

Aligned with the 2021 Exam Content Outline, The PMBOK® Guide
7th Edition, and the Process Groups: A Practice Guide

 Arranged by Knowledge Area

 Exam Tips

 Real World Examples

 Quick Review Exercises

PMP®

CREDENTIAL EXAMINATION STUDY GUIDE

Everything You Need to Know to *Master*
the PMP® Credential Examination

SEAN WHITAKER, BA, MSC, MBA, PMP

PMP® Credential Examination Study Guide

Everything You Need to Know to Master the PMP® Credential Examination

Sean Whitaker, BA, MSc, MBA, PMP

Copyright © 2024 by Sean Whitaker. All rights reserved. Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written permission of the publisher and author.

Version 6.2

By Sean Whitaker, BA, MSc, MBA, PMP

“PMP”, “PMBOK”, “The PMBOK® Guide”, and “PMI” are registered marks of the Project Management Institute, Inc.

This book is an ongoing work in progress so if you discover any errors or omissions, please contact the author directly and I will make the amendments and issue an updated version.

Please check back regularly for any updated copies of the book as I will be updating it regularly to make sure it still stays relevant.

Sean Whitaker

E-mail: sean@seanwhitaker.com

Web: www.seanwhitaker.com – The Practical Project Manager

www.crystal.consulting - Crystal Consulting provides all your project management consultancy & training needs.

You only need to buy this book once and you are entitled to all future updates. Check the version number above and email me occasionally to see if there is a new version.

This book is dedicated to you for choosing to commit to your own ongoing professional development.

No form of education is ever wasted and without doubt the greatest investment you can ever make is in your own development.

noli cedere cognoscere

Contents

How to Use This Book.....	1
1. Foundational Concepts of Project Management.....	3
1.1 The PMBOK® Guide & Process Groups: A Practice Guide.....	3
1.2 What is a Project, a Program, and a Portfolio?.....	6
1.3 What is Project Management?.....	8
1.4 Project Management, Operations Management, and Organizational Strategy.....	9
1.5 Internal and External Influences on Project Management.....	11
1.6 The Project Life Cycle.....	13
1.7 An Introduction to Agile.....	15
1.8 Compliance and Delivering Value.....	17
1.9 Supporting Organizational Change.....	18
1.10 Chapter Summary.....	19
1.11 Exercises.....	20
1.12 Review Questions.....	22
1.13 Answers.....	24
2. Project Integration.....	29
2.1 What is Integration Management?.....	29
2.1 Develop Project Charter.....	30
2.3 Develop Project Management Plan.....	37
2.4 Direct and Manage Project Work.....	42
2.5 Manage Project Knowledge.....	46
2.6 Monitor and Control Project Work.....	49
2.7 Perform Integrated Change Control.....	52
2.8 Close Project or Phase.....	57
2.9 Chapter Summary.....	60
2.10 Exercises.....	62
2.11 Review Questions.....	62
2.12 Answers.....	65
3. Scope Management.....	69
3.1 What is Project Scope Management?.....	69
3.2 Plan Scope Management.....	71
3.3 Collect Requirements.....	74
3.4 Define Scope.....	79
3.5 Create WBS.....	82
3.6 Validate Scope.....	85
3.7 Control Scope.....	88
3.8 Chapter Summary.....	90
3.9 Exercises.....	91
3.10 Review Questions.....	91
3.11 Answers.....	93
4. Time Management.....	96
4.1 What is Project Time Management?.....	96
4.2 Plan Schedule Management.....	97
4.3 Define Activities.....	99
4.4 Sequence Activities.....	102
4.5 Estimate Activity Durations.....	107
4.6 Develop Schedule.....	114
4.7 Control Schedule.....	122
4.8 Chapter Summary.....	126
4.9 Exercises.....	127
4.10 Review Questions.....	128
4.11 Answers.....	130
5. Cost Management.....	134
5.1 What is Project Cost Management?.....	134
5.2 Plan Cost Management.....	135
5.3 Estimate Costs.....	137

5.4 Determine Budget	143
5.5 Control Costs	147
5.6 Chapter Summary	153
5.7 Exercises	154
5.8 Review Questions.....	154
5.9 Answers	157
6. Quality Management	161
6.1 What is Project Quality Management?	161
6.2 Plan Quality Management	162
6.3 Manage Quality	166
6.4 Control Quality	177
6.5 Chapter Summary	180
6.6 Exercise	181
6.7 Review Questions.....	181
6.8 Answers	184
7. Resource Management	187
7.1 What is Project Resource Management?	187
7.2 Plan Resource Management.....	188
7.3 Estimate Activity Resources.....	196
7.5 Develop Team.....	203
7.6 Manage Team.....	212
7.7 Control Resources	215
7.8 Chapter Summary	218
7.9 Exercises	219
7.10 Review Questions.....	220
7.11 Answers	222
8. Communications Management	225
8.1 What is Project Communications Management?	225
8.2 Plan Communications Management.....	226
8.3 Manage Communications	232
8.4 Monitor Communications	236
8.5 Chapter Summary	239
8.6 Exercises	240
8.7 Review Questions.....	240
8.8 Answers	242
9. Risk Management.....	246
9.1 What is Project Risk Management?.....	246
9.2 Plan Risk Management.....	247
9.3 Identify Risks	251
9.4 Perform Qualitative Risk Analysis.....	256
9.5 Perform Quantitative Risk Analysis	259
9.6 Plan Risk Responses.....	265
9.7 Implement Risk Responses	270
9.8 Monitor Risks.....	272
9.9 Chapter Summary	275
9.10 Exercises	275
9.11 Review Questions.....	277
9.12 Answers.....	280
10. Procurement Management.....	286
10.1 What is Project Procurement Management?.....	286
10.2 Plan Procurement Management	287
10.3 Conduct Procurements	293
10.4 Control Procurements.....	300
10.5 Chapter Summary	304
10.6 Exercises	305
10.7 Review Questions.....	305
10.8 Answers	308
11. Stakeholder Management	312
11.1 What is Project Stakeholder Management?.....	312

11.2 Identify Stakeholders.....	313
11.3 Plan Stakeholder Engagement.....	317
11.4 Manage Stakeholder Engagement	321
11.5 Monitor Stakeholder Engagement.....	325
11.6 Chapter Summary	329
11.7 Exercises	330
11.8 Review Questions	330
11.9 Answers.....	333
12. Agile Approaches, Tools, and Techniques	337
12.1 What is Agile?.....	337
12.2 Agile Frameworks and Methodologies.....	338
12.3 Agile Planning and Estimation	339
12.4 Agile Monitoring and Controlling.....	342
12.5 Agile Tools and Technologies	344
12.6 Agile Leadership and Soft Skills.....	346
12.7 Risk Management in Agile.....	347
12.8 Agile and Organizational Change	347
12.9 Chapter Summary.....	348
12.10 Exercise.....	349
12.11 Review Questions	349
12.12 Answers.....	351
13. Ethics and Professional Conduct	353
13.1 Responsibility, Respect, Fairness, and Honesty.....	353
13.2 Responsibility	354
13.3 Respect.....	355
13.4 Fairness.....	356
13.5 Honesty	357
13.6 Chapter Summary	358
13.7 Exercise.....	359
13.8 Review Questions	359
13.9 Answers.....	363
14. Eligibility, Study and Exam Taking Tips	367
15. Formulae to Remember.....	369
16. Glossary of Key Terms	371

How to Use This Book

Congratulations on committing to studying to sit the Project Management Professional (PMP®) credential. This book contains all the information you need to pass the PMP® examination. I have taken my time to include all the information necessary to pass the examination and also some extra information about the profession of project management.

There are several ways to organize a book such as this. I could have organized the material in the same way as the PMP® Examination Content Outline (ECO) presents the material which defines the exam (e.g. People, Process, and Business Environment Domains). I could have presented the material following the process groups structure of the Process Groups: A Practice Guide document from the Project Management Institute (PMI) e.g. Initiating, Planning, Executing, Monitoring & Controlling, and Closing. Either one of these would have been suitable for your studies. What I have chosen to do instead is organize the study materials mainly by the individual knowledge areas, not process groups, contained in the Process Groups: A Practice Guide, as this presents the material in a comprehensive way, and you get to focus your attention on a specific topic.

Remember that the way the information is presented isn't that important because the questions in the exam are not presented by process group, domain, or knowledge area. They are completely random so the aim of a book like this is to pass on the knowledge you need to be successful.

Here is a guide to all the extra bits and pieces in the book:

- Words in Italics – these are key terms and you should try and memorize and understand all of them. Each of them is included in the Glossary of Key Terms at the rear of the book.
- Exam Tips – these highlighted pieces of text give you direct tips for the exam.
- Real World - these highlighted sections of the book provide examples of the theory in action from my own experience. They are intended to add to your understanding of the concept being explained and also to share with you some of the lessons I have learned throughout my career.
- Notes – this information provides slightly more information about the topic being discussed that is not always directly related to the exam but is usually very interesting.
- Quick Check – The Quick Check questions and answers are at the end of each section and are intended to give the opportunity to quickly review the material you have just read with some simple questions.
- Review Questions - at the end of each chapter there are multi choice questions that test your knowledge and understanding of the topics just covered.
- Exercises – Each chapter concludes with exercises to test how well you understand the topics just covered.

Take your time to go through this book and complete all the exercises and questions. Use it as an ancillary text to your other study materials. The more you study, the greater the chances of success when sitting the PMP® examination.

Finally, think of me as your personal PMP® coach. Not only do you have access to the contents of this book but you can email me at any time with questions and I will answer.

Good Luck!



Sean Whitaker

sean@seanwhitaker.com

CHAPTER 1

1. Foundational Concepts of Project Management

This chapter describes foundational concepts contained in both the PMBOK® Guide and also the Process Groups: A Practice Guide document – these are two of the books that you should have a copy of as part of your study for the PMP® examination. This chapter will introduce you to the purpose and content of both the PMBOK® Guide and also the Process Groups: A Practice Guide, and provide some definitions of projects, project management, program management, portfolio management, organizational project management, operations management, organizational strategy, business value, and the project life cycle. All of these foundational concepts are important to ensure that you understand the terminology used by the PMBOK® Guide and Process Groups: A Practice Guide, because they are foundational elements of the PMP® exam. It is important that you take time to fully understand these foundational concepts, because they underpin many of the processes, tools, and techniques that come later in the book.

EXAM TIP

Remember that the PMP® exam is testing a lot of elements, including your understanding of the PMBOK® Guide and Process Groups: A Practice Guide terminology and concepts. You may come across questions that have an answer that is what you would actually call something in real life but it is not how the PMBOK® Guide or Process Groups: A Practice Guide would refer to it. In this instance, always answer according to the PMBOK® Guide and Process Groups: A Practice Guide. Also, pay close attention to not only the terms but also the various inputs and outputs as questions will often outline a particular specific situation and you will need to know what has already occurred to reach this point in a project, and what should occur next.

Objectives

- To introduce and outline the key foundational terms, purpose, and contents of the PMBOK® Guide and Process Groups: A Practice Guide.
- To understand the differences and interrelationship, between project, program, and portfolio management.
- To understand the relationship between organizational project management, operations management, and organizational strategy.
- To understand the role that business value and strategic planning have in project management.
- To define organizational process assets and their benefit to project management.
- To define enterprise environmental factors and the ways in which they can assist and constrain a project.
- To define and understand the characteristics of the project life cycle, including project phases

1.1 THE PMBOK® GUIDE & PROCESS GROUPS: A PRACTICE GUIDE

There are many sources that can be used to study for the PMP® examination and you need to know that the examination is not based on any single source. It is based on a wide range of sources but we are fortunate to have both the PMBOK® Guide and also the Process Groups: A Practice Guide books from PMI. Each of these books contains a lot of information that is useful for your study for the examination. As such it is worthwhile taking a closer look at each of them. You can download pdf versions of each from the PMI website, and if you are a member they are free to download.

The full title of the *PMBOK® Guide* is *A Guide to the Project Management Body of Knowledge*. If you break that down into its component parts, you can get an understanding of what sort of document it is.

First of all, it is a guide. This means that it is not a prescriptive instruction manual that must be followed to the letter, and individuals and organizations can, and do, choose to only implement appropriate portions of the PMBOK® Guide. It presents the information as a guide for you to use when and if it is useful. Obviously, it is a guide to the profession of project management. Because the profession of project management is both relatively young and also very wide in its application, any book purporting to be about it is necessarily going to be both iterative and also broad in the information contained within it. This is the 7th edition of the PMBOK® Guide and represents a major change from previous versions, as it splits the previous combined knowledge into foundational elements in the PMBOK® Guide, while full descriptions of the processes, tools and techniques are now contained in the publication

called *Process Groups: A Practice Guide*. In previous versions these two documents were combined into a single document.

The development and updating of the PMBOK® Guide is an ongoing process, with an updated edition being released every three to four years. Make sure you have access to the latest copy of the PMBOK® Guide and also *Process Groups: A Practice Guide*. Both documents are also aligned with ISO 21502:2012 Guidance on Project Management.

EXAM TIP

ISO 21502:2012 is an international standard for project management developed by the International Organization for Standardization (The initials ISO come from the French way of saying this). It provides guidance and a high-level description of concepts and processes that are considered to form good or best practice in the profession of project management.

Finally, as a body of knowledge, both documents combined contain what is considered to be a fairly complete set of knowledge about the profession of project management. Many professions, including civil engineering, software engineering, contracting, and even event management have bodies of knowledge associated with them.

Overall, both the PMBOK® Guide and *Process Groups: A Practice Guide* present what is generally recognized to be good practice in the profession of project management. This means that the processes, tools, and techniques that it presents are useful to most projects most of the time. It is up to the organization or the project management team to determine which, if any, of the processes, tools, or techniques are useful for any project they are working on. This process of selecting only those processes, tools, and techniques that actually provide benefit when managing your projects is called *tailoring*.

Real World

Neither the PMBOK® Guide nor *Process Groups: A Practice Guide*, is a project management methodology. They are both framework documents containing the collection of what is considered good project management practice for projects of any size, complexity, and industry. In order to build a project management methodology, you are directed to take from the PMBOK® Guide and *Process Groups: A Practice Guide* only those processes, tools, and techniques that are appropriate and add value to your project via the process of tailoring.

In addition to representing a robust body of knowledge, the PMBOK® Guide and *Process Groups: A Practice Guide* also presents standardized terminology. This means that there is generally a single word or phrase to define and describe each element of project management. It allows project managers and project team members within the same organization, and between organizations, to communicate effectively.

Real World

The benefit of a standardized terminology cannot be underestimated. I have been in many situations with people from differing organizations who make simple mistakes because they use different words for the same thing. I remember once I asked a contract manager on my team for the project schedule, and he sent me the schedule of materials. After three requests and increasing confusion on both sides, we finally figured out that I was requesting what he referred to as the project timeframe. On another occasion, I was assisting a firm that was growing rapidly and recruiting project managers every week. The biggest challenge they faced was the different terminology all these experienced project managers used. We worked on developing a common organization-wide project management vocabulary to improve communication between all the project managers and project team members.

Of course, your main interest in the PMBOK® Guide and *Process Groups: A Practice Guide* is that they are very useful texts upon which to base your study for the Project Management Professional (PMP®) certification. Passing the PMP® examination requires knowledge of the contents of the PMBOK® Guide, and *Process Groups: A Practice Guide*, as well as knowing the "Project Management Institute Code of Ethics and Professional Conduct." There are other sources as well, but these documents contain most of what you need to pass. This study book presents all the information you need to pass the examination.

EXAM TIP

Even if you have a photographic memory and could remember every page of the PMBOK® Guide and *Process Groups: A Practice Guide*, you will not necessarily score 100 percent on the PMP® examination because the PMP® examination is based upon the results of a Role Delineation Study (RDS) about what professional attributes a project

manager should have. The PMBOK® Guide and Process Groups: A Practice Guide presents very useful texts upon which to base your study. This is because the contents of the PMBOK® Guide and Process Groups: A Practice Guide are built upon the knowledge of many disciplines, and often a single phrase or sentence in the PMBOK® Guide and Process Groups: A Practice Guide can refer to an entire other subject area. That is why simply studying the PMBOK® Guide and Process Groups: A Practice Guide is not the best approach to preparing to sit the PMP® examination. This book will not only introduce you to the entire contents of the PMBOK® Guide and Process Groups: A Practice Guide, but also present a lot of other information so you are prepared to pass the examination.

Quick Check

1. How should you use the PMBOK® Guide and Process Groups: A Practice Guide in your projects?
2. Apart from offering a collection of good practices in project management, what other main benefit do the PMBOK® Guide and Process Groups: A Practice Guide books provide?

Quick Check Answers

1. You should use them wisely and select from them only those processes, tools, and techniques that are appropriate for your projects based on size, complexity, and industry.
2. They provide a standardized terminology, or lexicon, for the profession of project management.

EXAM TIP

How to use the Process ITTO to Answer Exam Questions: A lot of exam questions will describe a particular scenario which outlines a specific point a project. If you read the question carefully you will realize exactly where you are in the project, which means you will know the work that has been done, and what processes, documents, and outputs have been created, in order for you to be at this point; and you will also know the work that hasn't been done yet.

For example, if the question says something like “you are currently reviewing prospective seller responses to and RFP you have issued”, you know immediately that the project is well underway so the project charter has been complete, the project management plan is well underway including the scope management plan, scope baseline, the procurement management plan in particular, and also that seller proposals have been received – these are all inputs into this process. If you look at the other inputs in the Conduct Procurements process you will also see what else has been completed to enable you to be at this point.

Now you should look at the outputs from the Conduct Procurements process to see what hasn't been done (assuming this is the first time you are reviewing seller responses of course. Those outputs, and processes they become inputs into are the likely next steps which may be what the question is asking. You will see the outputs and the next thing you should think about is where they go on to become inputs. For example, selected sellers is an output from Conduct Procurements that goes on to become an input into Control Procurements; Change requests are an output that go on to become inputs into the Perform Integrated Change Control process; and agreements are outputs from this process that go on to become inputs into ten other processes (check out figure 6-18 on page 158 of Process Groups: A Practice Guide to see them all).

So, as you work through this book try to really focus on the process by which inputs get turned into outputs using particular tools and techniques. In most cases I will document where inputs come from, and where outputs go to, but if I don't I want you to start to think about this and have an educated guess before looking for the answer. Refer to the Process Groups: A Practice Guide as it has mind maps for each process clearly showing where inputs come from, and where outputs go to.

1.2 WHAT IS A PROJECT, A PROGRAM, AND A PORTFOLIO?

It may seem straightforward to define exactly what a *project* is, but it is important that you know how the PMBOK® Guide and Process Groups: A Practice Guide defines one. There are several key elements that separate project work from ongoing or operational work.

The first and most important element of a project is that it has a defined start and end, making it a temporary endeavor. On the other hand, operational, or ongoing, work is ongoing and repetitive.

A project also delivers something unique, something that hasn't been done before. Ongoing work is repetitive and delivers the same thing every day or every year.

Finally, a project delivers a product, service, or result. This allows projects to be used to deliver a range of deliverables in many industries, whether they are based on goods or services.

EXAM TIP

There are only two types of work in the world, according to the PMBOK® Guide and Process Groups: A Practice Guide. All work is either operational work or project work. If it is operational work, then it is repetitive and ongoing. If it is project work, then it has a defined start, middle, and end and delivers a product, service, or result.

Real World

You may find a degree of overlap between project work and operational work. There are certainly some projects that bear a striking resemblance to operational work and perhaps could be construed as ongoing work. It is the unique aspect of each—and that it is done slightly differently, in a different location, to produce a slightly different product, service, or result—that makes it a project.

A portfolio of projects includes all the projects, whether interdependent or not, that an organization is undertaking. They are only connected by their common goal of delivering the organization's strategic goals.

A *program* of projects describes projects that have some sort of interdependency between them. They may all be part of a larger deliverable; for example, you could have several projects, each of which makes a different part of a new aircraft, but the final deliverable depends on managing the projects together as a program. The projects may also share a common goal, and the program manager needs to monitor and resolve any actual or potential conflicts in the pursuit of those goals.

A project can be part of a program and part of a portfolio. Figure 1-1 shows that all programs are part of a portfolio, but that projects can either be directly part of a portfolio or part of a program.

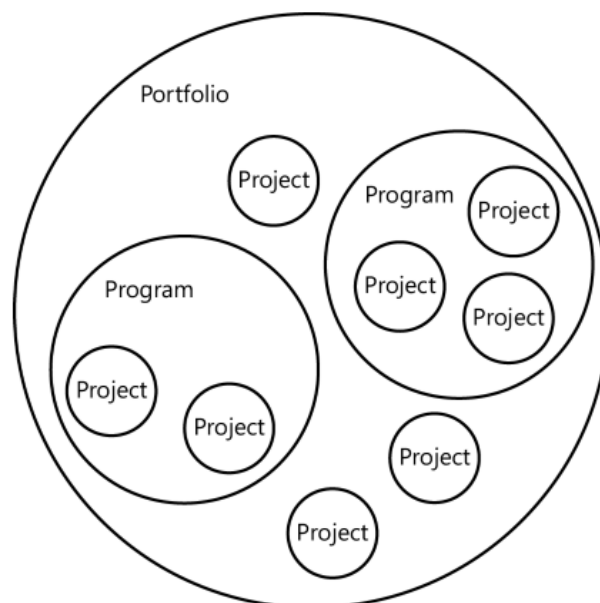


FIGURE 1-1 The relationship between portfolios, programs, and projects within an organization.

Project, program, and portfolio management are separate yet interrelated elements of the profession of project management. The combination of the project management, program management, and portfolio management

disciplines is seen as integral and necessary to deliver the organizational strategy and, therefore, any action undertaken in any of the three elements should always align with the organization's strategy.

Portfolio management ensures that all projects selected to be completed by the organization align with the organizational strategy. Portfolio management has an organizational scope that reflects the organizational strategy. Often projects or programs are grouped together into a single portfolio that reflects a specific strategy.

EXAM TIP

The PMBOK® Guide places a great deal of emphasis on the alignment of organizational strategy and the profession of project management as a strategic enabler for delivering the strategy. Always assume that the default position in a question is that an organization has a strategy and is using project management to achieve that strategy.

Program management focuses on managing interdependencies within projects with a common goal or capability. Program managers are skilled at forecasting, anticipating, and dealing with real or perceived conflict between projects in the same program. All programs have projects, but not all projects are part of programs.

EXAM TIP

An interesting distinction made by the PMBOK® Guide and Process Groups: A Practice Guide is that if the relationship between separate projects is based upon having a shared client or seller, or shared technology or resources, then the projects should be managed as a portfolio rather than a program.

The *project management office (PMO)* is the part of the organization responsible for project management excellence. It provides support for the project manager, which can mean many things, depending on the level of organizational project management maturity. A project management office can simply be a place where a project management methodology is developed and stored, or at the other end of the spectrum, it can be where all the project managers are located, a place that provides common reporting and manages shared resources and it is responsible for portfolio, program, and project management across the entire organization.

The Process Groups: A Practice Guide defines three main types of project management office, differentiated by the level of control and influence they have, as shown in Figure 1-2. The supportive project management office provides templates and basic processes and captures lesson learned. The controlling project management office may take responsibility for development and implementation of a project management methodology and provide project governance as well. The directive project management office takes direct control of management of projects within the organization.

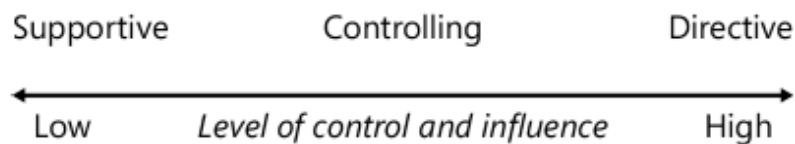


FIGURE 1-2 The types of project management office (PMO) from supportive to directive.

The type of project management office an organization should have also depends upon the level of organizational project management maturity the organization has attained. *Organizational project management maturity* is a way of assessing where an organization is currently with its level of sophistication and maturity around project management processes, tools, templates, and methodology, and then assessing where they should be. Organizations handling large and complex projects should be at a higher level of project management maturity than organizations managing small and simple projects. Organizations with a high level of project management maturity should have a more directive project management office.

EXAM TIP

If you see a reference to OPM3 in the exam, it is referring to the Organizational Project Management Maturity Model, which is a tool from the Project Management Institute (PMI) for assessing an organization's level of portfolio, program, and project management maturity.

Quick Check

1. What are the three key elements that distinguish project work from ongoing work?
2. What are the key differences between a program and a portfolio of projects?
3. How would you describe the main differences between project, program, and portfolio management?
4. What function would a project management office play in an organization with a high level of project management maturity?

Quick Check Answers

1. First, a project has a temporal element defining a start and an end, making it temporary rather than ongoing. Second, it delivers something unique and never done before. Finally, it involves delivery of a product, service, or result.
2. In a program of projects the projects share an interdependency, whereas in a portfolio of projects the projects are only united by the fact that they are all being completed by the same organization.
3. Portfolio management is the top-level selection process of projects to ensure that they deliver the organization's strategy. A program of projects contains projects that share a common goal or capability, and individual projects are focused on delivering a product, service, or result that will contribute to achievement of the organizational strategy. Remember that all programs have projects, but not all projects are part of programs.
4. An organization with a high level of project management maturity will use a directive project management office to take control of the way in which all projects are selected, managed, reported on, and communicated about within the organization

1.3 WHAT IS PROJECT MANAGEMENT?

Project management takes the tools, techniques, and skills contained in both The PMBOK® Guide and the Process Groups: A Practice Guide and applies them to the project to deliver the product, service, or result. It is a proactive, rather than a reactive, discipline.

EXAM TIP

Being proactive is a key point about professional project management. If there is any question in the exam that gives you the option to be proactive, it is probably the correct answer.

The Process Groups: A Practice Guide contains a description of 49 project management processes in 10 knowledge areas. These 49 processes are placed within five process groups of initiating, planning, executing, monitoring and controlling, and closing to describe the stage in the project in which they are best used. Managing a project means taking the appropriate process and the tools and techniques associated with it and applying them appropriately to the work that needs to be done. Project management, then, is simply the application of any of the Process Groups: A Practice Guide knowledge areas with the goal of delivering a product, service, or result.

One of the tasks of project management is the balancing of competing constraints on a project. These constraints can be scope, quality, schedule, budget or cost, resources, and risk. If any one of these constraints changes, it will likely place additional pressure on one or more of the other constraints. For example, if you have to deliver a project in a shorter time period, you may need additional budget to complete the work, and your known risks may increase while quality decreases.

EXAM TIP

You should know that one important aspect of project management is recognizing and navigating your way through competing constraints on a project. This is evident in planning a project and also when considering a request for a change to a project, where a request for more time may impact schedule, risk, or quality.

An important aspect of project management is that, generally speaking, you cannot know everything there is to know about a project at the outset and, thus, project management is highly iterative. This means that you may be able to define the work to be done for the next few weeks accurately, but beyond that you can't plan as well because there is more uncertainty, so you plan in an iterative manner, meaning that you plan many times, each time with more information. *Progressive* elaboration is an iterative process that acknowledges that you will know more the more you do. For example, at the beginning of a software project you may know the general expected outcome and the first steps on the path to delivering it, but as you move along in the project you become more aware of the magnitude of the work and can plan the project schedule, budget, and risks better. *Rolling wave planning* is another type of iterative planning where you plan in detail the next appropriate time period and, as you keep progressing throughout a project, you keep planning that same length of time in detail.

EXAM TIP

If you see the term “progressive elaboration” or “rolling wave planning” in the examination, it is referring to the concept of knowing more about the project the more work you do.

Real World

It is important to let your project stakeholders know that projects are generally iterative and subject to progressive elaboration, to counter the expectation that you can plan everything at the beginning of a project.

Quick Check

1. How would project management differ from managing an ongoing business activity?
2. How does iterative planning differ from progressive elaboration of a project?

Quick Check Answers

1. Project management uses the process, tools, and techniques of Process Groups: A Practice Guide, is subject to multiple interdependent constraints, and is subject to iterations and progressive elaboration. It is also a temporary endeavor with a defined end. Ongoing operational business activity may or may not be subject to interdependent constraints, and it does not have a defined end.
2. You can deliberately choose to plan iteratively even with a known scope of work. You can decide to focus your detailed planning activities on the immediate future and revisit the planning stages as the project progresses. Progressive elaboration, or rolling wave planning, implies that not everything is known about a project and more will become known as the project moves along.

1.4 PROJECT MANAGEMENT, OPERATIONS MANAGEMENT, AND ORGANIZATIONAL STRATEGY

As you already know, project management is all about delivering a product, service, or result. After this product, service, or result has been delivered as part of the entire project work or simply as part of a project phase, it normally gets handed over to operational management. Operational management differs from project management in that it is a permanent part of any organization and is focused on the ongoing activities of the business, whereas project management is focused on the temporary activities of project delivery. Operational management also provides the overall strategy for the organization, which is used to help select the right projects.

Obviously, each area intersects at the point where the deliverable is handed over. At this point, the normal operations of the organization may need to change or adapt to accommodate the deliverable. This is one role of operational managers.

EXAM TIP

For the exam, you need to know the difference between operational work and project work, and that operational management often takes responsibility for the deliverable for the project when it has been completed.

Real World

An important tip for any project manager is to include the end users responsible for use and maintenance of any deliverable in the list of stakeholders to be consulted. They will often have real-world experience in the use and ongoing maintenance of the deliverable that perhaps the people who design the deliverable don't.

The *business value* is the sum of all tangible and intangible values in the organization. It can include all capital assets of an organization as well as intangible elements such as brand recognition. Organizations strive to increase their business value, and they can use project management to help them do this. The successful creation of business value is enhanced by having a clear strategy and using the strategy to select projects that deliver appropriate business value. In this way, project management can contribute to the business value of an organization.

More specifically, portfolio management selects the projects that align with organizational strategy, program management manages interconnected projects, and project management delivers unique products, service, and results, all of which contribute to greater business value. The creation of business value is the final link in the process whereby project management can be seen as a key strategic enabler for a business.

Project management and organizational strategy are interrelated insofar as organizations achieve strategic goals by delivering successful projects which means that project management can be viewed as a strategic enabler. Although a project manager may not be involved in checking strategic alignment of all projects prior to approval they should ensure that any project they are given to manage can be mapped back to a strategic goal of the organization. Projects that are not aligned with organizational strategy may suffer from lack of political support and the organization may not have the core competencies required to complete the project.

Real World

It is important that project managers have a sound understanding of operational management objectives so they understand why their projects are important and how they fit into the overall organization strategy and add business value. In my own career I have found that a business education has helped my project management and, conversely, my project management experience has helped my operational management efforts.

Quick Check

1. Describe the two main points at which the worlds of operational management and project management intersect.
2. What are the key elements that make up business value?
3. How can project management contribute to the creation of business value?
4. How does portfolio management assist in the creation of business value?

Quick Check Answers

1. The first point of intersection is that operational management provides the overall organizational strategy that is used to select the right projects. The second main point where the two worlds meet is when operational management takes ownership of any project deliverable.
2. Business value is made up of both the tangible and intangible elements of a business.
3. Project management delivers products, services, or results that add either tangible or intangible business value.
4. Portfolio management focuses on ensuring that any projects selected are aligned with the organizational strategy and that the strategy delivers increased business value.

1.5 INTERNAL AND EXTERNAL INFLUENCES ON PROJECT MANAGEMENT

Projects are not completed in a vacuum, devoid of influence by an organization's culture, style, or structure. It is important for a project manager to recognize that each of these elements can positively or negatively influence the outcome of a project. Different organizations have different cultures. These cultures can be observed by noting such things as the values, beliefs, and expectations held by senior management; any relevant policies and procedures that the organization has; the motivation and reward systems its tolerance toward risk; its attitudes toward hierarchy and power and authority relationships; and such things as the expected work and work hours. The organizational culture is usually established by the founders of the organization, developed by the current employees, and perpetuated through its ongoing recruitment policies.

Real World

Often in the real world you will see organizations that do the same work technically but have completely different organizational cultures. I know of several people who have left one organization to go to a competitor, only to return within a few months because they didn't like the particular organizational culture.

In addition to the internal organizational culture founded by recruitment policies and current employees, an organization's culture can also be influenced by the broader cultural environment in which it operates. This includes factors such as employment market conditions, level of competition, and external political influences. It is up to the project manager to make sure he or she assesses and understands how these cultural factors may impact the project. This creates challenges for the project manager, who must be aware of issues around multiculturalism, particularly with the increase of globalization and the use of project team members from different countries.

EXAM TIP

Both the organization's culture and its structure are enterprise environmental factors, because they sit outside of the direct realm of the project and can assist or constrain the project.

So far, this chapter has looked at the impact of organizational culture upon projects. Other important aspects of organizational influence upon projects are Organizational Process Assets (OPA) and Enterprise Environmental Factors (EEF).

Organizational process assets, as the name suggests, are any existing artifacts, plans, procedures, policies, templates, and knowledge bases that the organization owns that can be used to assist the project. Organizational process assets appear as inputs into most of the 49 planning processes in *Process Groups: A Practice Guide*. Specific examples of organizational process assets include the project management methodology, artifacts, any blank templates, any change control processes and procedures, any financial control reporting requirements, any defined communication methods, any standardized approach to risk management the organization has, and any project closure guidelines, requirements, or checklists.

Enterprise environmental factors are always external to the project but not necessarily external to the organization; they are just not under the control of the project team. Enterprise environmental factors feature as inputs into most of the 49 processes in *Process Groups: A Practice Guide*. Specific examples of enterprise environmental factors include the organizational culture and structure, any relevant government or industry standards that can affect the project, any personnel administration requirements, any external marketplace conditions, the stakeholder risk tolerances, the external political climate, and any project management information systems, including any software purchased or licensed by the organization. Many people assume that project management software is an organizational process asset; however, it is generally considered to be an enterprise environmental factor because it is usually licensed rather than owned.

NOTE Referring to OPA and EEF in this book

We will only list examples of OPA and EEF for the first few processes as it can become very repetitive. We will always list when OPA and EEF are used as inputs to a process, or updates to them are outputs of a particular process, but will leave it to you to think about specific examples for that particular process.

Real World

The most common form of organizational process asset that most project managers encounter is the project management methodology that an organization has. A project management methodology

itself can mean many things. It can be as simple as a range of blank templates available to the project manager, or at the other end of the spectrum it can be a fully defined set of processes, procedures, templates, and databases that must be used for all projects.

EXAM TIP

A general rule of thumb for remembering the difference between organizational process assets and enterprise environmental factors is that, generally speaking, organizational process assets can be used to assist a project, whereas enterprise environmental factors will often constrain a project. Additionally, as the name suggests, with organizational process assets the organization must own the assets.

The main external factor influencing project management is the external business environment. The external business environment plays a pivotal role in determining the trajectory and ultimate success of any project. A project, no matter how meticulously planned or expertly executed, doesn't exist in a vacuum. It's subjected to an array of external factors such as economic conditions, technological advancements, socio-cultural shifts, political landscapes, legal stipulations, and even ecological dynamics. Ignoring or downplaying these elements can lead to strategic oversights, missed opportunities, or grave misalignments with market demands. A project that might seem feasible and lucrative in one economic climate could be rendered obsolete or unprofitable if there's an unexpected market downturn, regulatory change, or technological disruption.

Consequently, astute project managers and decision-makers always integrate an external environmental analysis into their planning and review processes. By staying attuned to external shifts and potential disruptions, organizations can preemptively adjust their strategies, allocate resources more effectively, and establish contingencies to navigate unforeseen challenges. Not only does this approach foster resilience and agility, but it also provides a competitive edge. In an ever-evolving global marketplace, the ability to anticipate and respond to external environmental changes can be the difference between project success and failure. To assist you in analyzing the potential impact of the external business environment there are three frameworks you can use.

The PESTLE framework is an analytical tool used to identify and assess external macro-environmental factors that might affect an organization. It's an acronym that stands for the six key areas of consideration:

- **P - Political:** This refers to the impact of political factors on an organization or industry. Examples include government regulations, political stability or instability, taxation policies, trade tariffs, and other political dynamics that might affect an organization's operations.
- **E - Economic:** Economic factors pertain to the overall health and direction of a nation's economy and can include aspects such as economic growth rates, interest rates, exchange rates, inflation, consumer spending patterns, and unemployment rates.
- **S - Social:** These factors encompass the societal and cultural influences that can affect demand for a company's products or services. Examples include demographic trends, shifts in values and cultural norms, and societal attitudes towards issues like health, wealth, or sustainability.
- **T - Technological:** Technological factors consider the impact of emerging and existing technologies. This could include aspects like research and development activity, automation, the rate of technological change, and the adoption of technology in broader society.
- **L - Legal:** These factors pertain to the impact of laws and regulations on an organization. This could involve labor laws, health and safety regulations, data protection laws, and any other legal factors that might affect the way a company operates.
- **E - Environmental:** Environmental considerations revolve around the ecological and environmental aspects that might affect a company's operations or products. This can include climate change concerns, regulations related to environmental protection, and the broader public's sentiment towards environmental issues.

The PESTLE framework assists businesses and strategists in understanding the bigger picture and the external environment in which they operate. By analyzing these factors, organizations can devise strategies that take advantage of opportunities and mitigate potential threats from the external environment.

The second framework is the VUCA framework. VUCA, an acronym for Volatility, Uncertainty, Complexity, and Ambiguity, describes the challenging and unpredictable conditions of the external business environment. In the realm of project management, the VUCA model serves as a framework to assess these external factors that can impact a project's trajectory. By understanding the volatility of market dynamics, the uncertainty of future events, the complexity of interrelated factors, and the ambiguity of available information, project managers can better anticipate risks, allocate resources, and design adaptive strategies, ensuring more resilient and agile project execution amidst external uncertainties.

The third useful framework is the TECOP model. TECOP, which is an acronym for Technical, Environmental, Commercial, Operational, and Political, is a model used to assess external factors influencing a project. Within the

project management landscape, the TECOP model provides a structured approach to evaluate the myriad external challenges a project might encounter. By dissecting these factors—ranging from the technical challenges inherent in project design, environmental concerns affecting sustainability, commercial constraints impacting budget and profit,

Quick Check

1. What are some of the main defining characteristics of an organization's culture?
2. Why should a project manager be aware of the organizational culture?
3. How is an organization's culture established and perpetuated?

Quick Check Answers

1. The main defining characteristics of an organizational culture can be observed in the organization's visions and values, beliefs, policies, procedures, reward systems, tolerance for risk, work ethic, and view of authority relationships.
2. A project manager needs to be aware of the overall organizational culture and specific elements within it because these will affect the projects they are working on and it is best to leverage those parts of the organizational culture that contribute to project success and mitigate those parts of the organizational culture which may increase the chances of project failure.
3. The culture of an organization generally reflects the values of its founding members and it is then perpetuated and reproduced by both senior managers and leaders and the organization's recruitment policies.

operational elements tied to logistics and resources, to political dynamics like regulatory compliance and stakeholder interests—project managers can gain a holistic perspective. This thorough understanding enables better risk identification, strategic planning, and effective decision-making, ensuring projects remain resilient and adaptive to external pressures.

1.6 THE PROJECT LIFE CYCLE

The project *life cycle* is central to both the PMBOK® Guide and Process Groups: A Practice Guide. It forms the basis for the five Process Groups: A Practice Guide process groups. The project life cycle provides a framework and also describes the generally sequential activities undertaken in any project, beginning with the process of starting or initiating the project, organizing and preparing to do the work of the project, then carrying out the defined project work, and finally recognizing the closeout of a project.

There are three ways to describe typical project life cycles. The first is the predictive life cycle where a lot of planning work can be done up front and then the work is carried out according to this plan with relatively little change. We often see these types of project life cycles in the construction industry.

The iterative or incremental project life cycle features planning and executing work being concurrently or at the same time to deal with projects where there is a lot of change. We often see iterative or incremental project life cycles in many types of information technology projects.

The adaptive project life cycle is used when there is a great deal of uncertainty and it recognizes that very little planning work can be done up front. Highly complex information technology projects are good examples of adaptive life cycles.

The concept of the project life cycle moving from a project's beginnings to its closure can be applied to an entire project or to the different *phases* within the project. Project phases are best used when there is a clear and defining milestone between activities. For example, a project may have a design phase that requires signoff on the design (which would be the milestone) before the project is allowed to proceed to the implementation phase. Project phases can be performed in a linear, sequential fashion, with successive phases having to wait until a predecessor phase is complete before proceeding. Alternatively, phases can also overlap, with the successive phase able to start prior to the completion of the predecessor phase.

EXAM TIP

Be prepared to see terms such as "milestone," "stage gate," "phase gate," "kill point," or "stop/go point" in questions relating to phases of a project.

A project management *methodology* takes an approach based on the project life cycle and perhaps its phases, and describes the processes that will be followed and the tools and templates to be used. Most project management methodologies are built upon the concept of the project life cycle and have different procedures that reflect different parts of the project life cycle.

Real World

There are many different types of project management methodologies in existence. They range from the highly iterative agile methodologies used in information technology projects to the more predictive methodologies also known as waterfall methodologies, where there is a clear linear progression from start-up through to closure of a project. In developing an appropriate project management methodology for an organization, consideration must be given to the type of projects, the size of projects, the organizational culture, the timeframe for project delivery, and the maturity of the organization. The development of a project management methodology is not a one-size-fits-all proposition. In fact, a good methodology will always be flexible enough to accommodate different projects.

The concept of the project life cycle incorporating the initiation, planning, execution, and closing phases of the project is based upon the Shewhart and Deming *Plan-Do-Check-Act (PDCA) cycle*. This cycle starts with making a plan, then doing what you planned, then checking that what you are doing is what you planned, then acting if you find any variance between what you are doing and what you planned to do, and then going back and planning again. Figure 1-3 shows the Shewhart and Deming Plan-Do-Check-Act (PDCA) cycle.

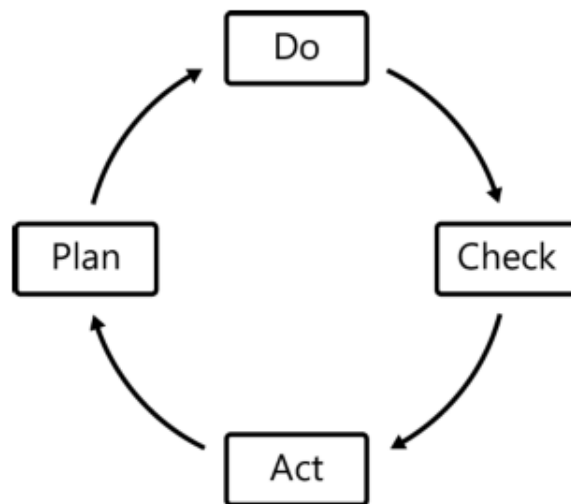


FIGURE 1-3 The Shewhart and Deming Plan-Do-Check-Act cycle showing the iterative nature of project management.

This cycle forms the basis of the initiating, planning (Plan), executing (Do), monitoring and controlling (Check and Act), and closing process groups of Process Groups: A Practice Guide. Figure 1-4 shows Process Groups: A Practice Guide process groups.

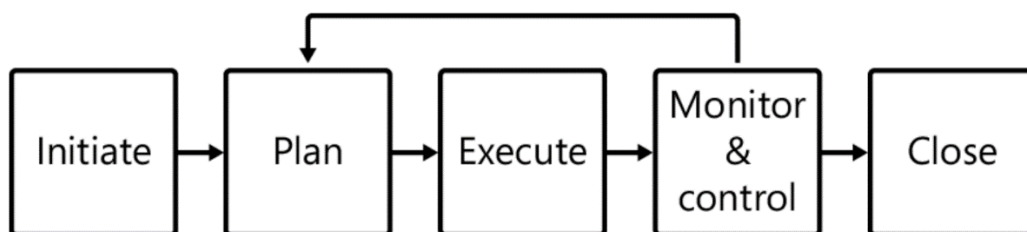


FIGURE 1-4 The Process Groups: A Practice Guide process groups shown as an iterative cycle of activity.

EXAM TIP

Take care to read any questions about life cycles to determine whether they are referring to the project life cycle or the product life cycle. The project life cycle refers to the project from initiation to closing. The product life cycle refers to the design, manufacturing, use, and obsolescence of the product. The product life cycle can be many years longer than the project life cycle.

The five process groups describe work to be done in each of the five process groups of Initiating, Planning, Executing, Monitoring & Controlling, and Closing. There are also ten specific knowledge areas – this is where each of the processes can be grouped according to their similar nature and this presents a convenient way to focus our study. Previous versions of the PMBOK® Guide used this system of organizing the information. Table 1-1 shows how the five process groups from Process Groups: A Practice Guide and the ten knowledge areas overlap. You should practice memorizing this table.

TABLE 1-1 Process Groups: A Practice Guide Process Groups and Knowledge Areas

	Initiating Processes	Planning Processes	Executing Processes	Monitoring and Controlling Processes	Closing Processes
Project Integration Management	<ul style="list-style-type: none"> Develop Project Charter 	<ul style="list-style-type: none"> Develop Project Management Plan 	<ul style="list-style-type: none"> Direct and Manage Project Work Manage Project Knowledge 	<ul style="list-style-type: none"> Monitor and Control Project Work Perform Integrated Change Control 	<ul style="list-style-type: none"> Close Project or Phase
Project Scope Management		<ul style="list-style-type: none"> Plan Scope Management Collect Requirements Define Scope Create WBS 		<ul style="list-style-type: none"> Validate Scope Control Scope 	
Project Time Management		<ul style="list-style-type: none"> Plan Schedule Management Define Activities Sequence Activities Estimate Activity Durations Develop Schedule 		<ul style="list-style-type: none"> Control Schedule 	
Project Cost Management		<ul style="list-style-type: none"> Plan Cost Management Estimate Costs Determine Budget 		<ul style="list-style-type: none"> Control Costs 	
Project Quality Management		<ul style="list-style-type: none"> Plan Quality Management 	<ul style="list-style-type: none"> Manage Quality 	<ul style="list-style-type: none"> Control Quality 	
Project Resource Management		<ul style="list-style-type: none"> Plan Resource Management Estimate Activity Resources 	<ul style="list-style-type: none"> Acquire Resources Develop Team Manage Team 	<ul style="list-style-type: none"> Control Resources 	
Project Communications Management		<ul style="list-style-type: none"> Plan Communications Management 	<ul style="list-style-type: none"> Manage Communications 	<ul style="list-style-type: none"> Monitor Communications 	
Project Risk Management		<ul style="list-style-type: none"> Plan Risk Management Identify Risks Perform Qualitative Risk Analysis Perform Quantitative Risk Analysis Plan Risk Responses 	<ul style="list-style-type: none"> Implement Risk Responses 	<ul style="list-style-type: none"> Monitor Risks 	
Project Procurement Management		<ul style="list-style-type: none"> Plan Procurement Management 	<ul style="list-style-type: none"> Conduct Procurements 	<ul style="list-style-type: none"> Control Procurements 	
Project Stakeholder Management	<ul style="list-style-type: none"> Identify Stakeholders 	<ul style="list-style-type: none"> Plan Stakeholder Engagement 	<ul style="list-style-type: none"> Manage Stakeholder Engagement 	<ul style="list-style-type: none"> Monitor Stakeholder Engagement 	

1.7 AN INTRODUCTION TO AGILE

This section of the Introduction provides a brief introduction to Agile. For a more detailed explanation please refer to Chapter 12.

Agile, in its early inception, was a response to traditional project management methodologies, which were often seen as rigid, slow, and inflexible. In the late 1990s and early 2000s, various lightweight software development processes, like Scrum, Extreme Programming (XP), and Dynamic Systems Development Method (DSDM), emerged as alternatives to the prevalent waterfall model. These methodologies prioritized collaboration, customer feedback, and rapid adaptation over heavy documentation and strict adherence to plan.

The term "Agile" was coined in 2001 when seventeen software developers convened in Snowbird, Utah, to discuss these lightweight processes. The culmination of their discussions was the Agile Manifesto, a document that articulated the core values and principles of Agile. It represented a significant shift in the software development paradigm, moving away from detailed upfront planning and towards iterative and incremental development.

There are four key foundational elements to Agile, which are captured at www.agilemanifesto.org:

"We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

*Individuals and interactions **over** processes and tools
Working software **over** comprehensive documentation
Customer collaboration **over** contract negotiation
Responding to change **over** following a plan*

That is, while there is value in the items on the right, we value the items on the left more."

There are also twelve guiding principles:

1. *Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.*
2. *Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.*
3. *Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.*
4. *Business people and developers must work together daily throughout the project.*
5. *Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.*
6. *The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.*
7. *Working software is the primary measure of progress.*
8. *Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.*
9. *Continuous attention to technical excellence and good design enhances agility.*
10. *Simplicity--the art of maximizing the amount of work not done--is essential.*
11. *The best architectures, requirements, and designs emerge from self-organizing teams.*
12. *At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.*

The Agile movement gained rapid traction in the software industry and, over time, expanded its influence to other domains. Today, Agile is not just a software development methodology but also a broader project management and product development approach, embraced by organizations across industries.

The defining features of Agile are:

- **Iterative and Incremental:** Agile projects are broken into small, manageable pieces called iterations that can typically run from 1 to 4 weeks duration. Each iteration results in an increment, a potentially releasable piece of the product. This allows for regular feedback and adjustments as the project progresses.
- **Collaboration and Communication:** Agile emphasizes open communication among cross-functional teams and stakeholders. Daily stand-ups, retrospectives, and planning sessions are common practices to ensure everyone is aligned and challenges are addressed promptly.
- **Customer Feedback:** Close collaboration with the customer or end-user ensures the product or service meets their needs. Regular reviews give customers an opportunity to provide feedback on the product, and the team can make necessary changes based on this input.
- **Adaptive Planning:** While Agile recognizes the value of planning, it also understands the inevitability of change. As such, Agile plans are flexible, and teams are prepared to pivot based on new insights, changes in the market, or feedback.
- **Simplicity and Focus:** Agile promotes simplicity by emphasizing the work that adds the most value and eliminating or deferring unnecessary features or tasks. Prioritization techniques, like the MoSCoW method (Must have, Should have, Could have, Won't have) or a prioritized product backlog, are employed to ensure focus on what's most important.

Since the initial development of the guiding principles there have been many attempts to develop what are called Agile methodologies. There are approximately 40 or 50 different defined Agile approaches, each with their own strengths and weaknesses. Here are some of the top Agile approaches with a brief description of each:

1. **Scrum:** Scrum is a time-boxed, iterative framework that divides work into short cycles called Sprints, typically lasting 2-4 weeks. It emphasizes teamwork, accountability, and iterative progress towards a well-defined goal using ceremonies like Daily Stand-ups, Sprint Review, and Sprint Retrospective.
2. **Kanban:** Kanban is a visual system for managing work as it moves through different stages. Its core principles focus on visualizing tasks, limiting work in progress (WIP), and enhancing flow, making it easier to identify bottlenecks and areas for improvement.
3. **Extreme Programming (XP):** XP is a software development methodology that emphasizes customer satisfaction, flexible responses to changing requirements, and frequent delivery of high-quality software.

It introduces practices like pair programming, continuous integration, and test-driven development to improve software quality and responsiveness to evolving customer needs.

4. **Lean Software Development:** Inspired by lean manufacturing principles and practices, Lean Software Development aims to optimize efficiency, reduce waste, and deliver software faster. Its seven principles, such as "Eliminate Waste" and "Build Quality In," encourage teams to focus on delivering value to customers rapidly and efficiently.
5. **Disciplined Agile (DA):** Disciplined Agile is a methodology that enables organizations to integrate different Agile and Lean approaches (like Scrum, XP, Lean, and more) in a manner best suited for the organization's needs. It is goal-driven, allowing teams to determine the way of working (WoW) based on their unique context.
6. **Scaled Agile Framework (SAFe):** SAFe is an expansive framework that provides a detailed and customizable approach to scale Agile across large enterprises. It emphasizes alignment, collaboration, and delivery across multiple Agile teams and integrates principles from Agile, product development flow, and Lean into its foundation. SAFe structures the enterprise into four levels: Team, Program, Large Solution, and Portfolio. Each level has its roles, responsibilities, and activities. This structure aids in coordinating and synchronizing activities across large numbers of Agile teams and aligning project objectives with enterprise goals.
7. **Feature-Driven Development (FDD):** FDD is a model-driven, short-iteration methodology that focuses on developing and delivering "features," which are small, functional components of software. It starts with an overall model, followed by a feature list, and then proceeds with iterative development of those features.

Each of these approaches has its unique strengths and is best suited to particular types of projects or organizational cultures. The choice of approach often depends on the project's requirements, team preferences, and the specific challenges faced.

This study book will reference tools and techniques from these approaches as the exam will test you on your knowledge of them.

