports update the necessary stakeholders on the status and progress information, and may include bar charts, S-curves, histograms, and tables. These reports provide documentation about the project and project team's overall performance during the project's execution. Performance can measure work results, time, cost, scope, quality, and other specifics within the project. For more information, see the PMBOK, Sections 9.4.1.8 and 10.3.3.1.

PMBOK Guide A book published by Project Management Institute (PMI) that serves as a guide to the project management body of knowledge. It is generally accepted in the project management discipline as providing good practices for most projects, most of the time. For more information, see the PMBOK, Section 1.1.

Preliminary project scope statement This is a preliminary, high-level definition of the project scope. This early project document will be refined through progressive elaboration as the project moves deeper into the planning processes. For more information, see the PMBOK, Section 4.2.

Probability and impact matrix Demonstrates through either a cardinal or an ordinal scale the probability, impact, and risk score of each identified risk event. The process is a result of both qualitative and quantitative risk analyses. For more information, see the PMBOK, Section 11.1.3.1.

Process improvement plan This project management subsidiary plan instructs the project management team how to identify and react to any non-value-added activities and waste that may exist or creep into the project. For more information, see the PMBOK, Section 8.1.3.4.

Procurement management plan This subsidiary plan of the overall project management plan defines the processes and policies for choosing, selecting, and working with a vendor on the project. The plan defines the contracts that should be used, the standard procurement documents, and the conditions to work with (and sometimes manage) the client-vendor relationship. For more information, see the PMBOK, Section 12.1.3.1.

Product scope The features and function of the product, service, or result that a project may bring about. For more information, see the introduction to Section 5 in the PMBOK.

Product scope description This document defines the product, service, or condition that the project promises to create. As the project moves through planning, the product scope description becomes more detailed. For more information, see the PMBOK, Section 4.1.1.2.

Project calendar The time when project work is allowed to happen within the project. For more information, see the PMBOK, Section 6.5.2.8.

Project charter The document that authorizes the project or project phase. It identifies the business needs and the new product, service, or result the project will bring about in the organization. For more information, see the PMBOK, Section 3.2.1.1.

Project closure documents The documentation of the project's completion, closure, and transfer of the project deliverables to other parties within the organization or to the project customers. If the project has been cancelled, the project closure documents detail why the project has been cancelled and what has happened to the project deliverables that may have been created during the limited project execution. For more information, see the PMBOK, Section 4.7.3.4.

Project management plan This document defines all of the accepted project management processes for the current project, including how the project will be initiated, planned, executed, monitored, controlled, and closed. The project management plan is comprised of the following subsidiary plans (these plans are also defined in this appendix, but for quick reference, their PMBOK location is listed here as well). For more information, see the PMBOK, Section 4.3:

- Project scope management plan (Section 5.1.3.1)
- Schedule management plan (introduction to Section 6)
- Cost management plan (introduction to Section 7)
- Quality management plan (Section 8.1.3.1)
- Process improvement plan (Section 8.1.3.4)
- Staffing management plan (Section 9.1.3.3)
- Communication management plan (Section 10.1.3.1)
- Risk management plan (Section 11.1.3.1)
- Procurement management plan (Section 12.1.3.1)
- Milestone list (Section 6.1.3.3)
- Resource calendar (Section 6.3.3.4)
- Schedule baseline (Section 6.5.3.3)
- Cost baseline (Section 7.2.3.1)
- Quality baseline (Section 8.1.3.5)
- Risk register (Section 11.2.3.1)

Project notebook The project team may elect to keep their individual project records in a project notebook. The project notebooks then become part of the organizational process assets. For more information, see the PMBOK, Section 10.2.3.1.

Project presentations Formal communication often happens in the form of project presentations. These presentations then become part of the organizational process assets. For more information, see the PMBOK, Section 10.2.3.1.

Project records All of the project documentation and communication should be kept and managed by the project management team. These project records become part of the organizational process assets. For more information, see the PMBOK, Section 10.2.3.1.

Project reports Project reports vary by organization, but generally include information on the project's status, lessons learned, issue logs, and project closure. Project reports become part of the organizational process assets. For more information, see the PMBOK, Section 10.2.3.1.

Project schedule network diagram A visual representation of the sequence of project activities. The most common project schedule network diagram is the precedence diagramming method, which uses predecessors and successors to illustrate the flow of the project work. For more information, see the PMBOK, Section 6.2.2.1.

Project scope management plan This is a subsidiary plan of the overall project plan. It defines how the project scope will be defined, documented, verified, managed, and controlled. This plan also defines how the project's WBS will be defined, maintained, and approved. The scope verification process is also documented within the project scope management plan. Finally, this plan defines the scope change control process the project will adhere to. For more information, see the PMBOK, Section 5.1.3.1.

Project scope statement This document defines the scope of the project and the work required to deliver the project scope. For more information, see the PMBOK, Section 5.2.3.1. The project scope statement provides several pieces of project information:

- Project objectives
- Product scope description
- Project requirements
- Project boundaries
- Project deliverables
- Product acceptance criteria
- Project constraints
- Project assumptions
- Initial project organization
- Initial defined risks
- Schedule milestone
- Fund limitations

- Cost estimates
- Project configuration management requirements
- Project specifications
- Approval requirements

Project statement of work The project statement of work, often just called an SOW, defines the products or processes that the project will provide. This document is an input to the project charter. For more information, see the PMBOK, Section 4.1.1.2.

Proposal A response to a request for proposal, which often includes project approaches, ideas, and suggestions to complete the procured work, in addition to a price. For more information, see the PMBOK, Section 12.3.3.3.

Published estimating data A collection of production rates, material costs, labor trades, and industry-specific price guidelines. For more information, see the PMBOK, Section 6.3.2.3.

Qualified seller lists A list of vendors that are qualified to do business with the performing organization. For more information, see the PMBOK, Section 12.3.2.3.

Quality baseline This document defines the quality objectives for the project. Results of project performance measurement are compared against the project baseline so that improvements may be made; if the work is acceptable, the project may continue. For more information, see the PMBOK, Section 8.1.3.4.

Quality checklists A checklist, as the name implies, is a project management tool used to ensure that a series of steps have been performed as planned and required by the project management team. For more information, see the PMBOK, Section 8.1.3.3.

Quality management plan This subsidiary project management plan defines how the project management team will adhere to and implement the requirements of the performing organization's quality policy. For more information, see the PMBOK, Section 8.1.3.1.

RACI chart A responsibility-assignment matrix that documents the project roles and the responsibilities for each within the project. In a RACI chart, the activities of *responsible*, *accountable*, *consult*, and *inform* are used (hence, the acronym RACI). For more information, see the PMBOK, Section 9.1.2.1.

Request for proposal A request from the buyer to potential vendors to provide a price, approaches, and ideas on how to complete the proposed work to be procured. For more information, see the PMBOK, Section 12.2.3.1.

Request for quote A document inviting a prospective vendor to bid on the contents of the contract statement of work. This is a price-based decision model. For more information, see the PMBOK, Section 12.2.3.1.

Resource breakdown structure (RBS) A hierarchical decomposition of the resources required to complete the deliverables within the project. For more information, see the PMBOK, Section 5.3.3.2.

Resource calendar The calendar that defines when people and equipment are available for the project's use. The resource calendar identifies if a resource is idle, on vacation, or being utilized on the current or another project within the organization. For more information, see the PMBOK, Sections 6.3.3.4 and 6.4.1.7.

Responsibility assignment matrix (RAM) Illustrates the connection between the project work and the project team members who will complete the project work. For more information, see the PMBOK, Section 9.1.2.1.

Risk breakdown structure (RBS) The project's risks are depicted in a hierarchy of risk categories. For more information, see the PMBOK, Section 5.3.3.2.

Risk register A component of the project management plan that documents the outcome of all risk management activities. For more information, see the PMBOK, Section 11.2.3.1. The risk register includes:

- List of identified risks
- List of potential responses
- Root causes of risk

Risk-related contractual agreements Should the planned response to a risk event use transference, a contractual agreement is often demanded. For more information, see the PMBOK, Section 11.5.3.3.

Risk management plan This defines how the risk management activities within the project will occur. A risk management plan is a subsidiary plan of the overall project management plan. For more information, see the PMBOK, Section 11.1.3.1. The risk management plan includes:

- Methodology
- Roles and responsibilities
- Budgeting
- Timing
- Risk categories
- Definitions of risk probability and impact
- Updated risk categories

Run charts Similar to a control chart, these charts show measured trends over time. For more information, see the PMBOK, Section 8.3.2.6.

Scatter diagram A quality-control diagram that shows the relationship between two or more variables within a project. For more information, see the PMBOK, Section 8.3.2.7.

Schedule activities The work package is decomposed into the tasks needed to create the work package deliverable. The collection of schedule activities may also be called the activity list. For more information, see the PMBOK, Section 6.1.2.1.

Schedule baseline A baseline depicting the expected start and completion dates of project activities, dates for the milestones, and finish dates for the entire project or project phase. For more information, see the PMBOK, Section 6.5.3.3.

Schedule comparison bar charts A bar chart that depicts the discrepancies between the current activity status and the estimated activity status. For more information, see the PMBOK, Section 6.6.2.6.

Schedule network templates An organization that may be repeating the same type of projects may elect to use a schedule network template. These templates are prepopulated with activities and their preferred sequence. Often, schedule network templates are based on previous similar projects and are adapted for the current project. For more information, see the PMBOK, Section 6.2.2.3.

Scope baseline The project's scope baseline is comprised of the project's scope statement, the WBS, and the WBS dictionary. For more information, see the PMBOK, Section 5.3.3.4.

Staffing management plan The project management subsidiary plan that defines when and how staffing needs will be fulfilled in the project's life cycle. The plan defines, at a minimum, the process of staff acquisition, the timetable for resource utilization, release criteria, training needs, the rewards and recognition for the project, human resource compliance, and safety issues for the project team members. For more information, see the PMBOK, Section 9.1.3.3.

Strategic plan An organization's strategic plan is considered when a project is being chartered. All projects within an organization should support the organization's strategic plan. For more information, see the PMBOK, Section 4.1.1.2.

Subnetwork template When a project includes repetitive work, such as the creation of identical floors within a skyscraper, the network diagram may use a subnetwork template to illustrate the repetition in the project. For more information, see the PMBOK, Section 6.2.2.3.

Summary budget Project charters often refer to a summary budget, which may address the predetermined budget allotted for a project or a rough order of magnitude estimate based on the preliminary project scope statement. For more information, see the PMBOK, Section 4.1.

Summary milestone schedule A schedule of when the project management team can expect the milestones within the project to be reached. This schedule is part of the project charter. For more information, see the PMBOK, Section 4.1.

Text-oriented responsibility formats When roles and responsibilities need more documentation than a RACI or RAM chart can provide, a text-oriented version is used. These may also be known as position descriptions or role-responsibility-authority forms. For more information, see the PMBOK, Section 9.1.2.1.

Three-point estimate An estimate based on the average of the optimistic, most likely, and pessimistic time estimates. For more information, see the PMBOK, Section 6.4.2.4.

Time and materials contract A simple contract type in which the buyer pays the seller for the time and materials to deliver the product or service the contract calls for. This contract type should have a "not-to-exceed" clause to cap the contract's total costs. For more information, see the PMBOK, Section 12.1.2.3.

Work breakdown structure (WBS) A document that visualizes the deliverables that comprise the project scope. The WBS uses a code of accounts to number and identify the elements within the decomposition. The smallest item within the WBS is called the work package. For more information, see the PMBOK, Section 5.3.

