ROBIN ABERNATHY

Cert Guide

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CompTIA® Project+ Exam PK0-004

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CompTIA Project+ Cert Guide

Robin Abernathy

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CompTIA Project+ Cert Guide

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About the Author

Robin M. Abernathy has been working in the IT certification preparation industry at Kaplan IT Training, the owners of the Transcender brand, for more than 15 years. She has written and edited certification preparation materials for many (ISC)2, Microsoft, CompTIA, PMI, Cisco, EC-Council, and ITIL certifications and holds multiple IT certifications from these vendors.

Robin provides training on computer hardware and software, networking, security, and project management. She has served as technical editor for several publications and coauthored Pearson's *CompTIA Advanced Security Practitioner (CASP) CAS-002 Cert Guide* and *CISSP Cert Guide*, Second Edition. She also gives presentations at technical conferences and hosts webinars on IT certification topics.

Dedication

For my husband, Michael, and my son, Jonas. I love you both!

Acknowledgments

First, I once again thank my Heavenly Father for knowing what I was meant to do, even when in my early adult years I said, "I will never work on computers or write for a living." God always has a plan. And I *know* He has a sense of humor!

My life would not have been complete without my surrogate brothers. While you entered my world through tragic circumstances, you have come to be my real brothers. Doug Carey and John Carey, thanks for introducing me to all things Cincinnati Reds, Batman, *Star Trek*, and Elvis. Thanks for adopting two little sisters, which I know as teenagers must have been trying at times. Love you both! Lynne and Lorrie, we love having you in our family as well! Will Carey, Bobby Carey, Christian Carey, and Jacob Carey, you have fine fathers, and I love watching as you become so much like them!

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I must thank my wonderful husband, Michael, and son, Jonas, for once again being willing to do "guy things" while I was locked away in the world of project management. You are my world! What a wonderful ride we are on!!!

Thanks to all at Pearson for once again assembling a wonderful team to help me get through this Project+ journey. Robin Drake and Ann Lang, I honestly think this was the best team yet. You two are rock stars!

To you, the reader, I wish you success in your IT certification goals!

—Robin Abernathy

About the Technical Reviewer

Ann Lang is a certified project manager and technical writer. She has been a technical editor for Kaplan IT Test Prep's line of IT certification products for 10 years. Prior to working as a technical writer, she worked in public broadcasting, for a university press, and in various jobs related to her lifelong love of language.

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As the reader of this book, *you* are our most important critic and commentator. We value your opinion and want to know what we're doing right, what we could do better, what areas you'd like to see us publish in, and any other words of wisdom you're willing to pass our way.

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Introduction

The Project+ certification is an excellent entry-level project management certification. As a globally recognized credential, the Project+ certification demonstrates that the holder has knowledge and skills across a broad range of project management topics.

Every day, in every industry, organizations large and small launch new projects. Many of these organizations realize that personnel with skills and knowledge in project management are vital to successful projects. Project+ certified professionals have more than just basic project management knowledge; to pass the Project+ exam, certification candidates must understand all aspects of project management.

Project management knowledge and skills apply to all types of projects, from construction to software development to manufacturing and all other fields. Earning Project+ certification demonstrates the project management professional's ability to initiate, plan, execute, monitor and control, complete, and close projects.

Goals of the Project+ Certification

The Project+ certification is created and managed by the Computing Technology Industry Association (CompTIA), a well-known certification body. CompTIA Project+ certification has a number of stated goals. Although not crucial for passing the exam, having knowledge of the CompTIA organization and its goals for the Project+ certification can be helpful in understanding the motivation behind the creation and contents of the exam.

Sponsoring Body

CompTIA is a nonprofit trade association that provides a vendor-neutral certification process and works with partners to create educational materials. The Project+ certification is one of a number of certifications offered by CompTIA:

- A+
- Network+
- Security+
- Linux+
- Cloud+
- Mobility+
- Server+
- CDIA+

CompTIA also offers two master-level security certifications:

- CompTIA Advanced Security Practitioner (CASP)
- Cybersecurity Analyst+ (CSA+)

Stated Goals

The goal of CompTIA in its administration of the Project+ certification is to provide a reliable instrument to measure an individual's knowledge and skills for managing the project life cycle, ensuring appropriate communication, managing resources and stakeholders, and maintaining project documentation. The topics covered in the exam are technically more shallow than those tested by some other project management certifications.

The topics that comprise the four domains of knowledge covered by the Project+ exam (PK0-004) are discussed later in this Introduction.

Value of the Project+ Certification

The Project+ certification holds value for both the exam candidate and the organization. Project management is a job skill that is increasing in popularity on job sites. Project+ is often seen as a great entry-level certification for people who are new to the project management field.

To the Project Professional

Many reasons exist for a project management professional to spend the time and effort required to achieve Project+ certification:

- To meet growing demand for project management professionals
- To become more marketable in an increasingly competitive job market
- To enhance skills in a current job
- To qualify for or compete more successfully for a promotion
- To increase earnings

In short, this credential demonstrates that the holder not only has the knowledge and skills tested on the exam but also the wherewithal to plan and implement a course of study that addresses a broad range of project management topics.

To the Organization

For an organization, the Project+ certification offers a reliable benchmark against which job candidates can be measured by validating both knowledge and experience. Individuals holding this certification stand out, making the hiring process easier and adding a level of confidence in the final selection.

Project+ Objectives

The material contained in the Project+ exam (PK0-004) is divided into four domains, with several objectives in each:

- Project basics domain
- Project constraints domain
- Communication and change management domain
- Project tools and documentation domain

For the most part, this book devotes a chapter to each of these objectives. A few objectives have been combined logically into one chapter. Some overlap is inevitable between the domains and objectives, leading to some overlap between topics covered in the chapters. This section describes the domains and topics covered.