Quick Check

1. What sort of projects benefit from a phased approach?
2. What are the four parts of the Shewhart and Deming cycle?
3. What are the five process groups in Process Groups: A Practice Guide?

Quick Check Answers

1. Projects that have well-defined milestones are suitable for a phased approach.
2. The four parts are Plan, Do, Check, and Act
3. The five process groups are Initiating, Planning, Executing, Monitoring and Controlling, and Closing a project.

1.8 COMPLIANCE AND DELIVERING VALUE

In the realm of project management compliance is not merely a checkbox but an integral aspect that ensures projects adhere to established standards, regulations, and best practices. Compliance provides a framework that guides project managers through the intricate maze of legal requirements, industry standards, and organizational policies. By maintaining compliance, projects can mitigate risks associated with non-conformance, such as legal repercussions, financial penalties, and reputational damage. Furthermore, a compliant project reinforces stakeholders' trust, as it demonstrates the organization's commitment to operate within the boundaries of accepted norms and regulations.

Value delivery is at the heart of the PMBOK® Guide's approach to project management. The primary aim of any project is to provide tangible benefits, be it in terms of financial returns, enhanced capabilities, or stakeholder satisfaction. The PMBOK® Guide emphasizes the importance of aligning projects with an organization's strategic objectives, ensuring that every project undertaken contributes to the broader goals and delivers maximum value. This alignment facilitates prioritization, ensuring resources and efforts are directed towards projects that offer the

greatest returns. Moreover, by focusing on value delivery, project managers can make informed decisions throughout the project lifecycle, balancing constraints and making trade-offs that optimize the project's value proposition.

The PMBOK® Guide adeptly intertwines the concepts of compliance and value delivery, recognizing that the two are not mutually exclusive but rather complementary. Delivering value within the confines of compliance ensures that projects achieve their objectives while maintaining integrity, sustainability, and stakeholder trust. On the flip side, a compliance-driven approach that is cognizant of the value ensures that regulations and standards do not become mere bureaucratic hurdles but act as guidelines that enhance project outcomes. In essence, the PMBOK® Guide's emphasis on both compliance and value delivery equips project managers with a holistic framework, enabling them to steer projects to success in a responsible and impactful manner.

EXAM TIP

When tackling questions related to compliance and value delivery on the PMP exam, pay close attention to scenarios where maintaining regulatory standards intersects with project goals, ensuring that both are addressed without compromising the other. Remember, the PMBOK® Guide emphasizes a balanced approach where compliance acts as a guiding framework for delivering maximum value, so prioritize answers that reflect this symbiotic relationship.

1.9 SUPPORTING ORGANIZATIONAL CHANGE

In the dynamic world of project management, it's not just the tangible outcomes of the project that matter, but also the human and organizational aspects that surround it. Projects often introduce change, whether it's a new system, process, or organizational restructuring. While these changes may seem beneficial on paper, their success largely hinges on how well they're received, adopted, and internalized by the people they affect. This is where the significance of organizational change management (OCM) comes into play. A project manager's role isn't limited to delivering project outcomes; it extends to ensuring that these outcomes seamlessly integrate into the organization's operations and culture. Ignoring OCM can lead to resistance from stakeholders, decreased morale, and ultimately, a failure in realizing the project's intended benefits.

A structured approach to change management, encapsulated in a change management plan, provides a roadmap for transitioning individuals, teams, and organizations from the current state to a desired future state. Such a plan not only focuses on the technical aspects of the project but also on the human side of change. By anticipating potential resistance, understanding the concerns of stakeholders, and proactively addressing them, a change management plan ensures smoother transitions, faster adoption rates, and reduced disruptions. Furthermore, it emphasizes continuous communication, stakeholder involvement, and training – all crucial elements that foster understanding, buy-in, and support for the change.

The ProSci ADKAR model provides a systematic and goal-oriented approach to managing change at an individual level, making it an invaluable tool for project managers. The model, broken down into Awareness, Desire, Knowledge, Ability, and Reinforcement stages, outlines the progression of change adoption for individuals. By understanding and addressing needs at each of these stages, project managers can ensure that the change is not only introduced but also embraced and sustained over time. For instance, creating Awareness about the need for change sets the stage, fostering Desire ensures buy-in, imparting Knowledge provides the tools for change, enhancing Ability ensures the practical application, and Reinforcement ensures the change sticks. Leveraging the ADKAR model in a project's change management plan ensures a thorough, people-centric approach, maximizing the chances of successful, lasting change.

Let's take the example of a software project where an organization is transitioning from a traditional on-premises customer relationship management (CRM) system to a cloud-based CRM solution like Salesforce.

1. Awareness: The first step in the change is to make employees aware of why the change is happening. The project manager and stakeholders might conduct town hall meetings, distribute informational emails, or provide data-driven presentations showcasing the inefficiencies of the current CRM and the benefits of moving to a cloud-based solution, such as enhanced data access, better scalability, and cost savings.

2. Desire: Now, it's crucial to cultivate a desire among employees to support and participate in the change. To achieve this, the project manager might organize training sessions showing the enhanced features of Salesforce that make daily tasks easier. Feedback sessions where employees can voice concerns and get answers can also help. Highlighting success stories from other organizations or departments that have successfully made the transition can serve as a motivating factor.

3. Knowledge: Once there's a general acceptance of the change, it's essential to equip employees with the knowledge they need to work with the new system. This can include comprehensive training sessions on using Salesforce, providing manuals and how-to guides, organizing Q&A sessions with experts, and offering e-learning modules that employees can access at their convenience.

4. Ability: Knowledge alone isn't enough; employees need to translate that knowledge into ability. This might involve hands-on workshops where employees can try out the new CRM under expert guidance, sandbox environments where they can practice without any real-world implications, or mentorship programs where new users can be paired with Salesforce-savvy mentors.

5. Reinforcement: To ensure the change sticks and employees don't revert to old systems or methods, continuous reinforcement is vital. The project manager could set up a feedback loop where employees can report issues or provide suggestions, offer advanced training sessions for those looking to delve deeper, and recognize or reward departments or individuals that exemplify the successful adoption of the new system.

By applying the ADKAR model to this software project, the organization can ensure a smoother transition to Salesforce, taking into account the human factors that often determine the success or failure of such projects.

NOTE Change management versus Change control

These last few paragraphs have focused on change management, which is about preparing for the changes to individuals or organizations that a project may deliver. You may get this confused with change control, which is very different and is focused on controlling, documenting, and assessing any changes to the project while it is underway. Change management is a comprehensive approach that deals with transitioning individuals, teams, or organizations from a current state to a desired future state, encompassing strategies to drive adoption, reduce resistance, and ensure the effective implementation of a change initiative. In contrast, change control is a specific, formalized process used to ensure that any alterations to a project's scope, schedule, or resources are introduced in a systematic manner, evaluated for potential impact, and documented, ensuring that projects remain aligned with their initial objectives and constraints. Make sure you understand the difference between the two as the exam will ask you about both topics and you don't want to get them confused.

1.10 CHAPTER SUMMARY

- This chapter introduced you to many foundational concepts of the PMBOK® Guide and Process Groups: A Practice Guide. It began by looking at the purpose and contents of the PMBOK® Guide and Process Groups: A Practice Guide, and then went on to define a project and the unique characteristics that differentiate projects from ongoing or repetitive work. It is important that you understand how project work is different from ongoing or operational work.
- The chapter then looked at the differences between and the relationships among project management, program management, and portfolio management. The link to portfolio management also includes consideration of the link between projects and strategic planning and how project management can be a strategic enabler for an organization. Ultimately, the strategic decisions made and the way in which project management can support them will deliver increased business value.
- The role of the project management office (PMO) in any organization is an important one and reflects the level of organizational project management maturity that the organization has attained. The primary function of a PMO and whether it is supportive, controlling, or directive is a direct reflection of the level of maturity of the organization.
- The role of organizational process assets and enterprise environmental factors in the success or failure of project management is important. Additionally, organizational process assets and enterprise environmental factors feature in many of the 49 processes of Process Groups: A Practice Guide as inputs.
- The concept of the project life cycle, which begins with the start of a project and moves through the organization, preparation, execution of the planned project work, and finally the closing of the project, is a central concept to many of the processes and knowledge areas in Process Groups: A Practice Guide. The concept of the project life cycle can also be applied to separate project phases.
- Agile methodologies are an important part of product and project management, and are focused on continuously delivering value to the organization and customer.
- Prioritizing continuous and early delivery of value, as defined by the organization, is a key driver for project managers.
- Planning for successful change as a result of your project should happen early and be captured in a change management plan.

1.11 EXERCISES

1. Consider the following 12 scenarios. For each scenario, decide whether it is a project, a program, a portfolio, or ongoing work.
 - A. The implementation of a new piece of software to run an organization's payroll
 - B. The construction of a new house
 - C. The development of a new housing subdivision
 - D. Filming the first movie of a movie trilogy
 - E. Increasing sales from the previous year
 - F. The design phase of a new piece of software
 - G. The range of projects an organization is undertaking to increase market share
 - H. The installation of new servers as part of a major upgrade to an organization's software and hardware systems
 - I. A new marketing campaign designed to bring in more business
 - J. The development of a new product that will increase operational profit
 - K. Several different pieces of software being developed that use the same developers
 - L. All the new house projects being undertaken by a construction company

2. Practice filling out the following blank table with process groups, knowledge areas, and processes from Process Groups: A Practice Guide.

Process Groups: A Practice Guide Process Groups

The PMBOK® Guide Knowledge Areas

1.12 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 1 by answering these questions. The answers to these questions, and the explanations of why each answer choice is correct or incorrect, are located in the “Answers” section at the end of this chapter.

1. What is the primary role of the portfolio manager?
 - A. To deliver the unique product, service, or result of the project
 - B. To provide project governance and sponsorship
 - C. To assess all potential projects against known organizational strategic goals
 - D. To directly manage people assigned to several different projects

2. What is the primary purpose of the PMBOK® Guide and Process Groups: A Practice Guide?
 - A. To provide a flexible methodology for all projects, no matter how large or small
 - B. To identify a project management framework based on what is generally recognized as good practice
 - C. To define a prescriptive approach to managing projects
 - D. To present all the known project management information in a concise manner

3. What is the best description of rolling wave planning?
 - A. Project management planning activities that become more detailed as you move through the project
 - B. Only planning the first phase of a project
 - C. Planning the entire project before starting execution
 - D. Only planning the next phase in a project

4. What is the relationship between successful projects and an organization’s strategic goals?
 - A. There is no relationship between the two, because they are separate and distinct parts of an organization.
 - B. The successful delivery of projects can be a strategic enabler and deliver strategic goals.
 - C. The project selection methodology will determine what an organization’s strategic goals are.
 - D. Projects deliver programs, which in turn deliver portfolios, which in turn deliver strategy.

5. What is the best role for a project management office in an organization with a low level of project management maturity?
 - A. Directive
 - B. Controlling
 - C. Supportive
 - D. Enabling

6. What is the name for a group of related projects managed in a coordinated way to obtain a synergy not found by managing them individually?
 - A. Multi projects
 - B. Portfolio
 - C. Program
 - D. Strategy

7. Process Groups: A Practice Guide process groups are based upon which life cycle model?
 - A. The Check-Plan-Do-Act cycle
 - B. The Plan-Do-Check-Act cycle
 - C. The Plan-Check-Act-Do cycle
 - D. The Do-Check-Act-Plan cycle

8. How many processes are there in the Risk Management knowledge area?
 - A. Three
 - B. Four
 - C. Five
 - D. Six

9. How many processes are there in the Monitoring and Controlling process group?
 - A. 9
 - B. 10
 - C. 11
 - D. 12

10. Which two knowledge areas have more than one Monitoring and Controlling process?
 - A. Cost Management and Time Management
 - B. Initiating and Planning
 - C. Integration Management and Scope Management
 - D. Closing and Executing

1.13 ANSWERS

This section contains the answers to the questions for the Exercises and Review Questions in this chapter.

EXERCISES

1. Consider the following scenarios. For each scenario, decide whether it is a project, a program, a portfolio, or ongoing work.
 - A. The implementation of a new piece of software to run an organization's payroll
This is an example of a project.
 - B. The construction of a new house
This is an example of a project.
 - C. The development of a new housing subdivision
This would generally be seen as either a very large project or a program. This demonstrates that there is a grey area between projects, programs, and portfolios.
 - D. Filming the first movie of a movie trilogy
The first movie will be seen as a project; the entire trilogy would be seen as a program.
 - E. Increasing sales from the previous year
This is an example of ongoing work.
 - F. The design phase of a new piece of software
Because this is a phase, it would best be viewed as part of a project.
 - G. The range of projects an organization is undertaking to increase market share
This is an example of a program with a common goal of increasing market share.
 - H. The installation of new servers as part of a major upgrade to an organization's software and hardware systems
This is an example of a project that is part of a broader program.
 - I. A new marketing campaign designed to bring in more business
Marketing is generally considered to be an ongoing activity rather than a project.
 - J. The development of a new product that will increase operational profit
This is an example of a project that will be handed over to the operations side of the organization.
 - K. Several different pieces of software being developed that use the same developers
Merely using the same developers doesn't mean that these projects are part of a program. Instead, they should be considered as individual projects that are part of a portfolio.
 - L. All the new house projects being undertaken by a construction company
This is an example of a portfolio of projects.

NOTE: One of the reasons for this exercise was to demonstrate that there can be grey areas in defining projects, programs, and portfolios. So, if your answers are different from those given above it may be that it is correct for the size and complexity of your initiatives.

2. Practice filling out the following blank table with process groups, knowledge areas, and processes.

	Initiating Processes	Planning Processes	Executing Processes	Monitoring and Controlling Processes	Closing Processes
Project Integration Management	•Develop Project Charter	•Develop Project Management Plan	•Direct and Manage Project Work •Manage Project Knowledge	•Monitor and Control Project Work •Perform Integrated Change Control	•Close Project or Phase
Project Scope Management		•Plan Scope Management •Collect Requirements •Define Scope •Create WBS		•Validate Scope •Control Scope	
Project Time Management		•Plan Schedule Management •Define Activities •Sequence Activities •Estimate Activity Durations •Develop Schedule		•Control Schedule	
Project Cost Management		•Plan Cost Management •Estimate Costs •Determine Budget		•Control Costs	
Project Quality Management		•Plan Quality Management	•Manage Quality	•Control Quality	
Project Resource Management		•Plan Resource Management •Estimate Activity Resources	•Acquire Resources •Develop Team •Manage Team	•Control Resources	
Project Communications Management		•Plan Communications Management	•Manage Communications	•Monitor Communications	
Project Risk Management		•Plan Risk Management •Identify Risks •Perform Qualitative Risk Analysis •Perform Quantitative Risk Analysis •Plan Risk Responses	•Implement Risk Responses	•Monitor Risks	
Project Procurement Management		•Plan Procurement Management	•Conduct Procurements	•Control Procurements	
Project Stakeholder Management	•Identify Stakeholders	•Plan Stakeholder Engagement	•Manage Stakeholder Engagement	•Monitor Stakeholder Engagement	

REVIEW QUESTIONS

1. Correct answer: C

- A. **Incorrect:** The project manager takes responsibility for delivering the product, service, or result of a project.
- B. **Incorrect:** It may be that on occasion a portfolio manager may provide some governance and sponsorship advice, but it is not the portfolio manager’s primary role.
- C. **Correct:** The portfolio manager operates at a strategic level within the organization.
- D. **Incorrect:** It would be the program manager or even a functional manager who would take responsibility for managing people on several projects, depending on the type of organizational structure in place.

2. Correct Answer: B

- A. **Incorrect:** Neither the PMBOK® Guide nor Process Groups: A Practice Guide provides a methodology. You are able to build a methodology from the contents of the PMBOK® Guide and Process Groups: A Practice Guide via the process of tailoring.
- B. **Correct:** The PMBOK® Guide and Process Groups: A Practice Guide collects and presents what is generally considered to be good practice across a wide range of industries and presents this information as a framework rather than a methodology.
- C. **Incorrect:** The PMBOK® Guide and Process Groups: A Practice Guide emphasizes in several places that, through the process of tailoring, you should only take from the PMBOK® Guide what is appropriate to your project.
- D. **Incorrect:** The PMBOK® Guide and Process Groups: A Practice Guide does not claim to present all known project management information, only that which is generally considered good practice across a wide range of

industries.

3. **Correct Answer: A**

- A. **Correct:** Rolling wave planning acknowledges that you will iteratively plan the project as you move along the project life cycle.
- B. **Incorrect:** Only planning the first phase of a project is typical for phased projects, because there may be an important milestone between phases that prevents further planning.
- C. **Incorrect:** Planning the entire project before starting is a very rare occurrence and probably only suitable for small, easily defined projects.
- D. **Incorrect:** Iteratively planning a phase of a project is not an example of rolling wave planning.

4. **Correct Answer: B**

- A. **Incorrect:** There is a strong relationship between successful projects and an organization achieving its strategic goals.
- B. **Correct:** By selecting projects that deliver strategic goals and then successfully delivering these projects, an organization can achieve its strategic goals.
- C. **Incorrect:** It is the organization's strategy that dictates which projects get selected.
- D. **Incorrect:** There is not always a direct linear connection between projects, programs, portfolios, and strategy.

5. **Correct answer: C**

- A. **Incorrect:** Directive project management offices are generally best in an organization with a high level of project management maturity.
- B. **Incorrect:** Controlling project management offices are generally a sign of an organization improving its organizational project management maturity.
- C. **Correct:** Supportive project management offices are generally a sign of a low level of project management maturity, because they do not support a lot of complexity.
- D. **Incorrect:** This is a made-up term and is not from the PMBOK® Guide.

6. **Correct Answer: C**

- A. **Incorrect:** Multi projects is a made-up term that does not describe a coordinated approach to interrelated projects.
- B. **Incorrect:** Portfolios are groups of projects related only by the fact that they are being performed by a single organization.
- C. **Correct:** A program is a group of projects related in some way and that are managed to achieve benefits not gained by managing them independently.
- D. **Incorrect:** Strategy is the organization's future direction and how it is going to achieve this.

7. **Correct Answer: B**

- A. **Incorrect:** The correct order requires planning to come first and checking to come after doing.
- B. **Correct:** The Plan-Do-Check-Act cycle by Shewhart and Deming describes an iterative approach to management.
- C. **Incorrect:** The correct order requires checking to come after doing and before acting.
- D. **Incorrect:** The correct order requires planning to come first.

8. **Correct Answer: D**

- A. **Incorrect:** There are seven processes, not three, in the Risk Management knowledge area.
- B. **Incorrect:** There are seven processes, not four, in the Risk Management knowledge area.
- C. **Incorrect:** There are seven processes, not five, in the Risk Management knowledge area.
- D. **Correct:** The seven processes in the Risk Management knowledge area are Plan Risk Management, Identify

Risks, Perform Qualitative Risk Analysis, Perform Quantitative Risk Analysis, Plan Risk Responses, Implement Risk Responses, and Monitor Risks.

9. **Correct Answer: D**

- A. **Incorrect:** There are 12 processes, not 9, in the Monitoring and Controlling process group.
- B. **Incorrect:** There are 12 processes, not 10, in the Monitoring and Controlling process group.
- C. **Incorrect:** There are 12 processes, not 11, in the Monitoring and Controlling process group.
- D. **Correct:** The 12 processes in the Monitoring and Controlling process group are Monitor and Control Project Work, Perform Integrated Change Control, Validate Scope, Control Scope, Control Schedule, Control Costs, Control Quality, Control Resources, Monitor Communications, Monitor Risks, Control Procurements, and Monitor Stakeholder Engagement.

10. **Correct Answer: C**

- A. **Incorrect:** Each of these knowledge areas has a single monitoring and controlling process.
- B. **Incorrect:** These are process groups, not knowledge areas.
- C. **Correct:** Integration Management has Monitor and Control Project Work and Perform Integrated Change Control, and Scope Management has Validate Scope and Control Scope.
- D. **Incorrect:** These are process groups, not knowledge areas.

2. Project Integration

This chapter focuses on Project Integration Management, which recognizes that no part of the process of managing a project exists in isolation from any other part, and in fact there is a high degree of interdependency between different parts of a project. As such, a lot of the information discussed in this chapter reaches across many other knowledge areas within the profession. In addition to recognizing the interdependency of all other knowledge areas, Project Integration Management also specifically addresses those activities, such as change control processes, which are carried out over more than one knowledge area.

The seven processes in the Project Integration Management knowledge area are:

- Develop Project Charter (Initiating process)
- Develop Project Management Plan (Planning process)
- Direct and Manage Project Work (Executing process)
- Manage Project Knowledge (Executing process)
- Monitor and Control Project Work (Monitoring and Controlling process)
- Perform Integrated Change Control (Monitoring and Controlling process)
- Close Project or Phase (Closing process)

2.1 WHAT IS INTEGRATION MANAGEMENT?

The other nine knowledge areas focus on a specific knowledge area and have key inputs from, and provide outputs for, other knowledge areas. Project Integration Management is the only knowledge area that actually works across all the other knowledge areas. It has been described as the forest whereas the other knowledge areas are the trees. It is very much a coordination process that recognizes that none of the knowledge areas are isolated and discrete. Project Integration Management recognizes that the knowledge areas are all interdependent and rely on each other to a greater or lesser extent. They are also able to affect each other and as such, when defining, planning, executing, and controlling the project, a project manager must recognize this and take an integrated point of view. This is true of activity between knowledge areas and also between processes within the same knowledge area. They can also be highly iterative and are not necessarily a direct linear progression from one process to another.

For example, when preparing a cost estimate, you need to have a defined project scope and also be aware of resources available, risks, and any other factors from the other knowledge areas that may affect the cost estimate. If you consider each knowledge area as a separate and discrete activity, then developing cost estimates in isolation would result in highly inaccurate estimates. Project integration management reminds us that all knowledge areas and processes are connected.

The Project Integration Management knowledge area produces the project charter (Develop Project Charter), which is a foundational document for the project and most of the other processes. It also delivers the project management plan in its many iterations (Develop Project Management Plan), takes a coordinated and high-level view of all the work being done on the project to achieve the plans (Direct and Manage Project Work), checks the project progress (Monitor and Control Project Work), ensures proper record keeping and document control (Manage Project Knowledge), and assesses, influences, and controls changes as they occur (Perform Integrated Change Control). In addition to providing the foundational documents that initiate the project this knowledge area also manages the closure of the project, or a phase in a project (Close Project or Phase).

Additionally, the Project Integration Management knowledge area reinforces the fact that there are many successful ways to manage a project. Projects vary considerably in terms of depth, complexity, size, industry, and deliverables. As such, the level of interaction between selected processes will also be different. This process is called tailoring and involves selecting those processes that are appropriate to a project and ensuring throughout the life of the project that constant checking is done to ensure the selected processes and their application is still appropriate. By having a broad oversight of the project via the Project Integration Management knowledge area helps in selecting the right processes and applying them appropriately.

Real World

I am a big advocate of tailoring the tools, techniques, and processes to appropriately fit your organization and your project. There are all sorts of potential problems that arise from simply

applying too many, or too few, project management practices to a project. Take the time at the beginning of the project to choose those processes, tools, and techniques that will actually add value to your project and throughout the life of the project be prepared to reexamine your decisions to ensure that they are still correct. For example, on one small IT project I worked on, our project management methodology was tailored to be flexible and very simple because the project was simple and over a short time frame. A larger IT project I worked on had a very rigid methodology with many processes, reflecting the complexity of the project.

EXAM TIP

A high proportion of questions in the PMP® exam will expect you to know how one process or knowledge area interacts with, or is dependent on, other processes or knowledge areas. Do not be surprised if you have to read a question several times to determine exactly how many, and which, processes it is referring to. You should also get used to looking not just at the entire process, but also at the way in which inputs become outputs with the application of selected tools and techniques.

2.1 DEVELOP PROJECT CHARTER

TABLE 2-1 Develop Project Charter process

INPUTS ⇌	TOOLS AND TECHNIQUES ⇌	OUTPUTS
<ul style="list-style-type: none"> ▪ Business documents <ul style="list-style-type: none"> ▪ <i>Business case</i> ▪ <i>Benefits management plan</i> ▪ Agreements ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data gathering <ul style="list-style-type: none"> ▪ <i>Brainstorming</i> ▪ <i>Focus groups</i> ▪ Interviews ▪ Interpersonal and team skills <ul style="list-style-type: none"> ▪ <i>Conflict management</i> ▪ <i>Facilitation</i> ▪ <i>Meeting management</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Project charter ▪ Assumption log

The Develop Project Charter process is an initiating process with a main output that is the project charter. The Develop Project Charter process is one of only two initiating processes in Process Groups: A Practice Guide, the other being Identify Stakeholders.

EXAM TIP

Each of the 49 processes is represented by a diagram showing the Inputs, Tools and Techniques, and Outputs (ITTO). It is a simple and powerful way of displaying some quite complex information. Very simplistically, it is saying that if you want to produce an Output from the process (in this case the project charter), you should gather the appropriate Inputs and apply the appropriate tool to these to generate the output. So, in this case, you could take the business case and refer to appropriate organizational process assets such as your approval and stage gate, then apply expert judgment and meetings of the steering committee, to develop and approve the project charter. Remember that it is not prescriptive but instead suggests what is good practice and invites you to use the elements that you have.

The other important and useful element of these ITTO diagrams is for you to consider which process has generated the inputs, and also which processes will require the outputs. In this case, because this is one of the first processes, and steps in developing a project, the inputs don't actually come from another process. For most of the other inputs into the remaining 49 processes you will find you can trace them back as an output from another process.

In this instance the output, the project charter, goes on to be used as a potential input into 14 other processes so it is a very important element.

A key to the PMP examination questions is that they will often describe a particular situation and if you can figure out exactly what has already been done to arrive at this situation you will quickly know which inputs have contributed. If you can understand the flow of ITTO diagrams you will be able to answer questions that ask you what to do next. This is why knowing the inputs, tools and techniques, and outputs is a great help to your study.

It is the first process to be completed, and the one that kicks off a project. Unlike most of the other processes, the Develop Project Charter process features inputs that are not outputs from other processes. In this case, the inputs come from either the project sponsor (for example, any contracts or agreements, a business case, or the known

project statement of work) or from the organization or the environment in which the project must work and is constrained by (enterprise environmental factors and organizational process assets). The project sponsor is critical to this process, because the sponsor takes responsibility not only for providing some necessary inputs into this process but also for initiating and signing off on the development of the project charter.

Generally, the project manager may not always be directly responsible for preparation of the project charter. In a perfect world they would be but they are often handed a completed project charter and expected to then complete detailed planning.

EXAM TIP

The Develop Project Charter process is one of two initiating processes. The other is the Identify Stakeholders process from Project Stakeholder Management knowledge area. Because the project charter is an input into the Identify Stakeholders process, it must be done first.

Broadly speaking, many of the inputs used in this process are part of a project selection process that assesses any potential project against the organizational strategic goals and also against financial and non-financial criteria to help the organization make decisions about which project it will undertake and which it won't. Understanding this process will assist your understanding of the Develop Project Charter process. Only projects that are of a compliance nature, or emergency works, should be able to bypass this project selection process, which is illustrated in Figure 2-1. Examples of compliance projects are those that are necessitated when legal reporting requirements are changed and your organization must comply with them, even though there is no business value in doing so. An example of an emergency work could be the work you must do after a natural disaster strikes, to get your organization up and running again. There is not time to go through a formal process to justify these types of projects.

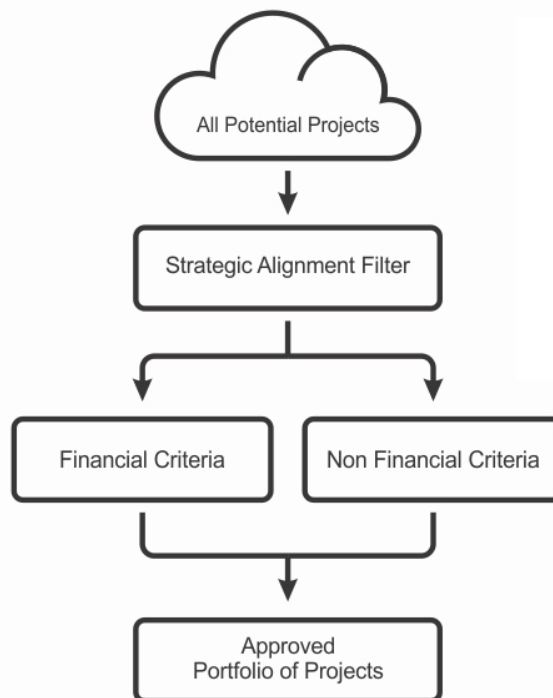


FIGURE 2-1 Project Selection Process.

This diagram shows that after an organization has identified all the potential projects it could undertake, it must put each project through a series of filters and criteria to enable it to choose the ones it will undertake. From this approved portfolio of projects it can then prioritize them and begin to develop a project charter. The first step in this selection process is for an organization to only choose those projects that first align with, and deliver, its strategic goals. This is because they will help an organization stay in business and meets its goals, and also because those strategic goals represent the core competencies an organization has.

Real World

The profession of project management is seen as a critical strategic enabler for organizations. This is because most organizations seek to deliver their strategic goals, and therefore the success or failure of the projects undertaken is a critical indicator of whether or not organizations will achieve their strategic goals.

After a project has been confirmed as meeting the strategic goals of an organization, it may go through either financial or non-financial criteria processes, or both, to further refine and approve or deny projects that will be undertaken as part of the approved portfolio of projects an organization is undertaking. This is usually done during the preparation of a business case.

The following list describes the most common financial criteria that can be used to determine which projects are suitable:

- **Benefit-Cost Ratio (BCR)** A ratio that looks at the financially quantifiable benefits expected from the project and weighs them against the cost of achieving those benefits. If the benefits outweigh the costs, then the project can be given the go-ahead.
- **Economic Value Add (EVA)** The profit earned by the organization after the cost of capital has been subtracted. Many organizations will set a target for this and only approve projects that meet or exceed this target.
- **Internal Rate of Return (IRR)** The rate of return after the external factors affecting cash flow (for example, interest or cost of capital, and inflation) have been deducted. The higher the IRR, the better the project.
- **Present Value** The value of future cash flows in today's dollars. The formula for calculating Present Value (PV) is:

$$PV = \frac{FV}{(1 + r)^n}$$

Where *FV* equals the future value of cash flows, *r* equals the interest rate, and *n* equals the number of time periods.

- **Net Present Value (NPV)** The value in today's dollars of future benefits minus the costs to achieve the benefits. The organization's own discount rate is applied to future cash flows to calculate today's value. A positive NPV is good, whereas a negative NPV is bad. NPV is calculated by subtracting the present value of costs from the present value of income and is the sum of all the present value calculations for income generated for a particular time period, subtracted from the initial spend on the project. To calculate NPV simply add up all the Present Value calculations for the expected income and then subtract this present value from the initial spend. The formula is:

$$NPV = \text{Initial Outlay} + \frac{\text{Year 1 income}}{(1 + r)} + \frac{\text{Year 2 income}}{(1 + r)^2} + \frac{\text{Year 3 income}}{(1 + r)^3} + \frac{\text{Year 4 income}}{(1 + r)^4}$$

For example, if you project had an initial spend of \$100 000, and was supposed to generate income of \$30 000 in the first year, \$35 000 in the second year, \$37 000 in the third year, and \$39 000 in the fourth year with a discount or interest rate of 10% the Net Present Value of your project would be \$10 634.52.

- **Opportunity Cost** The cost of not doing other projects and the profit, or financial surplus, they would bring the organization.
- **Payback Period** The time taken to pay back the investment in the project. An organization may set a required payback period, such as five years, within which time the project must pay back the original investment. Payback period is calculated by dividing the initial investment by the projected annual income.
- **Return on Investment (ROI)** The cost of a project subtracted from dollar gains on a project, divided by the cost of the project, expressed as a percentage. An organization will set criteria specifying that a ROI must first be positive, and the higher the ROI the better. Often organizations will also specify that the ROI must be greater than bank interest rates to reflect the risk in a project. Otherwise, from a commercial point of view, the organization is better off putting its money in a bank.
- **Return on Invested Capital (ROIC)** Used to describe in percentage terms how well an organization is using its money, or capital, on its projects. Positive is good, and the higher the better when it comes to selecting projects.
- **Future Value (FV)** Used to calculate the future value of an asset with a known interest rate to measure accumulation of value over time.

EXAM TIP

If you find ‘linear programming’ or ‘non-linear programming’ referred to in an exam question, the question is referring to a constrained optimization method for project selection. This is a complex mathematical process of maximizing the cost function of any calculation. The other category you will find is the benefit measurement model, in which an organization seeks to compare benefits and features of a particular proposal and make the selection on that basis.

INPUTS

The Develop Project Charter process uses some, or all, of the following inputs as part of the development of the project charter for the project.

BUSINESS DOCUMENTS

A business case can be used as an input into the project charter, or even as a project charter itself. Typically, the *business case* examines the financial and non-financial criteria that are used to assess whether or not the organization will commit to the project. These criteria are best used against a predefined expectation of what constitutes an acceptable project. For example, an organization might require a project to deliver a certain level of Return of Investment or a certain percentage of increase in market share before approving it. Projects that don’t deliver these defined metrics are not considered for approval. These predefined metrics can also be further used to prioritize which projects are done first, with the project scoring better being done first. These financial criteria were discussed in greater detail earlier in the chapter.

EXAM TIP

Assume that all projects must go through a rigorous and defined business case process prior to approval. This process will consider strategic alignment, financial and non-financial matters which are all captured in the business case.

The business case will also look at any predefined non-financial criteria that the organization wishes to consider. Examples of non-financial criteria an organization may consider are projects that increase market share, those that make it difficult for competitors to enter the market, projects that reduce dependencies on suppliers, and projects focused on delivering social, environmental, health, or educational benefits.

If the project is being executed in several phases with milestones between each phase, the business case can be revisited at these points to ensure it is both still valid and delivering the expected outcomes.

A business case will usually have most of the following elements in it:

- A description of the forecast, or actual, market demand of the product or service
- A description the organizational need for the project
- If it is for an external client, a description of the customer request
- A description of any technical advances that are presenting the opportunity to undertake the project
- Any legal or compliance requirements that are being addressed and met as a result of the project
- Any ecological or natural environmental impacts
- A description of the social need being fulfilled by the project

Clearly, the business case can be a very comprehensive document. If the project is a large and complex project, then the business case should reflect this. However, if the project is relatively simple and straightforward, the business case can be less complex to reflect this.

A Benefits Management Plan is a strategic document that outlines the expected benefits a project or program will deliver, detailing how and when these benefits will be delivered and measured. It provides a clear linkage between project outcomes and organizational objectives, ensuring that projects align with broader business goals. By incorporating the insights from the Benefits Management Plan, a Project Charter can be more effectively developed, ensuring that the project’s purpose, scope, and objectives are directly tied to tangible benefits and organizational value.

AGREEMENTS

The project charter can be based on any type of agreement between a performing organization and a requesting organization, or customer. An *agreement* can take the form of a signed contract, which in turn may be the result of a procurement process run by an external organization as part of its own project processes. The agreement may also

be in the form of a memorandum of understanding (MOU), letter of agreement, or heads of agreement. An exchange of email messages with an offer and acceptance will also form a valid agreement. A valid agreement can also be formed via a verbal exchange, in which case you will want to document the exchange as part of the project charter process.

If an agreement with an external party is used as an input into the Develop Project Charter process, the external party should be able to review and agree to the eventual project charter as it relates to them. This does not mean that they need to view the entire project charter, because there may be commercially sensitive information contained within it, but they should have the opportunity to comment on and agree to the content that relates to any agreement between the parties.

NOTE Verbal agreements

Projects that are undertaken with a simple verbal agreement must document the agreement at some point to ensure that all parties understand and agree to what was talked about and to ensure everyone's expectations are recorded and communicated. This is best done during the Develop Project Charter process before any planning work is done.

ENTERPRISE ENVIRONMENTAL FACTORS

Enterprise environmental factors are some of the most common inputs used. They can refer to many separate and distinct factors that can affect, and be used as inputs to, projects. In the Develop Project Charter process, the specific enterprise environmental factors that can influence the project charter development are any relevant government or industry standards that the project must comply with, any organizational infrastructure issues or constraints, and any known or forecast market conditions affecting the project selection process.

EXAM TIP

Enterprise environmental factors are some of the most widely used inputs. The term covers a lot of different factors that can influence a project. The environment referred to is not the ecological environment. It is the financial and human resource market environment, the legislative and legal environment, and the innovation and competitive environment, and it also includes external cultural factors. Take time to understand the variety of factors that are enterprise environmental factors and be able to differentiate them from organizational process assets. Very broadly, enterprise environmental factors can be considered as constraining the project, whereas organizational process assets can be considered as assisting the project.

ORGANIZATIONAL PROCESS ASSETS

An organizational process asset is any artifact, concept, process, or structure documented by the organization for use in project management. For the Develop Project Charter process, the relevant organizational process assets include any organizational processes relating the project selection, business cases, and the development of the project charter, including any templates that the organization may have. It will also include any existing project management methodology that the organization has. Organizational process assets that are useful in the initiation phase and the development of the project charter also include historical information and lessons learned from previous projects.

EXAM TIP

The PMP® exam places a large emphasis on the importance of gathering and referring to artifacts, historical information and lessons learned. You should always assume that this is done and available to you as a project manager. You should always assume that you will also contribute to the development of an organization's historical information and lessons learned database as part of the project management activities completed on your project. This is an extremely important part of a closeout process and should be part of your closure checklist. You should look to complete closeout interviews and meetings with all stakeholders, complete post-implementation reviews, and also complete benefits realization analysis to measure whether the intended benefits were achieved. All of this information becomes valuable lessons learned and historical information for future projects.

TOOLS AND TECHNIQUES

The following tools and techniques are available to be used to develop the inputs into this process in order to produce the project charter.

EXPERT JUDGMENT

Expert judgment is the most often used tool in all of the knowledge areas. Using expert judgment to help you use, and optimize, the inputs in the process allows you to consult with, and seek guidance from, any person or group who you consider can contribute to the process. This expertise may come from within your organization, from individuals, or from the Project Management Office (PMO). You may also choose to seek expert judgment from external consultants, competitors, and trade associations with expertise in the particular area you need guidance on. For example, you may seek guidance from experts in financial analysis as part of the business case.

The client or customer is also a valuable source of expert judgment, because they have clear expectations and experience with the product or service being delivered. Professional organizations, such as the Project Management Institute, may be consulted, as well as industry groups and subject matter experts.

DATA GATHERING

The purpose of these tools is to enable you and the organization to assess the inputs being used in the development of a project charter to determine whether it should be approved, declined, or simply have more information added to it.

- Brainstorming provides a collaborative environment where team members can freely generate diverse ideas, ensuring a comprehensive understanding of potential project objectives, constraints, and stakeholders.
- Focus groups assemble individuals from varied backgrounds to discuss specific topics, granting in-depth insights into stakeholder needs, expectations, and potential risks.
- Interviews, conducted one-on-one, offer a detailed exploration of individual stakeholder perspectives, revealing nuanced information about project scope, deliverables, and success criteria.

Collectively, these data gathering tools ensure a holistic and well-informed foundation for the development of a project charter, encompassing a wide range of stakeholder inputs and insights.

INTERPERSONAL AND TEAM SKILLS

The three tools mentioned here are designed to help you successfully get the input from experts to enable you to assess the information provided by the inputs you are using.

- Conflict resolution uses a variety of techniques to ensure that any conflict of opinions between experts does not derail the process. Conflict resolution includes problem-solving techniques that use a wide variety of methods to directly address and permanently resolve any problems that arise.
- The purpose of facilitation is to solicit information from team members and other key stakeholders who have a contribution to make in terms of using the process inputs and providing advice or further information to enable you to develop the project charter. There are many facilitation techniques that can be used; the most relevant for the Develop Project Charter process are:
- Meeting management involves getting your experts together and getting the best from them requires effective meeting management techniques that include structured and purposeful meetings with defined outcomes.

MEETINGS

The types of meetings you will hold will usually be steering committee meetings, or perhaps portfolio meetings to consider whether or not a project charter for the project should be approved or not. How to run successful meetings is a focus in the Communications Management knowledge area.

OUTPUTS

After applying the appropriate tools and techniques to the selected inputs, the Develop Project Charter process has the following output.

PROJECT CHARTER

The Develop Project Charter process has only a very important output—the project charter. The *project charter* is the foundational document for a project, and is like the birth certificate for a project. It proves the project exists and has financial and political support from the organization, and if applicable, an external client. It should be issued once the project has been through an appropriate project selection process.

The project charter authorizes the initial spend; defines the scope of work known at that time; lists any known constraints, risks, and milestones; and also identifies and authorizes the project manager and project sponsor. Ideally the project manager is identified and authorized in the project charter and assists with its development, but if not, the project manager should definitely be identified before any of the project planning processes begin.

Because the project charter is the foundational document for the project, changing it requires significant consideration and should not be done unless there are serious reasons. For this reason it can be left broad enough to allow the normal process of change control to take place through the project without having to constantly change the project charter. Any potential changes to the project charter must be referred to the project sponsor.

Not all project charters are created equal, and the size and complexity of the project will determine the size and complexity of the project charter. Additionally, if not much is known about the project, the charter may be big enough to authorize an investigation phase that is part of an iterative planning process. If the scope of the project is well known, the project charter may be a one-off—that is, a complete and complex business case.

NOTE Project Charter

The foundational document for a project is the *project charter*. Though in a perfect world it would probably be called a “project charter” by everyone involved in project management, you may call it by other names, such as “project mandate,” “project initiation document (PID),” “business case,” or “work order.” Remember, though, during the exam you must use the standardized PMI terminology.

EXAM TIP

Always assume that a project has a project charter of some sort and that you will refer to it when seeking answers to why the project exists and what its original goals were.

The project charter is then a key input into the following processes:

- Identify Stakeholders
- Develop Project Management Plan
- Plan Scope Management
- Collect Requirements
- Define Scope
- Plan Schedule Management
- Plan Cost Management
- Plan Quality Management
- Plan Resource Management
- Plan Communications Management
- Plan Risk Management
- Plan Procurement Management
- Plan Stakeholder Engagement
- Close Project or Phase

ASSUMPTION LOG

An assumption log is a documented collection of all assumptions made during the planning and execution phases of a project. Assumptions are beliefs or statements taken to be true without concrete evidence at a particular point in time. Key elements of an assumption log include:

- Assumption Description: A clear statement of what is being assumed.
- Reason: The rationale behind the assumption.
- Impact: Potential implications if the assumption is incorrect.
- Owner: The person responsible for verifying or validating the assumption.
- Status: Indicates whether the assumption has been validated, remains unverified, or has been proven incorrect.
- Date Logged: When the assumption was first identified.
- Validation Date: When the assumption is expected to be verified or validated.

Regularly updating and reviewing the assumption log is essential. Assumptions, if proven incorrect, can introduce risks to the project. By maintaining an updated log, project managers can validate assumptions as the project progresses, take corrective actions if necessary, and ensure that risks are mitigated.

Quick Check

1. Why is the Develop Project Charter process the first one to be completed in any project life cycle?
2. What is the benefit of choosing projects by a defined project selection process?
3. What is the role of the project sponsor in the Develop Project Charter process?

Quick Check Answers

1. Because it produces the project charter, which serves as a foundational document for the project as a whole, as well as for many other processes.
2. It enables an organization to select only those projects that assist it in meeting strategic goals, utilize its core competencies, and achieve defined financial and non-financial criteria.
3. The project sponsor provides key inputs, authorizes the project charter, and is responsible for assessing any proposed changes to the project charter.

2.3 DEVELOP PROJECT MANAGEMENT PLAN

TABLE 2-2 Develop Project Management Plan process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project charter ▪ Outputs from other processes ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data gathering <ul style="list-style-type: none"> ▪ <i>Brainstorming</i> ▪ <i>Checklists</i> ▪ <i>Focus groups</i> ▪ <i>Interviews</i> ▪ Interpersonal and team skills <ul style="list-style-type: none"> ▪ <i>Conflict management</i> ▪ <i>Facilitation</i> ▪ <i>Meeting management</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Project management plan

The Develop Project Management Plan process is a planning process that initiates and encompasses the planning activities of all the other knowledge areas. It is the only planning process for the Project Integration Management knowledge area, and one of 24 planning processes in total.

The *project management plan* itself is a document made up of all the other plans, and it provides a centralized means of planning your project. It does not necessarily have to be contained in a single document, because different formats, such as word processing, spreadsheets, project management software, and other formats can be used to develop and record the different plans. The Develop Project Management Plan process is a highly iterative process that may start with some blank templates that will eventually become the project management plan for a project.

The primary purpose of this process is to record and document how your project is going to be executed, monitored and controlled, and closed. As such, it should contain plans for each of these elements in the relevant

knowledge areas. When your project is underway, you can use the project management plan that has been developed to ensure that progress is as per the plan and act accordingly if there is a variance.

Real World

I have worked for organizations that have a single template for their project management plan, and it has section that need to be filled out and guidance on how to fill these sections out. However, I have also worked for organizations for whom the project management plan was a series of disparate documents held in both hard version as well as electronic document version but when viewed together formed a consolidated plan for managing the project. It is important that a project management plan reflect the complexity, size, and industry of the project. Too small a project management plan for a large, complex project will increase the chances of project failure. On the other hand, too large a project management plan for a simple project will also increase the chances of project failure.

INPUTS

The development of the project management plan uses some, or all, of the following four inputs.

PROJECT CHARTER

The project charter is an output from the Develop Project Charter process. It can take many forms, depending on the size and complexity of a project. It acts as the starting point that authorizes and guides the development of the project management plan, because it contains the known description of the work to be done and any assumptions, constraints, and milestones.

OUTPUTS FROM OTHER PROCESSES

The Develop Project Management Plan process is an iterative process and uses many of the outputs from other knowledge areas as inputs.

EXAM TIP

Take note of outputs from other planning, executing, monitoring and controlling, and closing processes for project management plan updates that indicate that they will be used as inputs into the Develop Project Management Plan process.

These outputs include, but are not limited to, the successive iterations of the following:

- The requirements management plan
- The requirements documentation
- The schedule management plan
- The schedule baseline
- The cost management plan
- The cost baseline
- The quality management plan
- The process improvement plan
- The human resource plan
- The staffing management plan
- The communications management plan
- The risk management plan
- The procurement management plan
- The stakeholder engagement plan

ENTERPRISE ENVIRONMENTAL FACTORS

Enterprise environmental factors are both external and internal factors outside the realm of the project that a project manager does not have control over that can influence the processes in a project. Specific enterprise environmental factors that can be used as inputs to aid the development of the project management plan can include the following:

- Any relevant government standards, such as mandatory compliance standards.
- Any relevant industry standards that the project must comply with.
- Any software being used as part of the project management information systems to develop any aspect of the project management plan. Software is considered an external factor, because it is generally licensed from a third party.
- The organizational culture and structure of all organizations involved in the project. Organizational culture in terms of acceptable behaviors, attitudes towards risk, the amount of power and authority the project manager has, and a flat versus tall organizational structure are some of the external factors that can all affect how a project management plan is developed.
- Any internal organization policies for the recruitment and release of staff.

ORGANIZATIONAL PROCESS ASSETS

Organizational process assets are a very common input into many processes. It is also worth remembering that several processes have organizational process assets updates as outputs. The specific organizational process assets that can be used as inputs into the Develop Project Management Plan process include the following:

- Any standard artifacts, templates or checklists the organization has. For example, they may have a blank template for some or all of the content of a project management plan or a checklist for project closure.
- Any artifact, processes, or project management methodology, the organization has that define when, how, and by whom the project management plan is put together.
- Any predefined change control procedures and levels of delegated authority the project manager and team have.
- The organization's standard configuration management system that defines how different version of documents will be recorded, controlled, and updated. This is particularly important to ensure that you are always working on the correct version of any document in what can be a highly iterative process.
- Any historical information from past projects that can be used to assist in the compilation of the current project management plan.

EXAM TIP

The PMP® exam places a great deal of importance on the value of historical information, particularly lessons learned. Even if you work for an organization that does not currently collect historical information about projects, you must remember that it is considered one of the most valuable organizational process assets in project management.

TOOLS AND TECHNIQUES

The following two tools and techniques are used upon the inputs to deliver the project management plan.

EXPERT JUDGMENT

Expert judgment is a great tool to use, and it is used several times as a tool to help take inputs and use them correctly and wisely in order to generate the outputs from a particular process. The experts providing the judgment can come from any source that is relevant to the needs at hand, and can include you as project manager as well. In this instance, when you are developing the project management plan, expert judgment can first be used to *tailor* the processes that are applicable and useful to the development of your particular project management plan. You can also use expert judgment during successive iterations of the development of the project management plan to determine if the inputs are still valid and applicable.

Expert judgment can also be used to help evaluate any other aspect of the inputs into this process, particularly the outputs from other processes. Because of the large number of outputs from other processes that can be used as inputs into the Develop Project Management Plan process, you may end up using several experts with skills and experience in different areas.

Real World

During my career as a project manager, I have made repeated and frequent use of experts with knowledge greater than my own. Not only does it assist with a better output, but it is also a great way to learn. Don't hesitate to gather around you experts who can help you with any aspect of project management. Additionally, don't discount your own experience when it comes to providing an expert opinion.

DATA GATHERING

The point of data gathering as a tool and technique is to assist in crafting the project management plan, usually over many iterations. The specific tools you can use include:

- Brainstorming involves gathering people together in a room and asking them to think about all possible ideas. The ideas can be as wide and as varied as possible with no limitation placed upon the brainstorming process. After all possible options, no matter how seemingly irrelevant, have been gathered, you can then go through a process of refining them.
- Checklists ensure that all essential components and considerations are addressed during the development of the project management plan, promoting consistency and comprehensiveness.
- Focus groups gather diverse stakeholders to discuss and refine specific elements of the plan, ensuring alignment with broader organizational needs and perspectives.
- Interviews provide in-depth, one-on-one insights from key project participants, enabling a nuanced understanding of roles, responsibilities, and expectations essential for a robust project management plan.

INTERPERSONAL AND TEAM SKILLS

- Conflict resolution techniques are important because dysfunctional conflict needs to be addressed promptly and dealt with and not swept under the carpet. The other element of conflict is when conflict is used to generate healthy debate, which often results in a more thought-out and considered end result. Problem solving, collaborating, compromise, smoothing, forcing, and withdrawing are all examples of conflict resolution techniques.
- Facilitation techniques are those techniques you use to gather information from individuals or groups of people in a constructive way that produces positive outcomes for your project. As the name suggests, they are means of facilitating information gathering from people. It is up to you as project manager to initiate, define, and lead many of these facilitation techniques. Depending on whether or not they are useful to you at this point, you may wish to consider using some or all of the following facilitation techniques to help you make sense of, develop, redefine, and use the inputs into this process:
- Meetings are also an excellent example of facilitation techniques. The use of and adherence to a clear agenda, rules for participants, and clear minutes and action points will greatly assist gathering of information relevant to the development of the project management plan.

MEETINGS

The specific kinds of meeting you will hold will be focused on the people needed to develop and refine your project management plan and all the various elements within it. You should hold meetings with senior executives, the client, the steering committee, your team members, and various stakeholders as necessary to get the appropriate input you need for the development of your project management plan.

OUTPUTS

The Develop Project Management Plan process produces the following output.

PROJECT MANAGEMENT PLAN

There is only a single output from the Develop Project Management Plan process, and that is the *project management plan* in all its many iterations. The project management plan can be many different things to many different people, depending on the project management maturity of the organization, the size and complexity of its projects, and the industry it is working in. The plan can be a single document or a collection of many documents in different formats. A mature organization will have established organizational process assets that help the project manager complete the project management plan.

EXAM TIP

The project management plan is not a Gantt chart. It is not uncommon for some people to think that the Gantt chart is the project management plan, but it is simply a scheduling and a communications tool.

The content and depth of the project management plan will reflect what is known about the project at that time, because you can only plan what is known. As such, the development of the project management plan is a great example of progressive elaboration and rolling-wave planning on a lot of projects. This means that you should carefully control and document each iteration of the project management plan so you can see how much it has

varied from the initial baseline, and also so you know what the current version you should be working on is. This is a great use for your configuration management system.