Work breakdown structure dictionary This is a companion document to the WBS and details each item in it. Every entry in the WBS dictionary includes its related code of account identifier, responsible organization, schedule, quality requirements, technical references, and may include charge numbers, related activities, and a cost estimate. For more information, see the PMBOK, Section 5.3.3.3.

Work breakdown structure template A work breakdown structure template is a WBS from a previous similar project that has been adapted and modified to map to the current project's deliverables. For more information, see the PMBOK, Section 5.3.2.1.

Work package The smallest item in the WBS that cannot, or should not, be decomposed any farther as a project deliverable. For more information, see the PMBOK, Section 6.1.2.1.

Work performance information This is an input to quality control measurement and includes work completion information, status of project deliverables, status of corrective actions, and overall technical performance measurements. For more information, see the PMBOK, Section 8.3.1.5.

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Passing the CAPM and the PMP Exam

Obviously, you want to pass your Project Management Professional (PMP) or Certified Associate in Project Management (CAPM) exam on the first attempt. Why bother sitting for an exam if you know you're not prepared? In this appendix, you'll find the details that you must know to pass the exam. These facts won't be everything you need to know to pass the PMP or CAPM exam—but you can bet you won't pass the exam if you don't know the critical information contained in this appendix.

Tips to Pass the Exam

For starters, don't think of this process as preparing to take an exam—think of it as "preparing to pass an exam." Anyone can prepare to take an exam: just show up. Preparing to take the PMP and then CAPM exam requires project management experience, diligence, and a commitment to study.

Days Before the Exam

In the days leading up to your scheduled exam, here are some basics you should do to prepare yourself for success:

- *Get some moderate exercise*. Find time to go for a jog, lift weights, take a swim, or do whatever workout routine works best for you.
- *Eat smart and healthy*. If you eat healthy food, you'll feel good and feel better about yourself. Be certain to drink plenty of water, and don't overdo the caffeine.
- *Get your sleep*. A well-rested brain is a sharp brain. You don't want to sit for your exam feeling tired, sluggish, and worn-out.
- *Time your study sessions*. Don't overdo your study sessions—long, crash study sessions aren't that profitable. In addition, try to study at the same time every day at the time your exam is scheduled.

Create Your Own Answer Key

If you could take one page of notes into the exam, what information would you like on this one-page document? Of course, you absolutely cannot take any notes or reference materials into the exam area. However, if you can create and memorize one sheet of notes, you absolutely may re-create this once you're seated in the exam area.

Practice creating a reference sheet so that you can immediately, and legally, re-create this document once your exam has begun. You'll be supplied with several sheets of blank paper and a couple of pencils. Once your exam process begins, re-create your reference sheet. The following are key pieces of information you'd be wise to include on your reference sheet (you'll find all of this key information in this appendix):

- Activities within each process group
- Estimating formulas
- Communications formula
- Normal distribution values
- Earned value management formulas
- Project management theories

Testing Tips

The questions on the PMP and CAPM exams aren't always direct and easy, they may offer a few red herrings, and some people have reported that they found the exam like reading *War and Peace*. But there are some practical exam-passing tips. For starters, you may face questions that state, "All of the following are correct options, expect for which one?" The question wants you to find the incorrect option or the option that would not be appropriate for the scenario described. You're looking for the answer that doesn't fit with the others listed. Be sure to understand what the question is asking for. It's easy to focus on the scenario presented in a question and then see a suitable option for that scenario in the answer. However, if the question is asking you to identify an option that is not suitable, then you just missed the question. Carefully read the question to understand what is expected for an answer.

Here's a tip that can work with many of the questions: Identify what the question wants for an answer, and then look for an option that doesn't belong with the other possible answers. In other words, find the answer that doesn't fit with the other three options. Find the "odd man out." Here's an example: EVM is used during the ____________________.

A. Controlling phase

B. Executing phase

C. Closing phase

D. Entire project

Notice how options A, B, and C are exclusive? If you choose A, the controlling phase, it implies that earned value management (EVM) is not used anywhere else in the project. The odd man out here is D, the entire project; it's considered the "odd" choice because, by itself, it is not an actual process group. Of course, this tip won't work with every question—but it's handy to keep in mind.

For some answer choices, it may seem like two of the four options are both possible correct answers. However, because you may only choose one answer, you must discern which one is the best choice. Within the question, there will usually be some hint describing the progress of the project, the requirements of the stakeholders, or some other clue that can help you determine which answer is the best one for the question.

Answer Every Question—Once

The PMP exam has 200 questions, while the CAPM exam has 150 questions. You need to answer every question. Do not leave any question blank, even if you don't know the answer to the question. A blank answer is a wrong answer. As you move through the exam and you find questions that stump you, use the "mark question" option in the exam software, choose an answer you suspect may be correct, and then move on. When you have answered all of the questions, you are given the option to review your marked answers.

Some questions in the exam may prompt your memory to come up with answers to questions you have marked for review. However, resist the temptation to review those questions you've already answered with confidence and haven't marked. More often than not, your first instinct is the correct choice. When you completed the exams at the end of each chapter, did you change correct answers to wrong answers? If you did it in practice, you'll likely do it on the actual exam.

Use the Process of Elimination

When you're stumped on a question, use the process of elimination. For each question, there'll be four choices. On your scratch paper, write down "ABCD." If you can safely rule out "A," cross it out of the ABCD you've written on your paper. Now focus on which of the other answers won't work. If you determine that "C" won't work, cross it off your list. Now you've got a 50-50 chance of finding the correct choice.

If you cannot determine which answer is best, "B" or "D" in this instance, here's the best approach:

1. Choose an answer in the exam (no blank answers, remember).
2. Mark the question in the exam software for later review.
3. Circle the "ABCD" on your scratch paper, jot any relevant notes, and then record the question number next to the notes.
4. During the review, or from a later question, you may realize which choice is the better of the two answers. Return to the question and confirm that the best answer is selected.

Everything You Must Know

As promised, this section covers all of the information you must know going into the exam. It's highly recommended that you create a method to recall this information. Here goes.

The 44 Project Management Processes

Table B-1 shows the 44 project management processes. The intersection of the knowledge area and each stage (initiating, planning, executing, controlling, and closing) describes the activity that happens at that point in the project. For example, follow the project scope management row and the controlling column to find *Scope verification and change control*. The number next to each process represents the number of processes you'll find in that process group.

	Process Groups				
Knowledge Area	**Initiating (2)**	**Planning (21)**	**Executing (7)**	**Monitoring and Controlling (12)**	**Closing (2)**
Project Integration Management	Project charter creation Preliminary scope statement	Create the project management plan	Project execution	Monitor and control project work Integrated change control	Close project
Project Scope Management		Scope planning Scope definition WBS creation		Scope verification Scope control	
Project Time Management		Define activities Sequence activities Resource estimating Duration estimating Develop schedule		Schedule control	
Project Cost Management		Cost estimating Cost budgeting		Control costs	
Project Quality Management		Quality planning	Quality assurance	Quality control	
Project Human Resources Management		Human resources planning	Acquire team Develop team	Manage team	
Project Communications Management		Communication planning	Distribute information	Performance reporting Manage stakeholders	
Project Risk Management		Risk management planning Risk identification Qualitative risk analysis Quantitative risk analysis Risk response planning		Risk monitoring and control	
Project Procurement Management		Plan purchases Plan contracting	Request seller responses Select sellers	Contract administration	Contract closure

Table B-1 The 44 Project Management Processes

Earned Value Management Formulas

Figure B-1 shows the EVM formulas you should know for the exam.

Quick Project Management Facts

This section has some quick facts you should know at a glance. Hold on—this moves pretty fast.

Organizational Structures

Organizational structures are relevant to the project manager's authority. A project manager has authority from weakest to highest in the following order:

- Functional
- Weak matrix
- Balanced matrix

PART III

Earned Value Management Formulas

Formula Name	Formula	Memory Device
Variance	V=BAC-AC	Victor
Earned Value	EV=%completed * BAC	Eats
Cost Variance	CV=EV-AC	Carl's
Schedule Variance	SV=EV-PV	Sugar
Cost Performance Index	CPI=EV/AC	Corn
Schedule Performance Index	SPI=EV/PV	S (these three spell SEE)
Estimate at Completion	EAC=BAC/CPI	E
Estimate to Complete	ETC=EAC-AC	E
Variance at Completion	VAC=BAC-EAC	Victor

Time Value of Money Formulas

Future Value
How much is the present value worth in the future?
FV=Present Value(1+i)N *where:*
FV is the value to be determined
i is the interest rate and **n** is the number of time periods

Present Value
How much will a future value be worth in today's dollars?
Present Value+FV/(1+i)n *where:*
FV is the promised return on investment
i is the interest rate and **n** is the number of time periods

Net Present Value
Finds the present value for each year the project has a return:
1. Each time period's promised return is calculated into present value.
2. Sum all of the time period's present value.
3. Sutract the project's original investment from the sum.
4. An NPV greater than one is good, less than one is bad.

Sundry Formulas

Communication Channels
N(N-1)/2 *where:*
N represents the number of project stakeholders.

Float Formulas
EF=ES+du-1 *where:*
EF equals early finish, **ES** equals early start, and **du** equals the activity duration.

LS=LF-du+1 *where:*
LS equals late start, **LF** equals the late finish, and **du** equals the activity duration.

Figure B-1 PMPs and CAPMs should know these formulas for their exams.

- Strong matrix
- Projectized

WBS Facts

The work breakdown structure (WBS) is the big picture of the project deliverables. It is not the activities that will create the project, but the components that the project will create. The WBS helps the project team and the project manager create accurate cost and time estimates. It also helps the project team and the project manager create an accurate activity list. The WBS is an input to five planning processes:

- Activity definition
- Resource planning
- Cost estimating

- Cost budgeting
- Risk management planning

Project Scope Facts

Projects are temporary endeavors to create a unique product or service. Projects are selected by one of two methods:

- **Benefit measurement methods** These include scoring models, cost-benefit ratios, and economic models.
- **Constrained optimization models** These include mathematical models based on linear, integer, and dynamic programming. (You probably won't see constrained optimization on the CAPM exam.)

The project scope defines all of the required work, and only the required work, to complete the project. Scope management is the process of ensuring that the project work is within scope and protecting the project from scope creep. The scope statement is the baseline for all future project decisions, as it justifies the business need of the project. There are two types of scope:

- **Product scope** Defines the attributes of the product or service the project is creating
- **Project scope** Defines the required work of the project to create the product

Scope verification is the process completed at the end of each phase and of each project to confirm that the project has met the requirements. It leads to formal acceptance of the project deliverable.

Project Time Facts

Time can be a project constraint. Effective time management is the scheduling and sequencing of activities in the best order to ensure that the project completes successfully and in a reasonable amount of time. These are some key terms related to time management:

- **Lag** Waiting between activities.
- **Lead** Activities come closer together and even overlap.
- **Free float** The amount of time an activity can be delayed without delaying the next scheduled activity's start date.
- **Total float** The amount of time an activity can be delayed without delaying the project's finish date.
- **Float** Sometimes called *slack*—a perfectly acceptable synonym.
- **Duration** May be abbreviated as "du." For example, du=8d means the duration is eight days.

There are three types of dependencies between activities:

- **Mandatory** This hard logic requires a specific sequence between activities.
- **Discretionary** This soft logic prefers a sequence between activities.
- **External** Due to conditions outside of the project, such as those created by vendors, the sequence must happen in a given order.