Project Basics Domain

The *project basics domain* covers a broad spectrum of general project management topics:

- Properties of a project
- Project roles and responsibilities
- Project phases
- Project cost control
- Project team organizational structures
- Project schedules
- Agile methodology
- Human resource, physical resource, and personnel management

Project Constraints Domain

The *project constraints domain* covers a broad range of project limiting factors:

- Project constraint variables and influences
- Project risk strategies and activities

Communication and Change Management Domain

The *communication and change management domain* covers the who, what, why, and when of communication and the change management process:

- Project communication methods
- Project communication influences
- Project communication triggers, audience, and rationale
- Project change control process and types of changes
- Organizational change

Project Tools and Documentation Domain

The *project tools and documentation domain* covers all the tools and documents that are used to manage a project successfully:

- Project management tools
- Project-centric documents
- Vendor-centric documents

Steps to Becoming CompTIA Project+ Certified

To become CompTIA Project+ certified, the candidate must meet certain prerequisites and follow certain procedures. This section covers those topics.

About the Project+ Exam

The Project+ exam is a computer-based test that the candidate can spend up to 90 minutes completing. There are no formal breaks, but you are allowed to take short breaks. Any time used for breaks counts toward the maximum cumulative time of 135 minutes, whether you take the test online or in person at a Pearson VUE authorized testing center. You must bring a government-issued identification card. No other forms of ID are accepted.

The test will have up to 100 multiple-choice questions and drag-and-drop questions. The passing grade is 710 out of a possible 900. Candidates will receive the results at the test center from the test administrator.

Qualifying for the Exam

While there are no experience requirements for taking the exam, CompTIA recommends at least 12 months of cumulative project management experience. Because this is not a requirement, candidates can sign up for the exam without this experience, but should spend adequate study time to ensure that they have the knowledge needed for this exam.

Signing Up for the Exam

CompTIA exams are offered at Pearson VUE testing centers around the world. Certain qualified students or other individuals in the U.S. and Canada may be eligible to take the Project+ exam remotely through ProctorU instead of visiting a testing center. If you want to take the exam online, review the requirements and follow the instructions at http://proctoru.com/portal/comptia.

The steps to sign up for the Project+ exam at your local Pearson VUE testing center are as follows:

1. Create a Pearson VUE account (www.pearsonvue.com/comptia).
2. Schedule your exam at your nearest Pearson VUE facility.
3. Save your exam appointment confirmation.

After you complete the exam, you will be given a score report. Save this score report until you confirm that you have been awarded the credential by logging into https://www.certmetrics.com/comptia/login.aspx.

How To Use This Book

The goal of this book is simple: Helping you to pass the 2017 version of the CompTIA Project+ Certification exam (PK0-004).

The Project+ exam stresses a complete understanding of the knowledge areas and experience of project management. Whether you have an extensive background as a project manager in multiple industries, or you are entering the project management field for the first time, this book is designed to help you understand and master the required objectives for the exam.

This book uses several methodologies to help you 1) discover the exam topics on which you need more review, 2) fully understand and remember details about those topics, and 3) prove to yourself that you have retained your knowledge of those topics. To pass the exam, memorizing terminology is not sufficient; you must understand the concepts covered in the exam and this book.

Each chapter is structured in the following way:

- **Objectives:** The chapter opens with a list of Project+ exam topics covered in the chapter, a brief introduction to those topics, and a list of the corresponding CompTIA Project+ objectives.
- **"Do I Know This Already?" Quiz:** This quiz tests your knowledge and understanding of the main topics covered in the chapter. Detailed answers are in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions." The quiz helps you to assess whether you should read the entire chapter, read only the sections on unfamiliar topics, or jump immediately to the "Exam Preparation Tasks" section.
- **Foundation Topics:** This section holds the core content of the chapter. It explores the chapter topics with both theory and examples. In-depth descriptions, lists, tables, and figures are geared to build your knowledge so that you can pass the Project+ exam.
- **Examples:** This book presents more than 125 true-to-life examples that demonstrate how project management actually *works* in the phases, tasks, documents, processes, etc. that are part of the project manager's job. These examples are designed to give you real-world insight that is particularly useful in scenario-based questions on the live Project+ exam.
- **Key Topics:** The Key Topic icon in the margin indicates important information that you should know for the exam. Although the contents of the entire chapter could be on the exam, you should definitely know the information listed in each key topic. All of the key topics for the chapter are gathered in a Key Topics table at the end of the chapter for quick reference to the text covering each key topic.

- **Exam Preparation Tasks:** This section of the chapter moves from active learning to active exam preparation. Now that you have grasped the chapter contents, use the activities in this section to test your understanding of the information in the chapter:
  - **Review All Key Topics:** The Key Topics table in this section provides a brief summary of each chapter element marked with the Key Topic symbol described earlier. Review the contents of this table carefully to check your understanding of that topic. In case you need to refresh your

memory or learn more, the table lists the corresponding page number where each topic begins, so you can jump instantly to that point in the chapter.

- **Define Key Terms:** This section lists all the important terms discussed in the chapter. You are expected to be familiar with these key terms for the Project+ exam. Provide your own definitions for the terms in the list, and then compare your definitions against those in the Glossary at the end of the book. The Glossary combines all the key terms from all the chapters, listed alphabetically to make each term easy to find.
- **Review Questions:** Each chapter ends with 10 multiple-choice questions, designed to test your knowledge of the chapter content. Check your selections against the answers and descriptions in Appendix A.

Who Should Read This Book?

The CompTIA Project+ examination is designed for project management in any field. The exam certifies that the successful candidate has the requisite knowledge and skills to manage projects for any type of organization.

As mentioned earlier, no project management experience is required for taking the exam. However, CompTIA recommends at least 12 months of cumulative project management experience.

This book is intended for the wide range of Project+ certification candidates, from people who seek entry-level project management know-how all the way up to experienced project managers who want to keep skills sharp, increase income, improve organizational ranking or title, or meet their organization's policies mandating certification.

Strategies for Exam Preparation

How you use this book to prepare for the exam will vary depending on your existing skills and knowledge. The ideal exam preparation would consist of years of active project management experience followed by rigorous study of the exam objectives, but that may not be practical in your case. The best way to determine your readiness for the Project+ exam is to work through the "Do I Know This Already?" Quiz at the beginning of each chapter and review the foundation topics and key topics presented in each chapter. If possible, work your way through the entire book until you can complete each subject without having to do any research or look up any answers.