The project management plan can contain all or some of the following plans and baselines:

- The change control process
- The requirements management plan
- The requirements documentation
- The schedule management plan
- The schedule baseline and milestone list
- The cost management plan
- The cost baseline
- The quality management plan
- The process improvement plan
- The human resource plan
- The resource calendar
- The communications management plan
- The risk management plan
- The risk register
- The procurement management plan
- The stakeholder engagement plan

Real World

When putting together a project management plan, I always make sure it is appropriate to the size and complexity of the project I am working on. I also recognize that it is a highly iterative process and you can only plan for those parts of the project you can define. This means that parts of the project off in the distance of time may not be able to be planned as well as parts of the project to be completed in the short term. It is important to communicate this well to stakeholders, who may think it is possible to plan a long-term project in its entirety.

Despite being a singular output, the project management plan is used, either in its entirety or in its component parts and subset plans, as an input into many other processes. The project management plan is a key input into the following processes:

- Direct and Manage Project Work
- Monitor and Control Project Work
- Perform Integrated Change Control
- Close Project or Phase
- Plan Scope Management
- Control Scope
- Plan Schedule Management
- Control Schedule
- Plan Cost Management
- Control Costs
- Plan Quality Management
- Plan Resource Management
- Plan Communications Management
- Monitor Communications
- Plan Risk Management
- Monitor Risks
- Plan Procurement Management
- Control Procurements
- Close Procurements

- Plan Stakeholder Engagement
- Monitor Stakeholder Engagement

Quick Check

1. Why is the project charter used as an input into the Develop Project Management Plan process?
2. Why do project management plan updates feature so much as outputs from other the processes?
3. Why does the development of the project management plan appear as part of the Project Integration Management knowledge area?

Quick Check Answers

1. During the first iteration of the development of the project management plan, the project charter is the document that authorizes time, money, and energy being directed towards the development of the project management plan, and it contains the initial information upon which to base the planning processes.
2. The development of the project management plan is a highly iterative process and, as such, it receives constant updates from other processes as it is fully developed.
3. The development of a project management plan requires the development of plans and baselines in all the other knowledge areas.

2.4 DIRECT AND MANAGE PROJECT WORK

TABLE 2-3 Direct and Manage Project Work process

INPUTS ⇒	TOOLS AND TECHNIQUES ⇒	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Any components</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Change log</i> ▪ <i>Lessons learned register</i> ▪ <i>Milestone list</i> ▪ <i>Project communications</i> ▪ <i>Project schedule</i> ▪ <i>Requirements traceability matrix</i> ▪ <i>Risk register</i> ▪ <i>Risk report</i> ▪ Approved change requests ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Project management information system ▪ Meetings 	<ul style="list-style-type: none"> ▪ Deliverables ▪ Work performance data ▪ Issue log ▪ Change requests ▪ Project management plan updates <ul style="list-style-type: none"> ▪ <i>Any component</i> ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Activity list</i> ▪ <i>Assumption log</i> ▪ <i>Lessons learned register</i> ▪ <i>Requirements documentation</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Organizational process assets updates

The Direct and Manage Project Work process is an executing process. It is one of six processes in the Project Integration Management knowledge area, and one of a total of eight executing processes.

The main focus of the Direct and Manage Project Work process is doing instead of planning, which means the execution and completion of the work on the project and the product, or deliverable, you have planned to do. This is why you do all that planning, so when it comes time to start doing work you know what to do.

There are three main components of the Direct and Manage Project Work process, each focused on a slightly different area of project execution. The first and probably largest area is the implementation of the project plans you have made that specify both project and product requirements. The second area of focus for this process is the iterative process whereby you must repair any defects discovered in deliverables in the Monitoring and Controlling processes. The third area is the focus upon implementation of any approved changes. As you can see, they are all doing something.

EXAM TIP

This process focuses on all the work that has to be done on the project and product, and the integration and interdependencies between all the executing processes. The other executing processes deal specifically with the execution of the quality, human resources, communications, procurement, and stakeholder engagement plans.

The role of the project manager is extremely important in this process and all the executing processes because, along with the rest of the project team members, the manager is responsible for the execution of the plans. The primary focus of this process is the production of deliverables. The Direct and Manage Project Work process is also where any approved changes are implemented.

INPUTS

The inputs used in this process reflect its focus upon doing the work that was planned and also implementing any approved change requests.

PROJECT MANAGEMENT PLAN

The project management plan is the primary input here for obvious reasons. Obviously, you can't execute any project or product work without a proper plan to work to. You can, however, start work without the project management plan being entirely complete due to the iterative nature of the executing process and of the profession of project management generally. You can start work on just those areas you have planned while other areas are still being planned.

Real World

I remember being new to the profession of project management and thinking it was better just to get on with the job and that planning was a negative outcome on a cost benefit analysis. It was with the wisdom gained with experience (and mistakes) that I learned that proper planning precedes execution, resulting in a much greater chance of project success.

PROJECT DOCUMENTS

The most important documents other than what are contained in the project management plan will be the:

- Change log, which lists all the change requests received and their status. This ensures you are fully aware of all changes to the work you are managing.
- Lessons learned register, so you can both learn from it, and add to it, to ensure that your work is always improving.
- Milestone list which provides a high level description of the work milestones you are expecting to reach on the project.

Other project documents that provide useful information about the work you are doing include project communications, project schedule, requirements traceability matrix, risk register and any risk reports.

APPROVED CHANGE REQUESTS

The process of Direct and Manage Project Work is not just about executing the project and product work detailed in the plans you have prepared. It is also about carrying out the work required as a result of approved changes. As such, *approved change requests* are an important input, because they describe the work to be done. Approved change requests can include a requirement for corrective action, a preventive action, or defect repair. Approved change requests are an output from the Perform Integrated Change Control process.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific enterprise environmental factors that can influence, or constrain, this particular process are any organizational culture or structure that affects the timing, commitment, and support for the execution process. Other factors that also influence or constrain the speed, timing, and execution of the plans prepared include decisions around project personnel and risk tolerances for stakeholders within and outside the performing organization. Access to adequate and appropriate project management information systems will also affect this process.

ORGANIZATIONAL PROCESS ASSETS

By now you will have figured out how often organizational process assets appear very commonly as a process input. For this process, the specific organizational process assets that can help are things such as standardized guides and work instructions that the organization has to assist the project manager and the project team in doing the planned work. Other organizational process assets that can assist in the execution of the planned work include historical information from similar projects, and any standardized and established communication requirements.

TOOLS AND TECHNIQUES

The three tools and techniques of this process are all used upon the separate inputs to deliver the planned work or the approved changes.

EXPERT JUDGMENT

Expert judgment as a tool for the Direct and Manage Project Work process is essential for taking the plans and other inputs and carrying out the implementation and execution of those plans. It is the job of the project manager and project team members to provide the expert judgment necessary to carry out the planning work and approved change requests to ensure that this process delivers its expected outputs.

In addition to the expertise of the project manager and project team members, you can also seek guidance from external experts and other stakeholders with skills and experience you require.

PROJECT MANAGEMENT INFORMATION SYSTEM

The *project management information system* is an automatic or manual system, such as common project management software or databases, used for storing and disseminating project information. Here it is used to track the work being done and communicate it effectively to the correct stakeholders.

EXAM TIP

Project management information systems can include software used for creating and monitoring schedule information such as Microsoft Project, Primavera, Trello, Atlassian, Wrike, Basecamp, ProjectLibre or any one of the hundreds of other great examples. They can also include databases used for cost estimating and control, and range from standalone installations to larger enterprise resource planning systems.

MEETINGS

Meetings have many purposes in communications processes. In this instance, meetings are used as a tool by the project manager to discuss and make decisions on matters affecting the execution of the project.

Real World

I have found that a properly organized meeting can be one of the most productive ways of sharing information, getting decisions made, and also building team spirit. To run one well, you need to spend time preplanning the meeting, set a clear agenda, have a real reason for the meeting, and set the expectation of the outcome from the meeting. You also need to invite only those people who need to be present and establish some ground rules. The absence of these basic points will result in a meeting that could potentially be a waste of time for all involved.

OUTPUTS

The major output from the Direct and Manage Project Work process is the project deliverables.

DELIVERABLES

The *deliverables* are often the major focus of any project. It is what the project was set up to do in the first place, and it is the primary output from this process. It can be a single deliverable or one of many deliverables. The product deliverable is the output from this executing process, whereas the other executing processes have outputs focused upon project, not product, work.

The deliverables go on to become an input into the Control Quality process prior to becoming verified deliverables if they are approved. Once approved by the project team, Verified Deliverables then become an input into the Validate Scope process prior to becoming Accepted Deliverables if they are accepted by the Customer.

Examples of deliverables include software modules for an IT project. If you are completing a construction project, the deliverable could be the entire building or significant parts of it. Clearly it is important that you are able to measure when a deliverable is complete, so you know when to complete this process.

WORK PERFORMANCE DATA

Another output from this process is the *work performance data*, which is the documented record of observation and measurements of the deliverables taken during this executing process. The work performance data can include any data that records the percent complete, any technical measurements taken, the number of change requests made and approved, the number of defects found and corrected, and start and finish times, both expected and actual. You can probably tell that some of this data is generated by other executing processes, but due to the integrated nature of the Direct and Manage Project Work process, it gets included here as an output because it may affect and be used as an input by the following monitoring and controlling processes:

- Validate Scope
- Control Scope
- Control Schedule
- Control Costs
- Monitor Communications
- Monitor Stakeholder Engagement
- Control Procurements
- Monitor Risks
- Control Quality

ISSUE LOG

You will make updates to the issue log and report on any significant issues to the appropriate people such as the client, sponsor, or steering committee.

CHANGE REQUESTS

As a result of doing the planned work, you may discover that there are some changes to part of the project management plan or product requirements. The *change requests* generated as a result of this process go on to become inputs into the Perform Integrated Change Control process.

EXAM TIP

All change requests must go through a documented and agreed-upon change control process and be either approved or declined. Change requests fall into one of the following four categories: corrective action, preventive action, defect repair, or updates.

PROJECT MANAGEMENT PLAN UPDATES

As part of doing the planned work, you may choose to update some or all of the component plans that make up the project management plan. *Project management plan updates* are different from change requests which. Change requests signify that there is something new that needs to be considered in an integrated manner. Project management plan updates are simply updates to documents and plans for clarification or revised approaches to executing the planned work and do not require a formal change request to be initiated.

PROJECT DOCUMENTS UPDATES

As well as updates to specific plans that form the project management plan, you are also able to carry out project document updates to provide clarification or to note any new information such as new issues, assumptions made, and decisions taken.

2.5 MANAGE PROJECT KNOWLEDGE

TABLE 2-4 Manage Project Knowledge process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>All Components</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Lessons learned register</i> ▪ <i>Resource breakdown structure</i> ▪ <i>Stakeholder register</i> ▪ Deliverables ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Knowledge management ▪ Information management ▪ Interpersonal and team skills <ul style="list-style-type: none"> ▪ <i>Active listening</i> ▪ <i>Facilitation</i> ▪ <i>Leadership</i> ▪ <i>Networking</i> ▪ <i>Political awareness</i> 	<ul style="list-style-type: none"> ▪ Lessons learned register ▪ Project management plan updates <ul style="list-style-type: none"> ▪ <i>Any component</i> ▪ Organizational process assets updates

The Manage Project Knowledge process is an executing process. It is one of seven processes in the Project Integration Management knowledge area, and one of a total of ten executing processes.

The Manage Project Knowledge process revolves around the utilization and management of knowledge acquired during the project lifecycle. This process is instrumental in ensuring that lessons learned, best practices, and critical insights are captured, shared, and applied throughout the project's phases. It involves both tacit knowledge (personal insights, intuitions, and hunches) and explicit knowledge (documented procedures, facts, and data). By effectively managing project knowledge, organizations can avoid repeating past mistakes, capitalize on previous successes, and enhance overall project performance. Furthermore, this knowledge, once documented and stored, can be invaluable for future projects, promoting continuous improvement and more efficient project execution.

You should note that it is a foundational element to recognize that a lot of learning can take place during projects. Some of the learning is specific to the project such as a better or faster way to complete specific work. Most of the learning can and should be shared with other project teams on other projects to improve their outcomes. The knowledge gained should also be shared throughout the organization so that over time the organisation gets better at delivering its projects. This will give you an indication of why the managed project knowledge process is so important.

You should also be aware that knowledge can be separated into two types, explicit and tacit. Explicit knowledge is codified, formalized, and can be easily documented and transferred. For instance, when a project manager creates a Gantt chart, documents standard operating procedures, or writes out a project's lifecycle phases, they are dealing with explicit knowledge. It's information that can be easily archived, shared in manuals, or presented in training modules. On the other hand, tacit knowledge is intuitive, experiential, and harder to articulate or document. It's the kind of knowledge that project managers acquire through personal experience or informal interactions. For example, a project manager's ability to navigate team dynamics, their instinct in making a crucial decision based on a gut feeling, or their skill in managing a stakeholder's expectations based on prior interactions, all fall under the umbrella of tacit knowledge. While explicit knowledge can be easily disseminated in a tangible format, tacit knowledge often requires personal interactions, mentorships, and hands-on experiences to be transferred effectively.

INPUTS

The inputs used in this process reflect its focus upon doing the work that was planned and also implementing any approved change requests.

PROJECT MANAGEMENT PLAN

Given that project knowledge can be taken from any part of the project at all you should be prepared to use any element of the project management plan.

PROJECT DOCUMENTS

In addition to any element of the project management plan there are some specific documents that you should be prepared to refer to as inputs into this process and these include the Lessons learned register as it is the primary focus of this the process. Additional documents that you may want to use include the resource breakdown structure and the stakeholder register.

DELIVERABLES

You should expect to have information about the deliverables so that you can document what you have learned in order to improve the current set of deliverables for your project, but also pass on this knowledge to other project teams and also to the wider organization.

ENTERPRISE ENVIRONMENTAL FACTORS

These will include, among others, organizational culture and structure, information technology software and infrastructure, and human resource policies and procedures.

ORGANIZATIONAL PROCESS ASSETS

These will include, among others, the lessons learned repository, knowledge management procedures and templates and form.

TOOLS AND TECHNIQUES

The three tools and techniques of this process are all used upon the separate inputs to deliver the planned work or the approved changes.

EXPERT JUDGMENT

You will use your own judgment and that of subject matter experts in order to assess the particular inputs that you have chosen to use for this process.

KNOWLEDGE MANAGEMENT

The primary goal of knowledge management is to facilitate the creation, sharing, use, and management of knowledge in an organization. Knowledge management ensures that the organization can leverage its collective wisdom to make better decisions and improve overall performance. It encompasses both explicit and tacit knowledge. Knowledge management within a project involves capturing lessons learned, facilitating workshops, mentorship, and collaboration platforms where team members can share insights and experiences. By effectively managing knowledge, an organization can prevent the same mistakes from reoccurring, harness effective strategies from past projects, and ensure that team members are continually learning and improving.

INFORMATION MANAGEMENT

Information management concerns itself with the collection, storage, dissemination, archiving, and ultimate disposal of information. It deals primarily with explicit data and information, typically structured and easy to distribute. This might include project reports, schedules, metrics, or any other kind of documented information. Information management involves tools and techniques like document management systems, data repositories, communication tools, and reporting systems. Effective information management ensures that all stakeholders have timely access to the precise information they need, presented in a usable format, and stored in a way that ensures its integrity and availability throughout the project life cycle.

In essence, while both knowledge and information management are critical for the success of projects, knowledge management focuses more on leveraging the collective experience and insights of the team, whereas information management emphasizes the proper handling of explicit, documented data and information.

INTERPERSONAL AND TEAM SKILLS

Getting the input from team members and important stakeholders to enable you to properly assess, document, and store effective knowledge requires you to use the following interpersonal and team skills effectively: active

listening, facilitation, leadership, networking, political awareness. An important part of this will be ensuring that you create an atmosphere and culture of trust so that people feel comfortable sharing their knowledge.

OUTPUTS

The major outputs from the Manage Project Knowledge process are:

LESSONS LEARNED REGISTER

We cannot overstate the importance that the exam will place on collecting, storing, and learning from lessons gathered in a project. The lessons learned register is the place where all of this information is referenced. Creation of the lessons learned register, and updates to it are the primary output from this process group.

PROJECT MANAGEMENT PLAN UPDATES

As part of this process you may also choose to update any part of your project management plan or ancillary documents as well.

ORGANIZATIONAL PROCESS ASSETS UPDATES

Be prepared to update any relevant OPA.

Quick Check

1. Why is it important to complete project planning prior to beginning the Manage Project Knowledge process?
2. Why does the Manage Project Knowledge process appear in the Project Integration Management knowledge area?
3. What sort of information do Lessons Learned include?

Quick Check Answers

1. The Manage Project Knowledge process is a doing process, and before you can do any work you must have planned what it is you are going to do.
2. Manage Project Knowledge process can have an impact upon other many other knowledge areas and, as such, it represents the integrated nature of project management and the interrelationship between processes.
3. The Lessons Learned document or database can include any aspect about the project. They should attempt to capture anything, and everything that can help the project perform better, carry out a great post implementation review, and allow future projects to be successful.

2.6 MONITOR AND CONTROL PROJECT WORK

TABLE 2-4 Monitor and Control Project Work process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Any component</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Assumptions log</i> ▪ <i>Basis of estimates</i> ▪ <i>Cost forecasts</i> ▪ <i>Issue log</i> ▪ <i>Lesson learned register</i> ▪ <i>Milestone list</i> ▪ <i>Quality reports</i> ▪ <i>Risk register</i> ▪ <i>Risk report</i> ▪ <i>Schedule forecasts</i> ▪ Work performance information ▪ Agreements ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Alternative analysis</i> ▪ <i>Cost-benefit analysis</i> ▪ <i>Earned value analysis</i> ▪ <i>Root cause analysis</i> ▪ <i>Trend analysis</i> ▪ <i>Variance analysis</i> ▪ Decision making <ul style="list-style-type: none"> ▪ <i>Voting</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Work performance reports ▪ Change requests ▪ Project management plan updates ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Cost forecasts</i> ▪ <i>Issue log</i> ▪ <i>Lesson learned register</i> ▪ <i>Risk register</i> ▪ <i>Schedule forecasts</i>

The key area of focus in the Monitor and Control Project Work process is checking that what you are doing matches what you planned to do. Obviously, to do this you must have done some planning and use these plans and baselines to check that the work you are doing matches what you planned to do. Remember that the work you are doing is not just the product work but also all the project work defined in your project management plan.

The Monitor and Control Project Work process is one of two monitoring and controlling processes in the Project Integration knowledge area and one of a total of 12 monitoring and controlling processes overall. Monitoring and controlling work is done throughout the life of the project from initiation to closure.

EXAM TIP

Hopefully by now you have started the process of immediately trying to determine what sort of inputs would be useful for completing a process and what sort of outputs that process will produce. Before reading any further, think about what sort of inputs would be useful for checking that what you are actually doing is what you planned to do.

INPUTS

There are six primary inputs into the Monitor and Control Project Work process, all specifically designed to assist you in producing the outputs of change requests, work performance reports, project management plan updates, and project documents updates.

PROJECT MANAGEMENT PLAN

Once again the project management plan, and any part of it, forms a key input into a process, this time because if you are going to check that what you are doing is what you planned to do, you should have available to you as an input the project management plan and all its subsidiary plans, because this is what you will be checking your work against. The project management plan is an output from the Develop Project Management Plan process.

PROJECT DOCUMENTS

In order to determine whether or not your project is on track in terms of the work that it's doing you should reference any and all appropriate project documents which help you understand this. There are a number of them listed as potential inputs and you will choose the ones that are most relevant to what you need at that point in time to understand whether the work you are doing is in accordance with the defined scope and stakeholder expectations.

EXAM TIP

To fully understand what *validated changes* means, you must understand the difference between the words *validate* and *verify*. The PMBOK® Guide has an extensive glossary at the back of the book that describes in detail the different words used throughout. *Validation* means that the product, service, or system meets the needs and requirements of the customer and other important stakeholders. *Verification* means that the product, service, or system complies with documented regulations, specifications, or imposed technical conditions. Think of validation as an external process and verification as an internal process done before validation.

WORK PERFORMANCE INFORMATION

Work performance information is a very common output of a lot of the other monitoring and controlling processes. It is an output from the following processes:

- Validate Scope
- Control Scope
- Control Schedule
- Control Costs
- Control Quality
- Monitor Communications
- Monitor Risks
- Control Procurements
- Monitor Stakeholder Engagement

It includes all the data collected during these processes, and as an input into this process it is valuable for assessing what is actually happening against what you had planned to happen.

EXAM TIP

You may recognize that work performance data becomes work performance information, which in turn becomes work performance reports. Each step is a further refinement of the information.

AGREEMENTS

You should be prepared to examine any agreements that have been made between parties to the project to ensure that the work described in the agreements is being delivered correctly.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific types of enterprise environmental factors that can be used in this process include any relevant government or industry standards, stakeholder risk tolerances, and your project management information system being used to provide information into this process and record and disseminate any results from the process.

ORGANIZATIONAL PROCESS ASSETS

The specific types of organizational process assets that can be used as inputs into this process include any existing processes and templates the organization has, lesson-learned databases, risk management procedures, documented change control processes and procedures, and issue and defect management procedures.

TOOLS AND TECHNIQUES

The following tools and techniques are available, if appropriate, to use on the selected inputs.

EXPERT JUDGMENT

Once again expert judgment appears as a key tool to assist in gathering, interpreting, and making sense of the inputs into the process to produce useful and meaningful outputs. In this process, the project manager and members of the project team would be the most relevant and easily accessible experts to consult.

DATA ANALYSIS

Data analysis allows you to make sense of the inputs into the processes and the data they contain to forecast potential future scenarios. For the exam you will need to be aware of the following analytical techniques:

- **Alternative analysis** involves evaluating multiple potential options or approaches to address specific project challenges or issues. This tool assists project managers in making informed decisions by comparing

the benefits, costs, and risks of each alternative before selecting the most appropriate solution.

- **Cost-benefit analysis** is a tool that evaluates the financial advantages (benefits) and costs associated with a particular project action or decision. This analysis assists project managers in determining if an action adds value to the project, by comparing the anticipated benefits against the estimated costs.
- **Earned value analysis** is a tool that compares the planned progress of a project to its actual progress, using key metrics like cost performance and schedule performance. This analysis provides project managers with insights into project performance, enabling them to forecast future performance and take corrective actions if necessary. There is a detailed explanation of this example in the Control Costs process later in this book. You should study it very carefully as there will be questions in the exam which will test you on this topic.
- **Root cause analysis** is a technique used to identify the fundamental reason or underlying cause of a problem or discrepancy within the project. By determining and addressing this root cause, project managers can implement effective corrective actions to prevent similar issues from reoccurring in the future.
- **Trend analysis** is a technique for observing data, trying to spot a trend in the data and use this observed trend to forecast a future state. You could use this in this process to spot a constant and regular trend in the product deliverable indicating that if the trend continues you will end up with a product that the client doesn't want.
- **Variance analysis** is a technique that evaluates the differences between planned and actual project performance. This analysis helps project managers identify deviations, determine their cause, and decide if corrective action is required to align the project with its objectives.

DECISION MAKING

The decision-making tool involves evaluating and selecting a course of action from multiple alternatives based on criteria or constraints. This tool assists project managers in making informed choices that align with project objectives, stakeholder expectations, and organizational goals.

MEETINGS

Meetings are a useful tool for the project manager, project team members, and relevant stakeholders to exchange and discuss information. They are best held in a face-to-face environment where participants can see each other, but can also be held in virtual formats. Meetings that would be useful during this process are status review meetings, change control meetings, and quality control meetings.

OUTPUTS

The following outputs are generated by the Monitor and Control Project Work process

WORK PERFORMANCE REPORTS

Work performance reports are generated by your project management information system in physical or electronic form and show how the project is progressing against what was planned, and any changes requested and subsequent actions taken. Typically work performance reports include any regular status updates, project memos, explanatory notes, and any other updates to project team members and stakeholders.

Real World

I have always found that not only are reports on work performance information a valuable means of communicating technical information but they are a valuable means of establishing and maintaining effective communications with team members and stakeholders. I have always been selective in what information goes to certain people, and also what the best format is to ensure the information I am distributing is understood by the recipients.

CHANGE REQUESTS

The key outputs from the Monitor and Control Project Work process are change requests, generated as a result of observing and comparing what is actually occurring against what was planned and also generated by changing requirements. There are several different categories of change requests that can be made; these include *corrective actions*, *preventive actions*, and *defect repair*.

Change requests become an input into the Perform Integrated Change Control process, where they are assessed and decisions are made as to whether they are approved or declined. They are not acted upon until they have been approved.

PROJECT MANAGEMENT PLAN UPDATES

As a result of monitoring and controlling the actual results against the planned results, you are going to detect variations, and as a result there will be some changes to your project, probably in several different areas. These need to be captured in updates to the relevant parts of your project management plan.

PROJECT DOCUMENTS UPDATES

Just as there will be updates to parts of your project management plan, there will also need to be updates to project documents that deal with forecast, performance, or issues.

Quick Check

1. How are the Monitor and Control Project Work process and the Perform Integrated Change Control process linked?
2. Why is the project management plan an important input into the Monitor and Control Project Work process?
3. When would you start the Monitor and Control Project Work process?

Quick Check Answers

1. The two processes are linked by change requests, which are a primary output from the Monitor and Control Project Work process and are an input in the Perform Integrated Change Control process, where decisions are made about the change request.
2. The project management plan provides a description of how the work is expected to be done and can be used to compare with what is actually occurring.
3. Monitoring and controlling activities are done throughout the life of the project and begin as soon as the project begins initiation and end when the project is closed.

2.7 PERFORM INTEGRATED CHANGE CONTROL

TABLE 2-5 Perform Integrated Change Control process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Change management plan</i> ▪ <i>Configuration management plan</i> ▪ <i>Scope baseline</i> ▪ <i>Schedule baseline</i> ▪ <i>Cost baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Basis of estimates</i> ▪ <i>Change log</i> ▪ <i>Requirements traceability matrix</i> ▪ <i>Risk Report</i> ▪ Work performance reports ▪ Change requests ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Change control tools ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Alternatives analysis</i> ▪ <i>Cost-benefit analysis</i> ▪ Decision making <ul style="list-style-type: none"> ▪ <i>Voting</i> ▪ <i>Autocratic decision making</i> ▪ <i>Multicriteria decision analysis</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Approved change requests ▪ Project management plan updates ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Change log</i>

The Perform Integrated Change Control process is one of two monitoring and controlling processes in the Project Integration Management knowledge area, and one of a total of 11 monitoring and control processes. The other 10 monitoring and controlling processes are focused on discovering any variations between what is planned and what is actually occurring, and generating change requests where appropriate. The Perform Integrated Change Control process deals with these change requests.

This is the process where all changes to any part of the project are considered and decisions are made about whether they are approved or rejected. As such, it receives inputs from all the other monitoring and control processes in the form of change requests that have been generated by these other processes. It is completed throughout the life of the project, as are all monitoring and control processes.

Change requests can come from many sources, including any stakeholder on the project. All changes, no matter how small, should be documented. Many change requests are initiated with a simple verbal request, but even these should be documented and recorded in some way. Documentation of change requests can range from simple email verification of verbal requests to completion of a formal change request document, right up to a complete business case for major changes to a project. Failure to document changes will result in scope creep. "Scope creep" occurs when undocumented change control is allowed to happen, involving small changes that are regarded as insignificant. Individually they may not pose a problem, but collectively they increase the chances of project failure.

"Gold plating" is the process of making small undocumented changes to a project that result in a better outcome for the client. Although it sounds good in theory, the key here is that it is still undocumented changes to a project. This is not to say that you should not pursue better outcomes for the project and the client, but that all changes should be documented and assessed according to an agreed change control process.

EXAM TIP

At all times you should be delivering what is documented and only what is documented. This doesn't mean that you can't change what is being delivered, but that all changes should be documented.

All changes should be recorded in a change log that assigns them a tracking number and records progress and outcomes on the decision-making process.

EXAM TIP

The identification and numbering of the changes in a change log is one example of a configuration management system at work. It is a system whereby you identify all the plans and the version of those plans to ensure you are always working on the latest plans or parts of a project. Configuration verification and audit is the process of checking that the configuration management system is being used correctly and that all changes to it are recorded appropriately. You will find the configuration management system used in several areas where it is broken down into the following three parts:

1. Configuration identification – deciding the type and format of an appropriate configuration system to use.
2. Configuration status accounting – actually using each of the configuration management systems to track and surveil the project.
3. Configuration verification and audit - checking that people are using the configuration management system to ensure documents are being tracked, the correct version of software is being used, processes are being used and the right parts of being used.

INPUTS

The following inputs can be used in this process.

PROJECT MANAGEMENT PLAN

The project management plan is a key input into this process, because it outlines what is planned to happen on the project. Many change requests are initiated as a result of observing a difference between what was planned and what is actually occurring. The primary parts of the project management plan that will be of most use are:

- Change management plan
- Configuration management plan
- Scope baseline
- Schedule baseline
- Cost baseline

The project management plan is an output from the Develop Project Management Plan process.

PROJECT DOCUMENTS

In order to assess whether any changes to the project need to be considered you should have access to the following important project documents which can provide important information about this process:

- Basis of estimates
- Change log
- Requirements traceability matrix
- Risk Report

WORK PERFORMANCE REPORTS

If you are going to assess the impact and nature of any changes, it is important that you have the work performance reports to assist you. This will give information about specific areas of the project and also allow the project manager and project team members to consider any impacts of a change in one area upon other areas of the project.

The work performance reports are an output of the Monitor and Control Project Work process.

EXAM TIP

The difference between work performance reports, work performance information, and work performance data is that the work performance data is the raw information work performance information is the raw information after it has been analyzed, and contextualized, and after it incorporates the integrated nature of project management; and the work performance reports are the information presented in a particular way to a particular group of stakeholders.

CHANGE REQUESTS

The change requests are an essential input into this process, because it is focused upon receiving the change request, considering it in light of the entire project, and making a decision about whether to approve or reject the change request.

As you have already learned, change requests are outputs of the other ten monitoring and controlling processes.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific enterprise environmental factor that can affect the Perform Integrated Change Control process is primarily the project management information system, because it records all the changes, the work performance information and reports, and the decisions made about the change requests.

ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can be used to assist the Perform Integrated Change Control process are any change control processes, templates, and procedures that the organization has that guide assessment, delegated authority, and decision-making.

Real World

I am a strong advocate of documenting very clearly the levels of delegated authority that project managers have when it comes to making assessment and decisions about change requests. It is simply not practical for all changes to go to a change control board that perhaps meets monthly. It is far more sensible to allocate a certain amount of delegated authority to the project manager so the project can keep moving along. This view is reflected in the PMP® exam.

TOOLS AND TECHNIQUES

The following tools and techniques can be used upon the selected and available inputs to generate the outputs.

EXPERT JUDGMENT

The specific type of expert judgment you will use as a tool in this process is those people with skills and experience to be able to assist in considering the change request and the information that will help decide whether or not to accept or reject the change requests. These experts can be individuals who will be consulted about particular issues, or they can be groups of stakeholders who form the change control board that meets to consider change requests.

CHANGE CONTROL TOOLS

Change control tools used in the Perform Integrated Change Control process can be any automated or manual system for organizing, recording, documenting, assessing, storing, and distributing decisions about change requests and the subsequent decisions made. You can tell that your project management information system will be one example of the sort of change control tool that can be used.

DATA ANALYSIS

The primary methods of data analysis that you will use to consider whether or not a change should be approved, and the magnitude of that change will be alternative analysis and cost-benefit analysis.

DECISION MAKING

By now you will be getting familiar with a lot of the repetition with the different tools and techniques that are used. You have already seen decision making as a tool and technique in other areas and you will now have an understanding that it is an important tool to help you make sense of any inputs that you are considering in order to make decisions about the outputs from the process. When it comes to assessing, and making decisions about, any potential changes to the project there are several ways to do this including voting, autocratic decision making (which is a top down decision making process), or making decisions based on the weighting of multiple criteria. Whatever your decision making process is it should be clearly documented in your approved change control process. Additionally, it is considered good practice to ensure that a project manager has sufficient levels of delegated authority to be able to make decisions about smaller changes with that having to refer back to the project sponsor or steering committee.

MEETINGS

Meetings, in this case *change control meetings*, are attended by the *change control board* that is responsible for assessing change requests and making the decisions to approve or reject the change requests. Not all changes need to go to the change control board via change control meetings though, only those specified in the documented change control process, which ideally should be part of your project management methodology, itself part of your organizational process assets.

OUTPUTS

The Perform Integrated Change Control process produces some or all of the following outputs.

APPROVED CHANGE REQUESTS

Approved change requests are the primary output from the Perform Integrated Change Control process. They are the result of the selected inputs and the tools and techniques applied. All approved change requests will be recorded in the change request log.

The approved change requests go on to be incorporated into existing baselines and become an input in the following processes:

- Direct and Manage Project Work
- Control Quality
- Control Procurements
- Manage Stakeholder Engagement

Real World

I have often seen assumptions made about approved change requests being carried out. Some people seem to think that simply because the change has been requested, considered, and a decision be made to approve it, that the change is automatically carried out. Unfortunately, this isn't always the case. This is one of the reasons you should record all change requests, their status, any decisions made, and any required follow-up actions on your change request log. Furthermore, assigning someone to be responsible for not only carrying out the change but checking that it was carried out correctly is an important factor in making sure all your approved change requests are implemented.

PROJECT MANAGEMENT PLAN UPDATES

Approved change requests are added to existing baselines to become new baselines. Additionally, many approved change requests will also affect other subsidiary project management plans. Project management plan updates are used as an input into the Develop Project Management Plan process.

EXAM TIP

A baseline is the original baseline plus any approved changes. This may differ from your current understanding of the baseline being only what you originally started with.

PROJECT DOCUMENTS UPDATES

Just as approved change requests can change parts of the project management plan, they can also affect other project documents and require them to be updated, particularly those associated with the change control process. The primary document to be updated would be the Change Log which is the document kept to record the change requests received and their status.

Quick Check

1. Why is the Perform Integrated Change Control process performed after other monitoring and controlling processes?
2. During what parts of the project life cycle are the activities associated with Perform Integrated Change Control process performed?
3. What is the role of the change control board?

Quick Check Answers

1. The Perform Integrated Change Control process requires change requests as a key input. These change requests are generated as outputs from other monitoring and controlling processes.
2. The activities of the Perform Integrated Change Control process are carried out throughout the entire project life cycle from initiation to closing.
3. The change control board is the group of experts who meet to consider change requests. They are defined by the documented change control processes in place within the organization.

2.8 CLOSE PROJECT OR PHASE

TABLE 2-6 Close Project or Phase process

INPUTS →	TOOLS AND TECHNIQUES →	OUTPUTS
<ul style="list-style-type: none"> ▪ Project charter ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>All components</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Assumption log</i> ▪ <i>Basis of estimates</i> ▪ <i>Change log</i> ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Milestone list</i> ▪ <i>Project communications</i> ▪ <i>Quality control measurements</i> ▪ <i>Quality reports</i> ▪ <i>Requirements documentation</i> ▪ <i>Risk register</i> ▪ <i>Risk report</i> ▪ Accepted deliverables ▪ Business documents <ul style="list-style-type: none"> ▪ <i>Business case</i> ▪ <i>Benefits management plan</i> ▪ Agreements ▪ Procurement documentation ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data analysis ▪ Document analysis ▪ Regressions analysis ▪ Trend analysis ▪ Variance analysis ▪ Meetings 	<ul style="list-style-type: none"> ▪ Project document updates <ul style="list-style-type: none"> ▪ <i>Lessons learned register</i> ▪ Final Product, Service, or Result transition ▪ Final report ▪ Organizational process assets updates

The Close Project or Phase process is the only closing process and provides guidance on all the steps, tools, and techniques to successfully close a project.

This process is the only closing process in the Project Integration Management knowledge area and is focused upon the activities involved in completing the work required in a project or a phase of a project. Because it is an integrated process, it involves closure over all the processes being used in the project and not just the deliverable. As the name of the process suggests, it is used when closing a project prior to deliverable handover, or when completing a phase of a project prior to awaiting approval to proceed to the next phase.

The role of the project manager during this process is important, because the project manager must take responsibility for closing the project and overseeing the required tasks. He or she has responsibility for reviewing all the documents created and ensuring that what is being delivered matches what is documented. Having a closeout checklist as part of your organizational process assets is an effective way to document what exactly closure means, the tasks that must be done, the signatures that must be obtained, and the final steps to confirm the project is complete. The role of the project sponsor is also important, because that individual officially signs off on project or phase closure.

EXAM TIP

The PMP® exam places a high degree of importance on the value of creating lessons learned during the project and finalizing these during the closeout process through informal means, surveys, interviews, workshops, and post-implementation reviews. You should always assume that you will create lessons learned as part of your project, and always assume that lessons learned are available to you from previous projects when you begin a new one.

EXAM TIP

All projects must be closed even if they end in less-than-perfect situations. If a project ends suddenly, then you must have a process in place to follow in this instance. If a question in the PMP® exam poses this scenario, you should also assume that whatever the situation, you will enter some form of project closure process.

Real World

Project closure is one of those processes that we know we should do, but usually by the time we move into the part of the project where the bulk of our effort is on project closure, we are being called away to start a new project. I have learned that there are tangible benefits in staying focused on project closure in the face of these calls to join new projects. It is important to make sure you get formal signoff that the project is complete, collect and store lessons learned, and, if possible, hold a post-implementation review sometime later to determine if the deliverable is actually doing what it was supposed to do.

INPUTS

The Close Project or Phase process uses the following inputs.

PROJECT CHARTER

Given that the project charter initiated the project it will be an important document to look at when considering whether or not the project has reached the stage of project closure.

PROJECT MANAGEMENT PLAN

The project management plan defines the work to be done, and so, as part of seeking to close a project or phase of a project, you will need the project management plan and must be able to prove that all the work planned has been completed. The project management plan is the contract between the project manager and the project sponsor, because it is the document that defines what constitutes project completion. The project management plan is an output from the Develop Project Management Plan process.

PROJECT DOCUMENTS

Given that closing a project can be quite a robust and intensive process it is prudent to use a wide range of existing project documents to determine whether or not the project can be closed and if so what steps need to be taken to achieve this. The following is a list of the project documents that you may find useful in this process:

- Assumption log
- Basis of estimates
- Change log
- Issue log
- Lessons learned register
- Milestone list
- Project communications
- Quality control measurements
- Quality reports
- Requirements documentation
- Risk register
- Risk report

ACCEPTED DELIVERABLES

Accepted deliverables are an output from the Validate Scope process in the Project Scope Management knowledge area. Because they are validated by your documented processes, they are now ready to be handed over as part of the project closure process.

BUSINESS DOCUMENTS

Business documents serve as critical references that encapsulate detailed project information and performance data. Examples of these documents include the business case, which justifies the project's value proposition and initial objectives, and the benefits management plan, which outlines the expected benefits the project is meant to deliver and provides a baseline for evaluating the project's success post-completion.

AGREEMENTS

Agreements refer to the documented and formalized understanding or contracts established with external stakeholders, particularly suppliers or vendors. Reviewing these agreements during closure ensures all contractual

terms and conditions have been met and any necessary final payments or formal sign-offs are appropriately addressed.

PROCUREMENT DOCUMENTATION

Procurement documentation encompasses all the formal records, contracts, terms, bids, proposals, and performance reports related to external vendors and suppliers. Reviewing these documents ensures that all procurement-related obligations are fulfilled, and the relationships are formally concluded in alignment with the set terms and conditions.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that can be used to assist the Close Project or Phase process are any documented closeout checklists, templates, processes, or requirements. Additionally, you can use any relevant historical information or lessons learned to assist you with this process.

EXAM TIP

You should always do your closure planning during the Develop Project Management Plan process and the other planning processes. Along with all your other plans, you should also have a plan for how to close the project.

TOOLS AND TECHNIQUES

The following tools and techniques can be used upon the inputs into the Close Project or Phase process.

EXPERT JUDGMENT

The type of expert judgment you will want to use during this process will be the project manager, the project team members, the project sponsors, the client, your legal team, and any other stakeholders who can provide advice and opinion on project closure.

DATA ANALYSIS

Data analysis was used as a tool or technique in the Monitor and Control Project Work process to analyze data and forecast future trends. As a tool in this process, they are used to substantiate any information that can be used to confirm project or product deliverables. Of the possible analytical techniques that could be used, regression analysis, variance analysis and trend analysis would be the most applicable and useful.

MEETINGS

Meetings between experts and other stakeholders involved in discussing and deciding on aspects of project or phase closure are an important tool in the process. Specific types of meetings that can be held include lessons-learned meetings, closeout meetings, and post-implementation review meetings.

OUTPUTS

The Close Project or Phase process produces the following outputs.

PROJECT DOCUMENTS UPDATES

As part of project closure it is an expectation that that you will together and store the final lessons learned so that they can be used for future projects. Therefore the primary document to be updated will be the lessons learned register.

FINAL PRODUCT, SERVICE, OR RESULT TRANSITION

This is the whole point of the project, the reason it was initiated in the first place. This is the deliverable the entire project was planned to provide the customer with. In the case of phase closure, it is the milestone that is expected before approval is given to proceed to the next phase. The *final product, service or result* is handed over to the customer as the final part of contractual closure.

FINAL REPORT

The final report is a comprehensive document that summarizes the entirety of the project or phase, capturing its performance against initial objectives, key milestones achieved, and any challenges encountered. This report serves as a formal record for stakeholders, providing insights into the project's successes and areas of improvement. Additionally, the final report often lays the foundation for post-project reviews, lessons learned sessions, and future project planning by offering valuable retrospective data.

ORGANIZATIONAL PROCESS ASSETS UPDATES

The end of a project and the time spent examining what was done well and what was not done so well is a great time to look at updating any relevant organizational process assets as part of your commitment to continuous improvement. The project files, including all the documentation resulting from the completion of the project activities, should be used to update any relevant organizational process assets. The gathering of historical information and lessons learned, and use of this information to update and improve organizational process assets is also an important step. *Organizational process assets updates* are the final act of administrative closure.

EXAM TIP

Know the difference between contractual and administrative closure, and understand that contractual closure is always completed before administrative closure is completed.

Quick Check

1. Why is the completion of the lessons-learned documentation during the Close Project or Phase process so important?
2. What is the difference between closing a project and closing a phase of a project?
3. What is the role of the project sponsor during the Close Project or Phase process?

Quick Check Answers

1. The lessons-learned documents ensure that any part of the project that was done well, and any part of the project that was not done well, is documented for future project managers to use so they can take advantage of the strengths and avoid repeating the weaknesses in your project.
2. Closing a project means the completion of all work on a project. Closing a phase of a project is the end of one phase and not necessarily the end of the project. The successful end of a phase means waiting for approval to move to the next phase, usually with the output from the phase that is being closed.
3. The project sponsor's role in the Close Project or Phase process is to accept the deliverable on behalf of the delivering organization and provide formal signoff for project closure.

2.9 CHAPTER SUMMARY

- The Project Integration Management knowledge area recognizes, and is focused upon, the way in which project work is not completed in separate discrete chunks but that there is both the need to take a high-level view across all project activities, and that activities in one knowledge area may influence activities in another knowledge area.
- The project charter is the foundational document for the project, and all projects must have a project charter.
- The project management plan contains all the elements of integrated project planning and also all the other outputs from the other planning processes.
- The project management plan is an output from the Develop Project Management Plan process and an essential input into the Direct and Manage Project Work, Monitor and Control Project Work, Perform Integrated Change Control, and Close Project or Phase processes.
- The Direct and Manage Project Work process is focused upon completing the work described in the project

management plan. The project deliverables are the primary output from this process.

- The Manage Project Knowledge process focuses on collecting and learning from knowledge gained during the project to improve the performance of the current project and also improve organization performance by sharing the information.
- The Monitor and Control Project Work process is focused upon checking that what is being completed as part of the Direct and Manage Project Work process is what was planned. Any changes are issued as outputs from the process as change requests for the Perform Integrated Change Control process to deal with. Change requests can be outputs from any of the other monitoring and controlling processes, with the exception of the Perform Integrated Change Control process for which they are an input.
- The Perform Integrated Change Control process is focused upon receiving and considering all change requests and processing them as per the approved and documented change control process. Change requests can be approved or rejected.
- The Close Project or Phase process is focused upon completing all the activities associated with administrative and contractual closure. It provides the deliverable and closure for a project, or the milestone for a project being delivered in phases.

2.10 EXERCISES

The answers for these exercises are located in the “Answers” section at the end of this chapter.

1. Calculate the following financial selection criteria for projects:
 - A. Calculate Present Value where your Future Value is \$300,000, the interest rate is 10 percent, and the time period is three years.
Calculate Net Present Value where the Present Value of Income is \$250,000 and the Present Value of Costs is \$180,000.
Calculate the Payback Period for a project with an initial cost of \$450,000 and annual income of \$110,000.
2. All of the following are either inputs, outputs, or both into processes in the Project Integration Management knowledge area. As such, it is possible to place them in the order in which they are generally completed so that one is completed prior to it being used as an input in a subsequent process. Place the following in order from first to last in relation to where they appear in the overall flow of inputs and outputs between the processes in the Project Integration Management knowledge area:
 - A. Change requests
 - B. Agreements
 - C. Schedule forecasts
 - D. Project management plan
 - E. Final product, service, or result
 - F. Accepted deliverables
 - G. Business case
 - H. Deliverables
 - I. Project charter
 - J. Validated changes
 - K. Project statement of work
 - L. Cost forecast
 - M. Approved change requests

2.11 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 2 by answering these questions. The answers to these questions, and the explanations of why each answer choice is correct or incorrect, are located in the “Answers” section at the end of this chapter.

1. Which of the following answers best describes a key benefit of the Develop Project Charter process?
 - A. Assess and manage all change requests
 - B. Define the project start, and create a formal record of the project
 - C. Iteratively prepare plans for execution throughout a project
 - D. Ensure all projects are closed
2. The high-level narrative description of the work to be done on the project is known as which of the following?
 - A. Strategic plan
 - B. Product scope description
 - C. Statement of work
 - D. Business case

3. Which of the following answers best describes the main purpose of the project management plan?
 - A. To initiate and approve the project
 - B. To define both project and product scope
 - C. To describe how the project will be executed, monitored, and controlled
 - D. To assess which projects should be done

4. Which project change requests must go through the approved change control process?
 - A. Only those that have an impact on project scope
 - B. Any change request that affects scope, time, cost, or quality
 - C. Only those change requests that the project managers decides should go through the process
 - D. All change requests must go through the change control process

5. What is the name of the group of people responsible for reviewing, evaluating, and deciding on changes to the project?
 - A. Change control board
 - B. Project steering group
 - C. Project team
 - D. Stakeholders

6. Which of the following is not an organizational process asset that would be updated as a result of completing project closure?
 - A. Historical information
 - B. Project files
 - C. Project charter
 - D. Project closure checklist

7. Consulting stakeholders and project team members, and using your own knowledge, are all examples of what sort of tool or technique used in the Project Integration Management knowledge area?
 - A. Stakeholder engagement
 - B. Meetings
 - C. Expert judgment
 - D. Analytical techniques

8. What is the correct order of project activities?
 - A. Develop project management plan, execute project, develop project charter, conduct project selection
 - B. Conduct project selection, develop project charter, execute project, develop project management plan
 - C. Conduct project selection, develop project charter, develop project management plan, execute project
 - D. Develop project charter, develop project management plan, execute project, conduct project selection

9. Which process in the Project Integration Management knowledge area deals with making decisions on change requests?
 - A. Monitor and Control Project Work
 - B. Develop Project Charter
 - C. Direct and Manage Project Work
 - D. Perform Integrated Change Control

10. What are the existing change control processes, policies, and templates referred to as?
- A. Organizational process assets
 - B. Enterprise environmental factors
 - C. Project documents
 - D. Project management plan
11. The final product, service, or result is an output of the Close Project or Phase process. Where does it go after this process?
- A. The Monitor and Control Project Work process
 - B. The customer
 - C. The Perform Integrated Change Control process
 - D. The Direct and Manage Project Work process
12. The document that authorizes the project is called what?
- A. Project management plan
 - B. Project document
 - C. Organizational process asset
 - D. Project charter

2.12 ANSWERS

This section contains the answers to the questions for the Exercises and Review Questions in this chapter.

EXERCISES

1. Calculate the following financial selection criteria for projects:
 - A. Calculate Present Value where your Future Value is \$300,000, the interest rate is 10 percent, and the time period is three years.

$$PV = \frac{FV}{(1 + r)^n}$$

Where FV equals the future value of cash flows, r equals the interest rate, and n equals the number of time periods.

Therefore, the calculation is:

$$PV = \frac{\$300,000}{(1 + 0.1)^3}$$

$$PV = \$225,394$$

Calculate Net Present Value where the Present Value of Income is \$250,000 and the Present Value of Costs is \$180,000.

NPV is calculated by subtracting the present value of costs from the present value of income.

$$= \$250,000 - \$180,000 = \$70,000$$

Calculate the Payback Period for a project with an initial cost of \$450,000 and annual income of \$110,000.

Payback period is calculated by dividing the initial investment by the projected annual income.

$$= \$450,000 / \$110,000 = 4.09 \text{ years}$$

The following order presents the inputs before they are required in a process, and subsequent outputs are presented before they are first used as an input.

- A. Project statement of work (input into Develop Project Charter)
- B. Business case (input into Develop Project Charter)
- C. Agreements (input into Develop Project Charter)
- D. Project charter (output from Develop Project Charter; input into Develop Project Management Plan)
- E. Project management plan (output from Develop Project Management Plan; input into all subsequent processes)
- F. Deliverables (output from Direct and Manage Project Work)
- G. Change requests (output from Direct and Manage Project Work and Monitor and Control Project work; input into Perform Integrated Change Control)
- H. Validated changes (input into Monitor and Control Project Work)
- I. Schedule forecasts (input into Monitor and Control Project Work)
- J. Cost forecasts (input into Monitor and Control Project Work)
- K. Approved change requests (output from Perform Integrated Change Control)
- L. Accepted deliverables (input into Close Project or Phase)
- M. Final product, service, or result (output from Close Project or Phase)

REVIEW QUESTIONS

1. **Correct answer: B**
 - A. **Incorrect:** The Perform Integrated Change Control process assesses and manages change requests.
 - B. **Correct:** The Develop Project Charter process does result in outputs that define the start of the project and does create a formal record of the project with the project charter.
 - C. **Incorrect:** The Develop Project Management Plan process iteratively prepares the different plans to guide project execution.
 - D. **Incorrect:** The Close Project or Phase process ensures all projects are formally closed.

2. **Correct answer: C**
 - A. **Incorrect:** The strategic plan is developed by the organization and is used to help it select the correct projects.
 - B. **Incorrect:** The product scope description is a well-defined description of the deliverable.
 - C. **Correct:** The statement of work is a high-level narrative description of the work to be done on the project and is used as an input into the Develop Project Charter process.
 - D. **Incorrect:** The business case prepares a justification for undertaking the project.

3. **Correct answer: C**
 - A. **Incorrect:** The project charter initiates and approves the project.
 - B. **Incorrect:** The scope statement defines both project and product scope.
 - C. **Correct:** The project management plan describes how the rest of the project will be executed, monitored, and controlled.
 - D. **Incorrect:** The business case can be used to assess which projects should be done.

4. **Correct answer: D**
 - A. **Incorrect:** All change requests, not just those that affect project scope, must go through the defined change control process
 - B. **Incorrect:** All change requests, not just those that affect scope, time, quality, and cost, must go through the defined change control process.
 - C. **Incorrect:** The project manager does play a proactive part in influencing those factors which may lead to change requests being initiated, but once initiated the requests must all go through the approved change control process.
 - D. **Correct:** All change requests must be considered as per the approved change control process.

5. **Correct answer: A**
 - A. **Correct:** The change control board is responsible for reviewing, evaluating, and deciding on changes to the project.
 - B. **Incorrect:** The project steering group is responsible for providing senior-level advice, oversight, and project governance.
 - C. **Incorrect:** The project team is responsible for carrying out the project work under the guidance of the project manager.
 - D. **Incorrect:** Stakeholders have many roles within the project, and members of the change control board are certainly stakeholders, but the broadest definition includes everyone who can affect or be affected by the project.