There are three types of precedence between activities that you should know for the exam:

- **Finish to Start** The predecessor activity must finish before the successor activity can start.
- **Finish to Finish** The predecessor activity must finish before the successor activity can finish.
- **Start to Start** The predecessor activity must start before the successor activity can start.

Project Cost Facts

There are several methods of providing project estimates:

- **Bottom-up** Project costs start at zero, each component in the WBS is estimated for costs, and then the "grand total" is calculated. This method takes the longest to complete, but provides the most accurate estimate.
- **Analogous** Project costs are based on a similar project. This is a form of expert judgment, but it is also a top-down estimating approach, so it is less accurate than a bottom-up estimate.
- **Parametric modeling** Price is based on cost per unit; examples include cost per metric ton, cost per yard, and cost per hour.

There are four types of costs attributed to a project:

- **Variable costs** The costs are dependent on other variables. For example, the cost of a food-catered event depends on how many people register to attend the event.
- **Fixed costs** The cost remains constant throughout the project. For example, a rented piece of equipment has the same fee each month even if it is used more in some months than in others.
- **Direct costs** The cost is directly attributed to an individual project and cannot be shared with other projects (for example, airfare to attend project meetings, hotel expenses, and leased equipment that is used only on the current project).
- **Indirect costs** These are the costs of doing business; examples include rent, phone, and utilities.

Quality Management Facts

The cost of quality is the money spent investing in training, in meeting requirements for safety and other laws and regulations, and in taking steps to ensure quality acceptance. The cost of nonconformance is the cost associated with rework, downtime, lost sales, and waste of materials.

Some common quality management charts and methods include the following:

- **Ishikawa diagrams** (also called fishbone diagrams) are used to find causes and effects that contribute to a problem.
- **Flow charts** show the relationship between components and the flow of a process through a system.
- **Pareto diagrams** identify project problems and their frequencies. These are based on the 80/20 rule: 80 percent of project problems stem from 20 percent of the work.
- **Control charts** plot out the result of samplings to determine if projects are "in control" or "out of control."
- **Kaizen technologies** comprise approaches to make small improvements in an effort to reduce costs and achieve consistency.
- **Just-in-time** ordering reduces the cost of inventory but requires additional quality because materials would not be readily available if mistakes occurred.

Human Resource Facts

There are several human resource theories that the CAPM and PMP candidate should be familiar with on the exams. They include the following:

- **Maslow's Hierarchy of Needs** There are five layers of needs for all humans: physiological, safety, social needs (such as love and friendship), self-esteem, and the crowning jewel, self-actualization.
- **Herzberg's Theory of Motivation** There are two catalysts for workers: hygiene agents and motivating agents.
  - **Hygiene agents** These do nothing to motivate, but their absence demotivates workers. Hygiene agents are the expectations all workers have: job security, a paycheck, clean and safe working conditions, a sense of belonging, civil working relationships, and other basic attributes associated with employment.
  - **Motivating agents** These are the elements that motivate people to excel. They include responsibility, appreciation of work, recognition, opportunity to excel, education, and other opportunities associated with work other than just financial rewards.
- **McGregor's Theory of X and Y** This theory states that "X" people are lazy, don't want to work, and need to be micromanaged. "Y" people are self-led, motivated, and can accomplish things on their own.

- **Ouchi's Theory Z** This theory holds that workers are motivated by a sense of commitment, opportunity, and advancement. People will work if they are challenged and motivated. Think participative management.
- **Expectancy Theory** People will behave based on what they expect as a result of their behavior. In other words, people will work in relation to the expected reward.

Communication Facts

Communicating is the most important skill for the project manager. With that in mind, here are some key facts on communications:

- Communication channels formula: N(N-1)/2. N represents the number of stakeholders. For example, if you have 10 stakeholders, the formula would read 10(10-1)/2, or 45 communication channels. Pay special attention to questions wanting to know how many additional communication channels you have based on added stakeholders. For example, if you have 25 stakeholders on your project and have recently added five team members, how many additional communication channels do you now have? You'll have to calculate the original number of communication channels: 25(25–1)/2=300 and then calculate the new number with the added team members: 30(30–1)/2=435 and, finally, subtract the difference between the two: 435–300=135, which is the number of additional communication channels.
- 55 percent of communication is nonverbal.
- Effective listening is the ability to watch the speaker's body language, interpret paralingual clues, and decipher facial expressions. Following the message, effective listening has the listener asking questions to achieve clarity and offering feedback.
- Active listening requires receivers of the message to offer clues, such as nodding the head to indicate that they are listening. It also requires receivers to repeat the message, ask questions, and continue the discussion if clarification is needed.
- Communication can be hindered by trendy phrases, jargon, and extremely pessimistic comments. In addition, other communication barriers include noise, hostility, cultural differences, and technical interruptions.

Risk Management Facts

Risks are unplanned events that can have positive or negative effects on the projects. Most risks are seen as threats to the project's success—but not all risks are bad. For example, let's say there is a 20 percent probability that a project will realize a discount in shipping, which will save the project $15,000. If this risk happens, the project will save money; if the risk doesn't happen, the project will have to spend the $15,000. Risks should be identified as early as possible in the planning process. A person's willingness to accept risk is the utility function (also called the utility theory or risk tolerance level). The Delphi technique can be used to build consensus on project risks.

The only output of the risk planning process is the risk management plan. There are two broad types of risks:

- **Business risk** The loss of time and finances (where a downside and upside exist)
- **Pure risk** The loss of life, injury, and theft (where only a downside exists)

Risks can be responded to in one of seven methods:

- **Avoidance** Avoid the risk by planning a different technique to remove the risk from the project.
- **Mitigation** Reduce the probability or impact of the risk.
- **Acceptance** The risk's probability or impact may be small enough that the risk can be accepted.
- **Transference** The risk is not eliminated, but the responsibility and ownership of the risk is transferred to another party (for example, through insurance).
- **Exploit** Positive risks that are likely to happen can be exploited to take advantage of the conditions the risk may create.
- **Sharing** Positive risks can be shared with other organizations.
- **Enhancing** Positive risks that may not occur on their own can be enhanced to increase their probability of occurring.

When a project manager does risk assessment, he'll be doing analysis and then a ranking of the risks. Here are the key terms with these activities:

- **Qualitative analysis** This approach qualifies the risks for further analysis.
- **Quantitative analysis** This method assigns numeric values to probability and impact.
- **Cardinal scale** A numeric ranking.
- **Ordinal scale** A word ranking (high, medium, low).

Procurement Facts

A statement of work (SOW) is provided to the potential sellers so that they can create accurate bids, quotes, and proposals for the buyer. A bidders' conference may be held so that sellers can query the buyer on the product or service to be procured.

A contract is a formal agreement, preferably written, between a buyer and seller. In order to be valid, a contract must have:

- An offer
- Acceptance
- Consideration

- A legal purpose
- Capacity to enter into a contract

On the CAPM exam, procurement questions are usually from the buyer's point of view. All requirements the seller is to complete should be clearly written in the contract. Requirements of both parties must be met, or legal proceedings may follow. Contract types include the following:

- **Cost-reimbursable contracts** require the buyer to assume the risk of cost overruns.
- **Fixed-price contracts** require the seller to assume the risk of cost overruns.
- **Time and material contracts** are good for smaller assignments, but can impose cost overrun risks to the buyer if the contract between the buyer and seller does not include a "not to exceed clause." This clause, commonly called an NTE clause, puts a cap on the maximum amount for the contract time and materials.
- **A purchase order** is a unilateral form of contract.
- **A letter of intent** is not a contract, but shows the intent of the buyer to purchase from a specific seller.

A Letter to You

My goal for you is to pass your exam. As I teach my PMP Boot Camp for different organizations around the globe, I'm struck by one similarity among the most excited course participants: these people want to pass their exam. Sure, project management is not the most exciting topic, but the individuals are excited about passing their exam. I hope you feel the same way I believe that your odds of passing the PMP or the CAPM is like most things in life, you're only going to get out of it what you put into it. I challenge you to become excited, happy, and eager to pass the exam.

Here are 10 final tips for passing your PMP or CAPM examination:

- Prepare to pass the exam, not just take it.
- If you haven't done so already, schedule your exam. Having a deadline makes that exam even more of a reality.
- If you haven't done so already, create a clutter-free area for studying.
- Study in regular intervals right up to the day before your examination.
- Repetition is the mother of learning. If you don't know the formula, repeat and repeat. And then repeat it again.
- Create your own flash cards from the terms and glossary in this book.
- Always answer the exam questions according to Project Management Institute (PMI), not how you'd do it at your organization.

- Practice creating the one page of notes that you'll create at the start of your exam.
- Create a significant reward for yourself as an incentive to pass the exam.
- Make a commitment to pass.

If you're stumped on something I've written in this book, or if you'd like to share your PMP or CAPM success story, drop me a line: certified@projectseminars.com. Finally, I won't wish you good luck on your PMP or CAPM exam—luck is for the ill-prepared. If you follow the strategies I've outlined in this book and apply yourself, I am certain you'll pass the exam.

All my best,
Joseph Phillips, PMP, Project+
www.projectseminars.com

APPENDIX C

Understanding the Code of Ethics and Professional Conduct

In this appendix you will

- Explore the new PMI Code of Ethics and Professional Conduct
- Learn the structure of the code
- Learn about the code's stance on fairness and honesty
- Learn how to adhere to the code's mandatory standards

In 1981, back when Jordache jeans and the song "Bette Davis Eyes" were all the rage, some folks at Project Management Institute (PMI) were more concerned with ethics than parachute pants. PMI created the Ethics, Standards, and Accreditation Group to create a code of ethics for the project management profession. Sounds like a bunch fun, doesn't it? By the end of the '80s, the group's discussions and reports evolved into the Ethics Standard for the Project Management Professional. In 1998, this document became the early version of a new member Code of Ethics. This was a code that all PMI members, whether certified as a project manager or not, agreed to abide by in their professional practices. Consequently, in January 1999, the Ethics, Standards, and Accreditation Group approved a process for ethics complaints to be filed, reviewed, and then acted on if the complaint proved valid.

Since the late '90s, the global economy has changed. The business world has been rocked by the demise of billion-dollar companies going bankrupt. We've all witnessed (or participated) in the dot-com bust, and we've experienced the realization of worldwide competition for jobs. Part of all this chaos is the realization that ethics and moral standards vary among countries, companies, and cultures. The once-simple PMI Code of Conduct, most recently a one-page document with broad definitions and approaches, has become outdated.

PMI also considered the boom of their membership population. The organization has grown from just a few hundred U.S.-based members to several hundred thousands of members worldwide as of today. The goal of the Code of Conduct, from its inception, was to create a moral guideline for project managers of all industries and to encourage them to subscribe to a common belief in fairness and honesty, and to hold themselves to a higher level of expectation than project managers who were not members of PMI. At least, that was the theory. I'm sure most of us know project managers who are PMI members and certainly don't subscribe to the PMI Code of Ethics.

Because the PMI Code of Conduct was outdated, PMI created a new governing body—the Ethics Standard Review Committee—to examine the project management code of ethics in this "new" world. Part of this committee was to include a global approach to review of the now-defunct Code of Conduct, the ethical considerations of the global market, and a desire to create a more exact and verbose description of what the ethics and character of a PMI member should be.

In October 2006, the new, six-page PMI Code of Ethics and Professional Conduct was officially released. Congratulations! The organization of the document is arranged by chapters and sections. And, as is the case with most documents from PMI, you'd think a bunch of attorneys wrote the document. No offense to my pals at PMI—it's a great document, really. However, in this appendix, I'm going to break down their document in a slightly less formal, and much less official, approach. I hope you like it.