If you need to study particular areas in the PK0-004 certification exam outline, find those sections in the book and review them carefully. Table I-1 lists the objectives in the Project+ exam and where those objectives are covered in this book.

Table I-1 CompTIA Project+ PK0-004 Exam Topics Mapped to Chapters

Project+ Objective	Description	Chapter
1.1	Summarize the properties of a project.	1
1.2	Classify project roles and responsibilities.	2
1.3	Compare and contrast standard project phases.	1
1.4	Identify the basics of project cost control.	3
1.5	Identify common project team organizational structures.	2
1.6	Given a scenario, execute and develop project schedules.	4
1.7	Identify the basic aspects of the Agile methodology.	6
1.8	Explain the importance of human resource, physical resource, and personnel management.	5
2.1	Given a scenario, predict the impact of various constraint variables and influences throughout the project.	7
2.2	Explain the importance of risk strategies and activities.	8
3.1	Given a scenario, use the appropriate communication method.	9
3.2	Compare and contrast factors influencing communication methods.	9
3.3	Explain common communication triggers and determine the target audience and rationale.	10
3.4	Given a scenario, use the following change control process within the context of a project.	11
3.5	Recognize types of organizational change.	11
4.1	Compare and contrast various project management tools.	12
4.2	Given a scenario, analyze project centric documentation.	13
4.3	Identify common partner or vendor-centric documents and their purpose.	14

When you feel confident in your skills, work through the "Exam Preparation Tasks" section of each chapter, and then attempt the practice exams in the Pearson Test Prep practice test software online. As you work through a practice exam, note the areas where you lack knowledge or confidence, and then review those concepts in the book. After you have reviewed those areas, work through the practice exam a second time and rate your skills. Keep in mind that the more you work through a practice exam, the more familiar the questions will be.

After you have worked through the practice exams successfully, schedule your CompTIA Project+ PK0-004 exam as described earlier. Typically candidates should take the exam within a week of when they feel ready for the exam.

Companion Website

Register this book to get access to the Pearson Test Prep practice test software and other study materials plus additional bonus content. Check the site regularly for new and updated postings written by the author that provide further insight into the more troublesome topics on the exam. Be sure to check the box that you would like to hear from us to receive updates and exclusive discounts on future editions of this product or related products.

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3. Enter this book's ISBN (9780789758835).
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NOTE Keep in mind that companion content files can be very large, especially image and video files.

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NOTE The cardboard sleeve in the back of this book includes a paper that lists the activation code for the practice exams associated with this book. *Do not lose the activation code!* The paper also includes a unique, one-time-use coupon code for discounted purchase of the digital-only *CompTIA Project+ Cert Guide Premium Edition eBook and Practice Test*, with additional practice exams. (See the later section "Premium Edition" for details.)

Pearson Test Prep Practice Test Software

In addition to the bonus content on the book's companion website, this book comes complete with the Pearson Test Prep practice test software. The practice tests are available to you either online or as an offline Windows application. To access the practice exams that were developed with this book, you will need the unique activation code printed on the paper in the cardboard sleeve in the back of this book.

Accessing the Pearson Test Prep Software Online

The online version of this software can be used on any device with a browser and connectivity to the Internet, including desktop machines, tablets, and smartphones. To start using your practice exams online, follow these steps:

1. Go to http://www.PearsonTestPrep.com.
2. Select **Pearson IT Certification** as your product group.
3. Enter your email/password for your account. If you don't have an account on PearsonITCertification.com, you will need to establish one by going to PearsonITCertification.com/join.
4. In the **My Products** tab, click the **Activate New Product** button.
5. Enter the access code printed on the insert card in the back of your book to activate your product.
6. The product will now be listed in your My Products page. Click the **Exams** button to launch the exam settings screen and start your exam.

Accessing the Pearson Test Prep Software Offline

If you want to study offline, you can download and install the Windows version of the Pearson Test Prep practice test software. There is a download link for this software on the book's companion website, or you can enter this link in your browser:

http://www.pearsonitcertification.com/content/downloads/pcpt/engine.zip

To access the book's companion website and the software, follow these steps:

1. Register your book by going to PearsonITCertification.com/register and entering the ISBN: **9780789758835**.
2. Respond to the challenge questions.
3. Go to your account page and select the **Registered Products** tab.
4. Click the **Access Bonus Content** link under the product listing.

5. Click the **Install Pearson Test Prep Desktop Version** link under the Practice Exams section of the page to download the software.
6. After the software finishes downloading, unzip all the files on your computer.
7. Double-click the application file to start the installation, and follow the onscreen instructions to complete the registration.
8. After the installation is complete, launch the application and select the **Activate Exam** button on the My Products tab.
9. Click the **Activate a Product** button in the Activate Product Wizard.
10. Enter the unique access code found on the card in the sleeve in the back of your book, and click the **Activate** button.
11. Click **Next** and then the **Finish** button to download the exam data to your application.
12. You can now start using the practice exams by selecting the product and clicking the **Open Exam** button to open the exam settings screen.

Note that the offline and online versions will sync together, so saved exams and grade results recorded on one version will be available to you on the other as well.

Premium Edition

In addition to the free practice exams provided with your purchase, you can purchase expanded exam functionality from Pearson IT Certification. The digital-only *CompTIA Project+ Cert Guide Premium Edition eBook and Practice Test* contains additional practice exams as well as the eBook (in PDF, ePub, and MOBI/Kindle formats). In addition, the Premium Edition title links each question to the specific part of the eBook related to that question.

If you purchased the print version of this title, you can purchase the Premium Edition at a deep discount. The cardboard sleeve in the back of this book contains a paper with a one-time-use coupon code and instructions for purchasing the Premium Edition.