6. **Correct answer: C**
- A. **Incorrect:** Historical information would be updated as part of project closure.
 - B. **Incorrect:** Many types of project files would be updated as part of project closure.
 - C. **Correct:** The project charter is an initiating document and would not be updated as part of project closure, although some historical information may refer to lessons learned about the project charter.
 - D. **Incorrect:** The project closure checklist would be completed and updated as part of project closure.
7. **Correct answer: C**
- A. **Incorrect:** Stakeholder engagement is the activity carried out as the focus of the Project Stakeholder Expectation Management knowledge area.
 - B. **Incorrect:** Meetings are used to gather groups of stakeholders together to discuss and make decisions.
 - C. **Correct:** The description in the question refers to different categories of experts who may be consulted for their advice and opinion.
 - D. **Incorrect:** Analytical techniques are mathematical techniques used to interpret raw data.
8. **Correct answer: C**
- A. **Incorrect:** Project selection and development of the project charter must be carried out before the development of the project management plan.
 - B. **Incorrect:** The development of the project management plan must occur before execution of the work.
 - C. **Correct:** Project selection feeds into the project charter, which in turns feeds into the development of the project management plan. The project management plan is used as the basis for project execution.
 - D. **Incorrect:** Conducting project selection must be done first in the process.
9. **Correct answer: D**
- A. **Incorrect:** The Monitor and Control Project Work process focuses on monitoring the actual work being done against the planned work. Change requests are an output from this process.
 - B. **Incorrect:** The Develop Project Charter process is focused upon project selection methods and the development of the project charter.
 - C. **Incorrect:** The Direct and Manage Project Work process is focused upon executing the work contained in the project management plan.
 - D. **Correct:** The Perform Integrated Change Control process uses change requests as an input and with the appropriate tools and techniques makes decisions whether to accept or reject the change requests.
10. **Correct answer: A**
- A. **Correct:** The existing change control processes, policies, and templates are all examples of process assets owned by the organization.
 - B. **Incorrect:** Enterprise environmental factors are external to the project, although they may still be within the performing organization. They can often be seen as constraining rather than assisting a project.
 - C. **Incorrect:** Project documents are produced as part of many processes. Some documents will be part of the organizational process assets.
 - D. **Incorrect:** The project management plan is the overall combination of subsidiary plans across all the knowledge areas.
11. **Correct answer: B**
- A. **Incorrect:** The Monitor and Control Project Work process uses forecast information and the project management plan to check actual against planned work.
 - B. **Correct:** The customer receives the deliverables from the project.
 - C. **Incorrect:** The Perform Integrated Change Control process uses change requests and work performance reports as inputs.
 - D. **Incorrect:** The Direct and Manage Project Work process uses the project management plan and approved change requests as inputs.

12. **Correct answer: D**

- A. **Incorrect:** The project management plan combines all subsidiary plans from other planning processes. The project charter feeds the development of the project management plan.
- B. **Incorrect:** "Project document" is a generic term for any document used to plan, record, and store information about the project. The project charter is one example of a project document.
- C. **Incorrect:** The process to produce the project charter and the blank template could produce organizational process assets, but are not examples of organizational process assets themselves.
- D. **Correct:** The project charter is the foundation document for any project; it authorizes resources to be used on the project.

3. Scope Management

This chapter looks at the processes focused upon how to plan, define, manage, and control changes to the project requirements, scope, and work breakdown structure (WBS).

The Project Scope Management knowledge area includes six processes. Four of the six processes are planning processes; the other two are monitoring and controlling processes. Properly defining the project scope statement is critical in order to complete other planning activities such as planning the project cost, project time, quality, communications, human resources, and procurement. Without properly defined requirements, scope, and WBS, you simply cannot complete these other activities well.

The six processes in the Project Scope Management knowledge area are:

- Plan Scope Management (Planning process)
- Collect Requirements (Planning process)
- Define Scope (Planning process)
- Create WBS (Planning process)
- Validate Scope (Monitoring and Controlling process)
- Control Scope (Monitoring and Controlling process)

Defining and documenting the project scope is about documenting all the work to be completed, and the work not to be completed, as part of the project and the product. It is important to note that the product scope is a subset of the project scope. Figure 3-1 shows the product scope as a subset of the project scope.

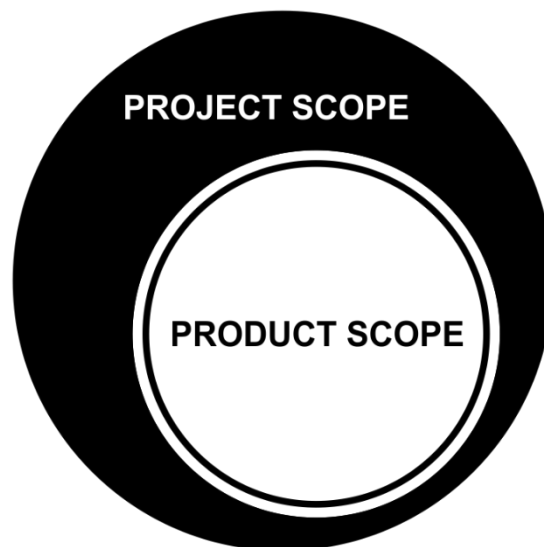


FIGURE 3-1 Product scope as a subset of project scope.

EXAM TIP

Many people are used to focusing on defining the product scope as part of their scope management work. It is important that you realize that there is more to the scope of the project than just the scope of delivering the product and its technical requirements. The project scope includes all the planning work, executing work, monitoring and control work, and closing work that has to be done in addition to the delivery of the product.

3.1 WHAT IS PROJECT SCOPE MANAGEMENT?

Project scope management is focused on defining and managing the scope of work to be completed as part of the project. It is a highly iterative process that begins with the initiation of the project and the statement of work contained in the project charter. The project charter is then used as an input into gathering the requirements, which results in requirements documentation; it may also result in a preliminary scope statement. After you have performed these next iterations of defining the scope statement, you will arrive at a project scope statement, which

in itself may only define and detail the work to be done in the short term and may leave some of the work to be done in the longer term relatively undefined.

Real World

Most people focus on the three pillars of project management: the scope, the time, and the cost of the project. This is for good reason, because it is these three foundational elements that are most often used as the primary metrics of success in a project, and they also feed into the other areas of the profession of project management. Therefore, you should pay extra attention to the time and effort committed to defining the scope of a project because, of the three pillars, it is the most crucial because it allows you to complete cost and time estimates.

There are distinct terms used to describe successive iterations of descriptions of the work to be done on a project. Figure 3-2 shows a hierarchical view of the different terms used to describe successive and progressively more detailed iterations of the scope.

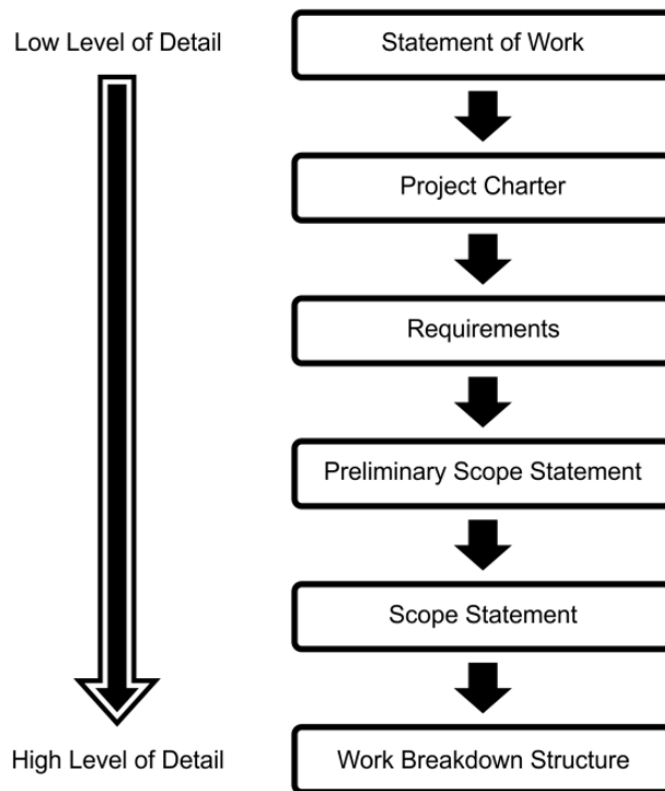


FIGURE 3-2 Descriptions of project work reflecting the level of detailed contained in the description.

Real World

When working on a project, I have often found that most people want to spend a lot of time and energy defining the product without giving much thought to planning and defining all the other work that must be done on a project. Not only does the lack of wider project work information create problems with your project as you proceed, it also creates a false impression that all of your work as a project manager is focused upon delivery of the product.

EXAM TIP

Make sure when reading a question in the exam that you are careful to look out for the words “project” and “product.” This is particularly important in questions relating to the project scope or the product scope. It is also important in the Project Quality Management knowledge area, where there are separate quality processes for the project and the product.

3.2 PLAN SCOPE MANAGEMENT

TABLE 3-1 Plan Scope Management

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project charter ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Quality management plan</i> ▪ <i>Project life cycle description</i> ▪ <i>Development approach</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data analysis ▪ <i>Alternatives analysis</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Scope management plan ▪ Requirements management plan

The Plan Scope Management process is a planning process with two major outputs, the scope management plan and the requirements management plan.

The Plan Scope Management process, like most of the other planning processes, sets out and defines your particular approach for further definition of the project and product scope, and the way in which you are going to validate scope and control any changes to the scope. All of these elements are captured in the scope management plan.

EXAM TIP

You may begin to notice that the key output from the initial planning processes in any knowledge area is some form of plan. For example, a key output from the Plan Scope Management process is the scope management plan.

INPUTS

The Plan Scope Management process uses some, or all, of the following inputs as part of the development of the scope management plan for the project.

PROJECT CHARTER

The project charter will contain everything that was known at the time of approval of the project charter and this will include a description of the expected scope of work of the project. Different organizations will have different standards for the level of detail and description of the scope that they require in a project charter so your particular project charter may have a high level description of the project scope or it may contain a fully detailed description of the project scope.

PROJECT MANAGEMENT PLAN

The project management plan, at whatever stage of its development, is used as an input here into planning your approach to managing your scope. Keep in mind that early on in the project, the project management plan, and its subsidiary plans, will be relatively ill defined. As the project progresses and more details are known about the project and the subsidiary elements of the project, the project management plan itself will become more fleshed out. This clearly demonstrates the highly iterative nature of planning how you will manage your project and product scope. The key parts of the project management plan that will be of most use to you will be the:

- Quality management plan
- Project life cycle description
- Development approach

Those final two will be particularly important in defining your project as an Agile project, predicate or hybrid, each of which manages scope differently. The project management plan is the key output from the Develop Project Management Plan process.

EXAM TIP

Keep in mind that the project management plan is the collection of all the other subsidiary plans and baselines.

PROJECT CHARTER

The project charter is used here as an input into the Plan Scope Management processes because it contains the description of the project scope that is known at that point. If the project charter contains a statement of work, this will need to be further developed and defined into a full scope statement. If the project charter is built upon the results of a negotiated contract, it may include a fully defined scope of work. The project charter is the sole output from the Develop Project Charter process.

ENTERPRISE ENVIRONMENTAL FACTORS

The types of enterprise environmental factors that can play a role in how you manage scope can include things such as the culture of the organization and its attention to detail, risk, and quality; and any external marketplace conditions that the project is being initiated to take advantage of.

EXAM TIP

Enterprise environmental factors are one of the most widely used inputs. The term covers a lot of different factors that can influence a project. Take time to understand the variety of factors that are enterprise environmental factors and be able to differentiate them from organizational process assets.

ORGANIZATIONAL PROCESS ASSETS

Once again organizational process assets play an important role as an input into a planning process. The types of organizational process assets that will be most useful in this section are any blank templates, defined policies and procedures, any historical information, lessons learned, and any project management methodology already in place.

TOOLS AND TECHNIQUES

The following tools and techniques are available to be used to develop the inputs into this process in order to produce the scope management plan.

EXPERT JUDGMENT

Expert judgment is one of the key tools used in all processes. In relation to the Plan Scope Management process, the experts that you will call upon include your own expert judgment, the expert judgment of team members, and any other experts that you want to consult to help you define your particular approach to scope management.

DATA ANALYSIS

Alternatives analysis aids in evaluating different methods or approaches to achieve the project's objectives or produce its deliverables. By assessing the potential benefits, costs, and risks associated with each option, project managers can select the most efficient and effective approach to define and manage the project scope.

MEETINGS

Meetings in which you gather project team members and relevant stakeholders together are an important tool and technique in defining your approach to scope management. Attendees at such meetings should include anyone with responsibility for any part of the scope management process.

EXAM TIP

The way in which you run your meetings will determine how effective they are. Meetings are both an important way to gather technical information and also an important means of distributing information and building a high-performing team. These latter attributes of a meeting will be more fully discussed in the Project Communications Management knowledge area and the Project Resource Management knowledge area.

OUTPUTS

After applying the appropriate tools and techniques to the selected inputs, the Plan Scope Management process has the following outputs.

SCOPE MANAGEMENT PLAN

The *scope management plan* is one of the more important subsidiary plans contained in the project management plan. It outlines your particular process for iteratively defining the detail of the project and product scope, the

process of decomposition for the creation of your work breakdown structure (a process that uses the scope statement that has been developed to execute project work), and the process by which any requested changes will be considered and either approved or declined. In addition to these elements, it also sets out the process of validating the project scope and deliverables, and how signoff for closure will be obtained. Again, the detail in the scope management plan will reflect the detail of the project scope. A highly defined scope will result in a well-defined scope management plan, and a loosely defined scope will result in a more flexible scope management plan allowing for further iterations.

The scope management plan is used as an input into the following processes:

- Collect Requirements
- Define Scope
- Create WBS
- Validate Scope

Real World

As a general rule of thumb, I like to make sure that about one-third of the content of the scope statement refers to what is not included in both the project and product scope of work. If you don't specifically list the exclusions, stakeholders will make assumptions about what is, and what isn't, included in the scope of work, and it is these assumptions which lead to disagreements.

REQUIREMENTS MANAGEMENT PLAN

The *requirements management plan* is a specific plan that addresses how the product requirements will be documented, defined, tracked, and reported against. It is also in the requirements management plan that detail of the configuration management activities will be defined. The requirements management plan will also contain methods for prioritizing the requirements, and any defined metrics to define the product. The requirements management plan is used as an input into the Collect Requirements process.

Quick Check

1. What is the main focus of the Plan Scope Management process?
2. What is the difference between the project scope and the product scope?
3. What are the key differences between the scope management plan and the requirements management plan?

Quick Check Answers

1. The main focus of the Plan Scope Management process is to develop a scope management plan that will guide your activities in defining the project requirements, scope, and work breakdown structure.
2. The project scope includes a definition of all the work required in the project, whereas the product scope focuses on defining the technical requirements of the expected deliverable.
3. The scope management plan can be seen as the broader of the two management plans because it focuses on the entire project and product scope and how it will be defined, documented, and controlled. The requirements management plan focuses solely on further iterations and definition of the requirements of the project deliverable.

3.3 COLLECT REQUIREMENTS

TABLE 3-2 Collect Requirements

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project charter ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Scope management plan</i> ▪ <i>Requirements management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Assumption log</i> ▪ <i>Lessons learned register</i> ▪ <i>Stakeholder register</i> ▪ Business documents <ul style="list-style-type: none"> ▪ <i>Business case</i> ▪ Agreements ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert Judgment ▪ Data gathering <ul style="list-style-type: none"> ▪ <i>Brainstorming</i> ▪ <i>Interviews</i> ▪ <i>Focus groups</i> ▪ <i>Questionnaires and surveys</i> ▪ <i>Benchmarking</i> ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Document analysis</i> ▪ Decision making <ul style="list-style-type: none"> ▪ <i>Voting</i> ▪ <i>Multicriteria decision analysis</i> ▪ Data representation <ul style="list-style-type: none"> ▪ <i>Affinity diagrams</i> ▪ <i>Mind mapping</i> ▪ Interpersonal and team skills <ul style="list-style-type: none"> ▪ <i>Nominal group technique</i> ▪ <i>Observation/conversation</i> ▪ <i>Facilitation</i> ▪ Context diagrams ▪ Prototypes 	<ul style="list-style-type: none"> ▪ Requirements documentation ▪ Requirements traceability matrix

Requirements can best be defined as a definition of the stakeholders’ needs to meet the project’s objectives. They can include technical requirements or known constraints. Therefore, the process of collecting requirements will involve stakeholders and documentation of what they believe the project objectives are. It is important to note that the project requirements can be much more than the product requirements.

EXAM TIP

In the exam, you should assume that unless otherwise explicitly stated, you must go through a requirements-gathering process prior to completing the scope statement.

Real World

I have often found that broader project requirements can be captured and documented as key performance indicators for determining the success or otherwise of the project, beyond the strict technical requirements of the product. For example, you could have customer satisfaction, health and safety compliance, environmental management requirements, or any other factors set as key performance indicators of project success, and these factors would be gathered in the requirements documentation.

INPUTS

The following inputs are used in the Collect Requirements process.

PROJECT CHARTER

The project charter authorizes the project and contains any high level information about the product and project deliverable which can be used to assist the process of collecting more detailed requirements. The project charter is the sole output from the Develop Project Charter process.

PROJECT MANAGEMENT PLAN

Obviously, in order to collect and define the project requirements, it is important that you act according to your scope management plan because the requirements are a subset of the project scope. The scope management plan is a key output from the Plan Scope Management process.

The requirements management plan is an important input into this process because it guides you as you seek to further define and document the requirements of the project and product. The requirements management plan is an output from the Plan Scope Management process.

The *stakeholder engagement plan* is an important input into this process because you will be approaching stakeholders and asking what the requirements are for the project and the product. Thus, the stakeholder engagement plan and the information it contains about how you identify and manage stakeholder expectations is a critical part of and input into this process. The stakeholder engagement plan is a key output from the Plan Stakeholder Engagement process.

PROJECT DOCUMENTS

To ensure that you do a robust requirements collection process it would be useful to have the assumption log so that you know what assumptions have been made about the project to date. It would also be useful to have the lessons learned register so you can learn from other projects what was done well in terms of collecting requirements and what wasn't done well. Stewart also be essential to have the stakeholder register because you will be going to the individual stakeholders to ask and collect their requirements for the project.

The *stakeholder register* identifies the known stakeholders, their power and interest in the project, an assessment of their expectations, and an analysis of their communication needs. You're able to use this information to effectively interact with the stakeholders to ensure that you have gathered all the project and product requirements. The stakeholder register is an output from the Identify Stakeholders process.

BUSINESS DOCUMENTS

The business case would have carefully considered all of the expected reasons or benefits to approve this particular project and somewhere in this document there would have been a description of the expected requirements for the project. So having the business case is very useful to ensure that you collect a full set of requirements.

AGREEMENTS

Having access to any agreements that have been undertaken as part of the project at this early point is very important as these agreements may contain information about expected requirements that the project is to deliver.

ENTERPRISE ENVIRONMENTAL FACTORS

Examples of EEF for this process include culture and structure, stakeholder groups, market conditions, commercial databases, and project management information systems (PMIS).

ORGANIZATIONAL PROCESS ASSETS

Examples of OPA for this process include relevant artifacts, templates, lessons learned, policies and procedures, and historical information.

TOOLS AND TECHNIQUES

The following tools and techniques can be used to produce the outputs from the Collect Requirements process.

EXPERT JUDGMENT

By now you would have seen expert judgment being used as a common tool or technique for many processes and it will continue to be used as a common tooling technique throughout the rest of this book. Remember that you are an expert, and you will also identify other experts upon whose judgment you can depend to help you document comprehensive requirements.

DATA GATHERING

The following data gathering techniques will be very useful to ensure that your requirements documentation is complete and comprehensive:

1. Brainstorming is a creativity technique where you can ask individuals or groups to think in different ways in order to challenge dominant ways of thinking or to come up with creative solutions.
2. When dealing with stakeholders, one of the most effective ways of soliciting information from them is by using *interviews*. Interviews can be formal or informal, and they can be conducted in person or via email or surveys.
3. *Focus groups* are a very effective means of bringing together relevant stakeholders and subject matter experts and gathering information from them in a structured way.
4. A key element of the Collect Requirements process is the gathering of information that can then be used to further define the requirements for the project and the product. *Questionnaires and surveys* present a very effective means of gathering this information from identified stakeholders. Depending on the development of the questionnaires and surveys, the information gathered may be able to have some statistical analysis applied to it to aid in your requirements-gathering process.
5. *Benchmarking* is a tool used in several processes. It involves comparing what you planned to do against other projects or organizations to determine whether you are better or worse than them. You can gather this important information from competitors, trade and industry associations, and the Project Management Institute.

DATA ANALYSIS

You will carry out a thorough document analysis of all of the relevant documents to ensure that you have captured and assessed all of the requirements. Please remember that simply because you have captured the requirements does not mean that you are committed to delivering the requirements but you will record your decisions that confirm whether or not you will deliver the individual requirements. As part of refining the requirements, you may want to carry out a document analysis and examine any relevant documents such as business plans, data models, software documentation, and issues logs to help you summarize the requirements

DECISION MAKING

Obviously as part of this the process you have to make decisions about what requirements you are going to deliver as part of your particular project. In which case you will want to have some decision making tools and techniques available to you. The most useful to you in this instance would be voting, which may decide that a majority decides the way forward, or you may ask for consensus as part of voting. You may also choose to give different criteria different weightings and then use this multi criteria decision analysis to help you decide on your requirements.

The goal of *group decision-making techniques* is to generate either a consensus among group members or a decision to abide by majority opinion. Obviously, there will be dissenting and differing views on which ideas should have greatest priority. An important part of running any group decision-making process is to establish early on how decisions will be made so that all participants are aware of the process for decision-making. You can agree on any one of the following group decision-making techniques to aid your decision-making process:

- Unanimity or consensus is where everybody agrees on a single course of action.
- The Delphi technique, which gathers information anonymously from experts to avoid peer pressure, can be used if you want to allow experts to provide anonymous feedback.
- You can decide to use a simple majority for any decisions made. If a majority (more than 50 percent of the members of the group) cannot be obtained, you may decide to use plurality, in which the largest bloc in a group decides.
- A final method of obtaining a group decision in the face of dissenting opinions is to agree to allow one individual in the group to make the decision for the group. This is commonly referred to as a dictatorship group decision-making technique.

DATA REPRESENTATION

Affinity Diagrams and Mind Mapping emerge as invaluable tools to structure and categorize the vast array of information that stakeholders provide about project requirements.

An *Affinity Diagram* assists teams in organizing a large number of ideas into natural groupings, facilitating clearer understanding and prioritization. After brainstorming sessions, project teams can use this tool to sort and cluster similar requirements together, allowing patterns to emerge and making it easier to analyze and address them.

On the other hand, *Mind Mapping* provides a visual representation of the hierarchical relationship between requirements. Starting with a central idea or objective, branches extend outwards, representing main requirements, which can further branch out into more specific details or sub-requirements. This technique ensures that all requirements are aligned with the core project objectives and helps in identifying interdependencies or gaps in the collected requirements. Utilizing both tools in tandem offers a comprehensive method for gathering, organizing, and visualizing the myriad requirements that a project might entail, ensuring clarity and thoroughness in the process.

FACILITATED WORKSHOPS

Facilitated workshops provide a forum to solicit information from various stakeholders in a controlled manner. They are focused and interactive by their nature and are often facilitated by an independent party. Examples of specific types of facilitated workshops include the joint application design/development sessions (JAD) and the quality function deployment (QFD) facilitated workshops used in new product development.

INTERPERSONAL AND TEAM SKILLS

The nominal group technique is a group creativity technique that uses a variety of voting methods by which group members rank the most useful ideas for further brainstorming. Examples include the fist-of-fives, where group members display their support for an idea by raising a number of fingers on their hands; weighted voting systems, where each member is given a certain number of votes to allocate between different ideas; and a simple, straightforward voting system to rank different ideas in terms of validity and prioritization.

Observations and conversations are a very accurate way of determining how a potential project or product scope will be implemented or used in real life. If the project scope includes certain processes, observing who will use these processes, how they will be used, and any other aspects of it in the real world will help define the process. If part of the project scope includes any product, observing the users of the product in the real world will also help define the product further.

CONTEXT DIAGRAMS

A *context diagram* is a simple tool showing visually how a business system and users interact. Figure 3-3 shows an example of a context diagram.

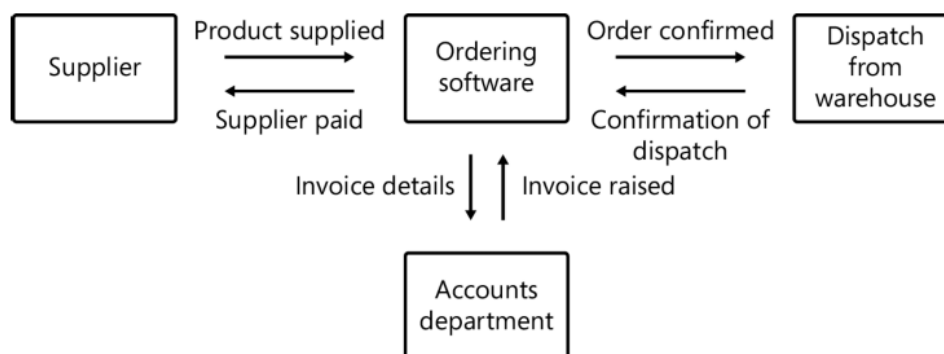


FIGURE 3-3 A context diagram showing the relationship between supplier, ordering software, accounts department and warehouse.

PROTOTYPES

Prototypes are a great way to get fast feedback on any element of the product by producing drafts and seeking feedback from stakeholders as to whether this is what they wanted. The practice of prototyping is quickly gaining support with the rise of technology that allows rapid prototyping. In addition to physical prototypes, storyboarding can be used to show the sequence of processes or product development to solicit feedback from stakeholders, particularly in the production of webpages or user interfaces.

OUTPUTS

The following outputs are generated from the Collect Requirements process.

REQUIREMENTS DOCUMENTATION

The *requirements documentation* itself is highly iterative; you may be able to fully define certain requirements and not yet define other requirements. When requirements are fully defined and documented, they will include a description of how the requirement meets the identified business need, objectives, or stakeholder requirements. They will also include a traceability matrix identifying which stakeholders requested each requirement, defining acceptance criteria, and providing a link back to the business objective that the requirement is intended to meet.

EXAM TIP

You can view the requirements documentation as a subsidiary of the scope statement. Rather than referring to the entire project and product scope, the requirements documentation focuses on individual requirements of parts of the project.

The requirements documentation as an output goes on to be used as an input into the following processes:

- Define Scope
- Create WBS
- Validate Scope
- Control Scope
- Plan Quality Management
- Plan Procurement Management

REQUIREMENTS TRACEABILITY MATRIX

The *requirements traceability matrix* is a valuable tool for ensuring that the documented requirements are mapped directly back to business objectives. A requirements traceability matrix is a table that links the origins of individual product requirements to the expected deliverable that meets those requirements so that you can track requirements throughout the project life cycle. This is particularly important if you want to either change a requirement and assess the impact it will have on deliverables or check that a deliverable still meets the original requirement.

The requirements traceability matrix is used as an input into the following two processes:

- Validate Scope
- Control Scope

Quick Check

1. What is the main focus of the Collect Requirements process?
2. How is the requirements documentation different from the project scope statement?
3. Why is consultation with stakeholders critical to successfully documenting project requirements?

Quick Check Answers

1. The main focus of the Collect Requirements process is to use a variety of means to gather from stakeholders their technical requirements, which will then be used to define the scope of work.
2. The requirements documentation is a subset of the total project scope statement and relates specifically to how requirements of the project and product align with and deliver project objectives. The project scope statement describes and defines the total work to be done in delivering the project and product.
3. Consultation with stakeholders is critical to successfully documenting and defining project requirements, because it is the wishes of stakeholders that are driving the project, and by consulting them you can ensure that you meet their expectations by delivering the requirements.

3.4 DEFINE SCOPE

TABLE 3-3 Define Scope

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project charter ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Scope management plan</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Assumption log</i> ▪ <i>Requirements documentation</i> ▪ <i>Risk register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Alternatives analysis</i> ▪ Decision making <ul style="list-style-type: none"> ▪ <i>Multicriteria decision analysis</i> ▪ Interpersonal and team skills <ul style="list-style-type: none"> ▪ <i>Facilitation</i> ▪ Product analysis 	<ul style="list-style-type: none"> ▪ Project scope statement ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Assumption log</i> ▪ <i>Requirements documentation</i> ▪ <i>Requirements traceability matrix</i> ▪ <i>Stakeholder register</i>

The Define Scope process is one of four planning processes in the Project Scope Management knowledge area.

Real World

It is very rare that you will ever begin a project with a complete and detailed description of the scope. Often this will only occur as a result of lengthy contractual negotiations. In almost every other situation you will begin a project with enough of the scope defined to allow you to begin, and then you will undertake successive iterations of definition and documentation as you go. You may also decide to commit time and energy to defining the scope for the immediate timeframe, and leave definition of the remainder of the scope until you get closer to the time of delivery.

INPUTS

The following inputs can be used in the Define Scope process.

PROJECT CHARTER

The project charter can be used as a key input into the Define Scope process because it contains the project approvals and any known description of the project and product scope. The project charter is the sole output from the Develop Project Charter process.

PROJECT MANAGEMENT PLAN

Obviously, in order to define the scope, you are going to have to work according to your scope management plan, which sets out the process you are going to use to iteratively define and document the scope of both your project and the product. The project scope management plan is the key output from the Plan Scope Management process.

PROJECT DOCUMENTS

The assumption log will list all assumptions made that may affect the definition of the scope. The more assumptions that have been made, the greater the likelihood that the scope will change throughout the project.

The requirements documentation is an output from the Collect Requirements process and contains the defined and documented project and product requirements. These requirements will form an important part of both the project and product scope.

Having your risk register as an input allows you to document and assess the impact of any relevant risks on your ability to deliver the scope.

ENTERPRISE ENVIRONMENTAL FACTORS

EEF such as market conditions and the regulatory environment may impact your project scope so should be considered.

ORGANIZATIONAL PROCESS ASSETS

Organizational process assets that can be used to define the scope include any project management methodology, policies, and blank templates that the organization has. There is also a high probability that the organization has completed a project with a similar scope in the past, and thus any lessons learned or historical information from previous projects or phases are important organizational process assets that can be used when defining the scope. These resources can also include important internal stakeholders such as the project sponsor.

TOOLS AND TECHNIQUES

The following tools and techniques can be used upon the inputs to generate the process outputs.

EXPERT JUDGMENT

Again, we can see expert judgment being used as an effective tool to use expert experience and skill to refine process inputs and develop them into the expected outputs. In this instance, you as project manager are one of the more important experts, as are your project team members who are responsible for completing the project work and any other stakeholders with relevant experience and skill in defining the scope.

DATA ANALYSIS

The specific form of data analysis to be used here is alternatives analysis which allows you to consider all the potential ways in which the project and product work can be performed in order to determine whether you are using the most efficient way of delivering the project and product scope.

DECISION MAKING

As with many other processes you will have to make a decision about all the things you can do and document only the things you will do as part of the scope of this particular project. As you would have already noticed there are many different decision making techniques but perhaps the most effective in this instance would be the multi criteria decision analysis where you assign different weights to different criteria that are important to the organization to help you make decisions about which elements of the project scope will be included.

INTERPERSONAL AND TEAM SKILLS

Facilitation involves bringing experts together in a workshop setting and having an independent facilitator guide the group to produce successive iterations of the project and product scope. The role of the independent facilitator is to stay neutral, set and enforce rules about how participants contribute, keep the workshop focused and on track, and make sure expectations are clearly understood.

PRODUCT ANALYSIS

Product analysis delves into understanding the specific characteristics, functions, and features of the product or deliverable the project aims to produce. This entails techniques such as product breakdown, systems analysis, requirements analysis, and value engineering to dissect and define the product's detailed attributes. Through this comprehensive examination, project managers can ensure that the project's scope is clearly articulated, aligned with stakeholder expectations, and encapsulates all necessary components to achieve the desired end product.

OUTPUTS

The following outputs are produced by the Define Scope process.

PROJECT SCOPE STATEMENT

The major output from the Define Scope process is the *project scope statement*, which describes in increasing detail the deliverables, assumptions, and constraints of the project. The project scope statement defines all the work to be done on the project, and only the work to be done on the project. It includes a detailed description of the exclusions and the work that will not be done as part of the project. The project scope statement also includes a full description of the work to be done to deliver the scope of the product.

NOTE Scope Creep and Gold Plating

One of the primary reasons to conduct scope management planning exercises and produce a clear definition of the scope statement with a documented change control process is to ensure that your project is not subject to scope creep. Scope creep happens because of undocumented scope change. At all times you must be delivering only what is documented for your project and product scope. This does not mean that change will not occur on your project; in fact quite the opposite—you can expect change at all points in your project. What it means is that you consider all changes, no matter how small or large, and if the change is accepted, you document this and incorporate it into your scope statement, thereby stopping scope creep. The other element to watch for with undocumented scope is gold plating. Gold plating occurs when you see the opportunity to deliver greater quality for less cost and in less time to the client and decide to proceed with this without documenting it. There is nothing wrong with delivering greater quality and exceeding expectations, but once again, at all times you must only be producing what is documented.

The project scope statement as an output goes on to be used as an input into the following processes:

- Create WBS
- Sequence Activities
- Estimate Activity Durations
- Develop Schedule

Quick Check

1. How do the Collect Requirements and Define Scope processes interact with each other?
2. Why is it important to define the exclusions in the project scope statement?
3. How is the information about the project and product scope statement contained in the project charter different from the information contained in the project scope statement?

Quick Check Answers

1. The Collect Requirements process takes the statement of work and project charter and seeks to gather requirements from stakeholders that are then used as an input into the Define Scope process to help define the scope statement.
2. It is important to define the known project and product exclusions as part of the project scope statement in order to avoid ambiguity and assumptions about what is, and what is not, included in the work to be done.
3. The project charter contains a description of the project and product work to be done that is known at the time of initiating the project and, as such, it may be at a much higher level than the information contained in the project scope statement. Additionally, the project charter contains other information such as the project's purpose, justification, and any required approvals.

PROJECT DOCUMENT UPDATES

The process of defining the scope will probably result in the requirement to update other project documents such as the stakeholder register to identify any changes to stakeholder expectations, the requirements documentation to account for any iterative development of the scope that affects requirements, and directly associated with the requirements documentation, the requirements traceability matrix.

3.5 CREATE WBS

TABLE 3-4 Create WBS

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Scope management plan</i> ▪ Project documents ▪ <i>Project scope statement</i> ▪ <i>Requirements documentation</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Decomposition 	<ul style="list-style-type: none"> ▪ Scope baseline ▪ Project document updates ▪ <i>Assumption log</i> ▪ <i>Requirements documentation</i>

The Create WBS process is the last of the planning processes in the Project Scope Management knowledge area and relies on the Collect Requirements and Define Scope processes to be complete.

EXAM TIP

In the exam, unless it is otherwise stated, you should assume that the processes of collecting requirements and defining the scope have occurred before beginning the process of creating the WBS.

INPUTS

The following inputs can be used to generate the outputs of the Create WBS process.

PROJECT MANAGEMENT PLAN

The particular part of the project management plan you will need to define the work breakdown structure (WBS) is the scope management plan. The scope management plan is a key input because in this plan you have detailed how you will approach the process of decomposing the project scope statement and creating the work breakdown structure (WBS). The scope management plan is a key output from the Plan Scope Management process.

PROJECT DOCUMENTS

The specific project documents that will be useful in the development of a WBS are the project scope statement and any requirements documentation.

The WBS is a breakdown of the entire project scope statement into its component parts and, therefore, the project scope statement is a key input into the Create WBS process. The project scope statement is the key output from the Defined Scope process.

The requirements documentation is a key output from the Collect Requirements process. In addition to the project scope statement, having access to the requirements documentation and the requirements traceability matrix will enable you to ensure that your process of decomposition to create the WBS captures all of the project and product scope and the associated requirements.

ENTERPRISE ENVIRONMENTAL FACTORS

There are some industry-wide enterprise environmental factors that can be useful as an input into the Create WBS process. For example, the ISO/IEC 15288 standard on systems engineering-system life cycle processes could be used for engineering projects.

ORGANIZATIONAL PROCESS ASSETS

The most useful organizational process assets to be used as an input into the Create WBS process include any project management methodology, policies, or blank templates for the creation of a WBS, and any historical information or lessons learned from previous projects.

TOOLS AND TECHNIQUES

There are two techniques used in the Create WBS process.

EXPERT JUDGMENT

Expert judgment is a key tool in the Create WBS process because the creation of the WBS is best done by those experts with knowledge about the work to be done and how it can best be decomposed into its component parts.

DECOMPOSITION

The process of *decomposition* involves taking a high-level description of the work to be done for the project and product, and successively breaking it down into deliverables, sub-deliverables, and finally down to the level of *work packages*. The work package is the lowest level to which you should break down the work breakdown structure (WBS). A work package is defined as a package of work that can reliably be estimated for time and cost. This means that you can easily allocate the work to one person and that it doesn't make sense to decompose it any further, because at that level you can develop an accurate estimate of the time it will take and the amount of money it will cost to complete the work package. Below the level of work packages are individual activities, which are used in the Project Time Management knowledge area to assist in building a project schedule.

The WBS is a graphical representation of the total project scope and, therefore, work that is not included in the WBS is not part of the project. If the project scope is being developed iteratively, this will be represented in the development of the WBS, and it too will develop iteratively.

Real World

I always use my project team members who are responsible for completing the work to help complete the WBS. Not only does this give me the right technical input from the people responsible for completing the work, but it also creates commitment to the process of completing the work, because people feel they have made a significant and personal contribution.

NOTE Decomposition

Decomposition is used in any of the breakdown structures used in project management. It simply describes a process of breaking down a larger concept into its component parts. It is used to create the work breakdown structure (WBS), the organizational breakdown structure (OBS), the risk breakdown structure (RBS), and another RBS, the resource breakdown structure (RBS).

OUTPUTS

The following outputs are generated by the Create WBS process.

SCOPE BASELINE

The *scope baseline* will be used to measure what is actually being produced against what is expected to be produced in relation to the project and product scope. It is comprised of three key and distinct elements. They are the project scope statement, the WBS, and the WBS dictionary.

EXAM TIP

The scope baseline is what you use to measure progress against in the project. Any baselines in project management can only be changed through the formal change control process. After an approved change is integrated into a baseline, the baseline itself is changed, thus the easiest way to think of a baseline is that a baseline is what you originally started with plus any approved changes.

The *work breakdown structure* (WBS) is often called the backbone of a project. This is because it acts as an input into many other planning processes. Without a complete and accurate WBS your efforts in cost estimating, budget estimating, activity definition, risk identification, and scope validation and all the subsequent processes they provide inputs into would be extremely difficult. Creation of the WBS is done by decomposing the top-level descriptions of project work into their component parts. The highest level is broken down into deliverables, then into sub-deliverables, and then into individual work packages. A work package is an amount of work that can reliably be estimated for time and cost and can generally be performed by one person. Below work packages are activities, which are used in developing a project schedule, as described in the next chapter.

Figure 3-4 shows a WBS for a new house project showing the breakdown of different work streams to work package level. Note that all nodes in the WBS have a unique identifying number that allows you to track work being done and also to allocate costs to specific work packages for better cost reporting. The numbering system should clearly identify each node and relate to the node above so you can easily see related nodes and the way they are decomposed. This numbering system is an example of a configuration management system.

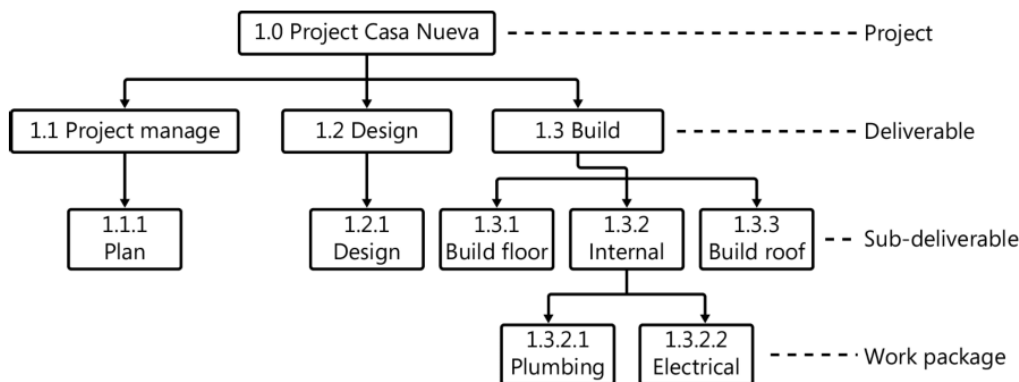


FIGURE 3-4 A work breakdown structure (WBS) showing the total project, deliverables, sub-deliverables and work packages.

NOTE WBS dictionary

When you are representing a WBS graphically, each node in the WBS can contain only summary information, such as the configuration management details; the name of the deliverable, sub-deliverable, or work package; and summary information about the time, cost, and resources allocated to each node. The WBS dictionary is a text-based document that provides additional information about the summary information contained in each WBS node. There may be a question in the exam which asks about this so take time to memorize it.

The WBS becomes an input into the following processes:

- Validate Scope
- Define Activities
- Estimate Costs
- Determine Budget
- Identify Risks
- Perform Qualitative Risk Analysis

EXAM TIP

There are many exam questions that pose a scenario where something is missing and ask what you should do. In most instances, it is acceptable to continue with the project and develop something in the interim to help tide you over. The only exception to this is if it is the work breakdown structure that is missing. If you are working on a project and you do not have the WBS, you must stop and create the WBS, because without it you cannot complete the planning processes of your project.

PROJECT DOCUMENT UPDATES

As a result of creating the WBS, information may be gathered that requires other project documents to be updated, such as the assumption log and the requirements documentation.

Quick Check

1. To what level of detail do you decompose the project scope when creating the WBS?
2. How would you define the key elements of a work package?
3. What elements make up the scope baseline?

Quick Check Answers

1. The project scope statement is decomposed to major deliverables, sub-deliverables, and down to the work package level.
2. A work package can best be defined as an amount of work that can reliably be estimated for time and cost. Going any further in the decomposition process delivers little benefit for the time taken to do the work.
3. The three key elements of the scope baseline are the project scope statement, the WBS, and the WBS dictionary.

3.6 VALIDATE SCOPE

TABLE 3-5 Validate Scope

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Scope management plan</i> ▪ <i>Requirements management plan</i> ▪ <i>Scope baseline</i> ▪ Project documents ▪ <i>Lesson learned register</i> ▪ <i>Quality reports</i> ▪ <i>Requirements documentation</i> ▪ <i>Requirements traceability matrix</i> ▪ Verified deliverables ▪ Work performance data 	<ul style="list-style-type: none"> ▪ Inspection ▪ Decision making ▪ <i>Voting</i> 	<ul style="list-style-type: none"> ▪ Accepted deliverables ▪ Work performance information ▪ Change requests ▪ Project documents updates ▪ <i>Lessons learned register</i> ▪ <i>Requirements documentation</i> ▪ <i>Requirements traceability matrix</i>

The Validate Scope process is a monitoring and control process, one of two monitoring and control processes in the Project Scope Management knowledge area.

NOTE Validation compared to verification

The process of validation is an important one to understand, as is the difference between it and the process of verification. Verification is about confirmation that the product, service, or result produced complies with agreed specifications or requirements. It is primarily an internal process that the delivering organization performs prior to submitting the product, service, or result for validation, which involves the customer as well. Validation also involves a check that the product, service, or result meets stakeholder requirements. Verification occurs before validation.

INPUTS

The Validate Scope process uses some, or all, of the following inputs.

PROJECT MANAGEMENT PLAN

The project management plan guides how you execute and monitor your project and, as such, it contains plans and baselines useful for validating the project scope. The particular parts of the project management plan that are most useful as inputs into the Validate Scope process are the scope management plan, the requirements management plan, and the scope baseline. The scope management plan is used as an input because it details how you plan to manage your scope in its entirety, including validation. The scope baseline, which includes the scope statement, the WBS, and the WBS dictionary, is absolutely necessary in validating the scope because it represents the baseline against which you are comparing the actual work performed. The project management plan is an output from the Develop Project Management Plan process; the scope management plan is a key output from the Plan Scope Management process; and the scope baseline is the key output from the Create WBS process.

PROJECT DOCUMENTS

There are a variety of project documents that should be referred when validating the scope. These include lessons learned register and quality reports. The requirements documentation lists the project objectives and the requirements that will deliver those objectives, and as such it is an essential input into validating the scope. Requirements documentation is the key output from the Collect Requirements process.

The requirements traceability matrix provides an additional measure of rigor when validating the scope, because you are able to link specific requirements back to identified business objectives. The requirements traceability matrix is an output from the Collect Requirements process.

VERIFIED DELIVERABLES

The *verified deliverables* are deliverables that have already been completed and checked for correctness against the required specifications through the control quality process and, as such, now need to be validated in order to become accepted deliverables and used in the Close Project or Phase process. Verified deliverables are a key output from the Control Quality process.

NOTE Deliverables

Project deliverables must go through the process of first being verified and then being accepted. Verification is an internal process that ensures correctness against predetermined quality standards, whereas validation is an external acceptance process completed by the project sponsor or customer.

WORK PERFORMANCE DATA

The work performance data indicates whether or not there is compliance with the documented requirements. Work performance data is an output from the Direct and Manage Project Work process.

TOOLS AND TECHNIQUES

The following two tools and techniques can be used to deliver the process outputs.

INSPECTION

Inspection as a technique literally means inspecting the deliverables to ascertain whether they meet the documented requirements and acceptance criteria.

DECISION MAKING

Group decision-making techniques are any techniques used to allow a group of people to reach a decision. It is best if the decision-making technique is outlined to the group prior to the decision-making process being undertaken, to be sure that all group members understand how the decision will be made. The most useful one in this instance is probably going to be voting where all decision makers cast votes about scope validation.

OUTPUTS

The Validate Scope process has the following outputs.

ACCEPTED DELIVERABLES

Accepted deliverables meet the acceptance criteria and are signed off and accepted by either the customer or the project sponsor. Accepted deliverables are used as the key input into the Close Project or Phase process.

EXAM TIP

A key role of the project sponsor is to act as the person internal to the performing organization who formally accepts the product. The customer is usually a person external to the organization who accepts the product.

WORK PERFORMANCE INFORMATION

Work performance information takes the work performance data and presents it in such a way that project progress can easily be determined and identified. This information is communicated to stakeholders as appropriate. Work performance information is used as an input into the Monitor and Control Project Work process.

CHANGE REQUESTS

If a deliverable is not accepted due to some areas of non-compliance or non-correctness, a change request for defect repair may be generated. Change requests are a key input into the Perform Integrated Change Control process.

NOTE Work performance

Work performance data is the raw data gathered in any process. Work performance information is the data after it has been interpreted into something meaningful. Work performance data becomes work performance information, which in turn is used in work performance reports.

PROJECT DOCUMENTS UPDATES

The types of project documents that may be updated include the lessons learned register, requirements documentation, requirements traceability matrix, the scope statement, and quality control documents.

Quick Check

1. What is the main focus of the Validate Scope process?
2. What is the difference between validation and verification?
3. Who formally accepts the project deliverables?

Quick Check Answers

1. The main focus of the Validate Scope process is to formally accept the completed project deliverables.
2. Verification is an internal process completed by the performing organization measuring the product, service, or result against defined requirements and specifications. It is completed prior to validation. Validation involves taking the verified product, service, or result and in conjunction with key stakeholders confirming that it meets stakeholder requirements.
3. The project sponsor formally accepts the project deliverables on behalf of the performing organization. The customer formally accepts the project deliverables on behalf of the external organization requesting the work to be done.

3.7 CONTROL SCOPE

TABLE 3-6 Control Scope

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Scope management plan</i> ▪ <i>Requirements management plan</i> ▪ <i>Change management plan</i> ▪ <i>Configuration management plan</i> ▪ <i>Scope baseline</i> ▪ <i>Performance measurement baseline</i> ▪ Project documents ▪ <i>Lessons learned register</i> ▪ <i>Requirements documentation</i> ▪ <i>Requirements traceability matrix</i> ▪ Work performance data ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Data analysis ▪ <i>Variance analysis</i> ▪ <i>Trend analysis</i> 	<ul style="list-style-type: none"> ▪ Work performance information ▪ Change requests ▪ Project management plan updates ▪ <i>Scope management plan</i> ▪ <i>Scope baseline</i> ▪ <i>Schedule baseline</i> ▪ <i>Cost baseline</i> ▪ <i>Performance measurement baseline</i> ▪ Project documents updates ▪ <i>Lessons learned register</i> ▪ <i>Requirements documentation</i> ▪ <i>Requirements traceability matrix</i>

The Control Scope process is a monitoring and control process, one of two monitoring and control processes in the Project Scope Management knowledge area.

INPUTS

The following inputs can be used in the Control Scope process.

PROJECT MANAGEMENT PLAN

The project management plan, or more correctly some of the subsidiary plans of the project management plan, are used as inputs to enable you to control the scope. By using a description of what you planned to do and comparing that to what you are actually doing, you can spot any variances. The parts of the project management plan that will provide the most relevant information to help you monitor and control the scope include:

- Scope management plan
- Requirements management plan
- Change management plan
- Configuration management plan
- Scope baseline
- Performance measurement baseline

The project management plan is a key output from the Develop Project Management Plan process.

EXAM TIP

Whenever you see the project management plan listed as an input into a process, it indicates that more than one subsidiary plan is used in this process. In this instance, elements of the scope management plan, change management plan, configuration management plan, and requirements management plan are used as inputs to control the scope.

PROJECT DOCUMENTS

In addition to parts of the project management plan, the following project documents will be useful in monitoring and controlling the project scope.

The lessons learned register will document all lessons learned about controlling the scope to this point in the project.

The clearly defined requirements documentation for the project and product can be used to detect any deviation in the scope during the Control Scope process. The requirements documentation is a key output from the Collect Requirements process.

Using the requirements traceability matrix as an input helps bring an additional level of rigor into the Control Scope process by enabling you to map requirements back to project objectives. The requirements traceability matrix is a key output from the Collect Requirements process.

WORK PERFORMANCE DATA

Work performance data in this instance refers to information about change requests received or the number and type of deliverables completed. Work performance data is the key output from the Direct and Manage Project Work process.

ORGANIZATIONAL PROCESS ASSETS

Key organizational process assets that can be useful as inputs into the Control Scope process include any change control-related or scope control-related guidelines, policies, or templates, and any documented monitoring and reporting methods.

TOOLS AND TECHNIQUES

There is a single technique used in the Control Scope process.

DATA ANALYSIS

Any *variance analysis* is simply an examination of what is actually occurring against what was planned to occur, and looking for any variances, positive or negative, and acting on them accordingly. If you discover any variance, you can decide to undertake corrective or preventive actions or initiate changes. By using trend analysis you will be able to analyze trends from past data and use this information to forecast likely future trends in relation to the project scope.

EXAM TIP

Variance analysis is a key tool in all the monitoring and controlling processes. Wherever you see variance analysis as a tool in a process, you should also look for some sort of baseline that is being checked for variance.

OUTPUTS

The following outputs are produced by the Control Scope process.

WORK PERFORMANCE INFORMATION

Work performance information as an output from this process will include information relating to the type and category of change requests received and how they may potentially affect other areas of the project. Work performance information goes on to be used as an input in the Monitor and Control Project Work process.

CHANGE REQUESTS

Change requests are a result of variances detected. All change requests must be processed according to the predefined change management process. Change requests go on to be used in the Perform Integrated Change Control process.

PROJECT MANAGEMENT PLAN UPDATES

Elements of the project management plan that may be updated as a result of the work done during the Control Scope process include those plans that were used as inputs into the process:

- Scope management plan
- Requirements management plan
- Change management plan
- Configuration management plan
- Scope baseline
- Performance measurement baseline

PROJECT DOCUMENTS UPDATES

As a result of performing the Control Scope process you may choose to update the lessons learned register, the requirements documentation, and the requirements traceability matrix to reflect new or changed information.

ORGANIZATIONAL PROCESS ASSETS UPDATES

Organizational process assets that may be updated as a result of the Control Scope process include any elements of the project scope management plan, change management plan, or lessons learned that have been gathered.

Quick Check

1. What is the main focus of the Control Scope process?
2. Why is variance analysis important to the Control Scope process?
3. What is the relationship between work performance data and work performance information?

Quick Check Answers

1. The main focus of the Control Scope process is to check the progress of the project against planned baselines, looking for variances and acting on any that are discovered.
2. Variance analysis is the process of checking what you planned to do against what you are actually doing. If you discover a variance between the two, then you must act.
3. Work performance data is the raw data collected while observing work being performed; it is turned into work performance information by applying metrics, formulas, and other ways of interpreting the data in order for it to make sense and be usable for measuring project progress.