Chapter One: Vision and Applicability

The first chapter of the PMI Code of Ethics and Conduct paints the big picture of what the code is intended for. The vision of the code is, no doubt, that the project management community will adapt the code in its day-to-day operations and lives as representatives of PMI. The code is necessary, however, because project managers are often in situations in which their ethics could be jeopardized. Let's take a detailed look at this first chapter.

Exploring the Code's Vision and Purpose

PMI wants the project management community to do what's "right and honorable." I'm sure we all want those same values from ourselves and other project managers. PMI expands that vision, however, to go beyond your role as a project manager. The code calls for adherence in all areas of our lives: "at work, at home, and in service to our profession." Don't most of us live, eat, and sleep project management, anyway?

The real purpose of the code is reputation. From PMI's point of view, the code—and our agreement to adhere to it—will raise the perception of the ethical value project managers agree to, and are expected to abide by, as members and participants in PMI programs. The code is also a motivation to become a better project management practitioner. By establishing a globally accepted code for our ethics and behavior, our credibility, reputation, and collective behavior should, in theory, rise to new standards.

Participating in the Code

In the past, project management professionals (PMPs) were expected to adhere to the PMP Code of Conduct. Certified associates in project management (CAPMs) were expected to adhere to the CAPM Code of Conduct. And, members of PMI who were credentialed as PMPs or CAPMs were also held to a separate ethical standard. It made more sense, of course, to create a blanket code of ethics for all members and certified candidates. So basically, everyone who is a PMI member, a CAPM, a PMP, or the latest PMI certification: the Program Manager Professional (PgMP), will have to agree to participate in this fresh PMI Code of Ethics and Professional Conduct. This code also applies to CAPM, PMP, and PgMP candidates.

NOTE Kudos to PMI on this decision! A simple solution is usually the best one. I'm thrilled with this new code, its detailed descriptions, and application for all PMI participants.

Learning the Code Details

The code includes four values that PMI has deemed core to the ethics and standards for project managers:

- Responsibility
- Respect
- Fairness
- Honesty

These four values comprise the final four chapters of the Code of Ethics and Professional Conduct. Within each of these values, there are aspiration standards and mandatory standards. Basically, there are characteristics of these values that we, as project managers, should aspire to, and then there are other facets of these values that we *must* adhere to.

The PMP Code of Ethics also includes a few scenarios and comments from PMI about their ethical standards. You'll find a glossary of terms in the code—something our pals at PMI haven't provided before. I'll list those terms at the end of this appendix. No peeking!

Chapter Two: Responsibility as a Project Manager

The second chapter of the PMI Code of Ethics and Professional Conduct centers on responsibility. We project managers already have a level of responsibility based on the organizational structure that we operate in (from functional to projectized).

What Is Responsibility?

According to the Code of Ethics and Professional Conduct, responsibility is our duty to take ownership for the decisions we make or fail to make. It's also our duty to take ownership of our action or lack of actions. And finally, it's our duty to take ownership of the results of those decisions and actions.

NOTE This is my favorite section of the Code of Ethics and Professional Conduct. I may be on my soapbox here, but I tire of project managers who won't own their decisions or failures.

Aspiring to Responsibility Expectations

Project managers need to aspire to responsibility. The details of the responsibility aspirations for this section of the Code of Ethics and Professional Conduct include the following:

- Make good decisions that affect the best interests of society, public safety, and the environment.
- Accept only assignments that mesh with our background, experience, skills, and qualifications.
- Deliver on our promises.
- Take ownership and accountability of our errors and omissions, and make quick and accurate corrections. Should we discover errors and omissions caused by others, communicate with the appropriate people as soon as the errors are discovered.
- Protect proprietary and confidential information. No gossiping or blabbing.
- Uphold the Code of Ethics and Professional Conduct, and hold others accountable to it as well.

Remember, these are aspirations of the responsibility portion of the Code of Ethics and Professional Conduct. There are going to be tough instances, mutually exclusive decisions, and scenarios that will call these aspirations into question.

Adhering to Mandatory Standards

There are regulations, laws, contracts, and other mandatory requirements that project managers have to deal with in their projects. This section acknowledges those requirements. Let's have a look at what the Code of Ethics and Professional Conduct calls for:

- Project managers have a mandatory responsibility to adhere to regulatory requirements and laws.
- Project managers have a mandatory responsibility to report unethical or illegal conduct to management and to those affected by such conduct.
- Project managers are required to bring valid, fact-driven violations of the Code of Ethics and Professional Conduct to PMI for resolution.
- Disciplinary action should commence for project managers who seek to retaliate against a person raising ethic-violations concerns.

Project managers must adhere to these points and agree to participate in them in their roles in the project management community.

Chapter Three: Adhering to the Respect Value

Rodney Dangerfield always quipped, "I can't get any respect." And Aretha Franklin sang, "R-E-S-P-E-C-T" in the movie *The Blues Brothers*. Okay, that may have been a stretch, but how many times in a project management book are you going to see Aretha Franklin *and* Rodney Dangerfield?

My point is that both of these performers were talking about the same thing: the admiration and reverence they believed they deserved from their peers. Respect in the PMI Code of Ethics and Professional Conduct centers not only on the respect we may deserve as project managers, but also on the respect that others are due through their work and contributions to our projects. Respect in project management is also aimed at our respect for the environment we operate within.

Aspiring to Respect

There are four aspiration standards for respect:

- We learn about the norms and customs of others, and avoid behavior that others may find disrespectful.
- We listen to others and seek to understand their points of view and opinions.
- We don't avoid people who we have conflicts or disagreements with; rather, we approach them in an attempt to resolve our differences.
- We always conduct ourselves professionally, even when those we deal with do not.

According to PMI, respect among individuals and towards the environment promotes trust and confidence.

Adhering to the Mandatory Values of Respect

As project managers, we demand four things from ourselves and fellow project managers regarding respect. Here's what the Code of Ethics and Professional Conduct details:

- Our negotiations are always in good faith.
- We don't influence decisions for personal gain at the expense of others.
- We do not behave in an abusive manner toward others.
- We respect the property rights of others.

These four values are mandatory for PMI participants. Obviously, the project manager is to "take the high road" in dealings with clients and stakeholders.

Chapter Four: Adhering to the Fairness Value

Ever hear the phrase, "All's fair in love and war?" Or how about, "Life just isn't fair?" Sure you have. So what is fairness? Do we need the wisdom of King Solomon to know what's fair? Is fairness different from what's just? These are the types of questions the PMI Code of Ethics and Professional Conduct hopes for us to ask of ourselves and one another.

Fairness, according to the code, is the duty to make decisions and act impartially and objectively. Our behavior as project managers is to be void of competing self-interests, prejudice, and favoritism. Sounds wonderfully complex, doesn't it?

Aspiring to Fairness

According to the Code of Ethics and Professional Conduct, there are four things that we are to aspire to in the realm of fairness:

- Demonstrate transparency in our decision-making.
- Constantly reexamine our impartiality and objectivity, and take corrective actions when appropriate.
- Provide equal access to information to those who are authorized to have it.
- Make opportunities equally available to all qualified candidates.

These are lofty aspirations, even for project managers. The goal, no doubt, is to establish these points as characteristics that we should strive towards in our day-to-day lives.

Adhering to the Mandatory Standards on Fairness

There are five values that PMI participants must adhere to on fairness. Two of the standards apply to conflict-of-interest scenarios, while the remaining three center on favoritism and discrimination. As project managers, we are to:

- Fully disclose any real or potential conflict of interest.
- Refrain from participating in any decision where a real or potential conflict of interest exists until we've disclosed the situation, have an approved mitigation plan, and have the consent of the project stakeholders to proceed.
- Don't hire or fire, reward or punish, or award or deny contracts based on personal considerations, such as favoritism, nepotism, or bribery.
- Don't discriminate against others on things such as race, gender, age, religion, disability, nationality, or sexual orientation.
- Always apply the rules of the organization (the organization being our employer, PMI, or other performing organization), without favoritism or prejudice.

I think it's safe to say in regards to these requirements that if we follow the rules of our employers, the laws of our country, and the calling voice of our conscience, we'll be on the right track.

Chapter Five: Adhering to Honesty

Honesty is being truthful in our conversations and in our actions. This means that we, as project managers, don't over-promise, give dates that we know are bad, or sandbag our budgets and deliverables. We do what we say and we say what's truthful. Like the other values in the Code of Ethics and Professional Conduct, honesty has both aspiring and mandatory standards.

Aspiring to Honesty

According to the Code of Ethics and Professional Conduct, there are five traits of honesty that we should aspire to:

- Seek to understand the truth.
- Be truthful in communications and conduct.
- Provide accurate and timely information.
- Provide commitments and promises in good faith.
- Strive to create an environment in which others feel safe to tell the truth.

These five aspirations, I think, are noble. As project managers, we are often in a rapid-paced, get-the-work-done environment, and allot time to get the work done. These five aspirations cause us to pause and reflect on what's honest and truthful in our communications to project team members, stakeholders, and ourselves.

Adhering to the Honesty Requirements

There are just two mandatory standards for honesty in the Code of Ethics and Professional Conduct:

- Do not engage in or condone behavior that is designed to mislead others; this includes, but is not limited to:
    - Creating misleading statements
    - Creating false statements
    - Stating half-truths
    - Providing information that is out of context
    - Withholding information that, if known, would render our statements false
- Do not engage in dishonest behavior with the intention of personal gain at the expense of others.

Basically, as project managers, we don't lie. We are required, according to the code, to tell the truth, regardless of the impact it may have on us, our project team, or our projects. How many project managers do you know who are living by this requirement already?

Key Terms

Abusive manner Treating others with conduct that may result in harm, fear, humiliation, manipulation, or exploitation. For example, berating a project team member because he or she has taken longer than expected to complete a project assignment may be considered humiliation.

Conflict of interest A situation in which a project manager may have two competing duties of loyalty. For example, purchasing software from a relative may benefit the relative, but it may do harm to the performing organization.

Duty of loyalty A project manager's responsibility to be loyal to another person, organization, or vendor. For example, a project manager has a duty of loyalty to promote the best interests of an employer rather than the best interests of a vendor.

PMI member Anyone, whether certified as a project manager or not, who has joined the Project Management Institute.

Practitioner A person who is serving in the capacity of a project manager or contributing to the management of a project, portfolio of projects, or program. For example, a program manager is considered to be a project practitioner under this definition.

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About the CD-ROM

The CD-ROM that comes with *CAPM/PMP Project Management Certification All-in-One Exam Guide* includes:

- **Live video training** Flash video/audio files with "live" video training on project management, presented by Joseph Phillips. This is a portion of a complete PMP training product. (For more information on the complete product, please see the ad at the back of the book.) The Flash player must be installed on your computer to play this file. It is available from **www.adobe.com/products/flashplayer/**. See the following sections for more instructions.
- **Practice questions** Total Seminars' Total Tester Software, with more than 350 practice questions covering all CAPM and PMP domains. This testing engine features Practice and Final modes of testing.

The CD-ROM is set up with an autorun function. If your computer does not have autorun turned on, browse the CD-ROM and double-click the launcher.exe file to access the software menu page. From the software menu page, you can launch the installation wizard (to install the Total Tester) or run the video training Flash files using the links provided.

Running the Project Seminars Video Samples

Once you have started the CD menu (either through autorun or by double-clicking the file on the CD-ROM), you may click the individual links to start the Flash Video files.