This chapter covers the following topics:

- **Understand the various constraint variables throughout the project:** Constraints include cost, scope, time and scheduling, deliverables, quality, environment, resources, and requirements.
- **Understand the various influences on constraints throughout the project:** Project influences include change requests, scope creep, constraint reprioritization, interaction between constraints, stakeholders/sponsors/management influences, and influences by other projects.

Project Constraints and Influences

Constraints limit projects in important ways, such as defining the project's scope and available resources. However, constraints are not always fixed in stone; they can be affected by events that occur while the project is underway. Project influences, such as a budget increase or a sponsor's interest in expanding the project, can also require changes to the project's constraints. This chapter examines how constraints—and changes in those constraints—affect the project.

This chapter covers the following objective for the Project+ exam:

2.1 Given a scenario, predict the impact of various constraint variables and influences throughout the project.

NOTE Risks are also considered a project constraint. Chapter 8, "Risk Activities and Strategies," discusses risks in more detail.

NOTE Reminder: CompTIA might use slight variations of industry-standard terminology on the Project+ exam. For a detailed list of known vocabulary differences, see Chapter 15, "Final Preparation."

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz allows you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 7-1 lists major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 7-1 "Do I Know This Already?" Foundation Topics Section-to-Question Mapping

Foundation Topics Section	Questions Covered in This Section
Common Constraints	1–3, 6–10
Project Influences	4–5

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. Which constraint is most strongly affected if a project team member will have a higher rate of pay than originally estimated?
   a. quality
   b. time
   c. scope
   d. cost

2. Which of the following project changes would mainly affect the project's scope?
   a. A new requirement for a web application is approved.
   b. A new team member is acquired.
   c. The lab will not be available until next quarter.
   d. The materials needed are only available during the spring season.

3. Which constraint is most strongly affected if a project team member can complete tasks at a faster rate than estimated?
   a. quality
   b. time
   c. scope
   d. cost

4. Three months into a project, one of the stakeholders wants to add a new feature to the application currently in development. The project sponsor approves this request and expands the project budget. Of which influence is this an example?
   a. triple constraint
   b. constraint reprioritization
   c. scope creep
   d. change request

5. Which of the following is an example of scope creep?
   a. A data center project is $100,000 over budget and six months behind schedule due to the project sponsor's requesting 10 additional server racks.
   b. A company has recently experienced financial troubles and requested project budget cuts that result in a lengthened schedule. When originally started, the project needed to be completed as quickly as possible.
   c. The project sponsor for a new construction project requests that fiber-optic cabling be installed instead of CAT 6 cabling. This request is approved.
   d. A project stakeholder requests that a new clothing line be manufactured using only products made in the United States. This request is approved.

6. During what project phase are constraints first established?
   a. Initiating
   b. Planning
   c. Executing
   d. Monitoring and Controlling

7. If a change to a constraint is necessary, what should the project manager do?
   a. Make appropriate changes in the schedule via the work breakdown structure.
   b. Write the new requirements into the communication plan.
   c. Obtain approval from the project sponsor via the change control process.
   d. Document the changes in the transition/integration plan.

8. Which factors are referred to as the *triple constraint*?
   a. scope, time, cost
   b. resources, time, scope
   c. time, requirements, quality
   d. cost, resources, quality

9. Which of the following does *not* describe a project constraint?
   a. If your organization's product is not released within five months, a major competitor will be first to market with a similar product.
   b. The project must include on-site training for the customer's staff, to be delivered three weeks in advance of project closure.
   c. The materials cost cannot exceed 10% of the budget.
   d. The product must run on the customer's existing point-of-sale terminals.

10. Which of the following describes an interaction between constraints?
    a. The sponsor wants to increase the budget and use a more expensive material. The sponsor asks the project manager to assess the impact of these changes on the timeline.
    b. A newly passed regulation requires an ongoing project to meet additional safety standards. The project manager allocates another month for testing and reschedules the prototype approval meeting.
    c. Because project B has a higher business priority, a senior manager requests that a key resource spend 70% of his time on project B and only 30% on project A.
    d. A team member submits a brochure to the client for approval. The client asks the team member to digitally retouch the executive staff's headshots before printing the brochure.

Foundation Topics

Key Topic

Common Constraints

A *constraint* is a factor that limits the scope or execution of a project. Constraints are first established during the Initiating phase of the project and documented at a high level in the project charter. During the Planning phase, constraints are documented for the project's scope statement. The project manager must ensure that all constraints are properly documented and monitored.

NOTE The scope statement is described in Chapter 1, "Project Properties and Phases."

If a change in a constraint is necessary, the project manager will need to obtain approval from the project sponsor. The project's change control process outlines how these changes should be approved and documented. The project manager is responsible for evaluating the impact of the change, updating any project documents affected by the change, and communicating the change to the appropriate team members and stakeholders.

NOTE For details on the change control process, see Chapter 11, "Change Control."

This section covers how to predict the impact of various constraint variables, including cost, scope, time and scheduling, deliverables, quality, environment, resources, and requirements.

Together, cost, scope, and time form the *triple constraint*. Altering one aspect of the triple constraint automatically affects the other aspects. Each constraint will have advocates. For example, the project sponsor might mainly be concerned with cost (getting the project result as inexpensively as possible), while the project's customer is mainly concerned with time (getting the project result as quickly as possible) and scope (getting all the necessary features in the project).

All three aspects of the triple constraint have equal weight when a project starts. As the project is initiated and planned, the constraints must be balanced to ensure that the project result is achieved within the scope, time, and cost constraints defined for the project.

Project managers should understand this rule: "Good, fast, cheap—pick any two." Achieving all three goals is impossible. In most projects, one or two constraints will have priority. If constraints are reprioritized during the project, a thorough review of the other constraints must be performed.

EXAMPLE: You are managing a project in which the main concern during the Planning phase was the project's cost. To reduce costs, the project schedule was lengthened, the materials are of lower quality, resources are less knowledgeable, and the scope does not include all the features that were originally proposed. Halfway through your project, a rival company starts work on a competing product. If your project's sponsor wants to beat your rival to market, your project's constraints will have to be reprioritized: Speeding up the schedule would result in higher costs, achieving the needed release date might require further reducing the project scope, and so on.