3.8 CHAPTER SUMMARY

- The Project Scope Management knowledge area is focused upon the processes of planning, defining, documenting, and managing change to the project requirements, scope, and work breakdown structure.
- Like other knowledge areas, the Project Scope Management knowledge area begins with a process of planning how you will manage the project scope. The key output from this is the scope management plan, which becomes a subsidiary plan of the project management plan.
- The first step in a linear process of defining the full project scope is to collect project requirements from stakeholders and develop both the requirements documentation and requirements traceability matrix.
- The process of defining the project scope is highly iterative and may be subject to rolling wave planning throughout the life of the project. After it is defined, the project scope will be captured in the project scope statement. The scope of the product is a subset of the total project scope.
- The work breakdown structure (WBS) is a graphical representation of the project scope statement, thus any work not included in the WBS is not included as part of the project. The WBS forms one of three key elements of the scope baseline. The scope baseline is made up of the project scope statement, the WBS, and the WBS dictionary.
- The work breakdown structure, after it is completed, serves as a valuable input into several other processes, including Project Cost Management, Project Time Management, and Project Risk Management.
- The process of validating the project scope involves internal and external stakeholders checking that the deliverables conform to stakeholder requirements and expectations. It is performed after scope verification.
- All changes to the project scope or requirements must go through the documented change control process. Any approved changes are incorporated into the scope baseline.

3.9 EXERCISES

The answers for these exercises are located in the “Answers” section at the end of this chapter.

1. Create a WBS.

You are working on a project, Project BlueTalk, to develop a new piece of software. As part of the development of the scope, you have identified that the four major deliverables are the software design, the testing of the software, the user training of the software, and the implementation of the software. At this early stage in the project, you are only able to further define the software design process and have broken that down into the sub-deliverables for module 1 and module 2. Using your project team members responsible for the software design, you have broken module 1 down into three work packages: database, user interface, and backup.

Use this information to complete a WBS for the project.

2. Map the following terms on the left to the definition that best fits them on the right:

- | | |
|--------------------------------|--|
| a) Project charter | i. An early iteration of the project scope statement |
| b) Statement of work | ii. A description of all the work to be done on a project |
| c) Requirements | iii. A description of the product, service, or result to be delivered as part of the project work |
| d) Preliminary scope statement | iv. A narrative description of the work to be completed; used as an input into the project charter |
| e) Project scope statement | v. The documented list of expectations and specifications from project stakeholders |
| f) Product scope | vi. The foundational document for a project, which contains a high-level description of the work to be completed |

3.10 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 3 by answering these questions. The answers to these questions, and the explanations of why each answer choice is correct or incorrect, are located in the “Answers” section at the end of this chapter.

- What is the correct order of activities in the Project Scope Management knowledge area?
 - Define Scope, Collect Requirements, Plan Scope Management, Create WBS
 - Plan Scope Management, Define Scope, Collect Requirements, Create WBS
 - Plan Scope Management, Collect Requirements, Define Scope, Create WBS
 - Collect Requirements, Define Scope, Create WBS, Plan Scope Management
- What are the elements of the scope baseline?
 - The project scope management plan and requirements documentation
 - The project scope management plan and project scope statement
 - The scope statement, the WBS, and the WBS dictionary
 - The project scope statement, the product scope statement, and the WBS
- What is the correct term for the component of the project management plan that describes how project requirements will be analyzed, documented, and managed?
 - The requirements management plan
 - The scope management plan
 - The project scope statement
 - The scope baseline

4. Brainstorming is an example of what sort of process tool or technique?
 - A. Group decision-making techniques
 - B. Observations
 - C. Facilitated workshops
 - D. Group creativity techniques

5. What is the main purpose of the requirements traceability matrix?
 - A. To hold people accountable for work delivery
 - B. To let stakeholders know when the project will be delivered
 - C. To map individual requirements back to specific business needs and objectives
 - D. To describe the work to be completed in the project

6. Which of the following best describes the relationship between the scope of the project and the scope of the product?
 - A. The scope of the project includes all the planning work to be done, whereas the scope of the product documents the technical requirements of the deliverable.
 - B. The product scope is a subset of the project scope.
 - C. The project scope is delivered as part of the delivery of the product scope.
 - D. There is no difference between the two terms.

7. What is the lowest level of WBS decomposition?
 - A. The deliverable
 - B. Project activities
 - C. The work package
 - D. The scope statement

8. What is the name of the document that provides additional information about each node of the WBS?
 - A. The scope management plan
 - B. The WBS dictionary
 - C. The project scope statement
 - D. The requirements documentation

9. What is the key purpose of the Validate Scope process?
 - A. It is an internal process to determine whether the product meets strict technical requirements.
 - B. It is the process of checking whether the deliverable conforms to requirements.
 - C. It is the process of managing changes to the project scope statement.
 - D. It is a process that involves internal and external stakeholders checking that the deliverable meets project requirements and stakeholder expectations.

10. Change requests that are generated as part of the Control Scope process are used as inputs into which process?
 - A. The Validate Scope process
 - B. The Perform Integrated Change Control process
 - C. The Control Quality process
 - D. The Plan Scope Management process

3.11 ANSWERS

This section contains the answers for the Exercises and Review Questions in this chapter.

EXERCISES

1. Create a WBS.

Your completed WBS should look like the following diagram shown in Figure 3-5. Did you remember to include the unique number identifiers in each node?

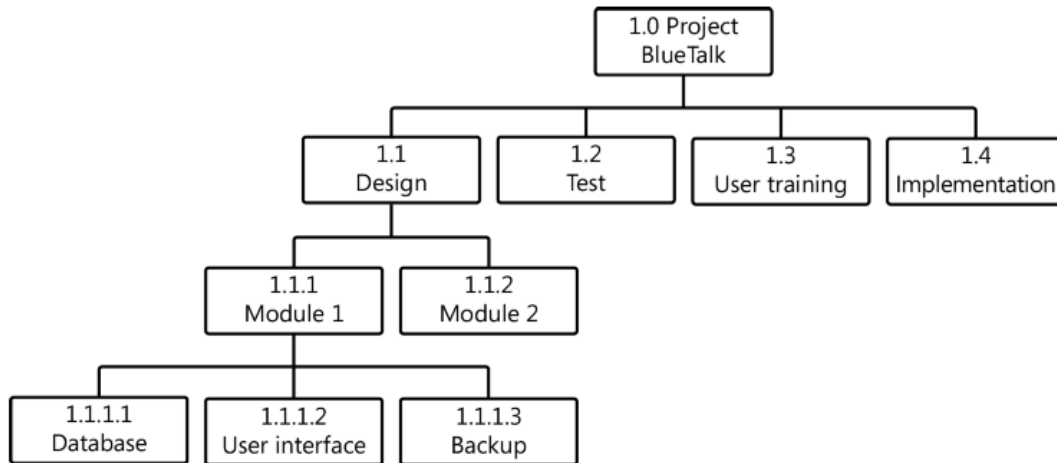


FIGURE 3-5 A completed work breakdown structure for Project Bluetalk

2. Map the following terms to the definition that best fits them:

- | | |
|--------------------------------|--|
| a) Project charter | vi. The foundational document for a project, which contains a high-level description of the work to be completed |
| b) Statement of work | iv. A narrative description of the work to be completed; used as an input into the project charter |
| c) Requirements | v. The documented list of expectations and specifications from project stakeholders |
| d) Preliminary scope statement | i. An early iteration of the project scope statement |
| e) Project scope statement | ii. A description of all the work to be done on a project |
| f) Product scope | iii. A description of the product, service, or result to be delivered as part of the project work |

REVIEW QUESTIONS

1. **Correct Answer: C**

- Incorrect:** Plan Scope Management is the first process to be completed so that you have a guide to completing the others.
- Incorrect:** Define Scope comes after Collect Requirements.
- Correct:** The sequence of Plan Scope Management, Collect Requirements, Define Scope, Create WBS describes the iterative development of Project Scope Management processes.
- Incorrect:** Plan Scope Management is the first process to be completed so that you have a guide to completing the others.

2. **Correct Answer: C**

- Incorrect:** The project scope management plan and requirements documentation are not part of the scope baseline.
- Incorrect:** The project scope management plan is not part of the scope baseline.

- C. **Correct:** The scope statement, the WBS, and the WBS dictionary are the three elements of the scope baseline.
- D. **Incorrect:** The project scope statement and the product scope statement are a part of but not all of the scope baseline.
3. **Correct Answer: A**
- A. **Correct:** The requirements management plan describes how project requirements will be analyzed, documented, and managed.
- B. **Incorrect:** The scope management plan describes how the project scope will be defined, documented, and managed.
- C. **Incorrect:** The project scope statement describes the scope of work to be done as part of the project.
- D. **Incorrect:** The scope baseline is made up of the scope statement, WBS, and WBS dictionary.
4. **Correct Answer: D**
- A. **Incorrect:** Group decision-making techniques are techniques to assist groups of people in making decisions in the face of differing, and often dissenting, opinion.
- B. **Incorrect:** Observations do not require brainstorming.
- C. **Incorrect:** Facilitated workshops describe focused workshops.
- D. **Correct:** Brainstorming is an example of a group creativity technique.
5. **Correct Answer: C**
- A. **Incorrect:** The requirements traceability matrix does not hold people accountable for work delivery.
- B. **Incorrect:** Letting stakeholders know when the project will be delivered would be part of your time management plan and communications management plan.
- C. **Correct:** The main purpose of the requirements traceability matrix is to map individual requirements back to specific business needs and objectives.
- D. **Incorrect:** The project scope statement is used to describe the work to be completed in the project.
6. **Correct Answer: B**
- A. **Incorrect:** The project scope includes all the work and only the work to be done, including a description of the product.
- B. **Correct:** The product scope is a subset of the project scope that focuses specifically on the product or deliverable of the project.
- C. **Incorrect:** The project scope is not delivered as part of the delivery of the product scope, it is the other way around.
- D. **Incorrect:** There is a difference between the two terms, because they describe different things.
7. **Correct Answer: C**
- A. **Incorrect:** The deliverable is a high-level description of the work to be done.
- B. **Incorrect:** Project activities are work packages that are further defined and used in developing a project schedule.
- C. **Correct:** The work package is the lowest level of WBS decomposition.
- D. **Incorrect:** The scope statement describes all the work to be done on the project.
8. **Correct Answer: B**
- A. **Incorrect:** The scope management plan describes how the project scope will be defined, documented, and managed.
- B. **Correct:** The WBS dictionary provides additional information to expand on the summary information contained in each node of the WBS.
- C. **Incorrect:** The project scope statement describes all the work to be done on the project.
- D. **Incorrect:** The requirements documentation describes individual requirements for the project.

9. **Correct Answer: D**

- A. **Incorrect:** The Validate Scope process is not simply an internal process.
- B. **Incorrect:** The process of checking whether the deliverable conforms to requirements is a Control Quality process.
- C. **Incorrect:** The change management process describes the process of managing changes to the project scope statement.
- D. **Correct:** The Validate Scope process is a process that involves internal and external stakeholders checking that the deliverable meets project requirements and stakeholder expectations.

10. **Correct Answer: B**

- A. **Incorrect:** Change requests are an output from the Validate Scope process.
- B. **Correct:** Change requests are used as an input into the Perform Integrated Change Control process.
- C. **Incorrect:** Approved change requests, which are change request that have been through the Perform Integrated Change Control process, are used as an input into the Control Quality process.
- D. **Incorrect:** Change requests are not an input into the Plan Scope Management process.

4. Time Management

This chapter focuses on the topic of project time management. Project Time Management, like the other knowledge areas, begins with a process of planning that produces a schedule management plan. Then there is an iterative, or repeating, process that produces and updates the project schedule. Then, as with all other knowledge areas with the exception of the Human Resource Management knowledge area, there is a controlling process that seeks to measure planned versus actual progress in relation to time and deal with any changes or corrective or preventive actions.

You may need to pay particular attention in this chapter to those activities that lead up to the construction of the network diagram, because there is quite a bit of technical information that you will need to learn.

The six processes in the Project Time Management knowledge area are:

- Plan Schedule Management (Planning process)
- Define Activities (Planning process)
- Sequence Activities (Planning process)
- Estimate Activity Durations (Planning process)
- Develop Schedule (Planning process)
- Control Schedule (Monitoring and Controlling process)

4.1 WHAT IS PROJECT TIME MANAGEMENT?

Project time management is focused upon the processes of developing a schedule management plan, estimating durations for activities and the overall project, preparing your project schedule, ensuring that the project progresses as planned and that milestones are reached on the communicated schedule, and influencing and assessing any changes to the project schedule.

EXAM TIP

There are some industries that use the term “schedule” in reference to a schedule of materials to be used in the execution of the project. For the exam you should note that the word “schedule” is used exclusively to mean project time estimates.

Apart from the Control Schedule process, the processes contained in this knowledge area present what appears to be a wonderfully logical and sequential flow of information, from defining the activities through to development of the project schedule. Figure 4-1 shows the general flow through this linear process.

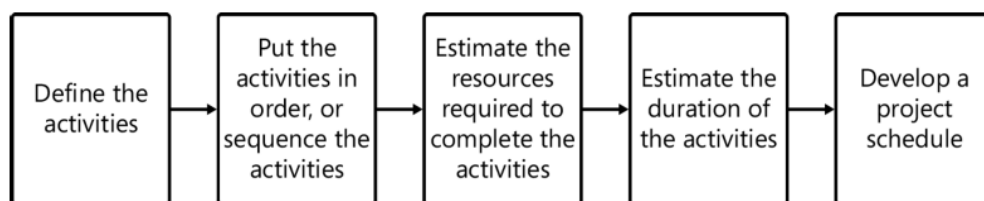


FIGURE 4-1 The sequential flow of the Project Schedule Development Process.

Real World

Even though the separate Project Time Management processes are often presented as separate, discrete processes, I have always found that the process of developing a project schedule is in fact done as one process usually at the same time.

EXAM TIP

Remember that the output of the time management processes is the project schedule, which refers to all elements of time management on a project and not just the ubiquitous Gantt chart. Also remember that a project management plan is more than just a Gantt chart.

4.2 PLAN SCHEDULE MANAGEMENT

TABLE 4-1 Plan Schedule Management process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project charter ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Scope management plan</i> ▪ <i>Development approach</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Alternatives analysis</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Schedule management plan

The Plan Schedule Management process is a planning process with a single output—not surprisingly, given the name of the process, it is the schedule management plan. Like all other planning documents, the schedule management plan will guide your efforts in defining and controlling the project schedule. It will form a subsidiary plan to the overall project management plan.

INPUTS

The Plan Schedule Management process uses some or all of the following inputs as part of the development of the schedule management plan for the project.

PROJECT CHARTER

The project charter, which is the foundational document of the project, providing and confirming financial and political support for the project, contains useful information about the known statement of work, any initial known constraints and assumptions, and an assessment of the known risks. This preliminary information contained in the project charter is particularly useful when you first begin defining your project schedule.

PROJECT MANAGEMENT PLAN

Any reference to the project management plan includes a reference to all subsidiary management plans that it contains. Obviously, any aspect of work on the project will incur some time and, therefore, the project management plan, with its information about other areas, provides a useful input into planning your particular approach to schedule management. Any and all information relating to the project scope, project cost, project risk, project communications, project procurement, and stakeholder expectation management will be useful in assisting you develop your schedule management plan.

A decision about an appropriate development approach should also be taken at this point in schedule development. Will you be using a predictive, iterative, adaptive, agile or hybrid approach?

ENTERPRISE ENVIRONMENTAL FACTORS

Enterprise environmental factors are any factors external to the project that can influence the outcome; they can usually be viewed as some sort of constraint on the project. Particular enterprise environmental factors that may assist with development of your schedule management plan include the wider organizational culture and structure, and the inherent skills available throughout the organization. Additional enterprise environmental factors that are useful in developing a project schedule include any external published commercial information that can be used to estimate time on a project, and any company work authorization systems.

ORGANIZATIONAL PROCESS ASSETS

Organizational process assets that may play an important part as inputs into the development of your schedule management plan include historical information, blank templates, and project management methodology guidelines.

EXAM TIP

Historical information and lessons learned are considered to be two of the most important organizational process assets that any project manager can rely upon in the development of any part of the project management plan. In the

exam, you will find an emphasis on historical information and lessons learned as an important input into many processes.

TOOLS AND TECHNIQUES

The following tools and techniques are available to be used to develop the inputs into this process in order to produce the schedule management plan.

EXPERT JUDGMENT

Again expert judgment is used as a tool. Expert judgment is the advice and opinion of any person or group who holds specific knowledge about a particular area. You as project manager are considered to be an expert, your project team members are experts, and any other person with specialist knowledge you choose to consult is also an expert.

EXAM TIP

Deciding to use expert judgment is one thing; how you get the information from selected experts is another matter and is the subject of other information-gathering tools and techniques, such as meetings, the Delphi technique, interviews, questionnaires, and surveys.

DATA ANALYSIS

As part of the development of the schedule management plan, you will have to make decisions about which processes, tools, and techniques are best used in your particular project. This process of analyzing the potential options available to you is referred to as using alternatives analysis.

MEETINGS

Meetings are a useful tool to bring together everyone with experience in developing the schedule management plan. When run properly, they are an effective and efficient means of getting work done. The most useful people to invite to these particular meetings are members of the project team and people with experience in developing schedules.

OUTPUTS

After applying the appropriate tools and techniques to the selected inputs, the Plan Schedule Management process has the following output.

SCHEDULE MANAGEMENT PLAN

The Plan Schedule Management process has only a single output—the *schedule management plan*. The schedule management plan is a subsidiary plan of the project management plan. The purpose of the schedule management plan is to guide the project manager and the project team; the plan also guides further activities, such as defining and developing the project schedule, checking for variance between what has been planned and what is actually happening, and managing any changes to the project schedule. As such, it is an important plan to have in place in order to provide oversight, standardization, and best practices to ensure that the project schedule, itself an essential part of any successful project, is well developed, monitored, and controlled.

EXAM TIP

Always assume that any aspect of your project management activities has some form of plan guiding it. The absence of a plan will result in inefficient and ineffective efforts that can increase the chances of project failure.

The schedule management plan is then a key input into the following processes, all of which are planning processes:

- Define Activities
- Sequence Activities
- Estimate Activity Resources
- Estimate Activity Durations
- Develop Schedule

Quick Check

1. What is the main purpose of the schedule management plan?
2. Why is the project charter an important input into the Plan Schedule Management process?
3. What role does the schedule management plan have in the overall project management plan?

Quick Check Answers

1. The main purpose of the schedule management plan is to provide a documented guide as to how your project schedule will be defined, documented, and used to check actual versus planned schedule, and to outline how any potential changes will be managed and assessed.
2. At the beginning of the development of your project schedule, the project charter provides a wealth of preliminary information about the statement of work, constraints, assumptions, risks, and other information that will ultimately affect the project schedule.
3. The schedule management plan is a subsidiary plan of the overall project management plan that focuses on the particular area of project time management.

4.3 DEFINE ACTIVITIES

TABLE 4-2 Define Activities process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none">▪ Project management plan▪ <i>Schedule management plan</i>▪ <i>Scope baseline</i>▪ Enterprise environmental factors▪ Organizational process assets	<ul style="list-style-type: none">▪ Expert judgment▪ Decomposition▪ Rolling wave planning▪ Meetings	<ul style="list-style-type: none">▪ Activity list▪ Activity attributes▪ Milestone list▪ Change requests▪ Project management plan updates<ul style="list-style-type: none">▪ <i>Schedule baseline</i>▪ <i>Scope baseline</i>

The Define Activities process is a planning process that takes the already-defined work packages from the Create WBS process and breaks them down further into individual activities.

The difference between an activity and a work package is that an activity is the smallest component of work to be performed during the course of a project. A work package is a convenient level of work to stop at when completing the work breakdown structure (WBS), because at that point the work can reliably be estimated for time and cost. At that point, breaking work packages down into activities for the purposes of the work breakdown structure has a decreasing benefit for the time and effort taken to do this. However, for the purposes of putting together an accurate project schedule, you must break these work packages down even further to the level of activities.

Real World

When completing any decomposition of the project scope statement, it sometimes seems arbitrary to stop the decomposition process at the level of work packages and then come back at some later time to break it down further into activities. Therefore, during the process of decomposition of the scope, whether to show it graphically in a WBS, or to obtain a list of work packages and activities to put into the project schedule, I generally do both processes at the same time.

INPUTS

The Define Activities process uses some or all of the following four inputs.

PROJECT MANAGEMENT PLAN

The schedule management plan is obviously a key input into the Define Activities process because the schedule management plan contains information about how you will break activities down, and the level of detail expected from the activities listed. The schedule management plan is an output from the Plan Schedule Management process.

The scope baseline is used to ensure that the project manager captures all of the activities contained in the project scope. When breaking the project scope down into its component parts, you can use the scope baseline and all the information it contains to ensure that you have captured all the activities required to complete the project. The scope baseline is an output of the Create WBS process.

EXAM TIP

Remember that the scope baseline includes the following three elements: the project scope statement, the WBS, and the WBS dictionary.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific types of enterprise environmental factors that are useful as inputs into the Define Activities process are any aspects of the project management information system, any relevant parts of the organizational culture and structure, and any published information from commercial databases.

ORGANIZATIONAL PROCESS ASSETS

The specific types of organizational process assets that are useful as inputs into the Define Activities process are any existing project management methodologies, processes, and templates that can assist with the development of the project schedule. Additionally, any configuration management system that defines how different versions of the project schedule will be recorded, controlled, and updated can be used as an input. This is particularly important to ensure that you are always working on the correct version of any document in what can be a highly iterative process. Of course, any historical information from past projects that can be used to assist in the compilation of the current project management plan is also useful.

TOOLS AND TECHNIQUES

The following three tools and techniques are used upon the inputs to deliver the process outputs.

EXPERT JUDGMENT

You may decide to call on the expert judgment of people with skills and experience in this type of project, and in the preparation of project schedules, in order to more accurately define your project activities

DECOMPOSITION

You have read about the process of decomposition used in the Create WBS process to take the scope of the project and decompose it down to the work package level. As a tool and technique in the Define Activities process, it is used to further decompose the already-defined work packages to activity level.

ROLLING WAVE PLANNING

Rolling wave planning is a key iterative element of the project manager's planning process. It is a form of progressive elaboration in which you can plan in detail that work which is in the immediate future, and plan in less detail the work that is further off.

A good example of rolling wave planning is when you have a project that is to go on for two and a half years. You will spend most of your planning activity on the work coming up in the next three months. Work to be done from three months to nine months out will have a lesser level of detail attached to it in the planning, but still enough to give you confidence about project time and cost. Work that is to be done beyond the nine-month period may have a very low level of detail attached to its time and cost elements.

MEETINGS

Using your team and other important stakeholders to define activities ensures that you will get information from the people charged with doing the work. A great way to do this is with well run meetings.

OUTPUTS

The Define Activities process produces some or all of the following outputs.

ACTIVITY LIST

The *activity list* is a comprehensive list that includes all currently known activities. In addition to listing the title and brief description of the activity, the activity list can provide additional information such as a unique identification number, which is an example of the configuration management system at work, and any other ancillary information that is relevant.

It is important to note that if you are undertaking any form of progressive elaboration or rolling wave planning, you may only have identified and defined the activities for the next immediate time period, and a definition and documentation of activities beyond this may yet need to be done.

The activity list is used as an input into the following processes:

- 6.3 Sequence Activities
- 6.4 Estimate Activity Resources
- 6.5 Estimate Activity Durations
- 6.6 Develop Schedule

ACTIVITY ATTRIBUTES

The *activity attributes* are to the activity list what the WBS dictionary is to the WBS. The activity list contains summary information about each activity, whereas the activity attributes document provides more detailed information about each of the activities. This detailed information can include any requirements, known constraints and assumptions, required milestones, and any other information that helps any person wanting to know more about the activity to understand it fully.

The activity attributes document is used as an input into the following processes:

- 6.3 Sequence Activities
- 6.4 Estimate Activity Resources
- 6.5 Estimate Activity Durations
- 6.6 Develop Schedule

MILESTONE LIST

As part of the development of the project schedule, and after the project activities have been defined, the project manager, in consultation with relevant stakeholders, may be able to produce a list of known milestones that should be achieved on the project. The *milestone list* contains these documented milestones.

EXAM TIP

Remember that a milestone has no duration and indicates a particular moment in time, usually when some specific work package or phase of a project has been completed. A milestone is often used as a point in the project where an assessment of work to date is done and decisions made about whether the project will continue.

Real World

Often when I am reporting progress of a project to senior-level stakeholders, the milestone list provides an appropriate means of communicating high-level information quickly. I will often use the milestone list and a description of which milestones have been achieved and which ones have not yet been achieved as a high-level way of communicating project progress quickly to senior stakeholders on the project.

CHANGE REQUESTS

As part of defining your activities you may generate some change requests for other parts of the project management plan or project documents. These change requests will become an input into the Perform Integrated Change Control process.

Quick Check

1. What is the difference between an activity and a work package?
2. How is rolling wave planning used?
3. What is the primary purpose of the activity attributes document?

Quick Check Answers

1. A work package is the lowest level of decomposition in the work breakdown structure (WBS). It represents a parcel of work that can reliably be estimated for time and cost. On the other hand, an activity is a decomposed work package, broken down into the actual tasks that need to be done on a project.
2. Rolling wave planning is an important tool to use on long-term projects. With rolling wave planning, planning and detail is done for the immediate time period, and time periods that are further out are planned in less detail.
3. The primary purpose of the activity attributes document is to provide further and more detailed information about each of the activities in the activity list.

4.4 SEQUENCE ACTIVITIES

TABLE 4-3 Sequence Activities process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Schedule management plan</i> ▪ <i>Scope baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Activity list</i> ▪ <i>Activity attributes</i> ▪ <i>Assumption log</i> ▪ <i>Milestone list</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Precedence diagramming method (PDM) ▪ Dependency determination and integration ▪ Leads and lags ▪ Project management information system 	<ul style="list-style-type: none"> ▪ Project schedule network diagrams ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Activity list</i> ▪ <i>Activity attributes</i> ▪ <i>Assumption log</i> ▪ <i>Milestone list</i>

The Sequence Activities process is a planning process that takes the list of activities that have already been defined and starts to put them in the order in which they will be completed.

INPUTS

The inputs used in this process allow for sequencing of the already defined project activities.

PROJECT MANAGEMENT PLAN

The schedule management plan is used as a key input into the Sequence Activities process because it outlines and defines how, and when, you will sequence the activities. The schedule management plan is an output from the Plan Schedule Management process

The project scope baseline is used as an input into the Sequence Activities process because it allows you to understand the complete scope of work to be delivered in the project and, thus, you can get a clear idea of which activities must be performed before other activities.

PROJECT DOCUMENTS

The activity list is a very important input into the Sequence Activities process, because you need the list of activities to put them in order. The activity list is an output from the Define Activities process.

The activity attributes document provides additional information about each of the activities that may be useful when it comes to deciding whether they are predecessors or successors for any other activity. The activity attributes document is an output from the Define Activities process.

The assumptions log lists all assumptions made to date about data and information to define and sequence the activities and knowing these will help you understand uncertainty in your schedule.

The milestone list is an important input because it has a description of the known project milestones, and with this you can determine which activities must be completed before the milestone and which must be completed after the milestone. The milestone list is an output from the Define Activities process.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific types of enterprise environmental factors that will be of use to you during the Sequence Activities process will be scheduling tools, government or industry standards, and any other external factors affecting the order in which work is to be completed on your project.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that can assist you in sequencing the activities include any existing processes, templates, historical information, or lessons learned documentation that the organization owns.

TOOLS AND TECHNIQUES

The four tools and techniques of this process are all used upon the separate inputs to deliver the process outputs.

PRECEDENCE DIAGRAMMING METHOD (PDM)

The *precedence diagramming method* (PDM) is a graphical representation of activities in a project, represented on nodes, with the relationships between them indicated by arrows. This is more commonly called the *activity-on-node* (AON) diagram. It establishes a *predecessor* and *successor* relationship between activities. An activity can be a predecessor of other activities, meaning that it must be done before them. The same activity can also be a successor activity to one or more activities, meaning it must be done after them.

As mentioned already, a predecessor activity is one that comes before another activity, and a successor activity is one that comes after another activity. A predecessor activity may have many successor activities, in which case it is known as a burst activity. A successor activity may have one or more predecessor activities. If the successor activity has more than one predecessor activity, it is known as a merge activity. Figure 4-2 shows an example of Activity A as the predecessor activity, with Activities B and C as the successor activities. Activity A is also a burst activity.

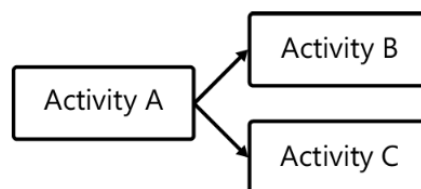


FIGURE 4-2 Predecessor and successors.

There are four types of relationships that exist between predecessor and successor activities:

Finish-to-start (FS) A finish-to-start relationship is one in which the successor activity cannot start until the predecessor activity has finished. For example, you cannot erect the walls of a house until the foundation has been completed. Figure 4-3 depicts how this would be represented diagrammatically.

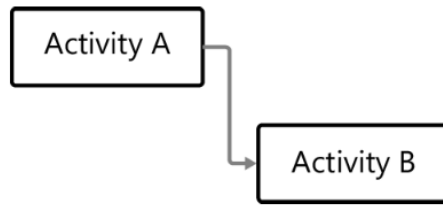


FIGURE 4-3 Finish-to-start relationship.

Finish-to-finish (FF) A finish-to-finish relationship is one in which the successor activity cannot finish until the predecessor activity has finished. For example, you cannot finish writing the user manual for a piece of software until the testing is finished. Figure 4-4 depicts how this would be represented diagrammatically.

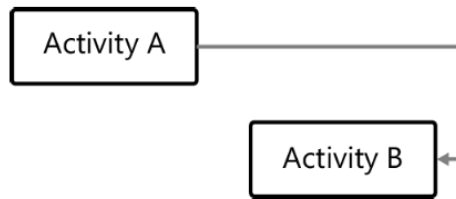


FIGURE 4-4 Finish-to-Finish relationship.

Start-to-start (SS) A start-to-start relationship is one in which the successor activity cannot start until the predecessor activity starts. For example, you cannot begin testing a new piece of software until you have started writing the code. Figure 4-5 depicts how this can be represented diagrammatically.

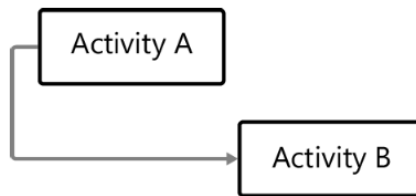


FIGURE 4-5 Start-to-Start relationship.

Start-to-finish (SF) A start-to-finish relationship indicates that the successor cannot finish until predecessor starts. For example, you may have an activity that is to send the invoice for a product, but the invoice cannot be sent (finished) until delivery of the product has started. This type of relationship is almost never used, because it seems to indicate that the successor should be the predecessor and vice-versa. Figure 4-6 depicts how this would be represented diagrammatically.

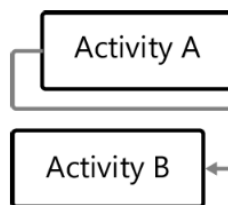


FIGURE 4-6 Start-to-finish relationship.

Real World

In most project management scheduling software, the default relationship for activities is finish-to-start. Check it out: if you enter *FS* after a predecessor, the *FS* disappears. However, if you enter *FF*, *SS*, or *SF*, they remain.

DEPENDENCY DETERMINATION AND INTEGRATION

In addition to the types of relationships that exist between predecessor and successor activities, there are also four types of dependencies that determine the nature of the relationship between the two activities.

In mandatory dependencies, the successor activity must always occur after the predecessor activity. For example, you must develop the code for a piece of software before you begin testing it.

In discretionary dependencies, the successor activity should occur after the predecessor activity, although the two activities can be performed in another sequence if necessary.

EXAM TIP

Be aware that discretionary dependencies have some flexibility built into them in terms of how they are scheduled. Generally, they should be performed in sequence, with successor activities after their predecessor activities, but they can be performed in parallel if necessary. There can be an increased risk associated with performing discretionary dependencies in parallel rather than in sequence, and this additional risk would need to be considered when putting together the project schedule.

In external dependencies, the activity is dependent upon an activity being completed outside of the project. For example, you cannot start construction on the house until you have received building consent.

In internal dependencies, the activity relies upon another activity that is external to the project but internal to the broader organization. For example, the recruitment of people on your project may be done by the human resources department, and you have to wait until they complete the work.

LEADS AND LAGS

As you start to put together your project network diagram by beginning with the sequencing of the activities, you can also choose to apply *leads* and *lags*. A lead is the amount of time that a successor activity can start before its predecessor activity finishes. For example, generally speaking, you do not start building the walls of a house until construction of the foundation has been completed. However, you can get a lead on the construction of the walls by having them built off site.

The opposite of a lead is a lag. A lag is the amount of time that a successor activity must wait after its predecessor activity has finished before it can start. For example, in the case of pouring concrete for a house foundation, you must wait several days while the concrete cures before you can start building on it. Because the concrete curing period has neither resources nor costs assigned to it, it cannot be included as an activity in your network diagram. Instead, you indicate that the successor activities must wait via a lag before they can begin.

Real World

If you want to indicate a lead between a successor and its predecessor by using Microsoft Project, Primavera or ProjectLibre, this can be done by using the relationship acronym, such as finish-to-start (FS), and a minus sign followed by the number of time periods the activity can start before the completion of its predecessor. For example, *FS-4* means that the successor activity has a finish-to-start relationship with its predecessor activity and can start 4 days before the predecessor activity ends. If you want to indicate a lag, you can do this by the use of a plus sign after the relationship acronym. For example, if you want to indicate a lag of 3 days, you would simply write the task ID number of the predecessor and then, for a finish-to-start relationship, *FS +3*.

PROJECT MANAGEMENT INFORMATION SYSTEMS

You won't be doing all this work manually. You will be using some sort of software such as MS Project, Project Libre, Primavera or anyone of the great Agile scheduling software that exists.

OUTPUTS

The major outputs from the Sequence Activities process are the following.

PROJECT SCHEDULE NETWORK DIAGRAMS

The *project schedule network diagram* represents all the activities in the project and the relationships between them all.

The process of completing the sequencing of activities is the first step in the completion of the project schedule network diagram. This first pass, which indicates the relationships between the activities, will be further fleshed out

with more information in the coming processes as you use the resource estimates to define the durations of each of the activities. Then you will be able to calculate the total project duration, the amount of slack or float in the project, and the critical path or paths.

Figure 4-7 shows what an Activity-on-node (AON) network diagram might look like at the end of the sequencing process. Information about each activity is represented in the nodes on the diagram, and the arrows indicate the relationship between the activities. In this case they are all finish-to-start (FS) relationships. The activity-on-node (AON) diagram is the most popular graphical way of representing a network diagram but there is another less intuitive way called the activity-on-arrow (AOA) diagram.

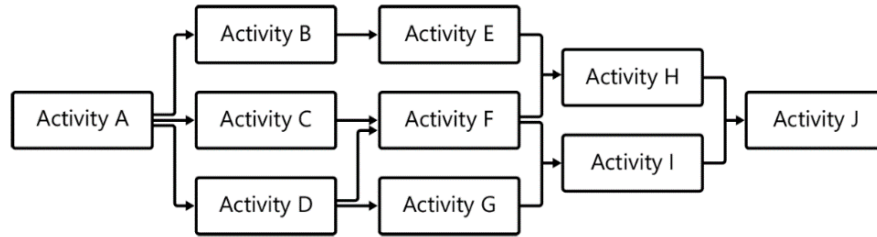


FIGURE 4-7 Activity-on-node network diagram.

Real World

It is highly unlikely that you will need to know how to construct a network diagram manually in the real world. I have found that the main benefit in knowing how to put together a network diagram, calculate the project duration, calculate any slack in the network diagram, and determine a critical path is for understanding and appreciating how project management software works. Perhaps the only time you will need to know how to do this manually is for a small part of your project schedule at short notice when software isn't available.

EXAM TIP

The other way of graphically representing a network diagram is what is called the Arrow diagramming method or the activity-on-arrow (AOA) diagram. The activity-on-arrow diagram is not used very much at all within the project management world, because it seems to run counter to the logical representations of activities and the relationships between them. Because the activities themselves are represented by arrows, it becomes a problem to also use arrows to show relationships between activities, so where there are multiple predecessors to an activity, a dummy activity is used, represented by a dotted line. Figure 4-8 shows an example of an activity-on-arrow diagram with a dummy activity showing a relationship between Activities B and G. In the exam, if you find a reference to a dummy activity, you know it is referring to activity-on-arrow diagrams.

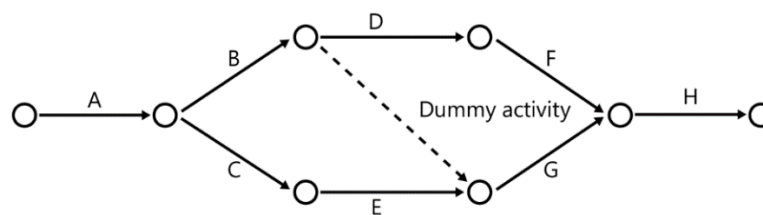


FIGURE 4-8 Activity-on-arrow (AOA) diagram.

PROJECT DOCUMENTS UPDATES

The types of project documents that may be updated as a result of the Sequence Activities process are the activity list, activity attributes, assumption log, milestone list, and any other relevant documents.

Quick Check

1. What is the most commonly used type of relationship between predecessor and successor activities?
2. What is the difference between a lead and a lag?
3. What is the difference between an activity-on-node diagram and an activity-on-arrow diagram?

Quick Check Answers

1. The most commonly used type of relationship between predecessor and successor activities is a finish-to-start relationship.
2. A lead is the amount of time that a successor activity can start before its predecessor finishes, whereas a lag is the amount of time a successor activity must wait after its predecessor activity finishes.
3. An activity-on-node diagram represents the project activities on nodes, with the arrows between the nodes representing the types of relationships. An activity-on-arrow diagram shows the activities of the project occurring on the arrows themselves, with nodes representing where multiple activities join.

4.5 ESTIMATE ACTIVITY DURATIONS

TABLE 4-5 Estimate Activity Durations process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Schedule management plan</i> ▪ <i>Scope baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Activity list</i> ▪ <i>Activity attributes</i> ▪ <i>Assumption log</i> ▪ <i>Lessons learned register</i> ▪ <i>Milestone list</i> ▪ <i>Project team assignments</i> ▪ <i>Resource breakdown structure</i> ▪ <i>Resource calendars</i> ▪ <i>Resource requirements</i> ▪ <i>Risk register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Analogous estimating ▪ Parametric estimating ▪ Three-point estimating ▪ Bottom-up estimating ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Alternatives analysis</i> ▪ <i>Reserve analysis</i> ▪ Decision making <ul style="list-style-type: none"> ▪ <i>Voting</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Duration estimates ▪ Basis of estimates ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Activity attributes</i> ▪ <i>Assumption log</i> ▪ <i>Lessons learned register</i>

The Estimate Activity Durations process is focused upon taking the previous data you have produced in defining the activities, sequencing the activities, and estimating the resources required for each activity, and then estimating the duration of each activity so that you can roll these individual estimates up into a total estimate for the project duration.

EXAM TIP

The reason that the Estimate Activity Resources process comes before the Estimate Activity Durations process is that generally you need to know what resources are available for you to be able to estimate how long activity will take, because the more resources you have, the faster an activity will be completed.

INPUTS

The following inputs can be used in the Estimate Activity Durations process to generate the outputs.

PROJECT MANAGEMENT PLAN

The schedule management plan is again a key input into this process because it outlines the way in which you are going to complete your estimate of activity durations. The schedule management plan is an output from the Plan Schedule Management process.

The use of the project scope baseline as an input into the Estimate Activity Durations process provides a great level of oversight to ensure that you have captured the entire project scope. Furthermore, the project scope baseline will contain additional information that you may need to be aware of when estimating activity durations, such as any pre-identified skilled resources and any known contract terms and requirements affecting duration estimates. The project scope baseline is an output from the Define Scope process in the Scope Management knowledge area.

PROJECT DOCUMENTS

The activity list provides information about all the activities on a project and is an essential input, because you are now going to be estimating the duration of each of these activities. The activity list is an output from the Define Activities process.

Though the activity list provides you with a list of all the activities, and some summary information about each of them, the activity attributes document provides more detailed information about each of the activities, including the resources allocated to them, any known constraints or assumptions, and any risks about them. Activity attributes are an output from the Define Activities process.

The assumption log will provide a list of all the relevant assumptions you need to take into account in making your duration estimates.

The lessons learned register will provide information from this, and possibly, other projects about knowledge gained that will improve your duration estimates.

The milestone list will list any known schedule constraints such as significant milestones that must be achieved.

Project team assignments will let you know who is available to for the work on your team or who you have to borrow from other teams.

EXAM TIP

The duration of any activity not only depends on the actual time taken to complete the work, but also on the availability of the person doing the work. You could have a situation where you have work that is forecast to take 40 hours to complete, but the person doing the work only works half a week, so the actual total duration will be two weeks, not one.

The resource breakdown structure provides you with a comprehensive decomposition of the types of resources you will require on the project, and with this information you can estimate durations better. The resource breakdown structure is an output from the Estimate Activity Resources process.

Resource calendars provide you with information about constraints on resource availability. They specify when resources are available and when they are not available. If they are referring to people, they may outline holidays and known non-working times so that you can build these into your duration estimates. Resource calendars are also useful for indicating when resources are allocated to other projects and are thus not available to work on your project. Resource calendars are an output from the Acquire Resources process.

The resource requirements match each activity in your activity list with allocated resources that have been estimated to complete the activity. The resource requirements are an output from the Estimate Activity Resources process.

The project risk register includes an analysis of the risks associated with resource use on the project and, as such, will contain important information about uncertainty in your activity duration estimates. The risk register is an output from the Identify Risks process in the Risk Management knowledge area.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific types of enterprise environmental factors that may be used as inputs into this process are any estimating databases that the organization has accumulated or that are available from external sources, and any known productivity metrics useful in determining the durations of particular activities when completed by specific resources.

ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can be used to assist in the Estimate Activity Durations process are any historical information you have from previous projects, any lessons learned from previous projects specifically in relation to estimating, activity durations, and any organizational methodology and processes that can assist you in this process.

TOOLS AND TECHNIQUES

The following tools and techniques can be used upon the selected inputs to generate the outputs.

EXPERT JUDGMENT

The specific type of expert judgment you will use as a tool in this process will be from anyone with specific knowledge about how long activities should take. This expert judgment can come from team members, others within the organization, or external people with specific experience.

ANALOGOUS ESTIMATING

Analogous estimating is an estimating technique in which you take a similar activity and extrapolate from that a current estimate based on the relationship between the other activity and this activity. For example, you may know that a similar activity took 3 days to complete, and the one you are currently estimating is twice as big; therefore, you would estimate a total duration of 6 days by using an analogous estimating technique.

NOTE Accuracy of estimates

Any estimating technique is simply an attempt to forecast what the future may hold. The better the information that goes into the estimating process is, the better the estimate will be. For example, let's say that you are trying to forecast the weather for tomorrow, for one week from now, for one month from now, and for one year from now. In order to estimate the weather for tomorrow, you have available to you a lot of data, including quantitative data on what today's weather pattern is doing and what historical information, and computer simulations, tell you this weather pattern will do tomorrow. As a result of this detailed information going into the estimating process, you can be reasonably sure that your estimate about tomorrow's weather will be fairly accurate. As you move out in time with your weather forecasts, the data available to you and the ability of computer simulations and historical information will provide less valuable input, and thus your weather forecast for a year away will basically just be a guess based on the seasonal expectations.

PARAMETRIC ESTIMATING

Parametric estimating uses known quantities and known units of measurement, and multiplies them together to arrive at an estimate. For example, you may know that each person can write 300 lines of code per day and that there are 3,000 lines of code to be written; therefore, your duration estimate using parametric estimating is 10 days.

THREE-POINT ESTIMATING

Three-point estimating is part of the *Program Evaluation and Review Technique* (PERT), a technique that uses a weighted average scenario to arrive at an estimate where there are most likely, optimistic, and pessimistic durations for an activity. If you were to take a simple average of three numbers, you would simply add the three numbers together and then divide by 3. The three-point estimating technique gives a higher weighting to the most likely estimate (tM) and assigns it a weight of 4, while assigning a weight of 1 to each of the optimistic (tO) and pessimistic (tP) duration estimates. With six numbers now instead of three, you divide by 6 to get the weighted average. Therefore, the formula for calculating a *three-point estimate* using this technique is:

$$\frac{tO + (tM \times 4) + tP}{6}$$

EXAM TIP

The same formula is used to estimate project costs. In this section, the letter *t* is used to denote the variable being used to estimate time. When you are using this formula to estimate costs, the letter *c* is used instead. You may find it easier just to remember the formula without the *t* or *c*. Expert judgment, analogous estimating, parametric estimating, and three-point estimating are also used in the Estimate Costs process.

For example, if you had an optimistic estimate of 4 days, a most likely estimate of 7 days, and a pessimistic estimate of 12 days and put these estimates into the three-point estimating formula, your three-point estimate for this activity is 7.33 days.

$$\begin{aligned} & \frac{4 + (7 \times 4) + 12}{6} \\ &= \frac{4 + 28 + 12}{6} \\ &= \frac{44}{6} \\ &= 7.33 \end{aligned}$$

In addition to calculating the expected duration, you can also calculate the *standard deviation* and variance. The standard deviation is a calculation of how far away from the average duration, or the expected duration using the three-point estimating formula, your data is spread. A smaller standard deviation means that the data is tightly grouped, while a larger standard deviation means that the data is more widely spread.

The standard deviation calculation we use in the three-point estimating technique is essentially a heuristic, or rule-of-thumb, way of calculating standard deviation rather than the full formula used by statisticians. The formula subtracts the optimistic from the pessimistic and divides the result by 6 so the formula is:

$$\frac{tP - tO}{6}$$

So, using the previous example, the standard deviation is 8 divided by 6, which equals 1.33 days.

A benefit of calculating the standard deviation is that you can then estimate the confidence interval for a range of estimates. The confidence interval states the amount of the data that you expect to fall between the number of standard deviations above and below the mean. A standard deviation of 1 either side of the mean represents a confidence interval of 68 percent, a standard deviation of 2 either side of the mean gives a confidence interval of 95 percent, and a standard deviation of 3 either side of the mean gives a confidence interval of 99.7 percent.

EXAM TIP

6 standard deviations either side of the mean contains 99.999 percent of the population. More commonly known as *Six Sigma*, it is used as a quality management tool in the Project Quality Management knowledge area.

Figure 4-10 shows a normal distribution and the range of a population you would expect to find with either one, two, or three standard deviations (SD) either side of the mean.

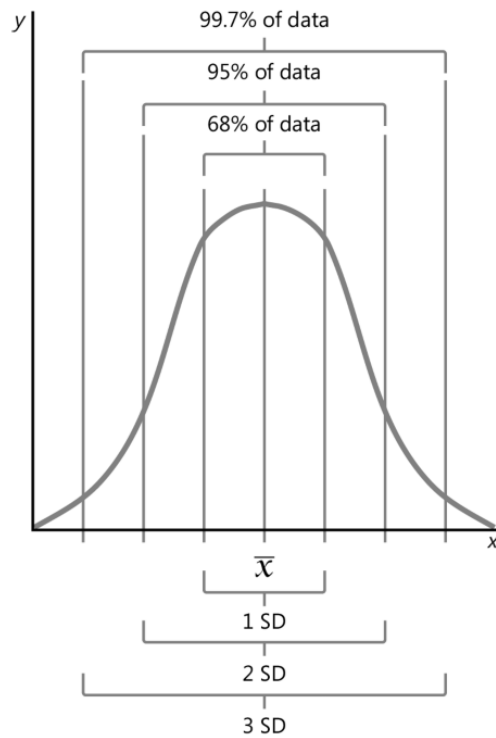


FIGURE 4-10 A curve showing standard deviations.

For example, in the previous scenario, you could say that you have a 95 percent degree of certainty that the estimate for the activity duration is between 7 ± 2.66 days. This is calculated by realizing that 95 percent certainty will reflect two standard deviations either side of the mean. The standard deviation, as already calculated, equals 1.33 days; therefore, two standard deviations equals 2.66 days.

EXAM TIP

In the exam, you may be asked a question about a range of estimates of which you are either 68 percent, 95 percent, or 99.7 percent certain, which means that the question is asking you to calculate 1, 2, or 3 standard deviations either side of the mean or average.

There is one more formula that you need to be aware of, and that is calculating the *variance*. The variance is calculated by multiplying the standard deviation by itself so the formula is:

$$\left(\frac{tP - tO}{6}\right)^2$$

Using the previous example, the variance is the standard deviation squared, which equals 1.33×1.33 , which equals 1.77.

NOTE Origins of three-point estimating

The origins of the three-point estimating technique are reportedly from the U.S. Navy Polaris submarine program in the 1950s. The technique was developed to help improve the delivery of large and complex projects. It is a subset of the Program Evaluation and Review Technique (PERT), which was one of the first analytical techniques to sequence activities and show the relationship between them.

A variation to the 3 point estimating technique, which provides a weighted average, is the triangular estimating technique which uses the same numbers but it is a simple average so divides the Realistic, most likely, and pessimistic numbers by 3, not 6. The Triangular Estimating Technique is a straightforward method for approximating project tasks' duration or cost. It takes into account the best-case, worst-case, and most-likely scenarios. To use it, you simply find the average of these three estimates. For example, if you're planning a software update, your best-case estimate might be 2 days, worst-case 8 days, and most-likely 4 days. To get the triangular estimate, you'd average these together: $(2+8+4)/3 = 14/3 \approx 4.67$ days. This technique offers a balanced outlook, drawing from optimism, pessimism, and realism to help you plan more effectively.

You'd generally use the Triangular Estimating Technique when you want a quick, easy-to-calculate estimate. It simply averages the best-case, worst-case, and most-likely scenarios, providing you with a single point estimate. This is particularly helpful when detailed historical data is lacking or when you want a rough initial estimate without investing too much time in analysis.

On the other hand, the Three-Point Estimating Technique involves weighted averages to provide a more refined estimate. This method is useful when you have more historical data and want to give more weight to the most-likely scenario, reducing the impact of overly optimistic or pessimistic estimates. It is often used in more complex or high-stakes projects where higher accuracy is desired.

In summary, use the Triangular Estimating Technique for quick and straightforward estimates, and opt for the Three-Point Estimating Technique when you need a more nuanced and accurate forecast.

EXAM TIP

In the exam, you will probably have to do some calculations using formulas. You should always round your answer to two decimal places. However, you may arrive at an answer that is a fractionally different from one of the ones presented. If this is the case, it is probably a safe bet, if you have used the right equation, that the answer closest to yours is correct.

BOTTOM-UP ESTIMATING

Bottom-up estimating involves breaking down complex activities into smaller, more detailed tasks and estimating the duration for each of these tasks individually. Once each task's duration is determined, they are aggregated to determine the total estimated duration for the entire activity, ensuring a comprehensive and detailed assessment.

DECISION MAKING

There are many ways to gather information from groups of people, each with their own benefits and drawbacks. The most common group decision-making techniques used are *brainstorming*, *nominal group techniques*, and the *Delphi technique*.

Brainstorming is an excellent way of getting a group of people to think about many possible options. If you are facilitating a brainstorming session, you should encourage all ideas. The *nominal group technique* takes all the ideas and uses the group to vote on which ideas are worthy of further investigation.

The *Delphi technique* is a technique for soliciting information from experts on an anonymous basis. The reason for this is that often, bringing experts together into a room to provide expert opinion and advice results in the loudest being heard, or peer pressure influencing the opinions of those present. The Delphi technique aims to get around these potential problems and allow experts to contribute freely by asking each expert anonymously, via a structured questionnaire, for his or her opinion. After the first round of opinions has been gathered, your summarized results are often circulated again to all experts taking part in the process. They can then review results and, if they want, change their original opinion.

Real World

The Delphi technique is a very effective way of getting accurate information from experts, however it is also time consuming and can cost a significant amount of money to do successfully. I have been part of a Delphi technique being used to determine the level of risk on IT projects, I never knew how many other experts were being consulted, but the whole process took about 3 weeks to complete.

NOTE Origins of the Delphi technique

The Delphi technique is named after the oracle of Delphi, who was a priestess at the Temple of Apollo in ancient Greece who would go into a trance and provide advice on what the future may hold.

MEETINGS

Running effective meetings with the right team members and stakeholders present will allow you to solicit information from people to allow you to make good duration estimates.

OUTPUTS

The Estimate Activity Durations process produces some or all of the following outputs.