The following are the minimum system requirements for the video samples:

- Windows 98, 800 MHz Pentium II, 24X CD-ROM drive, 64MB RAM, 800×600 monitor, millions of colors, QuickTime 5, Microsoft Internet Explorer 5 or Netscape Navigator 4.5, and speakers or headphones
- Macintosh OS 9.2.1, 450 MHz G3, 24X CD-ROM drive, 64MB RAM, 800×600 monitor, millions of colors, QuickTime 5, Microsoft Internet Explorer 5 or Netscape Navigator 4.5, and speakers or headphones

The following are the recommended system requirements for the video samples:

- Windows 2000, 2 GHz Pentium IV, 48X CD-ROM drive, 128MB RAM, 1024×768 monitor, millions of colors, QuickTime 6, Microsoft Internet Explorer 5.5 or Netscape Navigator 4.7, and speakers or headphones
- Macintosh OS 10.1, 800 MHz G4, 48X CD-ROM drive, 128MB RAM, 1024×768 monitor, millions of colors, QuickTime 6, Microsoft Internet Explorer 5.5 or Netscape Navigator 4.7, and speakers or headphones

Troubleshooting

This software runs inside of your Internet browser. You must have its preferences set for correct playback of Flash files. The Flashplayer installer (free download from **www.adobe.com/products/flashplayer/**) may not change all of your file helpers properly.

After installing Flash, if the video takes a very long time to load or doesn't load at all, verify that your browser associates the file type .swf with the Flash Player plug-in. To verify this, do the following:

- If using Internet Explorer for Windows, go to Tools | Internet Options | Advanced | Multimedia or Control Panels | FlashPlayer.
- If using Internet Explorer for Macintosh, go to Preferences | Receiving Files | Helpers.

Technical Support

For technical support for the video training samples from Joe Phillips, please e-mail jdp@projectseminars.com.

Installing Total Seminars' Test Software

Click the Install Test Software button on the wizard, and the installation will proceed automatically.

Once you've completed installation, you can open the test program by selecting Start | Programs | Total Seminars and then click on the CAPM or PMP test suites. You can also start the program with the shortcut the installation places on your desktop.

Navigation

The program enables you to take each of the six tests in either Practice or Final mode. An Adaptive mode exam, which uses a large pool of questions, is also included. Begin by selecting a testing mode and specific test from the menu bar.

Practice Mode

In Practice mode, the test includes an assistance window. This gives you access to several features: Hint (helps you figure out the correct answer), Reference (where in the book to learn more), Check (is your selection correct?), and Explanation (a short note explaining the correct answer). This is a good way to study and review: Answer each question, check to see if you answered correctly, review the explanation, and refer to the book for more detailed coverage. At the end of the test, you are graded by topic and can review missed questions.

Final Mode

Final mode enables you to test yourself without the ability to see the correct answers. This is a better way to see how well you understand the material. Upon completion, you receive a final grade by topic, and you can look over the questions you missed.

Minimum System Requirements for Total Seminars' Software

The minimum system requirements for Total Seminars' software include:

- Pentium 200 MHz
- 4X or faster speed CD-ROM
- 16MB of RAM
- 30MB available hard disk space
- 800×600 resolution at 256 colors
- Windows 9*x*/2000/XP operating system

Technical Support

For technical support of the Total Tester practice test application, please go to **www.totalsem.com**. For information on errata for this book, please go to **www.osborne.com** and click the "errata" link. Locate the title of the book for more information. For other technical support issues, please e-mail **customer.service@mcgraw-hill.com**. For customers outside the 50 United States, e-mail **international_cs@mcgraw-hill.com**.

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8/80 Rule A planning heuristic for creating the work breakdown structure (WBS). This rule states that the work package in a WBS must take no more than 80 hours of labor to create and no less than 8 hours of labor to create.

Acceptance A risk response appropriate for both positive and negative risks, but often used for smaller risks within a project. The acknowledgement of a risk without taking any actions towards avoidance, transference, or mitigation.

Acknowledgement The receiver signals that a message has been received; an acknowledgement shows receipt of the message, but not necessarily agreement with the message.

Active listening The receiver confirms that the message is being received through feedback, questions, prompts for clarity, and other signs of confirmation.

Activity list The primary output of decomposing the WBS's work packages.

Actual cost (AC) The actual amount of monies the project has spent to date.

Administrative closure The documentation of the closing process participants, their roles, responsibilities, and timings. The second part of administrative closure collects all of the project records, the lessons learned, and communications for the project archives.

Alternative identification A scope definition process of finding alternative solutions for the project customer while considering the customer's satisfaction, cost of the solution, and how the customer may use the product in operations.

Analogous estimating A somewhat unreliable estimating approach that relies on historical information to predict what current activity durations should be. Analogous estimating is more reliable, however, than team member recollections. Analogous estimating is also known as top-down estimating and is a form of expert judgment.

Application area The area of expertise, industry, or function where a project is centered. Examples include architecture, IT, health care, or manufacturing.

Assumption A belief that may or may not be true within a project. Weather is an example of an assumption in construction projects.

Authority power Project team members may have authority over other project team members, have the ability to make decisions, and even sign approvals for project work and purchases.

Avoidance A risk response to avoid the risk; sometimes called a workaround.

Balanced matrix structure An organization where organizational resources are pooled into one project team, but the functional managers and the project managers share the project power.

Benchmarking Comparing any two similar entities to measure their performance.

Benefit/cost ratio (BCR) model This is an example of a benefits comparison model. It examines the cost-to-benefit ratio.

Bid From seller to buyer. Price is the determining factor in the decision-making process.

Bidder conference A meeting of all of the project's potential vendors to clarify the contract statement of work and the details of the contracted work.

Bottom-up estimating The most accurate time- and cost-estimating approach a project manager can use. This estimating approach starts at "the bottom" of the project and considers every activity, its predecessor and successor activities, and the exact amount of resources needed to complete each activity.

Brainstorming The most common approach to risk identification; usually completed as a project team with subject matter experts to identify the risks within the project.

Budget estimate This estimate is also somewhat broad and is used early in the planning processes and also in top-down estimates. The range of variance for the estimate can be from −10 percent to +25 percent.

Business risks These risks may have a negative or positive outcome. Examples include using a less experienced worker to complete a task, allowing phases or activities to overlap, or foregoing the expense of formal training for on-the-job education.

Cardinal scale A ranking approach to identify the probability and impact on a numerical value from .01 (very low) to 1.0 (certain).

Cause-and-effect diagram This diagram shows the relationships between the variables within a process and how those relationships may contribute to inadequate quality. This diagram can help organize both the process and team opinions, as well as generate discussion on finding a solution to ensure quality.

Certified associate in project management (CAPM) A person who has slightly less project management experience than a PMP but has qualified for and then passed the CAPM examination.

Change control board (CCB) A committee that evaluates the worthiness of a proposed change before it is approved.

Change control system (CCS) The change control system communicates the process for controlling changes to the project deliverables. This system works with the configuration management system and seeks to control and document proposals to the project's product.

Change request A documented request to add to or remove from the project scope.

Checklist A simple approach to ensure that work is completed according to the quality policy; also considered to be a quick and cost-effective risk identification approach.

Choice of media The best modality to use when communicating that is relevant to the information that's being communicated.

Claims These are disagreements between the buyer and the seller, usually centering on a change, who did the change, and even if a change has occurred. Claims are also called disputes and appeals, and are monitored and controlled through the project in accordance with the contract terms.

Closing process group The project management process group that contains the activities to close out a project and project contracts.

Code of accounts A hierarchical numbering system for each item in the WBS. The PMBOK is a good example of a code of accounts, as each chapter and its subheadings follow a logical numbering scheme. For example, PMBOK 5.3.3.2 identifies an exact paragraph in the PMBOK.

Coercive power The project manager has the authority to discipline the project team members. This is also known as penalty power.

Collective bargaining agreement constraints Contracts and agreements with unions or other employee groups may serve as constraints for the project.

Commercial database A cost-estimating approach that uses a database, typically software-driven, to create the cost estimate for a project.

Communication assumption Anything that the project management team believes to be true but hasn't proven to be true. For example, the project management team may assume that all of the project team can be reached via cell phone, but there are parts of the world, as of this writing, that don't have a cell signal.

Communication barrier Anything that prohibits communication from occurring.

Communication channel formula N(N-1)/2, where N represents the number of identified stakeholders. This formula reveals the total number of communication channels within a project.

Communication constraints Anything that limits the project management team's options. Geographical locales, incompatible communications software, or even limited communications technology are all examples of communication constraints.

Communications management plan A project management subsidiary plan that defines the stakeholders that need specific information, the person who will supply the information, the schedule for the information to be supplied, and the approved modality to provide the information.

Competency This attribute defines what talents, skills, and capacity are needed to complete the project work.

Composite structure An organization that creates a blend of the functional, matrix, and projectized structures.

Compromising This approach requires that both parties give up something.

Confidentiality The privacy allotted to customers and stakeholders regarding the terms, conditions, and circumstances within a project.

Configuration identification This includes the labeling of the components, how changes are made to the product, and the accountability of these changes.

Configuration management system This system defines how stakeholders are allowed to submit change requests, the conditions for approving a change request, and how approved change requests are validated in the project scope. Configuration management also documents the characteristics and functions of the project's products and any changes to a product's characteristics.

Configuration status accounting The organization of the product materials, details, and prior product documentation.

Configuration verification and auditing The scope verification and auditing of completeness of project or phase deliverables to ensure that they are in alignment with the project plan.

Conflict of interest An ethical dilemma in which a project manager could affect a project decision for personal gain rather than in the best interest of the project.

Constraint A condition, rule, or procedure that restricts a project manager's options. A project deadline is an example of a constraint.

Contingency reserve This is a contingency allowance to account for overruns in costs. The contingency allowances are used at the project manager's discretion, with management's approval, to counteract cost overruns for schedule activities.

Contract A contract is a formal agreement between the buyer and the seller. Contracts can be oral or written—although written is preferred.

Contract change control system This defines the procedures for how the contract may be changed. The process for changing the contract includes the forms; documented communications; tracking; conditions within the project, business, or marketplace that justify the needed change; dispute resolution procedures; and the procedures for getting the changes approved within the performing organization.

Contract closure The formal verification of the contract's completeness by the vendor and the performing organization.

Contract statement of work (SOW) This document requires that the seller fully describe the work to be completed and/or the product to be supplied. The SOW becomes part of the contract between the buyer and the seller.

Control account A WBS entry that considers the time, cost, and scope measurements for that deliverable within the WBS. The estimated performance is compared against the actual performance to measure overall performance for the deliverables within that control account. The specifics of a control account are documented in a control account plan.

Control chart A quality control chart that maps the performance of project work overtime.

Corrective action A corrective action brings project work back into alignment with the project plan.

Cost aggregation Costs are parallel to each WBS work package. The costs of each work package are aggregated to their corresponding control accounts. Each control account is then aggregated to the sum of the project costs.

Cost baseline A time-lapse exposure of when the project's monies are to be spent in relation to cumulative values of the work completed in the project. The aggregation of the project deliverables and their associated costs. The difference between the cost estimates and the actual cost of the project identifies the cost variance.

Cost budgeting The cost aggregation achieved by assigning specific dollar amounts for each of the scheduled activities or, more likely, each of the work packages in the WBS. Cost budgeting applies the cost estimates over time.

Cost change control system A system that examines any changes associated with scope changes, the cost of materials, or the cost of any other resources and their associated impact on the overall project cost.