Cost Constraint

Budget is the classic constraint for any project, because every project has a limited amount of money available. During the Planning phase, the project manager estimates the amount of money that will be required to complete the project. Costs include resources, labor rates for contractors, risk estimates, materials, and so on. All aspects of the project that have a monetary component are part of the overall cost structure. The project manager uses all these cost details to estimate the project budget. Most projects include *reserves*, which are monies that are allocated to deal with risks. Even with reserves, however, only a finite amount of money is available for any project.

NOTE Chapter 8 discusses the different types of risk reserves.

If a project's cost estimates were inaccurate and more money is ultimately required, either the project budget will need to be increased and approved by the project sponsor, or some other project constraint(s) will need to be adjusted. The project's change control process outlines how these changes should be approved and documented.

EXAMPLE: While a project for building a new house is underway, the project manager learns that the lumber costs are significantly higher than projected. The project manager will need to meet with the project sponsor—in this case, the homeowner—to a) obtain additional funds to cover the increased costs, b) decrease costs in other areas, or c) both. Perhaps the homeowner will decide to cut costs in other areas to offset the increase in lumber prices. For example, switching to

cheaper light fixtures and omitting crown molding might provide enough money to cover the increased cost of the lumber.

Key Topic

Scope Constraint

Scope is a constraint because it restricts work on the project to only what is required to produce the project's final product, result, or service. During the Planning phase, the project manager determines the project requirements that help define the project scope. All requirements that are accepted provide guidance for the project scope.

Because scope combines with cost and time in the triple constraint, a change in scope alters one or both of the other aspects. If the project scope must change, the project budget will need to be changed and approved by the project sponsor, and/or the project schedule will need to be adjusted.

EXAMPLE: During a project for a new banking application, the project sponsor requests an additional feature. The project manager will need to meet with the project sponsor to a) obtain additional funds to cover the new feature and adjust the schedule to account for development, b) decide which other feature(s) can be sacrificed to offset the budget and schedule changes, or c) both. When the decisions are made, the project will need to be adjusted based on those decisions.

Key Topic

Time and Scheduling Constraints

Time is a project constraint because every project has a limited amount of time available to create the project's deliverables. The available time determines the project schedule, which is the time available to deliver a project. Time affects most other project constraints, including cost, scope, quality, and scheduling.

During the Planning phase, the project manager determines the project schedule, assigning all resources to project tasks or activities. The project schedule is based on the amount of time needed to complete the tasks and the amount of time all resources are available. The minimum amount of time required to complete the project (the critical path) also affects the minimum project budget for paid resource hours.

NOTE For a discussion of the critical path, see Chapter 4, "Project Schedules."

If the allotted time for a task is overrun, additional costs will be incurred as additional resources become necessary; for example, staff may need to be paid overtime to complete tasks that exceed the allotted hours. Other project constraints, including quality and scope, may be impacted if additional resource time cannot be obtained.

EXAMPLE: During a project for a new mobile application, the developers indicate that tasks are taking longer to complete than originally projected. The project manager may need to obtain additional staff to help the project stay on schedule, or she might ask current developers to work overtime to meet the original project release date. Either of these choices will result in higher project costs, which affect the project budget. The project manager could also ask for a reduction in the project scope, perhaps by omitting a feature from the application.

Deliverables Constraint

Deliverables are considered project constraints because every project creates some sort of deliverables. These deliverables are considered part of the project scope. Deliverables are also constraints because they must meet specific, measurable benchmarks or key performance indicators (KPIs) to be accepted.

NOTE For more on key performance indicators, see Chapter 12, "Project Management Tools."

During the Planning phase, the project manager determines the project deliverables. If the scope of the project changes after planning is complete, the deliverables from the project are usually affected. If the number of deliverables increases, for instance, the project budget and schedule are usually affected.

EXAMPLE: A new book project is underway, and the author decides to add a chapter to the planned outline. The project manager will probably need to adjust the project schedule to include time for writing the new chapter. The project manager might try to work with the author to ensure that the project schedule remains unchanged, but this option may be unlikely with only one author. Hiring another author would result in higher costs.

While deliverables are not part of the triple constraint, changing deliverables in any type of project definitely affects the project scope and may also affect cost and time.

Quality Constraint

Every project has quality parameters with which the deliverables must comply. The quality constraint is considered part of the project scope, defining the quality of the project deliverables based on the requirements documented in the requirements management plan. Requirements describe the desired outcome, but quality is how to measure whether that outcome is delivered.

NOTE Chapter 12 covers tools for measuring the quality of deliverables.

During the Planning phase, the project manager determines the project quality. The project scope affects project quality, and quality in turn affects other project constraints. For instance, if deliverables must be made from an expensive material to meet quality standards, the materials cost will be part of the minimum project budget, making it a priority constraint. If producing a correct deliverable takes a lot of time, sufficient resource hours must be scheduled.

Quality changes in any kind of project affect the project scope, and therefore affect the cost (project budget) and time (project schedule).

EXAMPLE: A company is creating a new machine part, and the project sponsor requests changing to a higher-quality metal alloy for the project. The project manager will need to increase the project budget to account for this more expensive material. In addition, the project schedule may be delayed by the time needed to order and receive the new alloy.

Environment Constraint

The environment in which the project takes place can constrain its scope, the quality of its deliverables, the availability of resources, its schedule, or numerous other factors. Environmental constraints include the corporate environment, the global environment outside the organization, and the project environment itself. Project managers must understand and document any effects these environments may have on the project.

The *corporate environment* includes the type of organization and the organization's culture. For example, in a functional company, project managers must work with functional managers to negotiate resource time. This type of environment would constrain resources and scheduling.

NOTE Functional team structure is discussed in Chapter 2, "Project Roles, Responsibilities, and Team Structures."