DURATION ESTIMATES

The main output from the Estimate Activity Durations process is the *duration estimates*, which define and record the individual assessments for the time required to complete each activity on the activity list. The individual activity durations estimates will include an expected duration for each activity and, if calculated, the range of uncertainty in each activity, which can be aggregated to provide an expected duration with the total range of uncertainty for the entire project. For example, you could report that the total project duration is expected to be 89 days with a 10 percent probability that it will take 95 days based upon the reserve analysis. The activity durations estimates go on to be used as an input into the Develop Schedule process.

BASIS OF ESTIMATES

The basis of estimates provides a detailed explanation of how the activity duration estimates were derived, including the underlying assumptions and data used. As an output from the Estimate Activity Durations process, it offers stakeholders clarity and justification for the projected timeframes, ensuring transparency and fostering trust in the project's scheduling decisions.

PROJECT DOCUMENTS UPDATES

The specific types of project documents that may be updated as a result of completing the Estimate Activity Durations process are the activity list, the activity attributes, assumptions log, and any other documents relating to expected durations of activities that the organization has.

Quick Check

1. Using the three-point estimating technique, what is the expected duration of an activity with an optimistic duration of 8 days, a most likely estimate of 10 days, and a pessimistic estimate of 16 days?
2. What is the main benefit of using the Delphi technique as an estimating tool?
3. What is the main difference between analogous and parametric estimating techniques?
4. What percentage of a data population would you expect to find within two standard deviations either side of a mean?
5. What are the two types of justifiable reserve that may be used on a project?

Quick Check Answers

1. If you apply the three-point estimating formula to this scenario, you will arrive at a three-point estimate of 10.66 days.
2. The main benefit of using the Delphi technique is to allow experts to contribute their opinions anonymously and without peer pressure.
3. Analogous estimating uses similar scenarios to extrapolate a current estimate, whereas parametric estimating uses a known quantity and multiplies it by a known metric.
4. You would expect to find approximately 95 percent of a population within two standard deviations either side of a mean.
5. Both the contingency reserve, for "known unknowns," and the management reserve, for "unknown unknowns," are developed by using quantitative data and historical information and, therefore, provide justifiable reserves.

4.6 DEVELOP SCHEDULE

TABLE 4-6 Develop Schedule process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Schedule management plan</i> ▪ <i>Scope baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Activity attributes</i> ▪ <i>Activity list</i> ▪ <i>Assumptions log</i> ▪ <i>Basis of estimates</i> ▪ <i>Duration estimates</i> ▪ <i>Lessons learned register</i> ▪ <i>Milestone list</i> ▪ <i>Project schedule network diagrams</i> ▪ <i>Project team assignments</i> ▪ <i>Resource calendars</i> ▪ <i>Resource requirements</i> ▪ <i>Risk register</i> ▪ Agreements ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Schedule network analysis ▪ Critical path method ▪ Resource optimization techniques ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>What-if scenario analysis</i> ▪ <i>Simulation</i> ▪ Leads and lags ▪ Schedule compression ▪ Project management information systems ▪ Agile release planning 	<ul style="list-style-type: none"> ▪ Schedule baseline ▪ Project schedule ▪ Schedule data ▪ Project calendars ▪ Project management plan updates <ul style="list-style-type: none"> ▪ <i>Schedule management plan</i> ▪ <i>Cost baseline</i> ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Activity attributes</i> ▪ <i>Assumptions log</i> ▪ <i>Duration estimates</i> ▪ <i>Lessons learned register</i> ▪ <i>Resource requirements</i> ▪ <i>Risk register</i>

The Develop Schedule process takes all the information you have gathered in the previous processes—Define Activities, Sequence Activities, Estimate Activity Resources, and Estimate Activity Durations—and combines them into the project network diagram, which graphically represents the project schedule.

Real World

On most projects that I've been involved in, the Develop Schedule process has been our primary focus and the preceding processes have all been completed at the same time, rather than as discrete, separate processes.

INPUTS

The Develop Schedule process uses the following inputs.

PROJECT MANAGEMENT PLAN

The schedule management plan is an essential input into the Develop Schedule process because it outlines the way in which you are going to develop the project schedule. The schedule management plan is an output from the Plan Schedule Management process.

The project scope baseline gives you information about the project and product scope of work to be completed, and it also provides information about known constraints and assumptions and any known contractual obligations that will affect your project schedule. The project scope baseline is an output from the Develop Project Scope process in the Scope Management knowledge area.

PROJECT DOCUMENTS

The activities attributes give you more detailed information about the activities on the activity list, which only provides summary information about each activity. The activity attributes are an output from the Define Activities process.

The activity list provides you with a list of all the activities that you have defined for the project that need to be completed. Each activity needs to be represented on the completed project schedule, and thus the activity list is a key input into this process. The activity list is an output from the Define Activities process.

The assumptions log will describe all assumptions made to date and you can use this to determine the level of uncertainty in your schedule and how much contingency you should allow for.

The basis of estimates provides detailed insight into how duration estimates were determined, encapsulating the assumptions and data used. When used as an input in the Develop Schedule process, it ensures that the scheduling decisions are grounded in well-documented reasoning, facilitating more accurate and informed timeline development.

The activity duration estimates are absolutely essential if you want to complete a project schedule. You will use these individual estimates and aggregate them to determine your total project duration. Activity durations estimates are an output from the Estimate Activity Durations process.

The Lessons learned register will contain valuable information about knowledge gained in this and past projects that will help you develop your schedule.

The milestone list will show the agreed key project milestones that your project schedule will need to incorporate and perhaps treat as constraints for other parts of the schedule.

The project schedule network diagrams present each of the activities and the relationship each has with predecessors and successors. The full development of the project schedule takes this preliminary information and adds additional detail to it, such as the estimate of activity resources and the individual estimate of activity durations, to produce the final project schedule. The project schedule network diagrams are an output from the Sequence Activities process.

The project team assignments specify which organizational employees are to be allocated to each activity and provide an analysis of experience and skills that each particular person brings. The project team assignments are an output from the Acquire Resources process in the Human Resource Management knowledge area.

The resource calendars provide information about any known constraints upon the use of resources on your project that may affect your scheduling. The resource calendars are an output from the Acquire Resources process in the Human Resource Management knowledge area.

The resource requirements are used to allocate resources to each of the activities identified in the project. Resource requirements are an output from the Estimate Activity Resources process.

The risk register contains information about known schedule risks and known resource risks of the project. As part of the analysis of these risks, there may be the development of contingencies relating to time that must be taken into account in developing a project schedule. The risk register is an output from the Identify Risks process in the Risk Management knowledge area.

AGREEMENTS

Agreements, which can include contracts, memorandums of understanding, or any formalized understanding between parties, often outline specific deliverables, timelines, and milestones. When used as an input in the Develop Schedule process, these agreements ensure that the project schedule aligns with contractual obligations and stakeholder commitments, thereby maintaining consistency and meeting external expectations.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific enterprise environmental factors that may be used as inputs, if appropriate, are any external standards, regulations, contractual obligations, or licensed scheduling tools that you will use to develop the project schedule.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that may be useful in developing your project schedule include any existing project management methodology, blank templates, tools, and other techniques owned by the organization for the preparation of a project schedule.

TOOLS AND TECHNIQUES

The following tools and techniques can be used upon the inputs into the Develop Schedule process.

SCHEDULE NETWORK ANALYSIS

Schedule network analysis is a primary tool used to bring together all the previous information you have gathered when you defined the activities, sequenced the activities, estimated the activity resources, and estimated the activity durations. You use all of this information to put together your full schedule network diagram and, when it is completed, you can use the critical path method, critical chain method, what-if analysis, and resource leveling to determine the total project duration and the amount of *total float or slack* between specific activities and in the overall project.

Real World

There are many ways of drawing the information contained in each node of an activity-on-node network diagram, and there are at least two ways of representing the numbering systems used to calculate durations between activities.

CRITICAL PATH METHOD

The *critical path* method focuses on identifying all the paths through a project and, with the aid of a network diagram, determining which of these paths presents the shortest duration and also the least amount of scheduling flexibility as indicated by the length of slack or float. The path with the shortest duration and the least slack or float through the project represents the path of most risk to the project, hence the name *critical path*.

There can be many paths through a project, as Figure 4-11 shows.

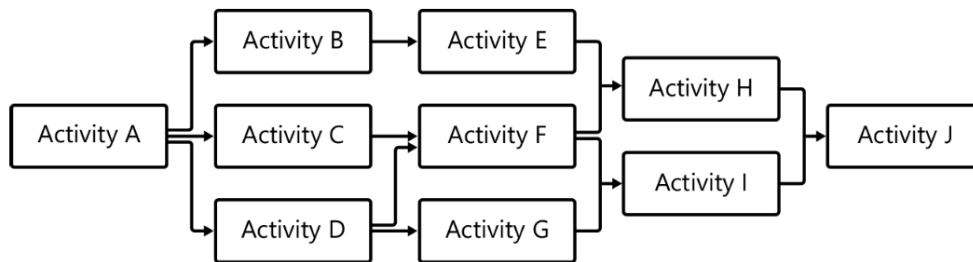


FIGURE 4-11 Network paths.

There are the following paths through this network diagram:

- A-B-E-H-J
- A-C-F-H-J
- A-C-F-I-J
- A-D-F-H-J
- A-D-F-I-J
- A-D-G-I-J

However, you are not able to determine which path or paths are the critical paths until you complete a full schedule network analysis.

NOTE Slack and Float

There are not many instances in the PMP® exam for which a single word has two meanings. The case of *slack* and *float* is one of the only times when two words are used to mean the same thing. There are two types of slack or float: free slack or free float, and total slack or total float. Free slack, or free float, indicates the amount of time an activity can be delayed before that affects the next activity on the path. Total slack, or total float, indicates the amount of time an activity can be delayed before it affects the total project duration. If an activity has zero total float, it means that if it is delayed, it will automatically increase the duration of the project. The critical path or paths through a project are those upon which there is no slack or float.

In order to complete a full schedule network diagram, you must understand how to complete an activity-on-node (AON) diagram. This next section will take you through the process of completing a schedule network diagram, completing a *forward pass* to determine the project duration, and completing a *backward pass* to determine the critical path or paths.

To calculate the critical path on an activity-on-node diagram, this example will use the node to represent the information about the activity. The information contained in the node will be the task ID, the duration of the activity, the *early start (ES)*, the *early finish (EF)*, the *late start (LS)*, the *late finish (LF)*, and the amount of total float in the activity. Figure 4-12 represents a typical node; however, be aware that in the real world and in the exam many different forms of node may be used with information displayed in different locations, yet they all display the same information, just in different ways.

Early Start (ES)	Duration	Early Finish (EF)
Activity Name		
Late Start (LS)	Total Float	Late Finish (LF)

FIGURE 4-12 The activity node.

Now if you take the information contained in Table 4-7 and map that out over an entire network diagram, you will be up to calculate the project duration and the critical path or paths.

TABLE 4-7 Activity information

Activity ID	Duration (DAYS)	Predecessor
A	3	-
B	5	A
C	4	A
D	2	B, C
E	6	C
F	5	D, E
G	4	E
H	7	F, G

The first step in the process is to construct a network diagram showing the relationships between the activities. In this instance, assume that all activities have a finish-to-start relationship and there are no leads and lags. Figure 4-13 shows the network diagram:

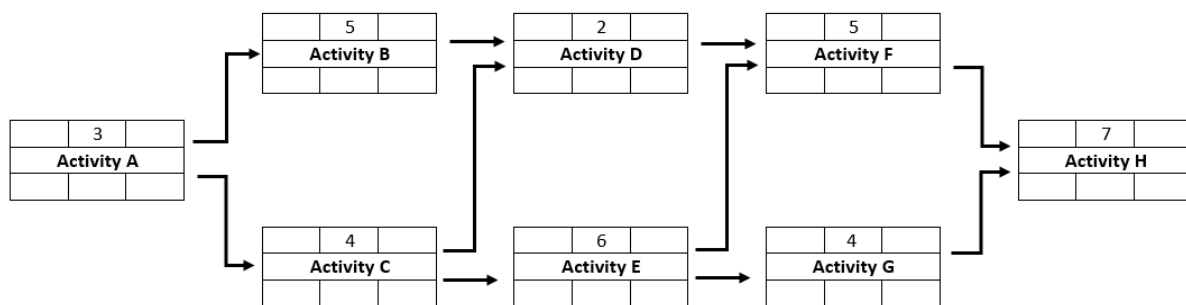


FIGURE 4-13 Network diagram example.

By examining this network diagram, you can now write out the paths through the diagram as follows:

- A-B-D-F-H
- A-C-D-F-H
- A-C-E-F-H
- A-C-E-G-H

The next step in the process is to complete a forward pass. The forward pass is completed by working from left to right and calculating the early start and the early finish for each task. The earliest a task can start is immediately after the latest early finish of all its predecessor activities. For example, if Activity A has an early finish of day 3 (which means it finishes at the end of day 3), then Activity B has an early start of day 4 (which means it starts at the beginning of day 4). If an activity has more than one predecessor, the earliest it can start is immediately after the latest early finish of all its predecessors. Figure 4-14 shows the network diagram with the forward pass completed. You can now determine that the project duration is 25 days.

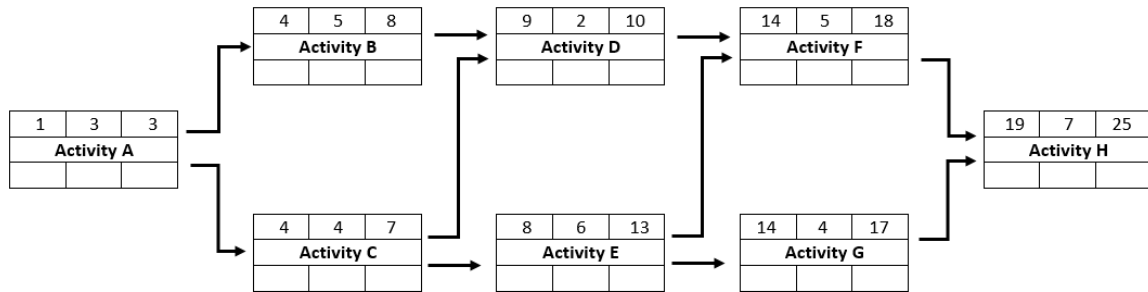


FIGURE 4-14 Forward pass completed.

The next step in the process is to complete a backward pass. This time, you work from right to left, and you calculate the late finish and the late start for each activity. This time, when calculating the late finish for an activity, you must look to its successor activities; the late finish for an activity is immediately prior to the earliest of all successor late start dates. For example, if Activity D is the successor to Activity B, and activity D has a late start of day 12, then Activity B has a late finish of day 11. As you complete the backward pass, you can also calculate the total slack for each task by subtracting the late start from the late finish. Figure 4-15 shows a completed backward pass.

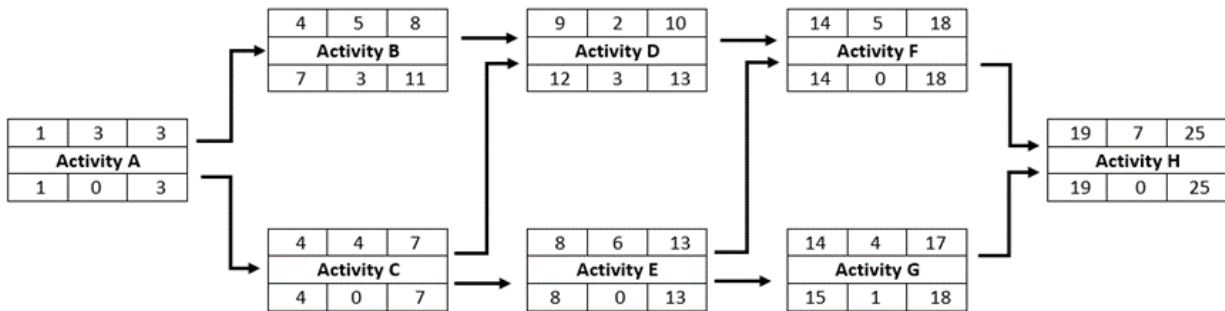


FIGURE 4-15 Backward pass completed.

To calculate which of the paths through the network diagram is the critical path, you simply look at all the activities that have zero total float, because these represent activities that if delayed will affect the total project duration. If you do this, you can determine that the critical path in this network diagram is A-C-E-F-H.

EXAM TIP

If you find a question in the exam asking about the application of buffer time, it is referring to the critical chain method which is a means of purposely adding in buffer time to identified activities, usually on the critical path, to account for limited resources and project uncertainties. The amount of buffer is usually worked out by using historical information or quantitative risk analysis. The purpose of adding buffer is to ensure that activities on the critical path that are identified as important feeder activities—that is, those that produce work for successor activities—always have float to ensure that they don't slip and cause the project duration to extend.

RESOURCE OPTIMIZATION

Often the first pass through any estimate of activity resources—either equipment, supplies or people—is what could be referred to as the optimal use of resources. However, this may not be the most efficient use of resources, and there may be times when resources are either over-allocated or under-allocated. If resources are over-allocated, you may not be able to use them, and if they are under-allocated, you may be paying for resources to sit around unused. Through the processes of *resource leveling* and *resource smoothing* you can attempt to make more efficient use of your resources, but this may have an impact on project cost and project duration.

Resource leveling involves moving the allocation of resources between time periods to level out either periods when a resource will be overused or periods when a resource will be underused. For example, you may have forecast one person to be working 60 hours in a week, while someone else will work 15 hours. Obviously, after you start moving a resource around to get more efficient use, you may end up changing the duration of activities or even the sequence of activities. *Resource smoothing* is a less intensive form of *resource leveling* because it adjusts resources only within the total float for each activity so as not to extend the total project duration.

Real World

Typically, resource leveling is best left to sophisticated project management software. If you try and do it manually, you may end up spending too much of your time completing it and not obtaining the optimal results.

DATA ANALYSIS

Data analysis typically uses computers to present a model of a potential outcome. They are particularly useful when you are developing your project schedule, because you can examine all potential options and easily find problems or opportunities within the project schedule.

A particular type of modeling technique is the *what-if scenario analysis*. What-if scenario analysis is a form of statistical and mathematical analysis that looks at the potential probabilities and likely outcomes of different scenarios occurring. For example, you may be able to use this technique to analyze what would happen to your project schedule if certain events occurred, and from this analysis, choose the scenario that best suits your project duration goals. Of all the what-if scenario analysis techniques, the most common simulation is *Monte Carlo analysis*. Monte Carlo analysis applies statistical analysis to examining a possible distribution of outcomes and extrapolates from this the likelihood of specific outcomes. Due to its complex use of mathematical modeling, this type of analysis is most often performed by a computer.

EXAM TIP

Often in the exam, if you find a question that relates to mathematical analysis of different scenarios, or the probability of different outcomes, the answer will most likely be what-if scenario analysis or Monte Carlo analysis.

NOTE Origin of Monte Carlo analysis

Monte Carlo analysis was used to assist with modeling potential effects of the atomic bomb during the Manhattan Project and was reportedly so named because the uncle of one of the lead scientists using the method liked to gamble at the casino in Monte Carlo.

LEADS AND LAGS

In completing your entire project schedule with the use of a schedule network diagram, you may choose to use leads and lags, as appropriate, to represent either the amount of time an activity can start before its predecessor finishes or the amount of time an activity must wait after its predecessor ends before starting, respectively.

SCHEDULE COMPRESSION

Often the first pass through the development of your project schedule results in an optimal timeframe. However, there may be existing schedule constraints, legislation requiring a set date for compliance, market conditions, or stakeholder expectations that mean that your original estimate of total project duration is too long. In this case, you will need to consider undertaking a variety of *schedule compression* techniques to shorten the duration of the project. The two most common and most often used techniques are crashing and fast tracking. *Crashing* involves adding extra resources to an activity in order to complete it in a shorter time period, which often involves extra cost. *Fast tracking* allows activities that would normally be done in sequence to be done in parallel for all, or at least a portion, of their duration. Obviously, the type of dependency between the two activities would need to be a discretionary dependency, and you may need to take into account extra risk analysis in relation to starting an activity early.

PROJECT MANAGEMENT INFORMATION SYSTEM

A *scheduling tool* can be a piece of project management software dedicated entirely to project scheduling, or it can be a module of a larger piece of project management software, such as Microsoft Project, Primavera, or ProjectLibre to name just three of the hundreds available.

AGILE RELEASE PLANNING

Agile Release Planning is a forward-looking planning method that aligns the team around delivering incremental value through set periods, often called releases. In the Develop Schedule process, this approach allows teams to map out features, user stories, or tasks to specific release cycles, ensuring a structured and iterative delivery of value. This iterative planning ensures that priority items are scheduled first, optimizing the delivery of benefits to stakeholders. Furthermore, as Agile emphasizes flexibility, Agile Release Planning in the scheduling process allows for adjustments based on feedback, ensuring the schedule remains relevant and adaptive to changing needs or insights.

OUTPUTS

The Develop Schedule process produces the following outputs.

SCHEDULE BASELINE

The schedule baseline is the final approved version of the project schedule used to track actual progress against planned progress.

EXAM TIP

There are four baselines in project management that are used to monitor progress after project execution has begun. They are the scope baseline, the time or schedule baseline, the project budget, and the quality baseline. All project baselines form part of the overall project management plan, because they provide information about what is intended.

Real World

The most often used form of schedule baseline is the Gantt chart. However, be aware that the Gantt chart is also an exceptional communications tool. On many projects I have worked on, I have used the Gantt chart for both reasons with great success. This is because it presents different levels of information graphically, which means it is easily understood by both technically minded and non-technically minded stakeholders.

PROJECT SCHEDULE

The *project schedule* can be represented in a number of ways. It is most commonly presented graphically by using either a Gantt chart, which is often called a horizontal bar chart, or a horizontal histogram. The project schedule can also be represented by a milestone chart or, less commonly, by the project schedule network diagram. Figure 4-16 shows an example of a Gantt chart.

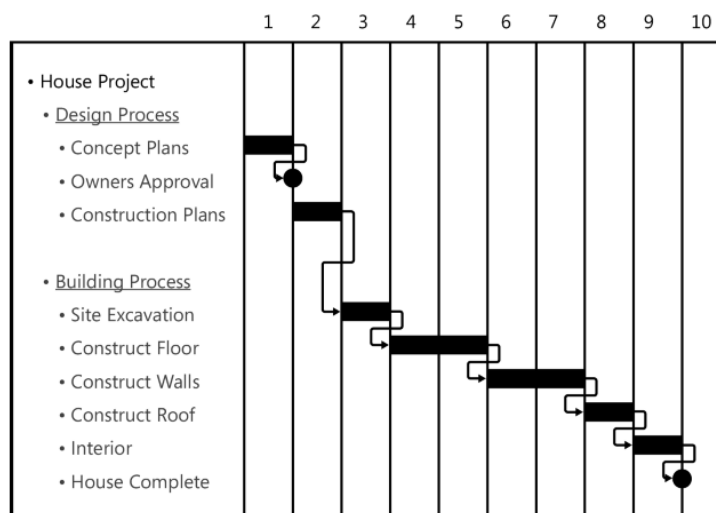


FIGURE 4-16 Gantt chart.

NOTE Origin of the Gantt chart

Many people think that Gantt is an acronym for something. I did have a student once who was absolutely convinced that it stood for *graphical analysis and numerical tracking tool*. I think that student was just making that up, because it is actually the surname of Henry Gantt, a mechanical engineer credited with using the chart to plot durations on a

project. If you take a close look at it, it is just a great way to combine the WBS and Network diagrams into a single diagram.

SCHEDULE DATA

The *schedule data* refers to all the data that makes up the project schedule, and it refers to data relating to activity duration estimates, resources, reserves, constraints, and any resource leveling undertaken.

PROJECT CALENDARS

The *project calendar* refers to the working time available for the project resources over the life of the project. If the project calendar is for people, then it may refer to the working week; if the project calendar is for machinery, it may refer to a 24-hour, seven-day-a-week schedule.

CHANGE REQUESTS

As a result of developing your project schedule you may need to change other elements in your plans or documents. These changes will go through the Perform Integrated Change Control process.

PROJECT MANAGEMENT PLAN UPDATES

The parts of the project management plan that may be updated as a result of developing a project schedule are the schedule management plan and the cost baseline.

PROJECT DOCUMENTS UPDATES

The types of project documents that may be updated as a result of completing the Develop Schedule process iteratively are any of the documents that feed into any part of the previous processes, such as activity resource requirements, activity attributes, project calendars, or the risk register.

Quick Check

1. Why is identifying the critical path so important?
2. After completing a forward pass you will have calculated what?
3. After completing a backward pass, you will have calculated what?
4. What method uses time buffers to ensure that feeder activities don't extend the project duration?
5. What is the key purpose of leveling resources?
6. What is the main difference between crashing and fast tracking?

Quick Check Answers

1. Activities on the critical path have no total float and therefore, if they are delayed, they will extend the overall project duration. Therefore, they represent a high degree of risk on the project.
2. After completing a forward pass, you will have calculated the project duration.
3. After completing a backward pass, you will have identified the total float for each activity and be able to determine the critical path.
4. The critical chain method uses time buffers inserted into the project schedule to ensure that high-risk activities do not cause the overall project duration to extend.
5. The key purpose of resource leveling is to maximize the efficient use of resources.
6. The main difference between crashing and fast tracking is that, generally, crashing costs more because it involves allocating more resources to a particular activity to shorten the duration.

4.7 CONTROL SCHEDULE

TABLE 4-8 Control Schedule process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Schedule management plan</i> ▪ <i>Schedule baseline</i> ▪ <i>Scope baseline</i> ▪ <i>Performance measurement baseline</i> ▪ Project documents ▪ <i>Lessons learned register</i> ▪ <i>Project calendars</i> ▪ <i>Project schedule</i> ▪ <i>Schedule data</i> ▪ Work performance data ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Data analysis ▪ <i>Earned value analysis</i> ▪ <i>Iteration burndown chart</i> ▪ <i>Performance reviews</i> ▪ <i>Trend analysis</i> ▪ <i>Variance analysis</i> ▪ <i>What-if scenario analysis</i> ▪ Critical path method ▪ Project management information system ▪ Resource optimization techniques ▪ Leads and lags ▪ Schedule compression 	<ul style="list-style-type: none"> ▪ Work performance information ▪ Schedule forecasts ▪ Change requests ▪ Project management plan updates ▪ <i>Schedule management plan</i> ▪ <i>Schedule baseline</i> ▪ <i>Scope baseline</i> ▪ <i>Performance measurement baseline</i> ▪ Project documents updates ▪ <i>Assumption log</i> ▪ <i>Basis of estimates</i> ▪ <i>Lessons learned register</i> ▪ <i>Project schedule</i> ▪ <i>Resource calendars</i> ▪ <i>Risk register</i> ▪ <i>Schedule data</i>

The Control Schedule process is focused mainly on monitoring any variations between what was planned in terms of individual activity durations and the overall project duration, and what is actually occurring. It is also focused upon documenting any requested changes to the project schedule as per the agreed change control procedure.

INPUTS

The Control Schedule process uses the following inputs.

PROJECT MANAGEMENT PLAN

Obviously, in order to control any process, you are going to need a plan, or plans, that guide you in determining your particular approach to monitoring and controlling. In this instance, the project management plan contains the plans and documents that are required to control the schedule. Foremost among these will be the schedule management plan and the schedule baseline. In addition, your change management plan and other subsidiary plans will be useful in guiding you in this process. The project management plan is an output from the Develop Project Management Plan process.

The schedule baseline is an essential input into the Control Schedule process, because you are going to use this to check for any variance. The schedule baseline outlines what you had planned to achieve in terms of time progress on the project. Through your efforts of checking this against what is actually happening, you will be a spot any variances and, as a result, raise any requested changes or corrective or preventive actions. The schedule baseline is an output from the Develop Schedule process.

PROJECT DOCUMENTS

During the Control Schedule process, teams often encounter challenges, insights, and innovative solutions that provide valuable learning experiences. The lessons learned register captures these insights, and as an input, it offers a repository of knowledge that can inform future scheduling decisions and assist other projects within the organization to avoid similar pitfalls or adopt effective strategies.

Project calendars, which outline the times that the project will carry out the planned activity, are useful particularly when there is more than one project calendar assigned to different resources being used on the project. Project calendars are an output from the Control Schedule process.

The existing project schedule can serve as a foundational document that outlines previously determined timelines, milestones, and dependencies. When used as an input in the subsequent Control Schedule process, it

allows for refining, updating, or modifying the schedule based on new data, changes, or constraints, ensuring continuity and iterative improvement in the project's time management.

Resource calendars detail the availability and capacity of individual resources, be they personnel, equipment, or facilities. When used as an input in the Control Schedule process, they ensure that activity timelines align with resource availability, preventing potential conflicts and optimizing the utilization of allocated resources.

Schedule data is the raw data that was used to develop the project schedule model and includes the known milestones, activities, activity attributes and, if known, any identified constraints and assumptions. You will use the schedule data to measure variance of planned versus actual. The schedule data is an output from the Develop Schedule process.

WORK PERFORMANCE DATA

Work performance data is the information you gather about progress on the activities that have started, what the actual duration is, and the status of any activities considered finished. You use this work performance data as a key input into the Control Schedule process. Work performance data is an output from the Direct and Manage Project Work process.

ORGANIZATIONAL PROCESS ASSETS

The types of organizational process assets that will be useful as inputs into the Control Schedule process are any existing policies or procedures that the organization has that assist with measuring and reporting on project schedule progress, any manual or automated schedule control tools, and any established reporting templates that can be used.

TOOLS AND TECHNIQUES

The following tools and techniques can be used upon the inputs into the Control Schedule process.

DATA ANALYSIS

Earned Value Analysis is a quantitative method used to assess the project's performance by comparing the work that was planned with the work actually accomplished. Through EVA, project managers can identify cost and schedule variances, enabling proactive decision-making to keep the project on track.

An Iteration Burndown Chart visualizes the amount of work remaining in an iteration or sprint over time. This tool is commonly used in Agile methodologies to monitor the progress of the current iteration, ensuring that the team is on track to complete the planned tasks by the end of the sprint.

Performance reviews are the key tool used to control the schedule, because the focus is on analyzing what you had planned to do in terms of project schedule performance and what you are actually doing. There are several techniques that may be used as part of applying performance reviews. One of these techniques, trend analysis, gathers data about your project performance to date and then, by using graphs that extrapolate from this information, what likely future performance will be. Another important tool or technique used for performance reviews is the critical chain method, which you also saw used as a tool in the Develop Schedule process. In the Control Schedule process it is used to continually assess the allocated time buffers against what is actually occurring, and make adjustments as necessary.

Trend analysis involves examining project performance over time to predict future performance. By analyzing patterns in schedule performance, project managers can forecast potential delays or advances and make informed decisions to ensure timely project completion.

Variance analysis focuses on identifying deviations between the planned schedule and actual performance. By pinpointing these discrepancies, managers can determine the root causes of schedule issues and implement measures to correct or mitigate them.

What-if scenario analysis is a technique used to assess the potential impact of different scenarios on the project schedule. By simulating various situations, like resource changes or delays, project managers can anticipate potential risks and challenges and develop strategies to address them proactively.

CRITICAL PATH METHOD

The Critical Path Method (CPM) is an excellent way to track your project schedule and dive deep in to reasons for any delays. The Critical Path Method (CPM) is a technique used to identify the sequence of crucial tasks that determine a project's completion date. Within the Control Schedule process, employing CPM allows project

managers to assess the impact of any delays or accelerations on the project's end date. By monitoring activities on the critical path, managers can prioritize interventions, ensuring that deviations do not compromise the timely completion of the project.

PROJECT MANAGEMENT INFORMATION SYSTEM

Given the in-depth nature of variance analysis and its focus on actual versus planned durations and completion of activities, completing the work manually would be tedious and inefficient. This is where the use of project management software is very helpful.

Real World

One of the key tasks I've always given to project administrators working on my projects is to take responsibility for using the project management software to keep track of both time and cost performance on the project. On one particularly complex project I was working on, I had our wonderful project administrator out on site nearly every day, checking what was actually being accomplished and recording this in the project management software against what we had planned to do. We were then able to use the project management software forecasting abilities to get early indicators of where we might end up if we continued at the same pace. This is one of the key benefits of using forecasting. A simple forecast of where you might end up is not a predetermination of the actual outcome; instead, it should be viewed as a warning of what may happen if you continue doing what you have been doing. If the results show that you will end up either over budget or over time, you have plenty of warning to implement strategies to make sure this doesn't happen.

RESOURCE OPTIMIZATION

After the project is underway and resources are being used to complete activities, you may want to utilize resource optimization techniques and use either resource leveling or resource smoothing to obtain a more efficient allocation of the resources.

LEADS AND LAGS

In the Develop Schedule process you also saw this tool used. The purpose of this is to be able to adjust leads and lags between activities to more efficiently achieve the expected activity duration and total project duration.

SCHEDULE COMPRESSION

In the process of examining planned versus actual time performance on the project, you may detect that some activities are taking longer than planned, and therefore that they threaten the total project duration. At this point, you may want to consider the application of schedule compression techniques in order to shorten the duration of particular activities, a sequence of activities, or the total project overall. The two most commonly used schedule compression techniques are crashing, which involves the use of more resources and usually costs more, and fast tracking, which involves the scheduling of activities in parallel that were previously scheduled in sequence.

EXAM TIP

In the exam, if any schedule compression technique being used involves more cost, you can be certain that this is referring to crashing. Conversely, if the question poses a scenario where you are asked to compress a project schedule but do not have access to any more budget, you will not be able to select crashing as an option.

OUTPUTS

The Control Schedule process produces the following outputs.

WORK PERFORMANCE INFORMATION

As a result of investigating how your project is doing in terms of individual activities durations, and the overall project duration, you will develop work performance information. If you recall, work performance data was used as an input into this process, and with the application of the selected tools and techniques, that data has been refined into work performance information. The work performance information can be presented as schedule variance (SV) and schedule performance index (SPI) values for individual activities and work packages. The work performance information itself goes on to be used as an input into the Monitor and Control Project Work process.

EXAM TIP

Work performance data is used to create work performance information, which in turn is used to produce work performance reports.

NOTE Earned value management

In Chapter 5, which focuses upon Cost management, you will look in depth at the earned value management system and the associated formula for measuring current progress and forecasting likely future progress on a project. Two of the indicators you will look at are the schedule variance (SV) and schedule performance index (SPI) formulas. Both of these formulas and earned value management analysis focus on assessing current performance in relation to time and are useful for detecting variance from what was planned.

SCHEDULE FORECASTS

Schedule forecasts are what you obtain by examining current performance and using this to extrapolate likely future performance. Chapter 5, Cost Management, looks in depth at the earned value management system. Of the earned value management system, it is the formula for calculating *estimate at completion* (EAC) and *estimate to complete* (ETC) that would be useful in forecasting the schedule. Schedule forecasts go on to be used as inputs into the Monitor and Control Project Work process.

NOTE Estimate at completion

As you will read in the next chapter, in its focus on the earned value management system, the estimate at completion (EAC) activity is one formula that can be calculated in a large number of ways. There are different formulas that take into account different parameters, and if you want to use estimate at completion (EAC) and take into account the time performance to date, you would select one of the formulas that uses the schedule performance index (SPI).

Real World

Usually immediately after you inform key stakeholders about how well the project is going to date, the next question they ask is how well it will go in the future. To answer this question, you are going to need to forecast future performance of the project. In relation to the time or cost performance, the best way to forecast future performance is simply to analyze past performance. I have always used earned value management on projects I work on in order to give people an indication—because that is all it is—of the likely future outcomes based on past performance.

CHANGE REQUESTS

If, during the process of examining actual versus planned performance in relation to project time, you discover any variances, one of your options is to submit a change request as per your documented and approved change control process. Change requests go on to be used as inputs into the Perform Integrated Change Control process in the Integration Management knowledge area.

PROJECT MANAGEMENT PLAN UPDATES

If, as a result of monitoring and controlling the project schedule, you do discover any variances, you may choose to update specific elements of the project management plan. Of these, the most common updates will be to the schedule management plan and the schedule baseline. Given the integrated nature of project management, though, any changes to the project schedule may also result in changes to the project cost baseline, project risks, project quality, and elements of the project scope. Project management plan updates are used in turn as inputs into the Develop Project Plan process.

PROJECT DOCUMENTS UPDATES

In addition to elements of the project management plan and its subsidiary plans, there are specific project documents that may be updated as a result of information gathered during the Control Schedule process. You may want to update the project schedule data, and as a result, the project schedule.

Quick Check

1. What is the key focus of variance analysis tools and techniques used in the Control Schedule process?
2. What is the relationship between work performance data and work performance information?
3. What is the key earned value management formula used for schedule forecasts?

Quick Check Answers

1. The focus of variance analysis tools and techniques used in the Control Schedule process is to look at what you had planned to achieve against what you are actually achieving and determine if there is a variance between the two.
2. Work performance data is the raw data gathered that gets filtered to become useful work performance information.
3. The key earned value management formula used for schedule forecasts is the estimate at completion (EAC) formula when it incorporates the schedule performance index (SPI) into its calculation.

4.8 CHAPTER SUMMARY

- The Time Management knowledge area is focused upon the development and checking of the project schedule.
- As with all the other knowledge areas, the Time Management knowledge area begins with an initial planning process, which in this instance produces the schedule management plan. The schedule management plan sets out how you will go about completing the planning, execution, and control of the project schedule.
- There is then a five-step iterative process that culminates in the development of a project schedule.
- The first of these five steps is to define the activities, which are a further level of decomposition of already-identified work packages from the Scope Management knowledge area.
- After the activities have been identified and documented in the Define Activities process, they can then be put in sequence with the relationships between the activities clearly identified and defined. This Sequence Activities process constitutes the beginning of the development of the schedule network diagram.
- The Estimate Activity Resources process then seeks to provide an estimate of the type and quantities of material, people, equipment, or supplies that will be required to complete each of the activities.
- After an estimate of the type and quantities of resources for each activity has been prepared, an estimate of the duration of each activity can then be completed. This is the main focus of the Estimate Activity Durations process.
- The Develop Schedule process takes the information from the previous four planning processes and combines them into the project schedule. Because it is a highly iterative process and subject to rolling wave planning, it may focus more on the immediate future, and leave further detail to be defined as the project progresses.
- After the planning activities have been completed and project execution is underway, the control schedule process seeks to monitor the schedule status of the project and what was planned against what is actually occurring by using the schedule baseline. Any variances from what was planned can be dealt with in a change request, corrective action, or preventive action recommendation.

4.9 EXERCISES

The answers for these exercises are located in the “Answers” section at the end of this chapter.

1. Based upon the information in the following table, complete a network diagram showing the project duration and calculate the critical path or paths.

Activity ID	Duration (DAYS)	Predecessor
A	4	-
B	3	A
C	6	A, B
D	5	B
E	3	C, D
F	7	D
G	2	D, E
H	9	F, G

2. Using three-point estimating, what is the expected mean, standard deviation, and variance of the following scenarios?

Optimistic	Most Likely	Pessimistic
6	8	12
3	10	15
12	14	18
27	35	48

3. You have been asked by your project sponsor to provide a date range for which you are 99.7 percent certain the project will be delivered, with an optimistic duration of 35 days, a most likely duration of 45 days, and a pessimistic duration of 60 days. What is your answer to your project sponsor?

4. Match up the estimating technique on the left with the appropriate description on the right.

- | | |
|---------------------------|--|
| 1. Analogous estimating | a. An estimating technique that multiplies a known quantity by a known metric |
| 2. Parametric estimating | b. An estimating technique that takes the weighted average of the optimistic, most likely, and pessimistic estimates |
| 3. Bottom-up estimating | c. An estimating technique that gathers information from experts anonymously |
| 4. Delphi technique | d. An estimating technique using information from a similar activity |
| 5. Three-point estimating | e. An estimating technique that takes low-level detailed estimates and aggregates them |

4.10 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 4 by answering these questions. The answers to these questions, and the explanations of why each answer choice is correct or incorrect, are located in the “Answers” section at the end of this chapter.

1. What is the correct order of processes in the Time Management knowledge area?
 - A. Define Activities, Sequence Activities, Estimate Activity Resources, Estimate Activity Durations, Develop Schedule
 - B. Define Activities, Sequence Activities, Estimate Activity Durations, Estimate Activity Resources, Develop Schedule
 - C. Sequence Activities, Define Activities, Estimate Activity Resources, Estimate Activity Durations, Develop Schedule
 - D. Sequence Activities, Define Activities, Estimate Activity Durations, Estimate Activity Resources, Develop Schedule
2. What is the document that provides additional information about activities identified on the activity list?
 - A. Project charter
 - B. Activities attributes
 - C. Resource breakdown structure
 - D. Scope statement
3. What is the BEST definition of rolling wave planning?
 - A. It is the breakdown of work packages into activities.
 - B. It is a form of progressive elaboration that focuses on defining work in the immediate future in more detail than work further off.
 - C. It is the process of first defining, then sequencing, then estimating durations in the preparation of the project schedule.
 - D. It is the process of comparing actual progress against planned progress.
4. What is the name of the document that will guide the definition, documentation, execution, and control of the project schedule?
 - A. Project management plan
 - B. Scope statement
 - C. Organizational process assets
 - D. Schedule management plan
5. Why are activity resources generally estimated before activity durations?
 - A. Because that is the way the PMBOK® Guide sets them out.
 - B. Because in order to estimate activity durations you must know what sequence they occur in.
 - C. Because you need to know how many resources are available to complete an activity because this will affect how fast the activity can be completed.
 - D. They don't—it's better to estimate activity durations first, then estimate activity resources.
6. What is the form of estimating that uses known quantities and multiplies them by known metrics?
 - A. Analogous estimating
 - B. Parametric estimating
 - C. Three-point estimating
 - D. The Delphi technique

7. You are obtaining information from a group of experts about your project durations, and each expert is being asked individually for their opinion without knowing who else is being interviewed. What sort of estimating technique are you using?
- A. Alternatives analysis
 - B. Parametric estimating
 - C. Three-point estimating
 - D. The Delphi technique
8. Which of the following estimating techniques is part of the PERT technique?
- A. Analogous estimating
 - B. Parametric estimating
 - C. Three-point estimating
 - D. Bottom-up estimating
9. If a successor activity cannot start until its predecessor activity has started, what sort of relationship is this?
- A. Finish-to-start
 - B. Start-to-start
 - C. Finish-to-finish
 - D. Start-to-finish
10. What is the name of the process of considering whether an additional amount of time should be provided based on quantitative risk analysis?
- A. Expert judgment
 - B. Parametric estimating
 - C. Reserves analysis
 - D. Monte Carlo analysis
11. The path, or paths, through a project schedule network that represent the most risk because there is no total float is called what?
- A. Critical chain
 - B. Network diagram
 - C. Gantt chart
 - D. Critical path
12. If you are compressing the project schedule by using a technique that generally does not increase project costs, which of the following techniques are you using?
- A. Fast tracking
 - B. Crashing
 - C. Resource optimization
 - D. Resource leveling
13. The amount of time a successor activity must wait after the completion of its predecessor activity is known as what?
- A. Lead
 - B. Resource leveling
 - C. Lag
 - D. Float

4.11 ANSWERS

This section contains the answers for the Exercises and Review Questions in this chapter.

EXERCISES

- Based upon the information in the following table, complete a network diagram showing the project duration and calculate the critical path or paths.

Activity ID	Duration (DAYS)	Predecessor
A	4	-
B	3	A
C	6	A, B
D	5	B
E	3	C, D
F	7	D
G	2	D, E
H	9	F, G

The project duration is 28 days.

The critical path is A-B-D-F-H.

The completed network diagram is shown in Figure 4-17.

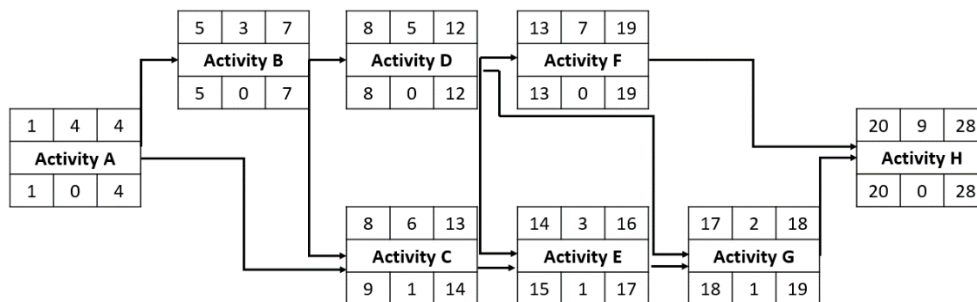


FIGURE 4-17 A completed Activity-on-node (AON) diagram

- Using three-point estimating, what is the expected mean, standard deviation, and variance of the following scenarios?

Optimistic	Most Likely	Pessimistic	Mean	Standard deviation	variance
6	8	12	8.33 days	1	1
3	10	15	9.67 days	2	4
12	14	18	14.33 days	1	1
27	35	48	35.83 days	3.5	12.25

- You have been asked by your project sponsor to provide a date range for which you are 99.7 percent certain the project will be delivered, with an optimistic duration of 35 days, a pessimistic duration of 60 days and a calculated mean of 45 days. What is your answer to your project sponsor?

To calculate the answer, first determine the standard deviation:

$$= \frac{60-35}{6}$$

$$= \frac{25}{6}$$

$$= 4.17$$

The question is asking for 99.7 percent certainty, which is 3 standard deviations either side of the mean, so multiply the standard deviation by 3:

$$4.17 \times 3 = 12.51.$$

Therefore, the answer is 45 ± 12.51 or 32.49–57.21 days

4. Match up the estimating technique on the left with the appropriate description on the right.
- | | |
|---------------------------|---|
| 1. Analogous estimating | d. An estimating technique using information from a similar activity |
| 2. Parametric estimating | a. An estimating technique that multiplies a known quantity by a known metric |
| 3. Bottom-up estimating | e. An estimating technique that takes low-level detailed estimates and aggregates them |
| 4. Delphi technique | c. An estimating technique that gathers information from experts anonymously |
| 5. Three-point estimating | b. An estimating technique that takes the weighted average of the optimistic, most likely, and pessimistic estimates. |

REVIEW QUESTIONS

1. Correct Answer: A

- A. **Correct:** First define activities, then sequence them, then estimate resources prior to estimating durations, then develop the schedule.
- B. **Incorrect:** Estimate Activity Durations generally occurs after Estimate Activity Resources.
- C. **Incorrect:** Sequence Activities occurs after Define Activities.
- D. **Incorrect:** Sequence Activities occurs after Define Activities.

2. Correct Answer: B

- A. **Incorrect:** The project charter contains high-level information.
- B. **Correct:** The activities attributes document provides additional detail about identified activities.
- C. **Incorrect:** The resource breakdown structure provides a breakdown of categories and types of resources required on the project.
- D. **Incorrect:** The scope statement describes all the work to be done on the project.

3. Correct Answer: B

- A. **Incorrect:** The breakdown of work packages into activities is the process of decomposition.
- B. **Correct:** It is a form of progressive elaboration that focuses on defining work in the immediate future in more detail than work further off.
- C. **Incorrect:** The process of first defining, then sequencing, then estimating durations in the preparation of the project schedule broadly outlines the Time Management processes.
- D. **Incorrect:** The process of comparing actual progress against planned progress is variance analysis.

4. Correct Answer: D

- A. **Incorrect:** The project management plan is the overall plan containing many subsidiary plans and

documents.

- B. **Incorrect:** The scope statement defines the work to be done on the project.
 - C. **Incorrect:** The organizational process assets are process polices, templates, and methodologies the wider organization owns that can assist project management.
 - D. **Correct:** The schedule management plan defines how the project schedule will be developed, executed, and controlled.
5. **Correct: C**
- A. **Incorrect:** The PMBOK® Guide is not prescriptive.
 - B. **Incorrect:** This answer links two processes that are separated by the Estimate Activity Resources process.
 - C. **Correct:** You need to know how many resources are available to complete an activity because this will affect how fast the activity can be completed.
 - D. **Incorrect:** Generally, it's better to estimate activity resources first, then estimate activity durations.
6. **Correct: B**
- A. **Incorrect:** Analogous estimating uses a similar activity to estimate the resources or duration of a current activity.
 - B. **Correct:** Parametric estimating uses known quantities and multiplies them by known metrics.
 - C. **Incorrect:** Three-point estimating uses a weighted average of an optimistic, most likely, and pessimistic estimate.
 - D. **Incorrect:** The Delphi technique solicits information from experts anonymously.
7. **Correct: D**
- A. **Incorrect:** Alternatives analysis considers a range of alternative approaches in order to determine the most appropriate one.
 - B. **Incorrect:** Parametric estimating uses known quantities and multiplies them by known metrics.
 - C. **Incorrect:** Three-point estimating uses a weighted average of an optimistic, most likely, and pessimistic estimate.
 - D. **Correct:** The Delphi technique solicits information from experts anonymously.
8. **Correct: C**
- A. **Incorrect:** Analogous estimating uses a similar activity to estimate the resources or duration of a current activity.
 - B. **Incorrect:** Parametric estimating uses known quantities and multiplies them by known metrics.
 - C. **Correct:** Three-point estimating uses a weighted average of an optimistic, most likely, and pessimistic estimate and is part of the Program Evaluation and Review Technique (PERT).
 - D. **Incorrect:** Bottom-up estimating aggregates low-level estimates and rolls them up to obtain higher-level estimates.
9. **Correct: B**
- A. **Incorrect:** A finish-to-start relationship means the successor cannot start until the predecessor finishes.
 - B. **Correct:** A start-to-start relationship means a successor activity cannot start until its predecessor activity has started.
 - C. **Incorrect:** A finish-to-finish relationship means the successor cannot finish until the predecessor finishes.
 - D. **Incorrect:** A start-to-finish relationship means the successor cannot finish until the predecessor starts.
10. **Correct: C**
- A. **Incorrect:** Expert judgment is a technique for getting information from acknowledged experts.
 - B. **Incorrect:** Parametric estimating uses known quantities and multiplies them by known metrics.
 - C. **Correct:** Reserves analysis considers whether an additional amount of time should be provided based on

quantitative risk analysis.

- D. **Incorrect:** Monte Carlo analysis uses sophisticated mathematical modeling to forecast future states from observed data.

11. Correct: D

- A. **Incorrect:** The critical chain method places time buffers around high-risk activities to mitigate any potential adverse impact on the project duration.
- B. **Incorrect:** The network diagram is a graphical representation of the project activities and the relationship between them.
- C. **Incorrect:** The Gantt chart is a graphical representation of the project schedule.
- D. **Correct:** The critical path is the path, or paths, through a project schedule network that represent the most risk because there is no total float.

12. Correct: A

- A. **Correct:** Fast tracking schedules activities in parallel that would normally be done in sequence.
- B. **Incorrect:** Crashing adds more resources to an activity to shorten its duration, but it usually costs money.
- C. **Incorrect:** Resource optimization is a technique of making most efficient use of resources on a project.
- D. **Incorrect:** Resource leveling is a type of resource optimization.

13. Correct: C

- A. **Incorrect:** The lead is the amount of time a successor can start before completion of the predecessor activity.
- B. **Incorrect:** Resource leveling is a type of resource optimization.
- C. **Correct:** The lag is the amount of time a successor activity must wait after the completion of its predecessor activity.
- D. **Incorrect:** The float is the amount of time an activity can be delayed before it has an impact upon successor activities or the total project duration.

5. Cost Management

This chapter focuses on project cost management. Project cost management, like the other knowledge areas, begins with a process of planning that produces a cost management plan. Then there is an iterative process that produces and updates the cost estimates and cost baseline. After these have been developed, a monitoring and controlling process is used to measure actual versus planned cost performance and to manage any change requests.

You may need to pay particular attention in this chapter to those activities of calculating earned value management, because there is quite a bit of technical information that you will need to learn.

The four processes in the Project Cost Management knowledge area are:

- Plan Cost Management (Planning process)
- Estimate Costs (Planning process)
- Determine Budget (Planning process)
- Control Costs (Monitoring and Controlling process)

5.1 WHAT IS PROJECT COST MANAGEMENT?

Project cost management is focused upon the processes of developing a cost management plan, the processes of estimating costs for activities and the overall project, preparing your project budget or cost baseline, recording performance, and influencing and assessing any changes to the project budget.

EXAM TIP

Although presented as discrete processes, the two processes of estimating costs and determining budget are usually done concurrently.

The processes contained in this knowledge area present a logical and sequential flow of information from estimating the costs through to controlling changes to your project budget. Figure 5-1 shows the general flow through this linear process without the general initial Plan Cost Management process.