Cost management plan This plan details how the project costs will be planned for, estimated, budgeted, and then monitored and controlled.

Cost of poor quality The monies spent to recover from not adhering to the cost of quality. Examples may include rework, defect repair, loss of life or limb because safety precautions were not taken, loss of sales, and loss of customers.

Cost of quality The monies spent to ascertain the expected level of quality within a project. Examples include training, testing, and safety precautions.

Cost performance index Measures the project based on its financial performance. The formula is CPI = EV/AC.

Cost plus fixed fee contract A contract that requires the buyer to pay for the cost of the goods and services procured plus a fixed fee for the contracted work. The buyer assumes the risk of a cost overrun.

Cost plus incentive fee A contract type that requires the buyer to pay a cost for the procured work plus an incentive fee, or a bonus, for the work if terms and conditions are met.

Cost plus percentage of costs A contract that requires the buyer to pay for the costs of the goods and services procured plus a percentage of the costs. The buyer assumes all of the risks for cost overruns.

Cost reporting system A system to record the actual costs of the project activities.

Cost variance The difference between the earned value amount and the cumulative actual costs of the project. The formula is CV = EV-AC.

Cost-benefit analysis A process to study the tradeoffs between costs and the benefits realized from those costs.

Crashing A schedule compression approach that adds more resources to activities on the critical path to complete the project earlier. When crashing a project, costs are added as the labor expenses increase.

Critical chain method (CCM) A network analysis approach in which the deadlines associated with individual tasks are removed and the only date that matters is the promised due date of the project deliverable. CCM works to modify the project schedule based on the availability of project resources rather than on the pure sequence of events, as in the critical path method.

Critical path method The path in the project network diagram that cannot be delayed or the project completion date will be late. There can be more than one critical path. Activities in the critical path have no float.

Cultural and social environment Defines how a project affects people and how those people may affect the project. Cultural and social environments include the economic, educational, ethical, religious, demographic, and ethic composition of the people affected by the project.

Customer/user The person(s) who will use the project's deliverables.

Data precision The consideration of the risk ranking in light of the biased nature of the ranking, the accuracy of the data submitted, and the reliability of the nature submitted to examine the risk scores. The precision of the risk data is considered when weighing the risk score.

Decision tree A method to determine which of two or more decisions is the best one. The decision tree model examines the cost and benefits of each decision's outcome and weighs the probability of success for each of the decisions.

Decoder The device that decodes the message as it is being received.

Defect repair The activity to repair a defect within the project.

Definitive estimate This estimate type is one of the most accurate. It's used late in the planning processes and is associated with bottom-up estimating. You need the WBS in order to create the definitive estimate. The range of variance for the estimate can be from –5 percent to +10 percent.

Deliverable A product, service, or result created by a project. Projects can have multiple deliverables.

Delphi Technique The Delphi Technique is an anonymous method to query experts about foreseeable risks within a project, phase, or component of a project. The results of the survey are analyzed by a third party, organized, and then circulated to the experts. There can be several rounds of anonymous discussion with the Delphi Technique without fear of backlash or offending other participants in the process. The goal is to gain consensus on project risks within the project.

Design of experiments An approach that relies on statistical scenarios to determine what variables within a project will result in the best outcome.

Direct costs These are costs incurred by the project in order for the project to exist. Examples include equipment needed to complete the project work, salaries of the project team, and other expenses tied directly to the project's existence.

Discretionary dependencies These dependencies are the preferred order of activities. Project managers should use these relationships at their "discretion" and document the logic behind the decision. Discretionary dependencies allow activities to happen in a preferred order because of best practices, conditions unique to the project work, or external events.

Early finish The earliest that a project activity can finish. Used in the forward pass procedure to discover the critical path and the project float.

Early start The earliest that a project activity can begin. Used in the forward pass procedure to discover the critical path and the project float.

Earned value (EV) Earned value is the physical work completed to date and the authorized budget for that work. It is the percentage of the budget at completion (BAC) that represents the actual work completed in the project.

Effective listening The receiver is involved in the listening experience by paying attention to visual clues from the speaker and paralingual characteristics, and by asking relevant questions.

Encoder The device that encodes the message to be sent.

Enhancing A risk response that attempts to enhance the conditions to ensure that a positive risk event will likely happen.

Enterprise environmental factors Any external or internal organizational factors that can affect a project's success. Enterprise environmental factors include the culture, organizational structure, resources, commercial databases the project will use, market conditions, and your project management software.

Estimate at completion (EAC) These forecasting formulas predict the likely completed costs of the project based on current scenarios within the project.

Estimate to complete (ETC) An earned value management formula that predicts how much funding the project will require to be completed. There are three variations of this formula, all based on conditions the project may be experiencing.

Executing process group The project management process group that provides the activities to carry out the project management plan to complete the project work.

Expectancy theory The expectancy theory states that people will behave based on what they expect as a result of their behavior. In other words, people will work in relation to the expected reward of the work.

Expected monetary value (EMV) The monetary value of a risk exposure based on the risk's probability and impact in the risk matrix. This approach is typically used in quantitative risk analysis, as it quantifies the risk exposure.

Expert power The project manager's authority comes from experience with the technology the project focuses on and from expertise managing projects.

Exploit A risk response that takes advantage of the positive risks within a project.

External dependencies These are dependencies outside of the project's control. Examples include the delivery of equipment from a vendor; the deliverable of another project; or the decision of a committee, lawsuit, or expected new law.

External quality assurance (QA) Assurance provided to the external customers of the project.

External risks These risks are outside of the project but directly affect it. Legal issues, labor issues, a shift in project priorities, and weather are all examples of external risks. *Force majeure* risks call for disaster recovery rather than project management. These are risks caused by earthquakes, tornados, floods, civil unrest, and other disasters.

Fast tracking A schedule compression method that changes the relationship of activities. With fast tracking, activities that would normally be done in sequence are allowed to be done in parallel or with some overlap. Fast tracking can be accomplished by changing the relationship of activities from finish-to-start (FS) to start-to-start (SS) or by adding lead time to downstream activities. Fast tracking adds risk to the project.

Feedback The sender confirms that the receiver understands the message by directly asking for a response, questions for clarification, or other confirmation.

Finish-to-finish (FF) An activity relationship type that requires the current activity to finish before its successor can finish.

Finish-to-start (FS) An activity relationship type that requires the current activity to finish before its successor can start.

Fixed costs Costs that remain constant throughout the project (the cost of a piece of rented equipment for the project, the cost of a consultant brought on to the project, and so on).

Fixed-price contracts Also known as firm fixed-price and lump-sum contracts, these are agreements that define a total price for the product the seller is to provide.

Flowchart A diagram illustrating how components within a system are related. A flowchart shows the relationship between components and also helps the project team determine where quality issues may be present and, once done, plan accordingly.

Force majeure An "act of God" that may have a negative impact on the project; consider fire, hurricanes, tornados, and earthquakes.

Forcing power The person with the power makes the decision.

Formal power The project manager has been assigned this role by senior management and is in charge of the project.

Fragnet A representation of a project network diagram that is often used for outsourced portions of a project, repetitive work within a project, or a subproject. Also called a subnet.

Free float This is the total time a single activity can be delayed without delaying the early start of any successor activities.

Functional analysis This is the study of the functions within a system, project, or—what's more likely in the project scope statement—the product the project will be creating. Functional analysis studies the goals of the product, how the product will be used, and the expectations the customer has for the product once it leaves the project and moves into operations. Functional analysis may also consider the cost of the product in operations, which is known as life cycle costing.

Functional structure An organization is divided by function, and each employee has one clear functional manager. Each department acts independently of the other departments. A project manager in this structure has little to no power and may be called a project coordinator.

Fund limitation A predetermined budget in relation to the project scope. There may be a qualifier on this budget, such as +/- 10 percent, based on the type of cost estimate created.

Funding limit reconciliation An organization's approach to managing cash flow against the project deliverables based on a schedule, milestone accomplishment, or data constraints.

Future value (FV) A benefit comparison model that determines a future value of money. The formula is $FV = PV (1 + I)^n$, where PV is present value, I is the given interest rate, and n is the number of time periods.

General management skills These include the application of accounting, procurement, sales and marketing, contracting, manufacturing, logistics, strategic planning, human resource management, standards and regulations, and information technology.

A Guide to the Project Management Body of Knowledge (PMBOK) A Project Management Institute (PMI) publication that defines widely accepted project management practices. The Certified Associate in Project Management (CAPM) and Project Management Professional (PMP) exams are based on this book.

Hard logic Logic that describes activities that must happen in a particular order. For example, the dirt must be excavated before the foundation can be built. The foundation must be in place before the framing can begin.

Herzberg's theory of motivation Frederick Herzberg's theory of the motivating agents and hygiene agents that affect a person's willingness to excel in his or her career.

Hierarchical organizational chart A chart that shows the relationships between superior and subordinate employees, groups, disciplines, and even departments.

Independent estimates These are often referred to as "should cost" estimates. They are created by the performing organization or outside experts to predict what the cost of the procured product should be.

Indirect costs Costs that are representative of more than one project (utilities for the performing organization, access to a training room, project management software license, and so on).

Influence diagram An influence diagram charts out a decision problem. It identifies all of the elements, variables, decisions, and objectives, as well as how each factor may influence another.

Influencers Persons who can positively or negatively influence a project's ongoing activities and/or the project's likelihood of success.

Information presentation tools A software package that allows the project management team to present the project's health through graphics, spreadsheets, and text. (Think of Microsoft Project.)

Information retrieval system A system to quickly and effectively store, archive, and access project information.

Initial project organization The project scope statement identifying the project team and key stakeholders. In some organizations, especially on larger projects, the team organization and structure is also documented.

Initiation process group The project management process group that allows a project to be chartered and authorized.

Integrated change control A process to consider the impact of a proposed change on the project's knowledge areas.

Internal quality assurance (QA) Assurance provided to management and the project team.

International and political environment The consideration of local and international laws, languages, communication challenges, time zone differences, and other noncollocated issues that affect a project's ability to progress.

Interpersonal interface This organizational interface considers the formal and informal reporting relationships that may exist among project team members. It also considers the job descriptions of the project team members, existing reporting structures between supervisors and subordinates, and if any existing relationships may affect the project work. This interface also considers any cultural or language differences among the project team that may need to be addressed.

Interpersonal skills The ability to interact, lead, motivate, and manage people.

Invitation for bid (IFB) From buyer to seller. Requests the seller to provide a price for the procured product or service.

Iron Triangle of Project Management Time, cost, and scope each comprise one angle of the triangle; if any side of the Iron Triangle is not in balance with other sides, the project will likely suffer.

Ishikawa diagram This cause-and-effect diagram is also called a fishbone diagram. It is used to find the root cause of factors that are causing risks within the project.

Issue log A logbook of the issues that the project team has identified and dates as to when the issues must be resolved by. The issue log may also include team members or stakeholders that are responsible for finding a solution to the identified issue.

Kill point The review of a phase to determine if it accomplished its requirements. A kill point signals an opportunity to kill the project if the project should not continue.

Known unknown An event that will likely happen within the project, but when it will happen and to what degree is unknown. These events, such as delays, are usually risk-related.

Lag time Positive time that moves two or more activities farther apart.

Late finish The latest that a project activity can finish. Used in the backward pass procedure to discover the critical path and the project float.

Late start The latest that a project activity can begin. Used in the backward pass procedure to discover the critical path and the project float.