The *global environment* is the backdrop that sets the stage for the project, such as the regulatory environment, the physical environment (the natural world), the political environment, and/or the fiscal environment. These issues may vary depending on where the project is being completed. For example, a project to design a new car would be constrained by the regulatory environment (safety tests and emission

standards). A construction project is constrained by regulations (building codes) and the building's physical environment (such as a need for earthquake-proof framing). A solar power project might be constrained by the physical environment (sun availability) and the political environment (located in a market with energy tax incentives).

EXAMPLE: A new building project is underway, and the city planning commission reports that the original plans overlap a neighboring property line by six inches. The project manager may need to have the site re-surveyed and work with the architect and designers to adjust the building plans. In addition, the project schedule may need to be adjusted to account for construction delays. Alternatively, the project manager could petition the city to obtain the neighboring property if it is available on the market and affordable.

The *project environment* includes any variables that must be present to complete the project. Some projects may need a "clean room" to carry out scientific experiments. Other projects might require specific environmental conditions, such as temperatures maintained within a certain range. Still other projects may require access to certain physical environments, such as the ocean or outer space. In many cases, these specific conditions can only be obtained at a certain time of year or in a certain location. It is the project manager's job to ensure that the project planning specifies these requirements.

EXAMPLE: A new project is designed to test whether a certain plant can grow in a certain temperate environment during a certain season. For this project, proper planning is essential to ensure that the project is ready to start where and when the season starts.

Changes to the project environment can affect all three triple constraints: scope, time, and cost.

Resources Constraint

Resources are the personnel and other assets needed to complete the project. Personnel might constrain the project by being available only at certain times, needing a fixed amount of time to perform a task, or lacking the skills to produce the deliverables. For personnel resources, the project manager will need to ensure that the team members have the appropriate skills needed to complete their project tasks. For all other assets, the project manager must ensure that the assets are procured and available in time to be used in the tasks for which they are needed.

EXAMPLE: After the Planning phase of a new project is complete, the project manager discovers that the limestone required for the project will not be available from the supplier for at least six months. Another supplier has enough of the limestone in stock for the project, but at a considerably higher price. The project

manager and project sponsor will need to make a choice between three alternatives: 1) Change the schedule to reflect the projected availability of the required limestone at the original cost. 2) Increase the budget to cover the inflated cost of the limestone that is available now. 3) Change the scope of the project to allow for using another building material.

During the Planning phase of the project, the project manager determines all resources needed for the project. In the Executing phase, the resources must be acquired and allocated to their tasks. The project tasks directly affect the resources needed.

EXAMPLE: In a current printing project, the project sponsor wants to change to using a higher-quality paper. The project manager will need to increase the project budget to account for the increased cost of the higher-quality paper. In addition, the project schedule might be delayed to accommodate ordering and receiving the new paper.

EXAMPLE: A team member resigns, and the project manager must find a replacement. The project manager may need to increase the budget if the replacement team member is paid at a higher rate than that of the original team member. The project schedule also may need adjustment if the replacement team member works at a different speed than the original team member, because the new team member may take a longer or shorter time to complete assigned tasks.

Project resource changes most likely affect time and cost.

Requirements Constraint

Requirements are conditions that must be present in the project's end product or service. Requirements are also constraints because they directly affect the project scope and determine the criteria by which the final product is graded. As stated earlier, requirements describe the desired outcome, but quality is how you measure whether you have delivered the outcome. Requirements are assessed using key performance indicators and acceptance criteria.

NOTE See Chapter 12 for details on assessing requirements with KPIs.

During the Planning phase, the project manager gathers requirements from the project sponsor and stakeholders, documents the requirements, and then negotiates with the project sponsor to determine which requirements will be included in the project. In an Agile framework, this phase includes gathering user stories. The requirements are then used to define the project scope. If the requirements change, the project scope must be changed. In addition, it may be necessary to change the

project budget and project schedule. In some cases, requirements are not attainable at all, or must be delayed until a future revision of the product.

NOTE For more on development with an Agile team, see Chapter 6, "Agile Methodology."

EXAMPLE: A state governmental agency specifies several requirements during an inspection of a construction project. The project manager will need to change the scope of the project to include these requirements, add any necessary tasks to the project to handle the requirements, and allocate resources for those tasks. Finally, the project manager will need to adjust the project budget to include any new costs incurred to meet the requirements.

Project requirement changes usually affect the project's scope, time, and cost.

Key Topic

Project Influences

An *influence* is a project event or condition that can affect a project constraint. Project managers must be able to recognize whether an influence is about to occur, taking appropriate actions to either prevent the influence or adjust the project constraints to account for the influence. Common influences include change requests, scope creep, constraint reprioritization, interaction between constraints, stakeholders/sponsors/management, and other projects.

Key Topic

Change Requests

A *change request* is a formal proposal to modify a project in some way. Change requests include changes to deliverables, baselines, procedures, or documents. No matter which aspect of the project is changed, any approved changes will affect at least one of the triple constraints.

All change requests must be submitted to the change control board and undergo the formal change control process. The change control board reviews the change and decides whether to accept or deny it. Prior to approving a change request, the change control board should thoroughly analyze any project changes that will be necessary to accommodate the change. If the change request is approved, the project manager will then need to change the project scope, budget, and/or schedule to address the approved change.

NOTE The change control process is discussed in detail in Chapter 11.

EXAMPLE: During a kitchen remodeling project, the homeowner decides he wants to install granite instead of laminate countertops. Because the homeowner is the project sponsor, the project manager will need to explain how the proposed change in countertop materials will affect the project schedule and the budget. If the homeowner approves these time and budgetary changes, the project manager will need to take the necessary steps to implement the approved changes, including ordering the granite, canceling the laminate, renting a granite saw, rescheduling the painters, giving the homeowner a new move-in date, and billing for the difference in materials and labor costs.

Change requests usually affect all three triple constraints: scope, time, and cost. Regardless of the type of project, project managers need to fully analyze any changes to determine ways to offset these changes. For example, counterbalances to a change in project cost could include decreases in scope, time, quality, and/or resources. The project sponsor is best able to determine the changes that should occur if project cost is affected.