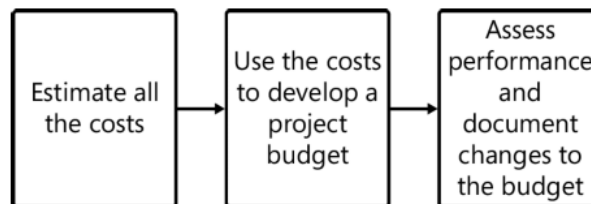


FIGURE 5-1 The project cost baseline development process flow.

Real World

I have always found that the development of the project cost estimates and the approved cost budget is one of the most iterative parts of project management. You start out with high-level estimates based on incomplete information and constantly revise and refine both the information you have and the estimates that are based on the information. When you check how progress is going, you may need to revisit your estimates and revise individual costs estimates. It is because of this iterative nature and the high expectations that stakeholders have upon project costs that I pay extra attention to the cost management processes.

5.2 PLAN COST MANAGEMENT

TABLE 5-1 Plan Cost Management process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project charter ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Schedule management plan</i> ▪ <i>Risk management plan</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Alternatives analysis</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Cost management plan

EXAM TIP

Did you notice that the inputs, tools, and techniques for the Plan Cost Management process are identical to the inputs, tools, and technique for the Plan Schedule Management process? The only difference between the two processes is the single output.

The Plan Cost Management process is a planning process with a single output—the cost management plan. Like all other planning documents, the cost management plan will guide your efforts in defining and controlling the project budget. It will form a subsidiary plan to the overall project management plan.

The Plan Cost Management process covers the following planning domain task:

INPUTS

The Plan Cost Management process uses some or all of the following inputs as part of the development of the cost management plan for the project.

PROJECT CHARTER

The project charter contains the approved initial budget for the project at the time of project initiation. It also contains known constraints, assumptions, and risks that may affect project costs and their management. The project charter is an output from the Develop Project Charter process.

PROJECT MANAGEMENT PLAN

The distinct elements of the project management plan that will be useful in developing your own cost management plan are the scope and schedule information contained in the scope baseline and schedule baseline, respectively. After it is created, the cost management plan will become part of the project management plan. You will also find the risk management plan useful as it will guide how you account for uncertainty in developing and controlling your project costs. The project management plan is an output from the Develop Project Management Plan process.

ENTERPRISE ENVIRONMENTAL FACTORS

Particular enterprise environmental factors that may assist with development of your cost management plan include the particular organizational culture and structure, any external market conditions that may affect project costs, and any published commercially available cost information that you may use to develop and check your cost estimates.

ORGANIZATIONAL PROCESS ASSETS

Organizational process assets that may play an important part in the development of your cost management plan include any historical information, and any established financial control procedures, policies, and templates for defining and controlling project costs and budget.

EXAM TIP

It is important to note that in your day-to-day work you may use the terms “cost” and “budget” interchangeably. However, for the purposes of this examination you must understand that the two words have separate meanings.

“Cost” refers to the actual costs of each activity or work package which, when aggregated, form a total project cost. “Budget,” on the other hand, refers to costs over time.

Real World

One way to keep your accounts people very happy is to be proactive with the development of your project budget. If you are able to tell them clearly when you expect to spend money, and when you expect to have money come in, they are able to better plan the organization’s cash flow requirements. It is important that you realize that as a project manager your project may impose serious cash flow problems upon the wider organization, and it is the accounts people who have to figure out how to make sure money is available when you need it. I have always found that giving the accounts people information early and often about when I plan to use money is a great way of managing this particular group of stakeholders.

TOOLS AND TECHNIQUES

The following tools and techniques are available to be used to develop the inputs into this process in order to produce the cost management plan.

EXPERT JUDGMENT

Expert judgment is used as a tool and technique in the Plan Cost Management process as again we rely on the experience, opinion, and expertise of individuals to assist the development of a cost management plan. The experts that you consult may be members of your project team, other employees in your organization, or people from outside your organization with particular experience in putting together an appropriate cost management plan.

DATA ANALYSIS

The use of analytical techniques such as an alternative analysis, in the development of your cost management plan is an important tool because you, or your financial department, will have to analyze options and make decisions about how the project will be funded. You may be able to fund the project with cash reserves, bank loans, funding with equity from shareholders, or funding with debt from other sources. Each of these options has its own benefits and drawbacks. In making the decision, you’re able to use a number of techniques, such as payback period, return on investment, internal rate of return, discounted cash flow, and net present value. Each of these terms was discussed in more detail in the Develop Project Charter process as part of the project selection process.

Real World

I have often found that many project managers are completely oblivious to how the project is going to be funded. I believe an important skill that any project manager should have is to have an understanding of project financing methods and the implications that the different finance sources have upon project costs. One of the first places you will look for guidance about funding criteria and sources of potential funding is the project charter.

MEETINGS

Meetings are a great way to bring together members of the project team who have expertise and skill in development of the cost management plan, because they are the people completing the work. You may also choose to invite selected stakeholders from outside the project team who have specialist knowledge and skills in this particular area. An example of this would be inviting members of your organizations financial or accounts department to contribute to the development of the cost management plan.

OUTPUTS

After the appropriate tools and techniques have been applied to the selected inputs, the Plan Cost Management process has the following output.

COST MANAGEMENT PLAN

The Plan Cost Management process has only a single output—the cost management plan. The *cost management plan* is a subsidiary plan of the project management plan and is used as a guide for the other cost management processes. The purpose of the cost management plan is to provide guidance to the project manager and the project team on how the organization expects costs to be estimated, budgets to be determined, cost performance to be assessed, and any potential changes assessed, documented, and reported upon. It will also outline the process of reporting progress in relation to forecast cost versus actual cost on the project and will prescribe acceptable tools, techniques, processes, and any other relevant information relating to how costs will be managed on the project.

The cost management plan is then a key input into the Estimate Costs and Determine Budget processes, both of which are planning processes.

Quick Check

1. What is the main purpose of the cost management plan?
2. What is the main reason for using analytical techniques during the Plan Cost Management process?
3. What sort of organizational process assets would be useful as inputs into the Plan Cost Management process?

Quick Check Answers

1. The main purpose of the cost management plan is to provide guidance on further planning of project costs, estimating costs, developing a project budget, checking planned cost performance against actual cost performance, and managing any potential changes to the cost baseline.
2. Analytical techniques are used as a tool to help assess the different options, and the pros and cons of each, for funding or financing the project.
3. The types of organizational process assets that would be useful as inputs into the Plan Cost Management process include any existing organizational financial control procedures, blank templates, established processes, gathered historical cost information, and any internal financial databases.

5.3 ESTIMATE COSTS

TABLE 5-2 Estimate Costs process

INPUTS ⇌	TOOLS AND TECHNIQUES ⇌	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Cost management plan</i> ▪ <i>Quality management plan</i> ▪ <i>Scope baseline</i> ▪ Project documents ▪ <i>Lessons learned register</i> ▪ <i>Project schedule</i> ▪ <i>Resource requirements</i> ▪ <i>Risk register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Analogous estimating ▪ Parametric estimating ▪ Bottom-up estimating ▪ Three-point estimating ▪ Data analysis ▪ <i>Alternatives analysis</i> ▪ <i>Reserve analysis</i> ▪ <i>Cost of quality</i> ▪ Project management information system ▪ Decision making ▪ <i>Voting</i> 	<ul style="list-style-type: none"> ▪ Cost estimates ▪ Basis of estimates ▪ Project documents updates ▪ <i>Assumptions log</i> ▪ <i>Lessons learned register</i> ▪ <i>Risk register</i>

The Estimate Costs process is a planning process that uses the cost management plan for guidance and takes the defined activities and work packages, and assigns a cost estimate for each one using a variety of tools and techniques. In order to easily track which estimates are for which particular work package, you can use the numbering systems from the work breakdown structure (WBS). This process is a highly iterative process that is repeated throughout the life of the project.

In assessing the estimate for each activity, it is important to have a basic understanding of different types of costs that may be estimated.

Variable costs are costs that change with the amount of production. The more you produce, the more costs you incur. For example, if you increase the amount of homes you are building, you will use more home building materials. If you use more electricity as a result of greater amounts of work, then your costs will increase.

Fixed costs are costs that are fixed no matter how much you produce. For example, the rental you pay for your warehouse storage space is constant whether or not the warehouse is full or empty. Also, the costs you pay for any consents you require or equipment needed to complete the job are fixed costs.

Direct costs are costs attributable directly to the actions of the project. For example, the materials you use on your project are direct costs.

Indirect costs are costs that are not incurred directly by the project but which the project may have to account for. For example, the project may have to make provision for paying a share of corporate overheads such as office rental space and shared services. Your cost management plan may contain guidelines on what portion, if any, of indirect costs you must account for in your cost estimates. These are often referred to as overheads.

Real World

Indirect costs, or overheads, are often overlooked by project managers when preparing their cost estimates. Unless there are clear guidelines from the organization about what portion, if any, of indirect costs the project must account for, a lot of project managers simply do not think about this. Many organizations will account for indirect costs in required margins or profits. Hopefully, your organizational process assets include guidance on how you are expected to manage this issue.

Sunk costs are costs spent on the project to date that cannot be recovered if the project was to stop. For example, the money you have spent developing code for a new piece of software is sunk cost if you stop halfway through, because it has no recoverable value. Your cost management plan may contain guidelines on how sunk costs are treated in determining whether to continue on a troubled project.

All estimates are simply your best guess at the future, based on the information you have available to you. The better the information you have, the better the estimates will be. Thus, there is nearly always an element of uncertainty inherent in any estimate. It is often important to express this range of uncertainty inherent in any estimate. As a rule, the accuracy of cost estimates will improve as the project progresses, and your organization may have, as part of its organizational process assets, guidelines on the necessary level of accuracy required before proceeding. Table 5-3 shows the typical description of a variety of estimate ranges.

TABLE 5-3 Range of estimates

ESTIMATE TYPE	ESTIMATE RANGE
Rough Order of Magnitude Estimate	-25% to +75%
Conceptual Estimate	-30% to +50%
Preliminary Estimate	-20% to +30%
Definitive Estimate	-15% to +20%
Control Estimate	-10% to +15%

INPUTS

The Estimate Costs process uses some, or all, of the following seven inputs.

PROJECT MANAGEMENT PLAN

The cost management plan is obviously a key input into the Estimate Costs process because it provides the guidance for how you are going to complete this process and, therefore, without it you would not be able to complete the process. The cost management plan is an output from the Develop Cost Management Plan process.

The quality management plan will provide guidance on your particular approach to quality on the project and this will have a direct impact on your cost estimates.

The scope baseline is composed of the project scope statement, the work breakdown structure (WBS), and the WBS dictionary, and it contains a full and detailed description of all the work to be done on the project. By using this information, you can then attribute costs to each of the work packages and also the activities taken from the project schedule, and aggregate these costs into a total project cost estimate. The scope baseline is an output from the Create WBS process.

PROJECT DOCUMENTS

The lessons learned register will provide valuable knowledge from other projects and what they have learned and allow you to apply them to your cost estimating process.

The project schedule is an important input into the Estimate Costs process because it gives an indication of when the work packages and activities are to be completed. The sequencing, timing, and duration of distinct project work packages and activities will affect the costs. The project schedule is an output from the Develop Project Schedule process, which in itself is the culmination of the other schedule management planning processes.

Resource requirements are a direct consideration for cost estimates because the cost and availability of resources will directly affect project costs.

The risk register is used as an input into the Estimate Costs process because it contains information around defined and documented uncertainty relating to specific work packages. This uncertainty is captured in the contingency reserve for each activity work package and needs to be taken into account in developing the project cost estimates. The risk register is an output from the Identify Risks process.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific types of enterprise environmental factors that are useful as inputs into the Estimate Costs process are external market conditions that will affect the prices of products and services being procured for the project, and any published commercially available estimating data.

Real World

It is worthwhile to carefully subscribe to, and pay for access to, reputable published estimating databases. These databases are usually very accurate sources of information about the costs of particular materials and resources, and they are often separated into regional areas to determine variances at a local level. Many organizations, industry associations, and professional bodies compile these databases and will allow access for a fee.

ORGANIZATIONAL PROCESS ASSETS

The specific types of organizational process assets that are useful as inputs into the Estimate Costs process are any relevant templates and processes useful in the development of project cost estimates, including any historical information and lessons learned owned by the organization.

TOOLS AND TECHNIQUES

The following ten tools and techniques are used upon the inputs to deliver the process outputs.

EXPERT JUDGMENT

The use of experts is an acknowledged tool in the preparation of project cost estimates. It is the experts, or people working on the project, who have an intimate knowledge of the work to be done and the likely cost of that work. In addition to project team members with expert judgment on the work to be done, you may also choose to consult

external experts, such as those involved in the quantity surveying profession, who can provide expert advice on the expected costs of materials and resources to be used.

ANALOGOUS ESTIMATING

Analogous estimating is a quick means of estimating what a likely cost is to be for a particular material or resource by comparing your current requirements with the requirements of a previous project that you have information on, and then looking at the similarities between the two instances to determine what your current estimate will be. For example, if on a previous project you used a particular amount of concrete and it cost you \$1,500, and on this project you expect to use twice as much, you would assume that your cost estimate is \$3,000, by using analogous estimating. Because you are using an analogy from previous experience, there is a certain degree of expected inaccuracy in this form of estimating.

PARAMETRIC ESTIMATING

Parametric estimating is generally considered to be more accurate than analogous estimating, because it uses known quantities of materials for resources and multiplies them by known financial rates. For example, you may know that you require 50 hours of work to be done by a business analyst, and that a business analyst costs \$80 an hour; therefore, multiplying 50 hours by \$80 an hour, you will arrive at a cost estimate of \$4,000 by using parametric estimating.

BOTTOM-UP ESTIMATING

Bottom-up estimating is generally considered to be quite an accurate form of estimating, because what you are doing is taking cost estimates from lower-level information—for example, the bottom level of the WBS—and then adding up, or rolling up, to higher levels and aggregating those costs to report a total cost.

THREE-POINT ESTIMATING

You saw the use of three-point estimating in the Estimate Activity Durations process from the Schedule Management knowledge area. Here it is used again as a method of determining an estimate where there is a most likely (cM), optimistic (cO), and pessimistic (cP) cost estimate for an activity.

EXAM TIP

Although the correct name for the formula is the “three-point estimate,” and it is part of the Program Evaluation and Review Technique (PERT), it is often simply called the “PERT formula.”

To get a *simple average*, which is used with a triangular distribution, you take these three figures and add them together and divide by three. The formula is:

$$\frac{cO + cM + cP}{3}$$

However, if you want to get a *weighted average* that gives greater weight to the most likely (cM) figure and is typical of a beta distribution, then the formula to use is:

$$\frac{(cO + (4xcM) + cP)}{6}$$

For example, if you have an optimistic cost estimate of \$10, a most likely cost estimate of \$16, and a pessimistic cost estimate of \$25, then the weighted average using three-point estimating is \$16.50.

You can also calculate the standard deviation which indicates how far from the average the optimistic and pessimistic figures are. A smaller standard deviation means they are closer to the average than a larger standard deviation. The formula for standard deviation is:

$$\frac{cP - cO}{6}$$

For example, using the numbers from the previous example, the standard deviation would be \$2.50.

After you have determined the standard deviation, you can then express your certainty about a cost estimate range. You express this certainty as a confidence interval where one standard deviation either side of the mean represents a confidence interval of 68 percent, two standard deviations either side of the mean gives a confidence interval of 95 percent, and three standard deviations either side of the mean gives a confidence interval of 99.7 percent.

For example, using the numbers from the previous example, you could say that you have a 95 percent certainty that the cost for the activity will be between \$11.50 and \$21.50.

Real World

In reality, when you are completing any sort of estimating process in the project, you are going to use a variety of estimating techniques. The type of estimating technique that you choose to use will depend on how much information you have. At the beginning of a project, when information is generally less available, you may choose to use less accurate forms of estimating. As the project progresses and you have more information available, you may choose to use more accurate and time-consuming forms of estimating for that work that you have greater information for, and still use less-accurate forms of estimating. In relation to rolling wave planning, you will most likely use more accurate forms of estimating on the work to be done in the immediate future, and less accurate forms of estimating on work to be done further off in the future.

DATA ANALYSIS

Alternatives analysis in the Estimate Costs process involves evaluating different options or approaches to achieve project objectives with cost implications in mind. By comparing the potential costs of various alternatives, project managers can select the most cost-effective and efficient methods to deliver the required scope. This technique ensures that decisions made during the planning phase are both economically sound and aligned with project goals.

Reserve analysis looks at the contingency reserves, or contingency allowances, provided for in the project cost estimates. The contingency reserve is an amount that reflects and allows for identified uncertainty in estimating particular costs. It is commonly known as “accounting for the known unknowns” in any project and is usually calculated during quantitative risk analysis performed as part of the Risk Management knowledge area. For example, you may determine that a particular activity has a 10 percent chance of experiencing a \$1,750 cost overrun, and therefore you would allow a \$175 figure ($\$1,750 \times 10\%$) in the contingency reserve. By aggregating, or adding up, all of the individual amounts allowed for in the contingency reserve analysis, you will arrive at a total contingency reserve for the entire project.

The management reserve for unknown unknowns is also able to be calculated during risk assessment, or by expressing the range of uncertainty in your estimates as a total amount. The management reserve is controlled by senior managers, and the project manager must apply to use it; it is not part of the approved budget.

Cost of Quality (CoQ) refers to the costs incurred to ensure a project's deliverables meet quality standards, as well as the costs stemming from non-conformance to those standards. In the Estimate Costs process, understanding the CoQ helps project managers anticipate expenses related to both preventive measures and corrective actions. By incorporating CoQ into cost estimations, projects can budget accurately for quality assurance activities and potential rework, ensuring that the final output meets the desired quality benchmarks.

Real World

In theory, the contingency reserve should be part of the approved project budget and under the control of the project manager, and the management reserve under the control of senior management or members of the steering group. In reality, you may find that your approved budget may just be for known costs and that sponsors can sometimes be reluctant to approve reserve budgets, because they view it as endorsing inaccuracy and sloppy estimating practices. My argument is that I would prefer to go forward on a “no surprises” basis and release the reserves once the

PROJECT MANAGEMENT INFORMATION SYSTEM

Project management software should be considered essential for any large and complex projects, because trying to collect and aggregate many cost estimates manually is simply not possible.

DECISION MAKING

Good cost estimates are prepared by people familiar with the activities being estimated, and when you get a group of these people together you are going to need some effective group decision-making techniques to make sense of the expert opinions supplied. These techniques are also used when estimating elements of the project schedule and include voting, brainstorming, nominal group techniques, and the Delphi technique.

OUTPUTS

The Estimate Costs process produces some, or all, of the following outputs.

COST ESTIMATES

The cost estimates are the individual estimates for each activity identified. They are the entire focus of this process and will be used to put together your cost baseline. The activity cost estimates are used as an input into the Determine Budget process.

BASIS OF ESTIMATES

The *basis of estimates* is a useful document, because it outlines the assumptions made, the type of estimating technique used, any known constraints, and an indication of the range of uncertainty and of the confidence level of the final estimates for each activity, and indeed the entire project. The basis of estimates is used as an input into the Determine Budget process.

EXAM TIP

There are several supporting documents that provide additional information to summary documents. For the requirements documentation you have the requirements traceability matrix. For the WBS, you have the WBS dictionary, providing additional information. For the activity list, you have the activity attributes, providing more detailed information. For the activity cost estimates, you have the basis of estimates. You can recognize that the summary document and the document containing greater detail are both important to provide a full picture.

PROJECT DOCUMENTS UPDATES

The specific project documents that may be updated as a result of estimating costs will include such things as the assumption log, lessons learned register, which may be updated as a result of the cost estimates, and elements of the risk register that are refined and updated as a result of specific cost estimates.

Quick Check

1. What is the difference between a simple average and a weighted average?
2. What is the difference between a contingency reserve and a management reserve?
3. What information does the basis of estimates contain?

Quick Check Answers

1. A simple average divides the most likely (cM), the optimistic (cO), and the pessimistic (cP) cost estimates by 3, whereas a weighted average gives a higher weighting of 4 to the most likely cost estimate and then divides by 6.
2. A contingency reserve is prepared for the known uncertainty, or known unknowns on a project, and should be under the control of the project manager. A management reserve is prepared for the unknown uncertainty, for unknown unknowns, and is generally under the control of senior management.
3. The basis of estimates contains information about the assumptions made in preparing cost estimates, the types of estimating techniques used, and the amount of uncertainty in the final activity cost estimates.

5.4 DETERMINE BUDGET

TABLE 5-4 Determine Budget process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project Management Plan <ul style="list-style-type: none"> ▪ <i>Cost management plan</i> ▪ <i>Resource management plan</i> ▪ <i>Scope baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Basis of estimates</i> ▪ <i>Cost estimates</i> ▪ <i>Project schedules</i> ▪ <i>Risk register</i> ▪ Business documents <ul style="list-style-type: none"> ▪ <i>Business case</i> ▪ <i>Benefits management plan</i> ▪ Agreements ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Cost aggregation ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Reserve analysis</i> ▪ Historical information review ▪ Funding limit reconciliation ▪ Financing 	<ul style="list-style-type: none"> ▪ Cost baseline ▪ Project funding requirements ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Cost estimates</i> ▪ <i>Project schedule</i> ▪ <i>Risk register</i>

The Determine Budget process is a planning process that takes the individual activity cost estimates and aggregates them into a total project cost, then applies the project schedule to determine the timing of when costs will be incurred in order to develop the project budget, or cost baseline.

INPUTS

The inputs used in this process take the individual cost estimates and aggregate them into the project budget.

PROJECT MANAGEMENT PLAN

The cost management plan is used as a key input into the Determine Budget process because it is the cost management plan that sets out the processes, policies, rules, and regulations that you are going to apply in order to determine a project budget. The cost management plan is an output from the Plan Cost Management process.

The Resource Management Plan outlines how project resources, both human and material, will be acquired, allocated, managed, and released. In the Determine Budget process, this plan becomes an invaluable input as it provides detailed insights into the costs associated with acquiring, training, and retaining personnel, as well as the expenses linked to procuring and maintaining materials and equipment. By integrating the financial implications from the Resource Management Plan, project managers can create a more comprehensive and accurate budget that encompasses all resource-related expenditures.

The scope baseline is a very important input into this process because it outlines all the work to be done, and the work not to be done, as part of the project. It is by breaking the scope baseline down into its component parts via the work breakdown structure (WBS), and subsequently down to activity level with the schedule work, that you are then able to estimate individual activity costs. The scope baseline consists of the project scope statement, the work breakdown structure, and the WBS dictionary, and it is an output from the Create WBS process.

PROJECT DOCUMENTS

The basis of estimates is an important input because it provides further information about each of the estimates you have determined for the individual activities. The basis of estimates is an output from the Estimate Costs process.

The cost estimates provide you with individual estimates of cost for identified activities by using a variety of tools and techniques from the Estimate Costs process. In order to put together your project budget you will take these individual activity estimates, aggregate them, and determine the time period in which those costs will be incurred. The activity cost estimates are an output from the Estimate Costs process.

The project schedule is used as an input into the Determine Budget process because you need to know when each activity will be performed so that you can determine when the costs of activity will be incurred. This is the essence of

developing a project budget, which is taking the project costs and applying them over time. The project schedule is an output from the Develop Schedule process.

The risk register is used as an input into this process because it will identify risks associated with both individual activity cost estimates and elements of the project schedule that need to be taken into account when developing the project budget. It is an output from the Identify Risks process.

BUSINESS DOCUMENTS

The business case provides a justification for the project, outlining its expected benefits, costs, and financial returns. When used as an input in the Determine Budget process, it offers a foundational financial framework, ensuring that the project's budget aligns with the organization's anticipated benefits and return on investment expectations.

The benefits management plan details the expected tangible and intangible benefits the project aims to deliver upon completion. When integrated into the Determine Budget process, this plan ensures that the allocated budget directly supports and facilitates the realization of these projected benefits, optimizing the investment-to-value ratio of the project.

AGREEMENTS

Any existing agreements are used by the project manager as an input into this process, because they will outline any agreement between parties to the project about costs, payments, and any other matters, such as retention payments, that need to be included in the project budget. For example, you may have an agreement for paying suppliers that requires payment regularly each month, or one that requires progress payments at certain project milestones. These agreements are an output from the Conduct Procurements process.

ENTERPRISE ENVIRONMENTAL FACTORS

Enterprise Environmental Factors (EEFs) encompass the internal and external conditions that can influence the Determine Budget process, such as market conditions, currency exchange rates, and organizational culture. By considering EEFs, project managers can account for external cost drivers and internal constraints, ensuring that the budget is both realistic and in alignment with the broader organizational and market context.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that can assist in the development of the project budget include any organizational policies and procedures relating to the development and presentation of the project budget, and any blank templates for preparing budgets and for reporting the budget.

TOOLS AND TECHNIQUES

The five tools and techniques of this process are all used upon the separate inputs to deliver the process outputs.

EXPERT JUDGMENT

Again expert judgment is a key tool and technique in determining the budget. The experts should be from the project team and also from outside the project team; for example, from the organization's finance or accounts department.

COST AGGREGATION

Cost aggregation is the process of taking the individual estimates for each of the activities and aggregating upward to work package level, then rolling these estimates up to high level, sub-deliverable level, and deliverable level, in order to arrive at a bottom-up estimate for portions of the project or the entire project. Figure 5-2 shows how individual activities are added up, or aggregated.

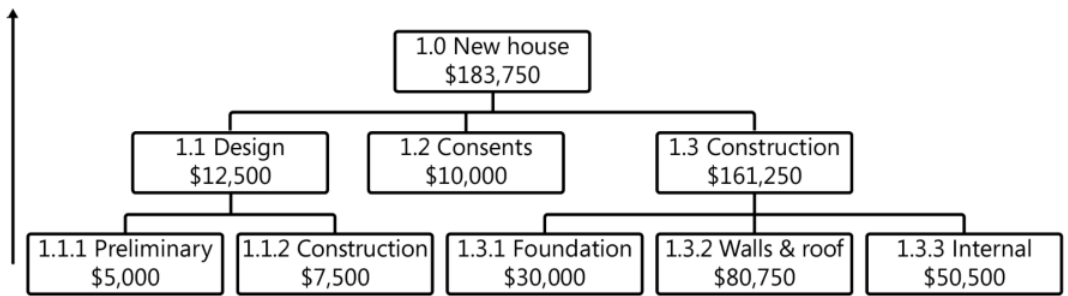


FIGURE 5-2 An example of bottom up cost aggregation.

DATA ANALYSIS

The reserve analysis is the method of looking at both the contingency reserve and the management reserve required for the project and the timing of access to those reserves. Contingency reserves will be identified for specific uncertain activities, or ‘known unknowns’, and access to the contingency reserve will be when the activity is being performed. The contingency reserve is approved as part of the project budget and is under the control of the project manager.

Access to the management reserve, which is for ‘unknown unknowns’ could be required at any time in the project. Use of the management reserve requires approval from management and once approved it is added to the cost baseline.

HISTORICAL INFORMATION REVIEW

If the organization is mature enough to have been recording information about historical relationships and the reliability and range of uncertainty in its cost estimating process, it can then use this information to further refine its current cost estimates, or to acknowledge a quantifiable amount of uncertainty in those estimates.

FUNDING LIMIT RECONCILIATION

As part of the Determine Budget process, you may find that there are *funding limit reconciliation* issues that need to be considered. For example, you may want to do a great amount of work but simply might not have the funds until a later period in time; therefore, you will have to limit the activity on the project until funds to complete the work become available.

Real World

It is important that you are able to determine how the project will be funded early on, and whether this funding process imposes any constraints upon your project schedule. I have often found that there are constraints on when funds will be available, which is generally related to the financial years into which the funds are allocated. This is the reason why the finance department of an organization is so interested in how much of your project budget you are spending, how much you are carrying over to the next financial year, or how much you want to bring forward into this financial year. You may not realize that someone has to find the finances to complete not only your project but all other projects that the organization is completing.

FINANCING

Financing refers to the methods and mechanisms through which the required funds for a project are acquired, such as loans, equity, or grants. In the Determine Budget process, understanding available financing options and their associated costs helps project managers ascertain the feasibility of the budget, ensure continuous cash flow, and select the most cost-effective funding strategy for the project’s financial needs.

OUTPUTS

The major outputs from the Determine Budget process are the following:

COST BASELINE

The *cost baseline* is one of four baselines that you will use to measure progress on the project. The other three are the scope baseline, the time baseline, and the quality baseline. The key element of the cost baseline is that it takes the

aggregated individual estimates of cost for each activity and applies them to the time periods in which the costs will be accrued. This is the baseline against which you are going to measure project cost performance. Figure 5-3 shows an example of a cost baseline represented graphically. It shows the total amount of spend for each time period, in this case in months. Additionally, it shows the cumulative spend over the life of the project. This is represented by the line, which is often referred to as the “S-curve” because it is in the shape of the letter S, because there is little spend at the beginning of a project, a lot of spend in the middle section of the project, and a decrease in spending toward the end of the project.

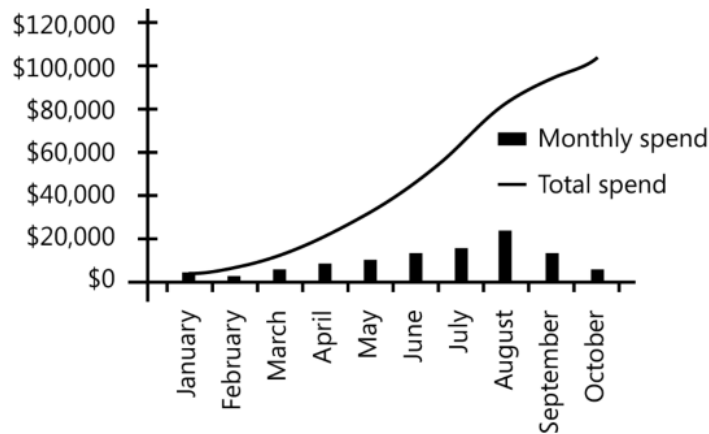


FIGURE 5-3 An example of a cost baseline.

EXAM TIP

Individual contingency reserve figures are added to the individual activity cost estimates. These are then aggregated and rolled up to work package level, with the aggregated contingency reserve applied against individual work packages. The management reserve is added to the total cost baseline once management has approved the use of it. The only way that you're able to use funds from the management reserve is to obtain approval by the documented and approved change control process.

PROJECT FUNDING REQUIREMENTS

The *project funding requirements* acknowledge when the funding for the project will be available; for example, annually, quarterly, or monthly. This recognizes that funding for a project often occurs in incremental amounts, whereas expenditure on a project may be continuous.

Real World

Matching up when funds will be available against when money will be spent is an important aspect of sound and prudent financial management for the project. You do not want to be in a situation where you have spent more than your ability to pay, because this may mean delays in paying creditors and ultimately delays to the project.

PROJECT DOCUMENTS UPDATES

The types of project documents that may be updated as a result of the Determine Budget process are the individual cost estimates, project schedule, and risk register.

Quick Check

1. Why is the project schedule an important input into the Determine Budget process?
2. How would you describe cost aggregation?
3. Why are funding limits reconciliations and the project funding requirements important aspects of any project cost baseline?

Quick Check Answers

1. The project schedule allows you to view the time period within which the project activities will be performed, and their costs incurred.
2. Cost aggregation is the process of adding up individual activity cost estimates up to the work package level, then the sub-deliverable level, and then the deliverable level.
3. Both the technique of funding limits reconciliation and the output of project funding requirements recognize that funds for the project may be incremental while spending may be continuous, and therefore there may be times when there are not enough funds to pay accrued expenses.

5.5 CONTROL COSTS

TABLE 5-5 Control Costs process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Cost management plan</i> ▪ <i>Cost baseline</i> ▪ <i>Performance measurement baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Lessons learned register</i> ▪ Project funding requirements ▪ Work performance data ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Earned value analysis</i> ▪ <i>Variance analysis</i> ▪ <i>Trend analysis</i> ▪ <i>Reserve analysis</i> ▪ To-complete performance index (TCPI) ▪ Project management information system 	<ul style="list-style-type: none"> ▪ Work performance information ▪ Cost forecasts ▪ Change requests ▪ Project management plan updates <ul style="list-style-type: none"> ▪ <i>Cost management plan</i> ▪ <i>Cost baseline</i> ▪ <i>Performance measurement baseline</i> ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Assumption log</i> ▪ <i>Basis of estimates</i> ▪ <i>Cost estimates</i> ▪ <i>Lessons learned register</i> ▪ <i>Risk register</i>

EXAM TIP

Did you notice that the outputs from the Control Costs process are the same as the outputs from the Control Schedule process, with the exception of the cost forecasts instead of schedule forecasts?

The Control Costs process is focused mainly on measuring actual against planned cost performance, forecasting likely future cost performance, and managing any changes to the cost baseline.

INPUTS

The Control Costs process uses the following inputs.

PROJECT MANAGEMENT PLAN

The project management plan, and its subsidiary plans, guide you in the process of controlling any potential changes to your cost baseline or any of the individual estimates that were prepared. As such, it is an important input into the Control Costs process. The specific parts of the project management plan of most interest to you to assist with controlling costs are:

- Cost management plan which outlines how you plan to control costs
- Cost baseline which sets out the forecast cost performance of the project
- Performance measurement baseline which provides a benchmark and process to measure cost performance

The project management plan is an output from the Develop Project Management Plan process.

PROJECT DOCUMENTS

The lessons learned register captures insights and feedback from previous phases or projects, including those related to cost management challenges and successes. As an input to the Control Costs process, these recorded lessons offer valuable guidance, helping project managers avoid past financial pitfalls and leverage proven strategies to effectively manage and control project expenditures.

PROJECT FUNDING REQUIREMENTS

The project funding requirements are an important input into the Control Costs process because they enable you to determine when expenditures will be incurred and when funding for the project will be available, and to therefore assess actual versus planned project funding requirements and control any changes to these elements. The project funding requirements are an output from the Determine Budget process.

WORK PERFORMANCE DATA

By now you should have picked up that work performance data is an important input into several controlling processes. Work performance data is the information you gather about what is actually occurring on the project down to the level of which activities have started, the costs associated with completing those activities, and any estimates for completing the remainder of the work to be done. Work performance data is an output from the Direct and Manage Project Work process.

ORGANIZATIONAL PROCESS ASSETS

The types of organizational process assets that will be useful as inputs into the Control Costs process are any existing organizational policies, procedures, templates, or any other element relating to how costs will be monitored and reported on in your project.

TOOLS AND TECHNIQUES

The following tools and techniques can be used upon the inputs into the Control Costs process.

EXPERT JUDGMENT

Expert Judgment involves leveraging the knowledge and experience of individuals or groups specialized in cost management and financial disciplines. In the Control Costs process, such expertise can provide nuanced insights, recommend effective cost-controlling measures, and assist in making informed decisions, ensuring the project stays within its budgetary constraints.

DATA ANALYSIS

The earned value management (EVM) system provides you with an effective and efficient way of to establish what has occurred in the past and use this information to forecast likely future scenarios by using a range of mathematical equations. It is better than simply taking one or two elements of past performance and simply expecting that performance to continue. For example, imagine that you are a project sponsor on a project, and your project manager tells you that the project is 50 percent of the way through and has only spent 40 percent of the budget. is this a good situation or not? It might be, but without knowing how much of the actual work has been

completed and how much value has been earned, you don't really know if this is a positive statement or not. This is exactly the scenario that earned value management is able to get around.

Earned value management takes the original project cost baseline, the planned value of the work you had expected to have completed by now, the earned value of the work you have completed now, and the actual cost of delivering that value to determine what the project cost and schedule performance to date is, and then forecast what the likely costs at completion will be. It does this by using the following formulas:

1. **Budget at completion (BAC)** The original forecast budget for the project. The BAC is also the total Planned Value (PV) for the project.
2. **Planned value (PV)** The amount of value that you should have earned by this time in the project. Because the total *planned value* (PV) for a project equals the budget at completion (BAC), you can determine the planned value by simply determining how far through the project you are in relation to time, and mapping this back to the approved cost baseline to establish the planned value. Figure 5-4 demonstrates how to determine the PV from the BAC.

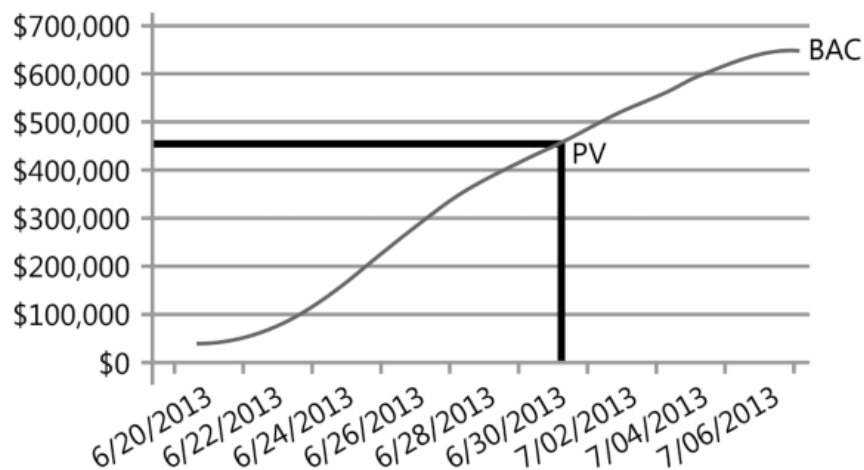


FIGURE 5-4 The project cost baseline showing Planned value (PV) and budget at completion (BAC).

If you do not have a cost baseline to read planned value from then the easiest way to determine what planned value is requires you to calculate the percentage of time that has been completed and multiply the BAC by this. So if you have completed 7 months of a 10 month project and the BAC is \$50,000, then your planned value is 70% of \$50,000 which equals \$35,000. Obviously this method assumes a linear spend on the project instead of the s-curve we normally see.

3. **Earned value (EV)** The value of the work that has been completed. This is not the actual cost of the work that has been completed but rather the original ascribed value from your approved cost baseline for the value of the work.
4. **Actual cost (AC)** The actual realized cost you incurred for the work that you have done to date. You will be able to get a record of this from your accounts system.

Figure 5-5 shows the budget at completion (BAC), planned value (PV), earned value (EV), and actual cost (AC) on a single graph. Incidentally, it shows a project in trouble in terms of both time and cost because the actual cost is above the planned value, and the earned value is less than the planned value.

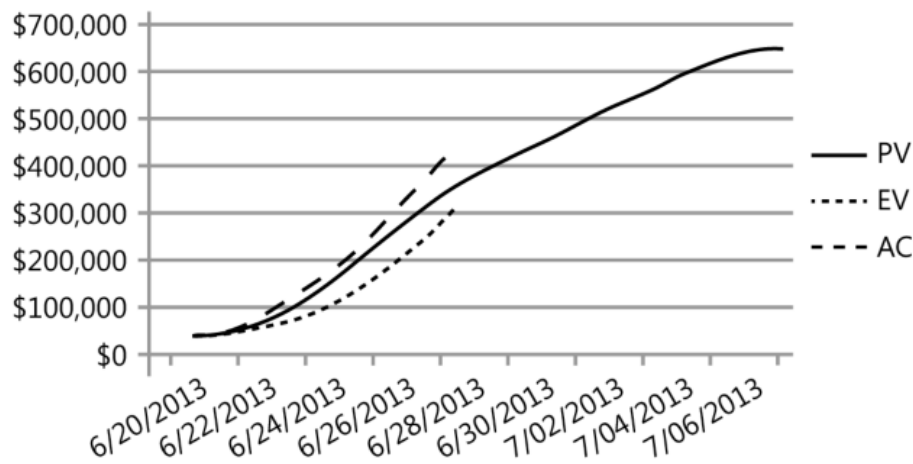


FIGURE 5-5 A record of project planned value, earned value and actual cost

EXAM TIP

On most questions you will be challenged to extract the BAC, PV, EV, and AC from the scenario given. Take your time to ensure that you are extracting the correct figures.

Real World

I've often found that when calculating the actual cost it is important to remove from this calculation the value of any material held in stock. On some projects, you may decide to procure a lot of required materials early to avoid potential cost increases over time. Therefore, you will have paid for these materials, and this will show up in your accounts. However, incorporating this amount into your actual cost figure for the purposes of earned value management will skew the results negatively. Therefore, I recommend that you do regular stock takes and remove the value of material held in stock from the actual cost figure that you use for the earned value management calculations.

- Cost variance (CV)** This is simply the difference between the value of what you expected to have earned (EV) at this point and the actual cost (AC) at this point. A positive *cost variance* is good and shows that the project is under budget, a negative cost variance is bad and shows that the project is over budget. The formula is:

$$CV = EV - AC$$

- Cost performance index (CPI)** One of the limitations of the cost variance equation is that it gives you a simple gross figure. You are not able to tell whether a \$10,000 cost variance is significant on your project. If you are working on a \$50,000 project it would be significant; if you are working on a \$10 million contract, it may not be so significant. The *cost performance index* calculation tells you the magnitude of the variance. A cost performance index of more than 1 is good, because it means that the project is under budget; a cost performance index of less than 1 is bad because it means that the project is over budget. For example, if you have a cost performance index of 1.1, it means that for every dollar you spend on the project you are getting a \$1.10 return. The formula is:

$$CPI = EV/AC$$

- Schedule variance (SV)** This tells you whether you are ahead or behind your planned schedule. It is the difference between the earned value (EV) and the planned value (PV). A positive schedule variance is good and means that you are ahead of schedule; a negative schedule variance is bad and means that you are behind schedule. The formula is:

$$SV = EV - PV$$

- Schedule performance index (SPI)** This is a ratio of the earned value and planned value that allows you to better determine the magnitude of any variance. A schedule performance index of more than 1 is good, because it means that the project is ahead of time; a schedule performance index of less than 1 is bad, because it means that the project is behind schedule. For example, if you have a schedule performance index of 0.95, it means that every day you spend working on the project you are getting a 0.95 day return. The formula is:

$$SPI = EV/PV$$

EXAM TIP

A quick and easy way to remember the formula for CV, CPI, SP, and SPI is that each of the formula starts with EV. If it is a formula relating to variance, CV or SV, then the next symbol is a minus sign. If it is a formula relating to a performance index, CPI or SPI, then the next symbol is a divide sign. If the formula is in relation to cost, CV or CPI, then the final part of the formula is AC. If the formula is in relation to schedule, SV or SPI, the final part of the formula is PV.

Forecasting is the process of taking time and cost performance to date and using this information to forecast a likely future scenario. The time and cost performance measurements are the cost variance (CV), schedule variance (SV), cost performance index (CPI), and schedule performance index (SPI). You can use these measurements and the following formulas to forecast a likely project cost at completion, the amount of money required to complete the project, and the difference between what you originally thought it would cost and what you now think it will cost.

9. **Estimate at completion (EAC)** There are many ways to calculate a forecast estimate at completion (EAC). Keep in mind that in order to forecast a likely future cost or time frame for the project, you are going to be using historical information. Therefore, the quality of your EAC calculation will depend entirely on the quality of the historical information that you are using. The following four formulas use different inputs to calculate the EAC. Each one will give a different answer for the same project.

EAC = BAC/CPI This is perhaps the simplest of the estimate at completion calculations because it simply takes your original budget at completion (BAC) and divides that by your cost performance index (CPI). Obviously, this is a useful calculation if your cost performance to date is indicative of your likely cost performance going forward, and by the same measure will not be a great calculation to use if your cost performance to date is not indicative of your cost performance in the future.

EAC = AC + ETC Simply adding your estimate to complete (ETC) to your actual cost (AC) spent to date is an effective way to determine your estimate at completion (EAC). However, the method by which you determine your estimate to complete calculation will have a great effect on whether or not this formula is accurate.

EAC = AC + (BAC - EV) This formula takes the actual costs (AC) spent to date and adds to them the total budget at completion (BAC) with your current earned value (EV) subtracted.

EAC = AC + ((BAC - EV)/(CPI × SPI)) This formula takes into account both your cost performance and your schedule performance and applies it to the value of the work you have left to complete.

EXAM TIP

Memorize all these formula, and as soon as you are allowed to start the exam, write them all down.

NOTE Cumulative versus Non-Cumulative

When using either the CPI or SPI formula you are able to choose whether you use cumulative or non-cumulative variations of these. The cumulative calculation calculates right from the start of the project to where you are now in the project, and obviously if you use this you are assuming that that particular range is indicative and typical of your cost or schedule performance going forward. If, however, for some reason there have been some atypical variances experienced in either time or cost on your project in the past, you may want to avoid using these when you use either CPI or SPI for forecasts. In this case, you will use non-cumulative CPI or SPI calculations taken from a specific period of time that you feel is a more accurate representation of likely future performance.

Real World

When using an EAC formula, as a general rule of thumb, I tend to use the BAC divided by CPI calculation for the first third of the project because the information coming out at this point tends to be less accurate. After I get past the halfway point on a project, I will use the $AC + ((BAC - EV)/(CPI \times SPI))$ formula, because it takes into account all parameters and is generally more accurate.

10. **Estimate to complete (ETC)** The estimate to complete calculation is simply your forecast of the remaining costs to be incurred on the project. The easiest way to calculate this is simply to subtract your actual cost (AC) spent to date from your estimate at completion (EAC). The formula is:

$$ETC = EAC - AC$$

11. **Variance at completion (VAC)** The *variance at completion* calculation is simply the difference between what you originally thought the project was going to cost (BAC) and what you now think it is going to cost (EAC). A negative variance is bad, and a positive variance is good. The formula is

$$VAC = BAC - EAC$$

EXAM TIP

In the exam you will often be presented with a scenario that requires you to work out one set of figures before you can work out another set of figures. For example, you may be required to work out the EAC by using either CPI or SPI but will not be given the CPI figures or SPI figures. You will instead be given figures for EC, AC, and PV, and be expected to work out either the CPI or the SPI first. Also, when looking at a question that requires you to calculate any formula, be on the lookout for any irrelevant information, because sometimes not all the information presented in the scenario is relevant.

Reserve analysis in this monitoring and controlling process is the process of re-examining the original reserves calculated, both the contingency and management reserves, and checking whether the assumptions made when calculating them are still valid, and also releasing any unused portions of contingency reserves from the approved project budget in order to enable other projects to access the pool of funds.

TO-COMPLETE PERFORMANCE INDEX (TCPI)

The *to-complete performance index* (TCPI) tells you the rate at which you have to work to achieve either your estimate at completion (EAC) or your budget at completion (BAC), depending on which one you are targeting. A to-complete performance index of less than 1 is good, whereas a *to-complete performance index* of more than 1 is bad. If you are using the original budget at completion as your target, the formula is:

$$TCPI = (BAC - EV) / (BAC - AC)$$

If you are using the estimate at completion as the target, the formula for TCPI is:

$$TCPI = (BAC - EV) / (EAC - AC)$$

EXAM TIP

When doing any calculations in the exam, round your answer to two decimal places but be prepared for an answer that is slightly different due to slight differences in the approach to rounding of decimal places.

PROJECT MANAGEMENT INFORMATION SYSTEM

Project management software is very useful in monitoring the performance of cost on a project as it is able to quickly do what would take a lot of time if done manually. Additionally, it can take both the original data and any data from calculations and display it graphically for easy interpretation and communication.

OUTPUTS

The Control Costs process produces the following outputs.

WORK PERFORMANCE INFORMATION

The easiest way to display work performance information based on the work performance data is by using the earned value calculations for cost variance (CV), schedule variance (SV), cost performance index (CPI), schedule performance index (SPI), and the to-complete performance index (TCPI). The work performance information goes on to be used as an input into the Monitor and Control Project Work process.

COSTS FORECASTS

Cost forecasts are obtained from the estimate at completion (EAC) values. Cost forecasts go on to be used as an input into the Monitor and Control Project Work process.

Real World

It is important to emphasize to project stakeholders that any estimate at completion calculation is just that, it is your estimate about what it will cost to complete the project. When calculating the estimate at completion, you are using historical information to try to forecast a likely future outcome. If project stakeholders consider that your estimate at completion figure is an absolute figure that you definitely achieve, this will create unrealistic expectations.

CHANGE REQUESTS

One of the key outputs from any controlling process is change requests that arise as a result of either variances detected or additional information provided. Change requests may include preventive or corrective actions. All change requests are processed as per your documented and approved change control process.

Change requests go on to be used as an input into the Perform Integrated Change Control process from the Integration Management knowledge area.

PROJECT MANAGEMENT PLAN UPDATES

Specific parts of the project management plan that may be updated as a result of the Control Costs process include the cost baseline and the cost management plan. Project management plan updates are used in turn as an input into the Develop Project Plan process.

PROJECT DOCUMENTS UPDATES

Specific project documents that may be updated as a result of the Control Costs process include any documentation relating to how you build up your cost estimates, such as the cost baseline and the basis of estimates document. You may also wish to update your assumptions log and risk register.

Quick Check

1. What is the difference between work performance data and work performance information?
2. If a project has a CPI of 1.1 and an SPI of .90, how is it performing in relation to time and cost?
3. What is the key difference between each of the four formulas for estimate at completion?

Quick Check Answers

1. Work performance data is the raw information collected by checking on cost and time performance. Work performance information applies filters to this data to make it useful information.
2. This project is under budget because the CPI is greater than 1, but behind schedule because the SPI is less than 1.
3. Each of the four formulas uses different historical information about the project to forecast a likely future outcome.

5.6 CHAPTER SUMMARY

- The Cost Management knowledge area is focused upon the development and checking of the project costs and begins with a planning process that produces the cost management plan, which then guides the individual cost estimating process and development of the cost baseline. It also provides guidance on monitoring actual versus planned cost performance and managing any changes to the cost baseline.
- The Plan Cost Management process focuses on the production of the cost management plan, which is a subsidiary plan of the project management plan.
- The Estimate Costs process is a highly iterative process repeated throughout the project that uses a variety of estimating techniques to developed individual activity cost estimates.
- The Determine Budget process aggregates the individual activity cost estimates and determines exactly when the costs will be incurred to produce a time-phased project budget, or cost baseline.
- The Control Costs process assesses planned cost performance against actual cost performance and forecasts a likely future state by using the earned value management systems. Any changes to the project cost baseline or individual activity cost estimates are managed through the approved change control process.

5.7 EXERCISES

The answers for these exercises are located in the “Answers” section at the end of this chapter.

1. You are the project manager on a project to build 10 identical offices. You expect to spend \$50,000 per office to complete the work and take 20 months to finish. You are 12 months into the work and have completed five offices and spent \$310,000 in total. Use this information to calculate the following:
 - i. Budget at completion (BAC)
 - ii. Actual cost (AC)
 - iii. Planned value (PV)
 - iv. Earned value (EV)
 - v. Cost variance (CV)
 - vi. Cost performance index (CPI)
 - vii. Schedule variance (SV)
 - viii. Schedule performance index (SPI)
 - ix. Estimate at completion (EAC)
 - x. Estimate to complete (ETC)
 - xi. Variance at completion (VAC)
 - xii. To-complete performance index (TCPI)

(b) Based on the information gained from the calculations you have performed, how is the project performing in terms of both cost and time?

2. You are the project manager on a project to complete 15 miles of road. Your approved budget for the project is \$930,000, and you have forecast that the project will take 35 weeks to complete. You are 13 weeks into the project, and have constructed 7 miles of road at a cost of \$58,000 per mile. Use this information to calculate the following:
 - i. Budget at completion (BAC)
 - ii. Actual cost (AC)
 - iii. Planned value (PV)
 - iv. Earned value (EV)
 - v. Cost variance (CV)
 - vi. Cost performance index (CPI)
 - vii. Schedule variance (SV)
 - viii. Schedule performance index (SPI)
 - ix. Estimate at completion (EAC)
 - x. Estimate to complete (ETC)
 - xi. Variance at completion (VAC)
 - xii. To-complete performance index (TCPI)

(b) Based on the information gained from the calculations you have performed, how is the project performing in terms of both cost and time?

5.8 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 5 by answering these questions. The answers to these questions, and the explanations of why each answer choice is correct or incorrect, are located in the “Answers” section at the end of this chapter.

1. What is the correct order of processes in the Cost Management knowledge area?
 - A. Plan Cost Management, Estimate Costs, Determine Budget, Control Costs
 - B. Plan Cost Management, Determine Budget, Estimate Costs, Control Costs
 - C. Plan Cost Management, Control Costs, Estimate Costs, Determine Budget
 - D. Plan Cost Management, Estimate Costs, Control Costs, Determine Budget

2. What is the single output from the Plan Cost Management process?
 - A. Activity cost estimates
 - B. Cost baseline
 - C. Cost management plan
 - D. Cost forecasts

3. All of the following could be included in the cost management plan EXCEPT?
 - A. A description of the accuracy of estimating.
 - B. The cost reporting formats to be used.
 - C. A description of the units of measure used to estimate costs.
 - D. The dates each activity will occur.