Lead time Negative time that brings two or more activities closer together.

Learning curve An approach that assumes the cost per unit decreases the more units workers complete because workers learn as they complete the required work.

Lessons learned When lessons-learned sessions are completed, they're available to be used and applied. They are now part of the organizational process assets.

Letter of intent This is not a contract, but rather a letter stating that the buyer is intending to create a contractual relationship with the seller.

Logistical interfaces The logistics of the team locale, time zones, geographical boundaries, and travel requirements within a project.

Low-priority risk watchlist Low-priority risks are identified and assigned to a watchlist for periodic monitoring.

Make-or-buy decision A process in which the project management team determines the cost effectiveness, benefits, and feasibility of making a product or buying it from a vendor.

Management reserve A percentage of the project duration set aside to combat Parkinson's law. If project activities are late, their lateness is subtracted from the management reserve.

Mandatory dependencies These are the natural order of activities. For example, you can't begin building your house until your foundation is in place. These relationships are called hard logic.

Maslow's hierarchy of needs Abraham Maslow's theory of the five needs all humans have and work in order to achieve.

Mathematical model A project selection method that determines the likelihood of success. These models include: linear programming, nonlinear programming, dynamic programming, integer programming, and multiobjective programming.

McGregor's theory of X and Y Douglas McGregor's theory which posits that management views workers either as competent and self-led (in the Y category) or as incompetent and needing to be micromanaged (in the X category).

Medium The device or technology that transports the message.

Milestone list This list details the project's milestones and their attributes.

Mitigation A risk response effort to reduce the probability and/or impact of an identified risk in the project.

Monitoring and controlling process group This project management process group oversees, measures, and tracks project performance.

Monte Carlo analysis A project simulation approach named after the world-famous gambling city. It predicts how scenarios may work out, given any number of variables. The process doesn't actually churn out a specific answer, but a range of possible answers. When this is applied to a schedule, for example, it can examine the optimistic completion date, the pessimistic completion date, and the most likely completion date for each activity in the project and then predict a mean for the project schedule.

Murder board This committee asks every conceivable negative question about the proposed project. Its goal is to expose the strengths and weaknesses of the project and kill the project if it's deemed unworthy for the organization to commit to. Also known as a project steering committee or project selection committee.

Negative stakeholder A stakeholder who does not want a project to succeed. This person may try to negatively influence the project and help it fail.

Net present value (NPV) Evaluates the monies returned on a project for each time period the project lasts.

Noise Anything that interferes with or disrupts the message.

Nonverbal Approximately 55 percent of communication is nonverbal. Facial expressions, hand gestures, and body language contribute to the message.

Oligopoly A market condition in which the market is so tight that the actions of one vendor affect the actions of all the others.

Opportunity costs The total amount of the opportunity that is refused to realize an opposing opportunity.

Ordinal scale A ranking approach that identifies and ranks risks from very high to very unlikely or some other ordinary value.

Organization chart A traditional organization chart depicts how the organization is broken down by department and disciplines. This chart is sometimes called the organizational breakdown structure (OBS) and is arranged by departments, units, or teams.

Organizational interfaces The project management team needs to identify which departments are going to be involved in the project.

Organizational process assets The methodology an organization uses to perform its business; the guidelines, procedures, and knowledge bases (such as the lessons-learned documentation from past projects); and any relevant historical information.

Organizational risks The performing organization can contribute to the project's risks through unreasonable cost, time, and scope expectations; poor project prioritization; inadequate funding or the disruption of funding; and competition with other projects for internal resources.

Organizational structure constraint The structure of the organization has a direct correlation to the amount of power a project manager has within a project.

Ouchi's Theory Z William Ouchi's theory is based on the participative management style of the Japanese. This theory states that workers are motivated by a sense of commitment, opportunity, and advancement.

Paralingual The pitch, tone, and inflections in the sender's voice affecting the message being sent.

Parametric estimating An approach that uses a parametric model to extrapolate what costs will be for a project (for example, cost per hour or cost per unit). It can include variables and points based on conditions.

Pareto diagram A histogram that illustrates categories of failure within a project.

Parkinson's law A theory stating that work expands so as to fill the time available for its completion. It is considered with time estimating, because bloated or padded activity estimates will fill the amount of time allotted to the activity.

Payback period An estimate that predicts how long it will take a project to pay back an organization for the project's investment of capital.

Performance report A report that depicts how well a project is performing. Often, the performance report is based on earned value management and may include cost and schedule variance reports.

Performing organization The organization whose employees or members are most directly involved in the project work.

Phase The logical division of a project based on the work or deliverable completed within that phase. Common examples include the phases within construction, software development, or manufacturing.

Phase gate The review of a phase to determine if it accomplished its requirement; this is also known as a phase exit.

Phase-end review The review of a phase to determine if it accomplished its requirements. Phase-end reviews are also called phase exits, phase gates, and kill points.

Physical environment The physical structure and surroundings that affect a project's work.

Planned value The work scheduled and the budget authorized to accomplish that work. It is the percentage of the BAC that reflects where the project should be at this point in time.

Planning package A WBS entry below a control account and above the work package. A planning package signifies that there is more planning that needs to be completed for this specific deliverable.

Planning process group The project management process group that creates the project management plan to execute, monitor and control, and close out the project.

PMP Code of Professional Conduct A PMI-endorsed code that PMP and CAPM candidates are expected to abide by in their career and role as a project manager.

Political interfaces The hidden goals, personal agendas, and alliances among the project team and the stakeholders.

Positive stakeholder A stakeholder who wants a project to exist and succeed. This person may try to positively influence the project and help it succeed.

Precedence diagramming method A network diagram that shows activities in nodes and the relationship between each activity. Predecessors come before the current activity and successors come after the current activity.

Preliminary project scope statement This document defines what the project needs to accomplish in order for it to be deemed complete.

Present value (PV) A benefit-comparison model that determines the present value of a future amount of money. The formula is $PV = FV \div (1 + i)^n$, where FV is future value, i is the given interest rate, and n is the number of time periods.

Preventive action A risk-related action that avoids risk within the project. A workaround to a problem within a project is an example of a preventive action.

Privity The contractual relationship between the buyer and the seller is often considered confidential and secret.

Probability and impact matrix A matrix ranking the probability of a risk event occurring and its impact on the project if it should happen; used in qualitative and quantitative risk analyses.

Problem solving This approach confronts the problem head-on and is the preferred method of conflict resolution.

Process An activity to create a product, result, or service; project management processes allow the project to move towards completion.

Process improvement plan This plan aims to eliminate non-value-added activity and waste, and determine how the project work, execution, and management can be improved.

Procurement management plan A project management subsidiary plan that documents the decisions made in the procurement planning processes.

Procurement planning A process that identifies which parts of the project warrant procurement from a vendor to the buyer.

Product acceptance criteria This component of the project scope statement works with the project requirements, but focuses specifically on the product and what the conditions and processes are for formal acceptance of the product.

Product breakdown A scope definition technique that breaks down a product into a hierarchical structure, much like a WBS breaks down a project scope.

Product life cycle The life cycle of the product a project creates. For example, a project can create a piece of software; the software then has its own life cycle until it becomes defunct.

Product scope Defines the product or service that will come about as a result of completing the project.

Product scope description This is a narrative on what the project is creating as a deliverable for the project customer.

Program A collection of related projects working in unison towards a common deliverable.

Progressive elaboration Describes the process of gathering project details in steady uniform steps. This process uses deductive reasoning, logic, and a series of information-gathering techniques to identify details about a project, product, or solution.

Project A short-term endeavor to create a unique product, service, or result. The end result of a project is also called a deliverable.

Project assumption A project assumption is anything that is held to be true but not proven to be true.

Project boundary A project boundary clearly states what is included with the project and what's excluded from the project. This helps to eliminate assumptions between the project management team and the project customer.

Project calendar The calendar that documents when the project work will occur.

Project charter A document that comes from outside of the project boundaries and authorizes the existence of a project.

Project constraint A constraint is anything that limits the project manager's options. A predetermined budget, deadline, resources, or materials the project manager must use within the project are examples of project constraints.

Project deliverable The output of the project.

Project environment The location and culture of the environment where the project work will reside. The project environment includes the social, economic, and environmental variables the project must work with or around.

Project float This is the total time the project can be delayed without passing the customer-expected completion date.

Project life cycle The collection of phases from the start of a project to the completion of the project.

Project Management Institute (PMI) An organization of project management professionals from around the world supporting and promoting the career, values, and concerns of project managers.

Project management office (PMO) A business unit or central project office that centralizes the operations and procedures of all projects within the organization or by department. The PMO supports the project manager through software, templates, and administrative support. A PMO can exist in any organizational structure, but it is most common in matrix and projectized structures.

Project management plan The documented approach to how a project will be planned, executed, monitored and controlled, and then closed out. This document is a collection of subsidiary project management plans and related documents.

Project management professional (PMP) A person who has proven project management experience, qualified for, and then passed the PMP examination.

Project management risks These risks deal with faults in the management of the project. The unsuccessful allocation of time, resources, and scheduling; unacceptable work results; and poor project management are all examples of project management risks.

Project management system The defined set of rules, policies, and procedures that a project manager follows and utilizes to complete the project.

Project network diagram A diagram that visualizes the flow of project activities and their relationships to other project activities.

Project objectives These are the measurable goals that determine a project's acceptability by the project customer and the overall success of the project. Objectives often include the cost, schedule, technical, and quality demands.

Project portfolio management The management and selection of projects that support an organization's vision and mission. It is the balance of project priority, risk, reward, and return on investment. This is a senior management process.

Project presentations These are useful in providing information to customers, management, the project team, and other stakeholders.

Project records All project communications are also part of the organizational process assets. This includes e-mails, memos, letters, and faxes.

Project reports Reports are formal communications on project activities, their status, and conditions.

Project requirements These are the demands set by the customer, regulations, or the performing organization that must exist for the project deliverables to be acceptable. Requirements are often prioritized in a number of ways, from "must have," "should have," and "would like to have."

Project scope Defines the required work to complete the project objectives.

Project scope management plan This project management subsidiary plan controls how the scope will be defined, how the project scope statement will be created, how the WBS will be created, how scope verification will proceed, and how the project scope will be controlled throughout the project.

Project scope statement This defines the project, the project deliverables, product requirements, project boundaries, acceptance procedures, and scope control.

Project stakeholder Anyone who has a vested interest in a project's operation and/or its outcome.

Project statement of work (SOW) This document defines all the products and services the project will provide.

Project variance The final variance, which is discovered only at the project's completion. The formula is VAR = BAC-AC.

Projectized structure An organization that assigns a project team to one project for the duration of the project's life cycle. The project manager has high-to-almost-complete project power.

Proposal From seller to buyer. Other factors—such as skill sets, reputation, and ideas for the project solution—may also be used in the decision-making process.

Purchase order (PO) A purchase order is a form of a unilateral contract that the buyer provides to the vendor which shows that the purchase has been approved by the buyer's organization.

Pure risks These risk types have only a negative outcome. Examples include loss of life or limb, fire, theft, natural disasters, and the like.

Qualitative risk analysis This approach qualifies the risks that have been identified in the project. Specifically, qualitative risk analysis examines and prioritizes risks based on their probability of occurring and their impact on the project should they occur.

Quality According to the American Society for Quality (ASQ), it is the degree to which a set of inherent characteristics fulfills requirements.

Quality assurance (QA) A management process that defines the quality system or quality policy that a project must adhere to. QA aims to plan quality into the project rather than inspect quality into a deliverable.