Scope Creep

Scope creep occurs when the project scope is changed without adjusting other project constraints, including cost, time, and resources. In most cases, this type of event occurs when the project's scope and requirements are not properly documented during the Planning phase, and it tends to be more likely in larger projects. Think of scope creep as project changes that skip the formal change control process and therefore affect the project constraints without approved adjustments being made.

EXAMPLE: An application development project is affected by a newly enacted government regulation. Unfortunately, the required changes were added to the project requirements without also adjusting the corresponding project constraints, including scope, schedule, and budget. These changes result in the project taking longer than originally projected, and at a higher cost.

Scope creep affects all three triple constraints: scope, time, and cost. Besides documenting the project's initial requirements, the best way to prevent scope creep from affecting the bottom line is to have—and follow!—the change management plan and communication plan described in Chapter 1.

NOTE Aspects of project change and the change control process are discussed in detail in Chapter 11.

Scope creep occurs when clients change their minds and are able to make project changes without going through the change control process. It can be a major

problem when a project has team members who work autonomously. The project manager must ensure that team members understand that *all* changes, large or small, must follow the change control process. Scope creep can happen in any project but is particularly a problem when project team members work from different locations.

EXAMPLE: ABC Corporation hires Designs for You, LLC to redesign the ABC Corporation website. Designs for You, LLC contracts with Jane Smith to code the site and David Jones to design the graphics. Jane and David only interact during virtual project meetings. One month into the project, management at ABC Corporation decides that a graphic for one of the new pages is unsatisfactory, even though it is exactly what the contract specified. ABC Corporation contacts David Jones about the graphic, and David implements the change as requested. However, the change was not formally approved based on the change control process documented in the change management plan. When David's work is complete, he bills Designs for You, LLC for all of his work, including the graphics change. The project manager at Designs for You, LLC adjusts the budget to cover the extra pay for David. When the finished graphics are delivered to Jane Smith, she discovers that the graphics change causes a functionality issue with her code. Jane will now need to adjust her coding, resulting in another budget increase to cover her work. If the higher costs for both workers exceed the budget reserves, Designs by You, LLC will need to either 1) absorb the budget overage, or 2) work with ABC Corporation to increase the budget. This late in the project, a budget increase is unlikely to be approved. To prevent this scope creep, which includes unauthorized graphics and coding changes, the project manager should have explained to all team members that *all* changes must go through the formal change control process, even if the change request comes directly from the project sponsor or customer.

Constraint Reprioritization

Constraint reprioritization occurs when a project that is limited by a particular constraint must shift priorities to another constraint. When reprioritization occurs, the project manager must fully assess all project constraints to document any effects on them. The project manager will then need to explain to the project sponsor what this reprioritization will do to the project.

If a project's cost estimates were inaccurate and more money is required to produce a deliverable, cost becomes the primary constraint for the project. To meet the original scope, the project budget will need to be increased and approved by the project sponsor. If the budget is not increased, another project constraint will need to be adjusted to reduce the pressure of the cost constraint; the project might need to drop a requirement or change the quality standards.

EXAMPLE: While a publisher is working on a new book project, a competitor announces plans to publish a book on a similar topic with an earlier release date. Because the project's original priority was minimizing costs, only a single author and editor were engaged. However, the publisher now wants to move up the book's schedule to beat its competitor's book to publication. To make the date, the publisher may need to increase the budget to employ additional resources or to give the current resources an incentive to speed up their work. Another option would be to change the scope of the book, perhaps by shortening the content. However, this change probably would also affect quality. No matter which choice is made, the project manager will have to adjust all of the affected project constraints.

Constraint reprioritization affects all three triple constraints—scope, time, and cost—and the ultimate effects depend on which constraint is being prioritized.

Key Topic

Interaction Between Constraints

Project constraints directly interact with each other throughout the life cycle of the project. During the Planning phase, the project manager uses the information gathered about constraints to create the project documents, budget, schedule, and scope.

It is important to realize that other constraints can actually affect one or more of the triple constraints (scope, time, and cost). Resources directly affect project costs. Quality, requirements, and deliverables directly affect project scope. Environment directly affects project time and costs. Results of such changes can be both negative and positive. Suppose two new team members are brought into an engine development project. While this staffing change will likely increase the project budget, it also has a good chance of shortening the project schedule.

EXAMPLE: A key project team member goes on medical leave halfway through a project. The project manager assesses the impact to the project schedule and then presents the sponsor or key stakeholder with possible courses of action. Suggestions might include securing more funding to hire another team member, or extending the project schedule to account for slower progress. The two options affect the project's constraints in different ways:

- If the project will remain understaffed but the schedule can be extended, the project manager will have to reassign the missing team member's work to other resources and adjust the task start/finish dates, dependencies, and critical paths. Project milestones will have to be rescheduled.
- If the original schedule must be followed but more funds will be made available, the project manager should assess the cost to hire new resources, the impact on the schedule if resources must be trained, and the impact on deliverable quality if a sufficiently skilled resource cannot be hired.

Project managers need to understand the relationships between all the constraints, adjusting project scope, budget, or schedule accordingly when other constraints change.

Key Topic

Stakeholder, Sponsor, and Management Influences

Stakeholders, sponsors, and management can also affect project constraints. Stakeholders and sponsors are involved in setting project requirements, which directly affect the project scope. Sponsors also establish the project budget and influence the project schedule.

Management usually affects the project schedule more than the other constraints, especially if the organization's structure is functional rather than projectized. In a functional team structure, the managers control access to the project team members.

NOTE For differences between functional and projectized team structures, see Chapter 2.

EXAMPLE: A key stakeholder asks the project manager to make a significant change in a deliverable. The stakeholder did not consult the project sponsor about this request. The project manager asks the stakeholder to complete a change request that documents the proposed revision and assesses the impact of the change. Only then should the project manager approach the sponsor to seek approval, following the change control procedure detailed in the change management plan.

As with other influences, stakeholders, sponsors, and management can affect all three triple constraints: scope, time, and cost.