Quality baseline Documents the quality objectives for the project, including the metrics for stakeholder acceptance of the project deliverable.

Quality control (QC) An inspection-driven process that examines the project work to determine if the project deliverables are adhering to the quality expectations.

Quality management plan This plan defines what quality means for the project, how the project will achieve quality, and how the project will map to organizational procedures pertaining to quality.

Quality metrics The operational definitions that define the measurements within a project and the expected targets for quality and performance.

Quality planning The process of first determining which quality standards are relevant to your project and then finding out what the best methods are of adhering to those quality standards.

Quantitative risk analysis A risk analysis approach that attempts to numerically assess the probability and impact of the identified risks. Quantitative risk analysis also creates an overall risk score for the project. This method is more in-depth than qualitative risk analysis and relies on several different tools to accomplish its goal.

Quotation From seller to buyer. Price is the determining factor in the decision-making process.

RACI chart A RACI chart is another matrix chart that only uses the activities of *responsible*, *accountable*, *consult*, and *inform*.

RAG rating An ordinal scale that uses red, amber, and green to capture the probability, impact, and risk score. The first letter of red, amber, and green equate to "RAG" in the system.

Receiver This is the person who receives the message.

Referent The project team personally knows the project manager. Referent can also mean the project manager refers to the person who assigned him or her the position.

Refinement An update to the WBS.

Regression analysis This is a statistical approach to predict what future values may be based on historical values. Regression analysis creates quantitative predictions based on variables within one value to predict variables in another. This form of estimating relies solely on pure statistical math to reveal relationships between variables and to predict future values.

Request for proposal (RFP) From buyer to seller. Requests the seller to provide a proposal to complete the procured work or to provide the procured product.

Request for quote (RFQ) From buyer to seller. Requests the seller to provide a price for the procured product or service.

Reserve analysis Cost reserves for unknown unknowns within a project. The contingency reserve is not part of the project's cost baseline, but is included as part of the project budget.

Residual risks These are risks that are expected to remain after a risk response.

Resource breakdown structure (RBS) This hierarchical chart can decompose the project by the types of resources used throughout it.

Resource calendar Resources are people and things like equipment, rooms, and other facilities. This calendar defines when the resources are available to contribute to the project.

Resource-leveling heuristic A method to flatten the schedule when resources are overallocated. Resource leveling can be applied using different methods to accomplish different goals. One of the most common methods is to ensure that workers are not overextended on activities.

Responsibility A responsibility is the work that a role performs.

Responsibility assignment matrix (RAM) A RAM chart shows the correlation between project team members and the work they've been assigned to complete.

Reward The project manager has the authority to reward the project team.

Risk A project risk is an uncertain event or condition that can have a positive or negative impact on the project.

Risk identification The systematic process of combing through the project, the project plan, the WBS, and all supporting documentation to identify as many of the risks that may affect the project as possible.

Risk management plan A subsidiary project management plan that defines how risks will be identified, analyzed, responded to, and monitored within the project. The plan also defines the iterative risk management process the project is expected to adhere to.

Risk management planning The agreed-upon approach to the management of the project risk processes.

Risk owners The individuals or entities that are responsible for monitoring and responding to an identified risk within the project.

Risk register The risk register is a project plan component that contains all of the information related to the risk management activities. It's updated as risk management activities are conducted to reflect the status, progress, and nature of the project risks.

Risk-related contractual agreements When the project management team decides to use risk response transference, a risk-related contractual agreement is created between the buyer and the seller.

Risk response audit An audit to test the validity of the established risk responses.

Risk responsibility The level of ownership an individual or entity has over a project risk.

Risk score The calculated score based on each risk's probability and impact. The approach can be used in both qualitative and quantitative risk matrixes.

Role This person is responsible for a specific portion of the project. Roles are usually tied to job titles, such as network engineer, mechanical engineer, or electrician.

Rolling wave planning The imminent work is planned in detail, while the future work is planned at a high level. This is a form of progressive elaboration.

Root-cause identification Root-cause identification aims to find out why a risk event may be occurring, the causal factors for the risk events, and then, eventually, how the events can be mitigated or eliminated.

Rough order of magnitude This estimate is "rough" and is used during the initiating processes and in top-down estimates. The range of variance for the estimate can be from –25 percent to +75 percent.

Rule of Seven The components of a control chart that illustrate the results of seven measurements on one side of the mean that are considered "out of control" in the project.

Run chart A quality control tool that shows the results of inspection in the order in which they've occurred. The goals of a run chart are to first demonstrate the results of a process over time and then use trend analysis to predict when certain trends may re-emerge.

Scatter diagram A quality control tool that tracks the relationship between two variables over time. The two variables are considered related the closer they track against a diagonal line.

Schedule baseline The expected timeline of the project; the difference between the planned schedule and the experienced schedule reveals schedule variances within the project.

Schedule management plan Defines how the project schedule will be created and managed.

Schedule performance index (SPI) A measurement of the project based on its schedule performance. The formula is SPI = EV/PV.

Schedule variance (SV) The difference between the earned value (EV) and the planned value (PV). The formula is SV = EV-PV.

Scheduled milestones The project customer may have specified set dates when phases of the project should be completed. These scheduled milestones are often treated as project constraints.

Scope baseline The sum of the project deliverables; the WBS is often called the project scope baseline. Differences between the WBS and what is created are scope variances.

Scope creep Undocumented, unapproved changes to the project scope.

Scope verification The formal inspection of the project deliverables that leads to project acceptance.

Scoring models These models use a common set of values for all of the projects up for selection. For example, values can be profitability, complexity, customer demand, and so on.

Screening system A screening system is a tool that filters, or screens out, vendors that don't qualify for the contract.

Secondary risks These are new risks that are created as a result of a risk response.

Seller rating system This is used by an organization to rate prior experience with each vendor that it has worked with in the past. The seller rating system can track performance, quality ratings, delivery, and even contract compliance.

Sender This is the person who wants to send a message.

Sender-receiver models Feedback loops and barriers to communications.

Sensitivity analysis A quantitative risk analysis tool that examines each risk to determine which one has the largest impact on the project's success.

Sharing A risk response that shares the advantages of a positive risk within a project.

Single source Many vendors can provide what your project needs to purchase, but you prefer to work with a specific vendor.

Smoothing This approach smoothes out the conflict by minimizing the perceived size of the problem. It is a temporary solution, but can calm down team relations and boisterous discussions.

Soft logic The order of the activities doesn't necessarily have to happen in a specific order. For example, you could install the light fixtures first, then the carpet, and then paint the room. The project manager could use soft logic to change the order of the activities if he or she desired.

Sole source Only one vendor can provide what your project needs to purchase. Examples include a specific consultant, specialized service, or unique type of material.

Staffing management plan A subsidiary plan of the project management plan that defines staff acquisition, timetables, release criteria, training needs, reward and recognition system, compliance issues, and safety concerns for the project.

Stakeholder analysis A scope definition process whereby the project management team interviews the stakeholders and categorizes, prioritizes, and documents what the project customer wants and needs. Stakeholder analysis demands quantification of stakeholder objectives; goals such as "good," "satisfaction," and "speedy" aren't quantifiable.

Stakeholder notifications Notices to the stakeholders about resolved issues, approved changes, and the overall health of the project.

Start-to-finish (SF) An activity relationship that requires an activity to start so that its successor may finish. This is the most unusual of all the activity relationship types.

Start-to-start (SS) An activity relationship type that requires the current activity to start before its successor may start.

Statistical sampling A process of choosing a percentage of results at random. For example, a project creating a medical device may have 20 percent of all units randomly selected to check for quality.

Status review meeting A regularly scheduled meeting to discuss the status of the project and its progress towards completing the project scope statement.

Strong matrix structure An organization where organizational resources are pooled into one project team, but the functional managers have less project power than the project manager.

Subnet A representation of a project network diagram that is often used for outsourced portions of project, repetitive work within a project, or a subproject. Also called a fragnet.

Subproject A smaller project managed within a larger, parent project. Subprojects are often contracted work whose deliverable allows the larger project to progress. The electrical wiring of a new building is a subproject of the parent project—the actual construction of the new building.

Sunk costs Monies that have already been invested in a project.

SWOT analysis SWOT analysis is the process of examining the project from the perspective of four characteristics (strengths, weaknesses, opportunities, and threats).

System engineering This project scope statement creation process studies how a system should work, designs and creates a system model, and then enacts the working system based on the project's goals and the customer's expectations. System engineering aims to balance the time and cost of the project in relation to the project's scope.

System or process flowcharts These flowcharts illustrate the flow of a process through a system, such as a project change request through the change control system or a work authorization through a quality control process.

Systems analysis A scope definition approach that studies and analyzes a system, its components, and the relationship of the components within the system.

Technical interfaces The project team identifies the disciplines and specialties that the project will require to complete the project scope statement. The technical interfaces are the resources that will be doing the project work.

Technical, quality, or performance risks Technical risks are associated with new, unproven, or complex technologies being used on the project. Changes to the technology during the project implementation can also be a risk. Quality risks are the levels set for expectations of impractical quality and performance.

Template A previous project that can be adapted for the current project.

Three-point estimate An estimating technique for each activity that requires an optimistic, most likely, and pessimistic estimate be created. Based on these three estimates, an average can be created to predict how long each activity should take.

Time and materials contract A contract type in which the buyer pays for the time and materials for the procured work. This is a simple contract, usually used for smaller procurement conditions. These contract types require a not-to-exceed (NTE) clause, or the buyer assumes the risk for cost overruns.

Time reporting system A system to record the actual time spent to complete project activities.

Total float This is the total time an activity can be delayed without delaying the project's completion.

Transference A risk response that transfers the ownership of the risk to another party. Insurance, warranties, a licensed contractor, or other project teams are good examples of transference. There is typically a fee and contractual relationship involved with the transference of the risk.

Trend analysis The science of taking past results to predict future performance.

Triple Constraints of Project Management Also known as the Iron Triangle. This theory posits that time, cost, and scope are three constraints that every project has.

Value analysis Like value engineering, this approach examines the functions of the project's product in relation to the cost of the features and functions. This is where, to some extent, the grade of the product is in relationship to the cost of the product.

Value engineering This project scope statement creation approach attempts to find the correct level of quality in relation to a reasonable budget for the project deliverable while still achieving an acceptable level of performance for the product.

Variable costs These are costs that change, depending on the conditions applied in the project (the number of meeting participants, the supply and demand of materials, and so on).

Variance The difference between what was expected and was experienced.

Variance at completion (VAC) A forecasting formula that predicts how much of a variance the project will likely have based on current conditions within the project. The formula is VAC = BAC-EAC.

WBS dictionary A WBS companion document that defines all of the characteristics of each element within the WBS.

WBS template A prepopulated WBS for repetitive projects. A previous project's WBS is often used as a WBS template for current similar projects.

Weak matrix structure An organization in which organizational resources are pooled into one project team, but the functional managers have more project power than the project manager.

Weighting system A system that takes out the personal preferences of the decision maker in the organization to ensure that the best seller is awarded the contract. Weights are assigned to the values of the proposals, and each proposal is scored.

Withdrawal This conflict resolution method has one side of the argument walking away from the problem, usually in disgust.

Work breakdown structure (WBS) A deliverables-orientated decomposition of the project scope.

Work package The smallest item in the WBS.

Work performance information The results of the project work as needed. This includes technical performance measures, project status, information on what the project has created to date, corrective actions, and performance reports.

Workaround An immediate response to a negative risk within the project. This is an example of a corrective action.

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