Influence by Other Projects

Other projects can influence project constraints; for example, by competing for the use of shared resources. The project manager may need to negotiate with other project managers and with the project management office (PMO), if one is available, to obtain the resources when needed.

EXAMPLE: Two projects need access to the same laboratory as part of the research portion of each project. During project planning, the project management office discovers that the two projects have planned to use the laboratory during the same two-week period. The PMO works with the project managers of the two projects to come up with three options: 1) finding a way to share the laboratory at the same time; 2) allowing each team half-day access to the laboratory, with one project team having mornings and the other having afternoons; or 3) giving primary laboratory

access to the higher-priority project and delaying laboratory access until later for the lower-priority project. The first two choices would require a schedule adjustment for both projects, and the third choice would require a schedule adjustment for only one of the projects. After fully assessing the options and reaching a decision on how to proceed, the project managers can make the necessary adjustments. In this case, it is not necessary to follow the change control process because the issue was discovered during the Planning phase, prior to project execution.

During the Planning phase, project managers should document any resources that will be shared with other projects. Inter-project conflicts should be negotiated between the project managers. If they are unable to resolve a problem, the PMO or upper management should make the decision. In larger corporations, company policies may dictate how such issues will be resolved.

Exam Preparation Tasks

As mentioned in the section "How To Use This Book" in the Introduction, you have several choices for exam preparation: the exercises here; Chapter 15, "Final Preparation"; and the Pearson Test Prep practice test software online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 7-2 provides a reference of these key topics and the page number on which each begins.

Key Topic

Table 7-2 Key Topics for Chapter 7

Key Topic Element	Description	Page Number
Section; example	Discussion and example of project *constraints* and the *triple constraint*	129
Section; example	Discussion and example of *cost constraint*	130
Section; example	Discussion and example of *scope constraint*	131
Section; example	Discussion and example of *time* and *scheduling constraints*	131
Section; example	Discussion and example of *deliverables constraint*	132
Section; example	Discussion and example of *quality constraint*	132
Section; examples	Discussion and example of *environment constraint*, *corporate environment*, *global environment*, and *project environment*	133

Key Topic Element	Description	Page Number
Section; examples	Discussion and examples of *resources constraint*	134
Section; example	Discussion and example of *requirements constraint*	135
Section	Definition of *project influence*	136
Section; example	Discussion and example of *change request* influence on project constraints	136
Section; examples	Discussion and examples of *scope creep*	137
Section; example	Discussion and example of *constraint reprioritization*	138
Section; example	Discussion and example of interaction between constraints	139
Section; example	Discussion of stakeholder, sponsor, and management influences on project constraints	140

Define Key Terms

Define the following key terms from this chapter and check your answers in the Glossary:

constraint, triple constraint, reserves, corporate environment, global environment, project environment, resources, influence, change request, scope creep, constraint reprioritization

Review Questions

The answers to these questions appear in Appendix A. For more practice with sample exam questions, use the Pearson Test Prep practice test software online.

1. You have been hired to take over as project manager for a research project. You discover that the costs for the project's supplies are significantly higher than originally estimated. However, the budget was not adjusted to show this increase. What could you do to resolve this issue? (Choose all that apply.)
   a. Request additional funds from the project sponsor.
   b. Find ways to cut costs in other areas of the project.
   c. Decrease the quality of the project.
   d. Shorten the project schedule to decrease costs.

2. During project planning, the project sponsor for a new electronic device requests that you add a new feature to the product. You meet with the sponsor to discuss adding this new feature. What should be the outcome of this meeting?
   a. Decrease the quality of the new device.
   b. Hire new personnel to develop the new feature.
   c. Obtain additional funds to cover the new feature development.
   d. Remove one of the other features of the device.

3. For your company's current project, the project manager discovers that creating the project deliverables is taking significantly longer than estimated. After discussing this issue with the project sponsor and following the proper change control procedure, the project manager hires a new team member. Which project constraints should be adjusted as a result of this action?
   a. cost, time, and scope
   b. time and scope
   c. cost and scope
   d. cost and time

4. You are hired to take over a project, and you discover that a deliverable was omitted. You discuss this issue with the project sponsor, who decides to add the deliverable. Which project constraints should be adjusted as a result of this action?
   a. cost, time, and scope
   b. time and scope
   c. cost and scope
   d. cost and time

5. For a new printing project, the project sponsor requests a higher-quality vinyl, which is not currently in stock. Which project constraints should be adjusted as a result of this request?
   a. cost, time, and scope
   b. time and scope
   c. cost and scope
   d. cost and time

6. You are the project manager for an application development project. As part of the project, quality assurance testers will need access to a lab environment. After completing project planning, you discover that the lab will not be available when you need it but will be available at a different time. Which project constraint should be adjusted as a result of this issue?
   a. scope
   b. time
   c. cost
   d. requirements

7. You are the project manager for a new construction project. During project planning, you learn that a backhoe owned by the project sponsor can be used for the project. However, two days before you need the backhoe, you find out that it is being repaired, and you must rent a backhoe instead. Which project constraint should be adjusted as a result of this issue?
   a. scope
   b. time
   c. cost
   d. deliverable

8. You are the project manager for a retail store redesign project. Two weeks into project execution, the project sponsor requests that you increase the width of the main aisles by one foot. This change is approved, and the project requirements are adjusted. Of which influence is this an example?
   a. change request
   b. scope creep
   c. constraint reprioritization
   d. another project

9. You are hired to take over as project manager for an existing project. On your first day, you discover that the project is over budget and behind schedule as a result of new requirements having been added to the project. The project's budget and schedule were not adjusted when these requirements were added. Of which influence is this an example?
   a. change request
   b. scope creep
   c. constraint reprioritization
   d. another project

10. You are managing a project to produce a new refrigerator design for commercial usage. When the project was originally planned, the project sponsor wanted to obtain the design as quickly as possible to be first to market. However, today you learned that the company is having a budget crisis, and the project sponsor asks you to adjust your project to minimize costs. Of which influence is this an example?

a. change request

b. scope creep

c. constraint reprioritization

d. another project

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