4. If you are estimating the cost for an activity by comparing the current activity with similar ones you have completed in the past, what sort of estimating technique are you using?
 - A. Analogous estimating
 - B. Parametric estimating
 - C. Three-point estimating
 - D. Bottom-up estimating

5. If you are aggregating the individual activity cost estimates up to the work package level, then the sub-deliverable level, and then the deliverable level to arrive at a total project cost estimate, what sort of estimating technique are you using?
 - A. Analogous estimating
 - B. Parametric estimating
 - C. Three-point estimating
 - D. Bottom-up estimating

6. If you are applying to senior management to obtain extra funds for unforeseen costs on your project, what are you using?
 - A. Contingency reserve
 - B. Funding limit reconciliation
 - C. Management reserve
 - D. Cost aggregation

7. If you have a project with a schedule performance index (SPI) of 1.05 and a cost performance index (CPI) of 0.92, how is your project performing?
 - A. The project is over budget and behind schedule.
 - B. The project is over budget and ahead of schedule.
 - C. The project is under budget and behind schedule.
 - D. The project is under budget and ahead of schedule.

8. If the budget at completion for your project is \$70,000, the earned value is \$30,000, and the actual cost is \$32,000, what is your estimate at completion?
 - A. \$70,000.00
 - B. \$65,625.00
 - C. \$74,468.08
 - D. \$62,000.00

9. If the budget at completion for your project is \$70,000, the earned value is \$30,000, and the actual cost is \$32,000, what is your variance at completion?
- A. \$0.00
 - B. \$7,375.00
 - C. -\$4 468.08
 - D. \$8 000.00
10. If the to-complete performance index calculated for the budget at completion for your project is 1.1, what does this mean?
- A. Your project is doing well and you can slow down and still achieve the budget at completion.
 - B. Your project is right on track to achieve the budget at completion.
 - C. You need to produce \$1.10 worth of effort for every \$1.00 spent to achieve the budget at completion.
 - D. You need to speed up the schedule but slow down the spending.
11. Which of the following is an example of work performance information?
- A. Reserve analysis
 - B. Activity cost estimates
 - C. Project funding requirements
 - D. Schedule variance

5.9 ANSWERS

This section contains the answers to the questions for the Exercises and Review Questions in this chapter.

EXERCISES

1. You are the project manager on a project to build 10 identical offices. You expect to spend \$50,000 per office to complete the work and take 20 months to finish. You are 12 months into the work and have completed 5 offices and spent \$310,000 in total. Use this information to calculate the following:
 - i. Budget at completion (BAC): $10 \text{ offices} \times \$50,000 \text{ each} = \$500,000$
 - ii. Actual cost (AC): You have spent \$310,000 in total so this is your actual cost.
 - iii. Planned value (PV): You are 12 months into a 20-month work program, so you planned to have created value equivalent to $12/20$, or 60%, of your total planned value, or budget at completion. Therefore, your planned value (PV) is $\$500,000 \times 60\% = \$300,000$.
 - iv. Earned value (EV): You have built five offices, each with a value to you of \$50,000, so your earned value is $5 \times \$50,000 = \$250,000$.
 - v. Cost variance (CV): $CV = EV - AC: \$250,000 - \$310,000 = -\$60,000$
 - vi. Cost performance index (CPI): $CPI = EV/AC: \$250,000/\$310,000 = 0.81$
 - vii. Schedule variance (SV): $SV = EV - PV: \$250,000 - \$300,000 = -\$50,000$
 - viii. Schedule performance index (SPI): $SPI = EV/PV: \$250,000/\$300,000 = 0.83$
 - ix. Estimate at completion (EAC)
 - a. $EAC = BAC/CPI: \$500,000/0.81 = \$617,283.95$
 - b. $EAC = AC + ETC: \$310,000 + \$307,283.95 = \$617,283.95$
 - c. $EAC = AC + (BAC - EV): \$310,000 + (\$500,000 - \$250,000) = \$560,000$
 - d. $EAC = AC + ((BAC - EV)/(CPI \times SPI)): \$310,000 + ((\$500,000 - \$250,000)/(0.81 \times 0.83)) = \$681,857.80$
 - x. Estimate to complete (ETC): The estimate to complete answer will depend on which estimate at completion figure you choose to use in the formula $ETC = EAC - AC$. If you use the estimate at completion (EAC) from the BAC/CPI formula, the answer is \$307,283.95.
 - xi. Variance at completion (VAC): The variance at completion answer will depend on which estimate at completion you choose to use in the formula $VAC = BAC - EAC$. If you use the estimate at completion (EAC) from the BAC/CPI formula, the answer is $-\$117,283.95$.
 - xii. To-complete performance index (TCPI): The to-complete performance index answer will depend on whether your target is your budget at completion (BAC) or the estimate at completion (EAC), and if it is the estimate at completion (EAC), it will depend on which formula you use to calculate that. The following example uses BAC/CPI to calculate EAC.
 - a. $TCPI \text{ for EAC} = (BAC - EV)/(EAC - AC) = 0.81$
 - b. $TCPI \text{ for BAC} = (BAC - EV)/(BAC - AC) = 1.31$

(b) Based on the information gained from the calculations you have performed, how is the project performing in terms of both cost and time?

Based on the information calculated, the project is over budget because the cost variance (CV) is negative and the cost performance index (CPI) is less than 1. The project is behind schedule, because the schedule variance (SV) is negative and the schedule performance index (SPI) is less than 1.

2. You are the project manager on a project to complete 15 miles of road. Your approved budget for the project is \$930,000, and you have forecast that the project will take 35 weeks to complete. You are 13 weeks into the project, and have constructed seven miles of road at a cost of \$58,000 per mile. Use this information to calculate the following:
 - i. Budget at completion (BAC): \$930,000
 - ii. Actual cost (AC): You have built seven miles of road at a cost of \$58,000 so your actual cost is $7 \times \$58,000 = \$406,000$.
 - iii. Planned value (PV): You are 13 weeks into a 35-week work program, so you planned to have created value of $13/35$, or 37%, of your total planned value, or budget at completion. Therefore, your planned value (PV) is $\$930,000 \times 37\% = \$344,100$.
 - iv. Earned value (EV): You are building 15 miles of road for \$930,000, so each mile of road has a value of $\$930,000/15 = \$62,000$. You have built seven miles of road each with a value to you of \$62,000, so your earned value is $7 \times \$62,000 = \$434,000$.

- v. Cost variance (CV): $CV = EV - AC: \$434,000 - \$406,000 = \$28,000$
- vi. Cost performance index (CPI): $CPI = EV/AC: \$434,000/\$406,000 = 1.07$
- vii. Schedule variance (SV): $SV = EV - PV: \$434,000 - \$344,100 = \$89,900$
- viii. Schedule performance index (SPI): $SPI = EV/PV: \$434,000/\$344,100 = 1.26$
- ix. Estimate at completion (EAC)
 - a. $EAC = BAC/CPI: \$930,000/1.07 = \$869,158.88$
 - b. $EAC = AC + ETC: \$406,000 + \$464,158.88 = \$870,158.88$
 - c. $EAC = AC + (BAC - EV): \$406,000 + (\$930,000 - \$434,000) = \$902,000$
 - d. $EAC = AC + ((BAC - EV)/(CPI \times SPI)): \$406,000 + ((\$930,000 - \$434,000)/(1.07 \times 1.26)) = \$773,407.41$
- x. Estimate to complete (ETC): The estimate to complete answer will depend on which estimate at completion figure you choose to use in the formula $ETC = EAC - AC$. If you use the estimate at completion (EAC) from the BAC/CPI formula, the answer is \$463,158.88.
- xi. Variance at completion (VAC): The variance at completion answer will depend on which estimate at completion you choose to use in the formula $VAC = BAC - EAC$. If you use the estimate at completion (EAC) from the BAC/CPI formula, the answer is \$60,841.12.
- xii. To-complete performance index (TCPI): The to-complete performance index answer will depend on whether your target is your budget at completion (BAC) or the estimate at completion (EAC), and if it is the estimate at completion (EAC), it will depend on which formula you use to calculate that. The following example uses BAC/CPI to calculate EAC.
 - a. $TCPI \text{ for EAC} = (BAC - EV)/(EAC - AC) = 1.07$
 - b. $TCPI \text{ for BAC} = (BAC - EV)/(BAC - AC) = 0.95$

(b) Based on the information gained from the calculations you have performed, how is the project performing in terms of both cost and time?

Based on the information from the earned value calculations, the project is ahead of schedule because the schedule variance (SV) is positive and the schedule performance index (SPI) is greater than 1. The project is also under budget, because the cost variance (CV) is positive and the cost performance index (CPI) is greater than 1.

CHAPTER REVIEW

1. Correct Answer: A

- A. **Correct:** First plan your approach to cost management, then estimate costs, then determine your budget, then control the costs.
- B. **Incorrect:** Estimate Costs occurs before Determine Budget.
- C. **Incorrect:** Control Costs occurs after Determine Budget.
- D. **Incorrect:** Control Costs occurs after Determine Budget.

2. Correct Answer: C

- A. **Incorrect:** Activity cost estimates are an output from the Estimate Costs process.
- B. **Incorrect:** The cost baseline is an output from the Determine Budget process.
- C. **Correct:** The cost management plan is the sole output from the Plan Cost Management process.
- D. **Incorrect:** Cost forecasts are an output from the Control Costs process.

3. Correct Answer: D

- A. **Incorrect:** A description of the accuracy of estimating would be included in the cost management plan.
- B. **Incorrect:** A description of the cost reporting formats to be used would be included in the cost management plan.
- C. **Incorrect:** A description of the units of measure used to estimate costs would be included in the cost management plan.
- D. **Correct:** The dates each activity will occur would be included as part of your project schedule, not the cost management plan.

4. Correct Answer: A

- A. **Correct:** Analogous estimating uses similar activities from the past and extrapolates from them a likely current cost estimate.

- B. **Incorrect:** Parametric estimating multiplies a known quality by a known dollar amount to arrive at a cost estimate.
- C. **Incorrect:** Three-point estimating takes the weighted average of a most likely, optimistic, and pessimistic cost estimate.
- D. **Incorrect:** Bottom-up estimating aggregates lower-level cost estimates.

5. **Correct Answer: D**

- A. **Incorrect:** Analogous estimating uses similar activities from the past and extrapolates from them a likely current cost estimate.
- B. **Incorrect:** Parametric estimating multiplies a known quality by a known dollar amount to arrive at a cost estimate.
- C. **Incorrect:** Three-point estimating takes the weighted average of a most likely, optimistic, and pessimistic cost estimate.
- D. **Correct:** Bottom-up estimating aggregates lower-level cost estimates up to higher levels to arrive at a total project cost estimate.

6. **Correct Answer: C**

- A. **Incorrect:** The contingency reserve is for known unknowns on the project.
- B. **Incorrect:** The funding limit reconciliation is an output from the Determine Budget process.
- C. **Correct:** The management reserve is available for truly unforeseen costs that arise on a project and is controlled by senior management.
- D. **Incorrect:** Cost aggregation is the technique of adding up lower-level costs to obtain higher-level cost estimates.

7. **Correct Answer: B**

- A. **Incorrect:** The project would need a CPI less than 1 and an SPI less than 1 to be over budget and behind schedule.
- B. **Correct:** A CPI less than 1 and an SPI greater than 1 indicate that the project is over budget and ahead of schedule.
- C. **Incorrect:** The project would need a CPI greater than 1 and an SPI less than 1 to be under budget and behind schedule.
- D. **Incorrect:** The project would need a CPI greater than 1 and an SPI greater than 1 to be under budget and ahead of schedule.

8. **Correct Answer: C**

- A. **Incorrect:** \$70,000 is the budget at completion.
- B. **Incorrect:** You would arrive at this figure if you reversed the calculation for cost performance index (CPI).
- C. **Correct:** If you calculate the cost performance index (CPI) first by dividing the earned value (EV) by the actual cost (AC), then divide the budget at completion (BAC) by the cost performance index (CPI), this is the answer you get.
- D. **Incorrect:** This is the answer you get if you add the earned value (EV) to the actual cost (AC).

9. **Correct Answer: C**

- A. **Incorrect:** There is a variance at completion, accordingly the formula $VAC = BAC - EAC$.
- B. **Incorrect:** This is the answer you arrive at if you calculate estimate at completion (EAC) incorrectly.
- C. **Correct:** Variance at completion (VAC) equals budget at completion (BAC) minus estimate at completion (EAC), which is $-\$4,468.08$.
- D. **Incorrect:** If you got this answer, you probably guessed or used the wrong equation.

10. **Correct Answer: C**

- A. **Incorrect:** A to-complete performance index (TCPI) of 1.1 is a bad thing and means you need to work faster or more efficiently to achieve your goal of either budget at completion (BAC) or estimate at completion (EAC).
- B. **Incorrect:** A to-complete performance index (TCPI) of 1.1 shows that the project is not on track.
- C. **Correct:** A to-complete performance index (TCPI) of 1.1 means that you have to work harder or more efficiently to achieve the goal of the budget at completion (BAC).

- D. **Incorrect:** A to-complete performance index (TCPI) of 1.1 means that you must pay attention to both schedule and spending, but neither one is in a good position, because the index is greater than 1.

11. Correct Answer: D

- A. **Incorrect:** Reserve analysis is the process of determining and monitoring contingency and management reserves.
- B. **Incorrect:** Activity cost estimates are an output of the Estimate Costs process.
- C. **Incorrect:** Project funding requirements are an output of the Determine Budget process.
- D. **Correct:** Schedule variance, cost variance, schedule performance index, and cost performance index are all examples of work performance information.

6. Quality Management

This chapter focuses on the topic of project quality management. Project Quality Management, like the other knowledge areas, begins with a process of planning that produces a quality management plan. It then has an executing process, *Manage Quality*, which is focused on defining and checking the quality of the processes in the project. It also has a monitoring and controlling process, *Control Quality*, which is focused upon defining and inspecting the quality of the project deliverables.

You may need to pay particular attention in this chapter to those activities and the range of different quality tools that are described, because many of them may be new to you.

The three processes in the Project Quality Management knowledge area are:

- Plan Quality Management (Planning process)
- Manage Quality (Executing process)
- Control Quality (Monitoring and Controlling process)

6.1 WHAT IS PROJECT QUALITY MANAGEMENT?

Project quality management is focused upon the processes of developing a quality management plan, defining and checking particular processes that affect the entire project, and inspecting the quality of project deliverables. The general process of quality management is aligned to the International Organization for Standardization (ISO) guide to quality management. Therefore, if you have experience with the standards, you will find this section easier to understand.

Let's start with the formal definition of what *quality* is. It is defined as the degree to which a set of inherent characteristics fulfills requirements. You should remember this definition because it may be different from how you define quality. It has two key elements: the first is a defined set of observed characteristics, which are then measured against the second element, a predefined set of requirements. The closer these two elements are, the higher the level of quality. As a result of defining the characteristics of quality and the requirements that will be met, you are seeking to satisfy customer and stakeholder expectations. The responsibility for establishing a professional approach to quality management within an organization, and within a project, lies with management.

In addition to the exact definition of what quality is, there are some basic foundational concepts of quality management that you must be aware of.

A key foundational concept of the approach to quality management is that, generally speaking, it costs less to prevent a mistake than it does to correct a mistake. This concept of prevention over inspection informs much of the approach to quality management. You should always assume that you have the ability to prevent mistakes rather than spend time and money correcting them once they are discovered. In addition to costing time and money to fix mistakes, poor quality will result in the client not accepting the product, and therefore it can also adversely affect your reputation.

You need to be aware that quality management is not something that only happens once; it is ongoing throughout the life of the project, and it is iterative. Not only is quality management highly iterative, like other project management processes, one of its central elements is the concept of *continuous improvement*, or *kaizen*. Continuous improvement is an iterative process of always seeking to improve your approach to, and results obtained from, quality management processes, and has the goal of improving the quality of the project processes as well as the project deliverables.

EXAM TIP

Kaizen is a loose Japanese translation of the term *continuous improvement*. So in the exam, if you find either term, you will know what it means.

Precision and *accuracy* are two separate terms; you will need to be aware of the definition of each. Precision relates to how tightly clustered results are. The closer the results are, the more precise the measurements being taken are. Accuracy, on the other hand, refers to how close the results are to the actual value. An example to illustrate the concepts would be a shooting target and ten shots taken at the target. Accuracy would refer to how close the shots are to the bull's-eye, which is the intended target. Precision would refer to how tightly grouped the ten shots are, no matter how close to the bull's-eye they are. If they are tightly grouped, then they demonstrate a high level of precision. Obviously, the preferred mix is high degrees of both accuracy and precision.

In your workplace, you may use the two terms *quality* and *grade* interchangeably. However, for the purposes of the exam, it is important that you realize that they are actually quite distinct concepts. Quality is defined as the degree to which a set of inherent characteristics fulfills requirements. Grade, on the other hand, refers to the amount of features that a particular product has. For example, there are several manufacturers that choose different brands to indicate the difference between low-grade and high-grade products. The products themselves are manufactured to the same quality standards, but some have fewer features, or are of a lower grade, than others.

Most people know *just in time* as an inventory control system in which suppliers provide materials just before they are required. It is often seen as an efficient way to manage organizational finances, because it does not require funds to be tied up in stock or materials being stored. However, just in time (JIT) can also be used as a quality management approach; the absence of materials in stock forces an organization to maintain a high level of quality because it cannot depend on simply going to its warehouse for more stock when poor quality is produced.

Total quality management (TQM) is a particular approach to quality management that means that everybody within an organization takes responsibility for quality within the organization or project. It is led by management, and everyone at all levels of the organization is expected, encouraged, and trained to participate in constantly improving all aspects of quality.

Six Sigma is a proprietary approach to quality management that offers credentials such as green belt and black belt. Six Sigma practitioners are focused upon reducing quality defects to as close to zero as possible.

Real World

When I was working in the telecommunications industry, we had to build telephone networks reliable enough that when someone dialed the emergency number for police, ambulance, or fire, it would connect 99,999 times out of every 100,000 attempts. This was known as *five nines* reliability; that is, 99.999 percent of the time it had to work. This is an example of a Six Sigma approach.

NOTE Deming, Juran, and quality management

Much of the modern history of the profession of quality management is rooted in the seminal works of William Edwards Deming. It was Deming who, through his approach to quality management, contributed greatly to the rise of the post-World War II Japanese economy based on competing on quality. Deming is also known for his collaboration with Walter Shewhart in producing and refining the Plan-Do-Check-Act cycle, which forms the basis not only of quality management but also of the profession of project management. At the same time that Deming was influencing Japanese industry, Joseph Juran was also working the same area and is most well-known for his approach to quality as a management activity, the Pareto analysis, and the cost of quality analysis. If you want to know more about quality management, I highly recommend reading the work of these researchers.

6.2 PLAN QUALITY MANAGEMENT

TABLE 6-1 Plan Quality Management process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project Charter ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Requirements management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ <i>Scope baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Assumptions log</i> ▪ <i>Requirements documentation</i> ▪ <i>Requirements traceability matrix</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data gathering <ul style="list-style-type: none"> ▪ <i>Benchmarking</i> ▪ <i>Brainstorming</i> ▪ <i>Interviews</i> ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Cost-benefit analysis</i> ▪ <i>Cost of quality</i> ▪ Decision making <ul style="list-style-type: none"> ▪ <i>Multicriteria decision analysis</i> ▪ Data representation <ul style="list-style-type: none"> ▪ <i>Flowcharts</i> ▪ <i>Logical data model</i> ▪ <i>Matrix diagrams</i> ▪ <i>Mind mapping</i> ▪ Test and inspection planning ▪ Meetings 	<ul style="list-style-type: none"> ▪ Quality management plan ▪ Quality metrics ▪ Project management plan updates <ul style="list-style-type: none"> ▪ <i>Risk management plan</i> ▪ <i>Scope baseline</i> ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Lessons learned register</i> ▪ <i>Requirements traceability matrix</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i>

The Plan Quality Management process is a planning process with a range of outputs including, most importantly, the *quality management plan*. Similar to the other planning documents, the quality management plan will guide your efforts in defining and controlling the quality of both the project processes and the deliverables. It will form a subsidiary plan to the overall project management plan. Another important output from the Plan Quality Management process is the process improvement plan, which is also a subsidiary of the project management plan and details how you will define and continuously improve all the processes on your project.

INPUTS

The Plan Quality Management process uses some or all of the following inputs as part of the development of the quality management plan for the project.

PROJECT CHARTER

The project charter will probably contain important information about quality expectations for the project and as such it is an essential input into this process.

PROJECT MANAGEMENT PLAN

The distinct elements of the project management plan that will be useful in developing your own quality management plan are the requirements management plan, risk management plan, and stakeholder engagement plan because will all have valuable information about quality expectations for the entire project and product scope. You will also find the scope, schedule, and cost baselines useful, because they contain useful information against which to measure quality. The project management plan is an output from the Develop Project Management Plan process.

PROJECT DOCUMENTS

There are a range of project documents that will provide useful information about quality management expectations that you can incorporate into your quality management plan.

The assumptions log will spell out all of the assumptions you have made and you can use this information to see how these assumptions may impact project quality planning.

Given that the definition of quality is the degree to which a set of inherent characteristics fulfills requirements, it is important to use the requirements documentation and requirements traceability matrix as an input because it describes and documents the requirements. Requirements documentation is an output from the Collect Requirements process in the Scope Management knowledge area.

The risk register documents and assesses specific risks that may have an impact upon any quality management issues and decisions you are making. The risk register is an output from the Identify Risks process in the Risk Management knowledge area.

Given that the purpose of quality management is to deliver processes and products that meet customer and stakeholder expectations, the stakeholder register – which describes stakeholders, their interest in the project, the impact they have on the project, and their expectations in relation to the project generally and quality specifically – can be considered a very important input into the Plan Quality Management process.

The stakeholder register is an output from the Identify Stakeholders process in the Stakeholder Management knowledge area.

ENTERPRISE ENVIRONMENTAL FACTORS

Enterprise environmental factors that may assist with the development of your quality management plan include any external local or central government regulations pertaining to quality specifications, and any other industry rules or guidelines.

Real World

One of the key enterprise environmental factors affecting the quality management plans that I have worked on are external standards that different products and deliverables must meet. These are often set by industry organizations or government departments and may change during the duration of your project. Local governments may set building or manufacturing quality standards or health and safety standards, or industry or professional bodies may set employment standards. There are many examples of external enterprise environmental factors relating to quality. If you are getting accredited

as an ISO 9001 compliant organization or obtaining the PMP® credential because it is a government or industry requirement for you to work as a project manager, this is an example of an enterprise environmental factor at work.

ORGANIZATIONAL PROCESS ASSETS

Organizational process assets that may be important inputs into the development of your quality management plan include relevant organizational policies and guidelines relating to the organization's approach and expectations of quality, and any historical information or lessons learned from previous projects relating to quality.

TOOLS AND TECHNIQUES

The following tools and techniques are available to be used to develop the inputs into this process in order to produce the quality management plan.

EXPERT JUDGEMENT

By now you should expect expert judgment as common tool to help you in a lot of processes. Remember that you are an expert, but there are many other courses of expert information and judgment as well. In this case you would want experts in quality management to assist you.

DATA GATHERING

Benchmarking is the process of comparing your quality practices to those of other projects or other organizations and seeing how you compare.

Brainstorming is a way to get people to be creative and innovative and consider new ways of achieving objectives.

Interviews help you gather information from interested and experienced stakeholders and subject matter experts.

DATA ANALYSIS

Cost-benefit analysis is used as a tool in the Plan Quality Management process, because you need to look at the costs of meeting quality requirements, which generally increase as you seek to improve the quality and avoid rework and decreasing stakeholder satisfaction. The pursuit of quality is always a trade-off between the costs involved and the benefits obtained and, therefore, using cost-benefit analysis is an important tool for producing a quality management plan.

Cost of quality considers the total cost of quality over the life of the product, which is well beyond the life of the project and examines the cost of low quality, the subsequent warranty claims, any negative effect on brand or reputation, and loss of future work.

EXAM TIP

Cost of quality is mirrored by, and sometimes referred to as, cost of poor quality. Whatever the term used, it is the concept of assessing what the implications are for producing, or not producing, quality products far beyond the life of the project.

DECISION MAKING

Multi-Criteria Decision Analysis (MCDA) serves as a valuable tool in the Plan Quality Management process by providing a structured approach to evaluating complex decisions with multiple variables. In the planning stage, quality objectives often compete with other project factors like time and cost. MCDA allows project managers to assign weights to different criteria, such as performance, reliability, and cost-effectiveness, and then assess various quality options against these criteria. The outcome is a quantifiable score for each option, making it easier to choose quality initiatives that offer the best balance among competing needs. This data-driven method enhances decision-making and ensures that the planned quality standards are both rigorous and achievable.

DATA REPRESENTATION

In the Plan Quality Management process, various tools and techniques offer unique advantages for organizing information and setting a quality baseline. Flowcharts visually map out processes, helping to identify bottlenecks or points of failure. Logical data models give an abstract view of data requirements, ensuring that quality metrics are effectively captured and monitored. Matrix diagrams offer a way to evaluate the relationship between different variables or components in a project, aiding in decision-making. Mind mapping facilitates brainstorming by

capturing ideas in a non-linear format, allowing for the easy identification of quality criteria and interrelated concepts. Together, these tools help in comprehensively planning for quality, making it easier to meet project objectives.

MEETINGS

Meetings are a useful way to bring together members of the project team and other stakeholders so that they can contribute to the development of the quality management plan.

OUTPUTS

After applying the appropriate tools and techniques to the selected inputs, the Plan Quality Management process has the following outputs.

QUALITY MANAGEMENT PLAN

The Plan Quality Management process has the *quality management plan* as its primary output. Similar to other management plans, the quality management plan provides a description of the overall approach to quality management, guidelines for all project processes and how they will be implemented, and a description of expected quality, testing, and inspection of project deliverables. The detail contained in the quality management plan will reflect the size and complexity of the project, and it should be updated and reviewed regularly to ensure that it is still accurate. The quality management plan is then a key input into the Manage Quality, and Control Quality processes.

EXAM TIP

For the exam you should assume that every project should have a quality management plan. The quality management plan itself can be formal and documented, or it can be an informal set of policies and guidelines. It will reflect the size and complexity of the project but should always be done.

Real World

Many organizations, after they reach a certain size, are able to appoint a particular person to manage quality within the organization and also within projects. I believe that this is an important step for an organization to take, because a focus on quality is often a much more important element than a focus on cost. A simple way to remember why quality is so important to your project is that if you don't care about quality your competitor will. I remember on one large project I was managing, I wanted the quality of the project to be the legacy that I left rather than coming in under budget and ahead of time. We still focused on measuring cost and time performance, and we did come in under budget and ahead of time, but the element I was proudest of was the extra quality that we were able to deliver.

The *process improvement plan* is a subsidiary of the project management plan that focuses specifically on analyzing quality processes and describing ways in which continuous improvement can be applied to these processes. The process improvement plan is used as an input into the Manage Quality process.

EXAM TIP

Note that the process improvement plan is not used as an input into the Control Quality process because its primary focus is on project processes, which are the main focus of the Manage Quality process.

QUALITY METRICS

The development and documentation of specific *quality metrics* are necessary in order to be able to measure progress against what has been planned. The more specific the quality metric, the more detailed the measurement and reporting can be. The most common quality metrics developed include performance measurements relating to schedule, cost, defects, failure, and reliability. The quality metrics are used as an input into the Manage Quality and the Control Quality processes.

PROJECT MANAGEMENT PLAN UPDATES

As a result of completing the planning for your particular approach to project management you may wish to update the risk management plan to reflect new or amended risks. You may also wish to update the scope baseline if you planned quality management activities add, or change, the scope of the project.

PROJECT DOCUMENTS UPDATES

The specific project documents that may be updated as a result of completing the Plan Quality Management process are the lessons learned register, requirements traceability register, risk register and stakeholder register.

Quick Check

1. What is the key function of a quality management plan?
2. How can quality decision affect the project scope?

Quick Check Answers

1. The key function of a quality management plan is to describe your particular approach to quality in your project, the relevant policies, your approach to quality assurance and process improvement, and quality metrics and how you will control and measure quality of the project deliverables.
2. Your decisions on project quality may add work to the project scope.

6.3 MANAGE QUALITY

TABLE 6-2 Manage Quality process

INPUTS →	TOOLS AND TECHNIQUES →	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Quality management plan</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Lessons learned</i> ▪ <i>Quality control measurements</i> ▪ <i>Quality metrics</i> ▪ <i>Risk report</i> ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Data gathering <ul style="list-style-type: none"> ▪ <i>Checklists</i> ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Alternatives analysis</i> ▪ <i>Document analysis</i> ▪ <i>Process analysis</i> ▪ <i>Root cause analysis</i> ▪ Decision making <ul style="list-style-type: none"> ▪ <i>Multicriteria decision analysis</i> ▪ Data representation <ul style="list-style-type: none"> ▪ <i>Affinity diagrams</i> ▪ <i>Cause-and-effect diagrams</i> ▪ <i>Flowcharts</i> ▪ <i>Matrix diagrams</i> ▪ <i>Scatter diagrams</i> ▪ Audits ▪ Design for X ▪ Problem solving ▪ Quality improvement methods 	<ul style="list-style-type: none"> ▪ Quality reports ▪ Test and evaluation documents ▪ Change requests ▪ Project management plan updates <ul style="list-style-type: none"> ▪ <i>Quality management plan</i> ▪ <i>Scope baseline</i> ▪ <i>Schedule baseline</i> ▪ <i>Cost baseline</i> ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Risk register</i>

The Manage Quality process is an executing process that uses the quality management plan for guidance and is focused on implementing processes across the entire project and checking that these processes are being adhered to and continuously improved. The processes that you define and audit won't only be processes around quality management. For example, you could decide to have a process about setting up and choosing the right projects, culminating in a signed project charter, all of which would be covered in the Develop Project Charter process. The Manage Quality process will check that you have followed this process correctly.

EXAM TIP

A simple way to remember the difference between quality assurance and quality control is that quality assurance uses audits and focuses on processes, whereas quality control focuses on inspections and the project deliverables.

Real World

The ISO 9000 standard is an excellent example of quality assurance at work. This standard requires processes to be in place and regular audits to occur to ensure that the processes are being followed. The standard does not focus on the quality of the product being produced. Thus, there are some unscrupulous companies that have ISO 9000 accreditation but produce low-quality products.

INPUTS

The Manage Quality process uses some or all of the following inputs.

PROJECT MANAGEMENT PLAN

The quality management plan is obviously a key input into the Manage Quality process because it guides how the process will be carried out. The quality management plan is an output from the Plan Quality Management process.

PROJECT DOCUMENTS

Lesson learned will let you know what others have done successfully or not in managing quality and apply it to your project.

Quality control measurements are generated by the Control Quality process and are used in the Manage Quality process to analyze and evaluate the particular quality standards relating to the quality processes that are supposed to have been followed.

The quality metrics are specific variables that can be measured as part of checking whether or not you are implementing and adhering to particular quality processes. The quality metrics are an output from the Plan Quality Management process.

The risk report will let you know how quality issues are affecting levels of risk on the project.

ORGANISATIONAL PROCESS ASSETS

Organizational Process Assets (OPAs) can offer invaluable support in the Manage Quality process. These may include:

- **Quality Policies:** Guidelines and criteria set by the organization related to quality expectations can help frame the Manage Quality process.
- **Historical Information:** Past project records and lessons learned can provide insights into effective quality practices and pitfalls to avoid.
- **Templates and Checklists:** Pre-established forms or checklists for quality control and assurance can standardize the process, making it more efficient.
- **Procedures and Guidelines:** Standard Operating Procedures (SOPs) for quality management can help ensure consistency and adherence to best practices.
- **Metrics Database:** A repository of quality metrics from previous projects can serve as a reference point for performance measures.
- **Audit Results:** Internal or external audit findings on prior projects can highlight areas for attention in quality management.
- **Organizational Culture:** Understanding the company's attitude toward quality can shape the approach taken in the Manage Quality process.
- **Software Tools:** Existing tools used for project management or quality control can streamline the Manage Quality process.

TOOLS AND TECHNIQUES

The following tools and techniques are used upon the inputs to deliver the Manage Quality process outputs.

DATA GATHERING

Checklists in the Manage Quality process serve as simple but effective tools for ensuring that specific quality criteria are met. They provide a standardized framework for inspections or reviews, helping team members to identify any deviations from the established quality standards. By using checklists, the project team can perform

more consistent and thorough evaluations, thereby reducing the likelihood of oversights and errors in the quality management process.

DATA ANALYSIS

In the Manage Quality process, a variety of analysis tools can be employed to scrutinize different facets of project quality. Alternatives analysis helps in evaluating different solutions or methods for achieving the desired quality levels, allowing the team to select the most effective approach. Document analysis involves reviewing existing documentation like contracts, plans, or specifications to ensure they align with quality standards and project objectives. Process analysis dives into the workflows and procedures to identify inefficiencies or vulnerabilities that could impact quality. Root cause analysis, on the other hand, is particularly useful when quality issues have already emerged; it works to identify the underlying causes of defects or failures, rather than just treating the symptoms. These tools collectively provide a comprehensive way to manage and improve project quality at various stages.

DECISION MAKING

In the Manage Quality process, Multi-Criteria Decision Analysis (MCDA) can be instrumental in optimizing complex quality-related decisions that involve multiple variables. By assigning weights to different quality criteria such as cost, time, and performance, MCDA allows teams to evaluate and compare various quality control measures or corrective actions. The resulting analysis provides a quantitative basis for selecting the most effective strategies to meet or exceed the project's quality objectives.

DATA REPRESENTATION

The catchall phrase, *seven basic quality tools*, refers to the graphical representation of tools used to measure, assess, and determine causes of quality issues. They are a convenient and graphical way to represent what can often be quite complex text-based or numerical information to allow quick communication and assessment of quality issues.

EXAM TIP

Each of the seven basic quality tools refers to a particular type of diagram.

The *cause-and-effect diagram*, which is also called the *Ishikawa* or *fishbone diagram*, is used to describe a known defect and assess the variety of possible causes. It enables you to consider multiple causes for a single problem. Figure 6-1 shows a cause-and-effect diagram with one level of analysis done. You start by identifying a particular defect, then look at all the possible causes of that defect and, if you want, you can also go on to seek further root causes of each identified cause. After you have identified the potential causes, you can then use more quantifiable analysis, such as counting the number of times that cause is responsible for the defect, and come up with a prioritized list of causes.

EXAM TIP

This is one of those instances where there are multiple terms that mean the same thing in the exam. This diagram may be referred to as the cause-and-effect, Ishikawa, or fishbone diagram.

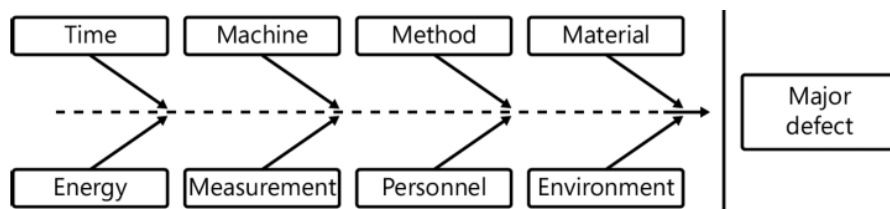


FIGURE 6-1 A diagram showing a cause-and-effect, Ishikawa, or fishbone diagram.

Flowcharts are a convenient way to show the flow of information, or the sequence of steps, in a particular process. Figure 6-2 shows an example of a flowchart.

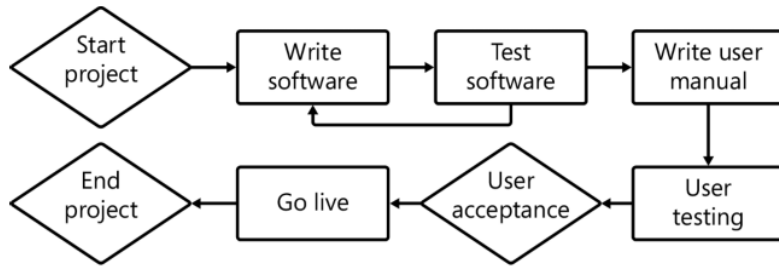


FIGURE 6-2 Flowchart.

Real World

Each shape used in a flow chart has a specific meaning attached to it. For example, the rectangle shape refers to a process, and the diamond shape refers to a decision point. Each and every shape used has a different meaning so that you can quickly look at the flowchart and get information about it very fast.

EXAM TIP

In the exam you may see the acronym SIPOC used. If so then it is referring to a particular type of flowchart used for documenting the flow of goods and information between and customers. The acronym SIPOC stands for Suppliers, Inputs, Process, Outputs and Customers.

Checksheets are a convenient way to document the activities that must be done and provide a way of checking that they have been done. Checksheets are sometimes called tally sheets. Figure 6-3 shows an example of a checksheet.

Activity	Status	Date
Produce first draft of quality management plan	Closed	4/8/14
Submit first draft for team feedback	Open	4/12/14
Finalize quality management plan	Not yet started	
Distribute quality management plan	Not yet started	

FIGURE 6-3 Checksheet.

EXAM TIP

The difference between a checksheet and a checklist is that a checksheet documents what is to be done, whereas a checklist documents what has been done. Additionally, a checksheet is a tool whereas a checklist is an input or output.

A *Pareto diagram* is a way of using a histogram to document the frequency of particular events in descending order and then adding up the cumulative percentage of the quality defects in order to assess which subset of defects causes the greatest amount of problems. The purpose of this Pareto analysis is to focus your attention and energy upon those 20 percent of problems that are causing 80 percent of the issues. Figure 6-4 shows an example of a Pareto diagram.

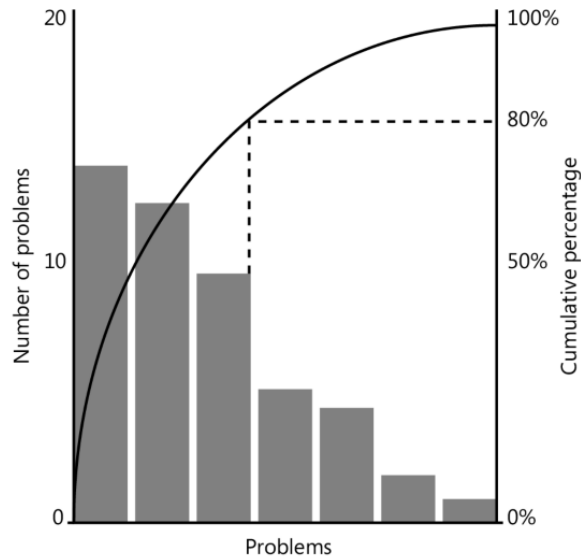


FIGURE 6-4 Pareto diagram.

NOTE Pareto principle

Joseph Juran first used the term *Pareto principle* to refer to what is now more commonly referred to as the 80:20 rule. It was called the Pareto principle because in the early part of the 20th century an economist by the name of Wilfried (or Vilfredo, if you are Italian) Pareto observed that 80 percent of the land in Italy was owned by 20 percent of the people. This 80:20 rule has come to be used in a wide variety of disciplines to describe any situation where a small amount of a population is responsible for a lot of the observations made.

Histograms, or bar charts, are a simple way of representing frequency, or occurrence, of particular events. Figure 6-5 shows an example of a histogram.

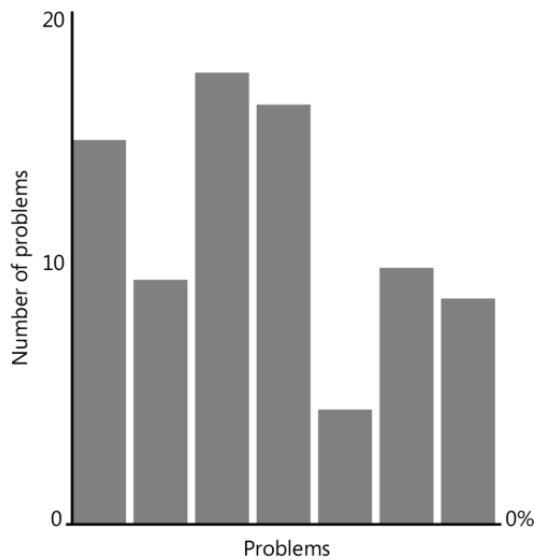


FIGURE 6-5 Histogram

Control charts are an effective way of recording data and determining whether or not a manufacturing process is still in control or is about to go out of control. Information is gathered and plotted on the control chart around an expected average, or mean. Using standard deviations, you can then set the upper and lower control limits, three standard deviations either side of the mean. Beyond these *control limits*, the upper and lower *specification limit* is set. Any data point that appears outside of the specification limit will not be accepted by the customer. Any data point that appears outside of the control limit but within a specification limit indicates that the process is out of control and investigation should commence immediately as to the cause of this. Any information or data gathered within the control limits is acceptable.

The exception to this rule is when seven consecutive data points appear either side of the mean. This is called the *rule of seven*, and it is statistically improbable that you will get seven consecutive points on either side of the mean. An easy way to understand the rule of seven is to consider a coin being tossed and the chances of it landing with either a head or tail facing up. You would expect a random distribution of heads and tails, but would consider it statistically improbable that you would get seven consecutive heads or tails. If you do note seven consecutive data points above or below the mean, it signals that you should investigate the cause, because the process may be about to go out of control. Figure 6-6 shows an example of a control chart. Note the appearance of seven consecutive data points above the mean, indicating the rule of seven.

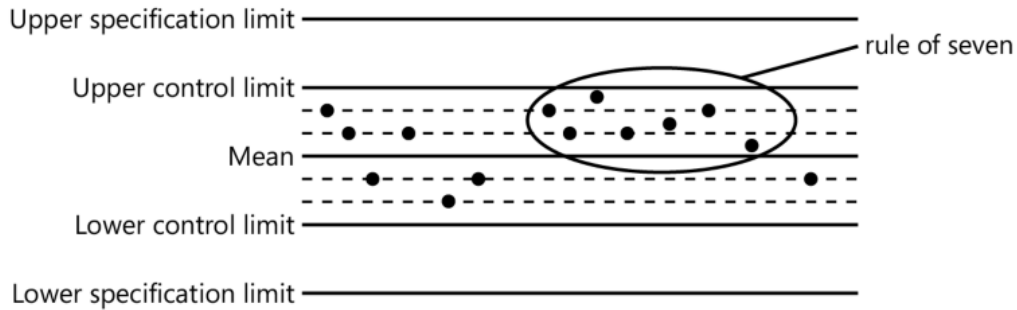


FIGURE 6-6 Control chart.

Scatter diagrams simply record the relationship between two variables in graphical form. Figure 6-7 shows an example of the *scatter diagram*.

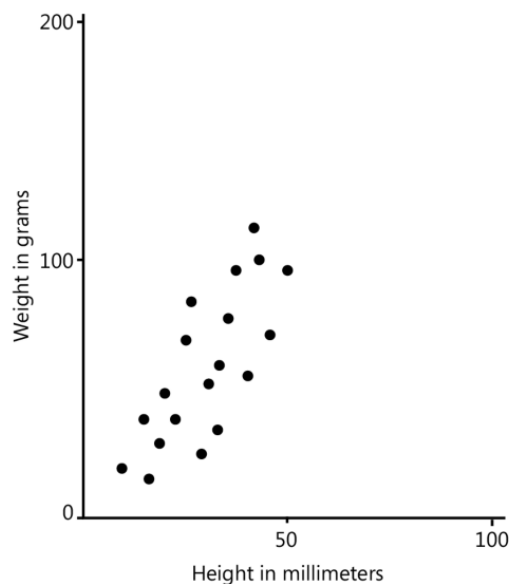


FIGURE 6-7 Scatter diagram.

NOTE Ishikawa and quality management

The development of the seven basic quality tools is attributed to the work of Kaoru Ishikawa, a Japanese professor and one of the great quality management advocates and developers.

DESIGN OF EXPERIMENTS

Design of experiments is a tool to assist with developing useful and reliable experiments to test quality. Key considerations in the design of experiments include the identification and control of variables and the understanding of how the testing process itself may affect observed outcomes. A well-designed experiment will be able to independently control different variables to determine which ones are causing problems.

STATISTICAL SAMPLING

Statistical sampling is used when there are either too many quality checks to do, or quality checks involve destructive testing. For example, you may want to do testing on lines of software code being written, but there are more than

100,000 lines of code. Instead of checking every line of code, you could simply select 100 lines of code and check them for accuracy. One constraint of statistical sampling is the assumption that the result from a small population is representative of the entire population.

Another quality planning tool that can be used is failure mode and effect analysis (FMEA). FMEA is a widely used technique that examines the consequence of failure in any part of the system and uses those observations to ensure that failure does not actually occur or that, if it does, the impact is anticipated and mitigated. In this process you could use this tool to determine the likely effect of failure of the product and prepare to ensure that it doesn't happen.

Additionally, there are the following *seven new quality tools* and techniques that can be used. Each of these additional quality management and control tools is used to document and represent particular measurements taken during the Manage Quality process.

NOTE Seven new quality tools

The seven new quality tools come from the book *Seven New QC Tools: Practical Applications for Managers* by Yoshinobu Nayatani, Toru Eiga, Ryoji Futami, and Hiroyuki Miyagawa (Productivity Press, 1994). Both these seven and the basic seven tools all represent data in graphical format for easy interpretation and communication.

Affinity diagrams, or KJ Methods diagrams, can be used during a brainstorming session to create cause-and-effect diagrams because they group data in logical relationships. Figure 6-8 shows an example of an affinity diagram.

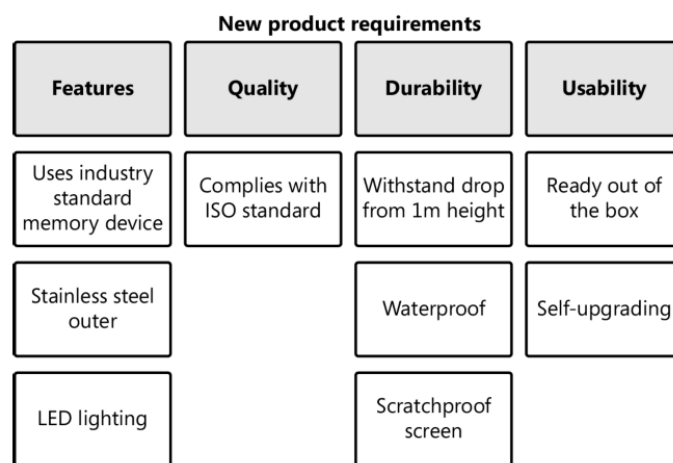


FIGURE 6-8 Affinity diagram.

A *process decision program chart* (PDPC) displays in graphical and hierarchical form the steps in a process in order to understand the issues that may positively or negatively affect the sequence of activities to reach a goal. In this sense, it is a cross between a flowchart and a breakdown structure. Figure 6-9 shows an example of a process decision program chart.

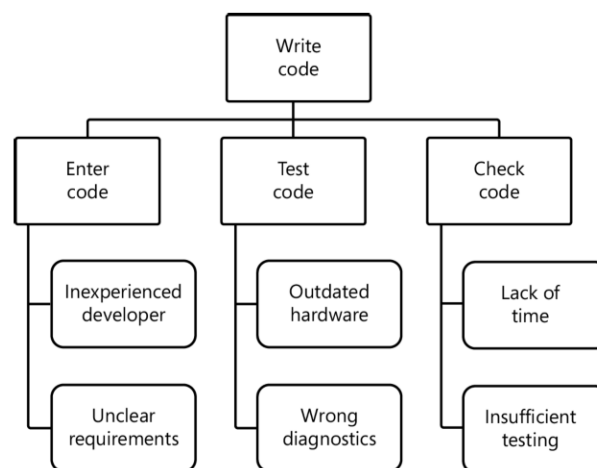


FIGURE 6-9 Process decision program chart.

Interrelationship digraphs are useful to graphically show multiple cause-and-effect relationships between various factors. Figure 6-10 shows an example of an interrelationship digraph.

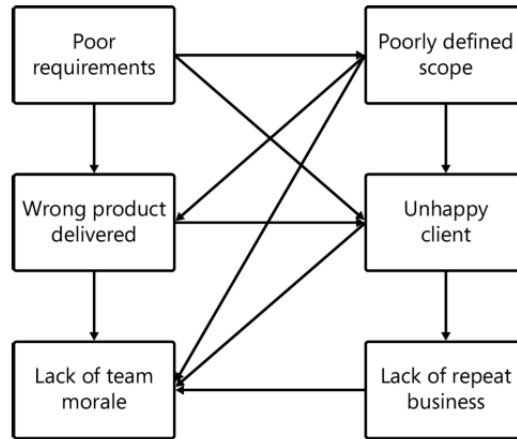


FIGURE 6-10 Interrelationship digraph.

A *tree diagram* is a very useful graphical representation of hierarchical relationships and parent-to-child relationships. You have seen the tree diagram as a work, risk and organizational breakdown structure. In managing quality, the tree diagram can be used to describe nested relationships between steps in the quality assurance process. Figure 6-11 shows an example of a tree diagram.

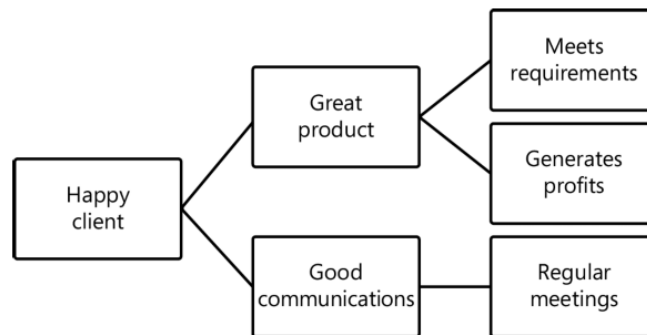


FIGURE 6-11 Tree diagram.

Prioritization matrices use a variety of weighted criteria to determine the priority of quality actions to enable the key issues to be determined. Figure 6-12 shows an example of a prioritization matrix.

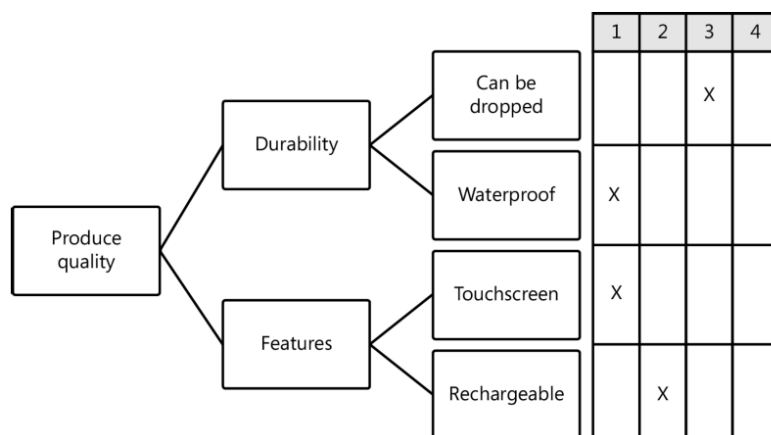


FIGURE 6-12 Prioritization matrix

Activity network diagrams are used to show relationships between activities to be completed. You have already seen these diagrams used in the managing the project schedule and determining the tasks on the critical path with activity-on-node (AON) diagrams. In quality management, they are used to show the sequence of, and interrelationships between, various quality activities. Figure 6-13 shows an example of an activity network diagram.

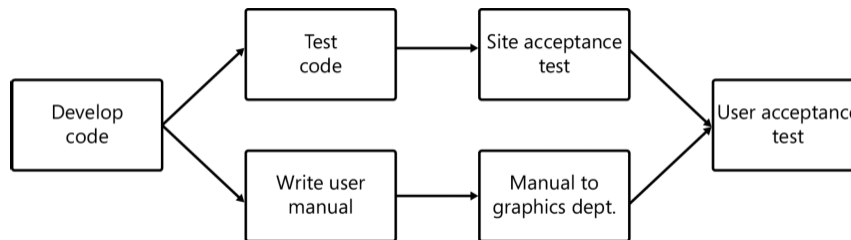


FIGURE 6-13 Activity network diagram.

Matrix diagrams are used to indicate whether a relationship exists between two variables. Figure 6-14 shows an example of a matrix diagram.

	Customer A	Customer B	Customer C	Customer D
Durability	High	High	Moderate	High
Features	Low	High	High	Moderate
Price	Low	Moderate	Low	High
Size	Small	Med	Large	Small

FIGURE 6-14 Matrix diagram.

AUDITS

A *quality audit* is an independent process that seeks to determine whether the defined project processes are being carried out as per the quality management plan. Quality audits are carried out by using the quality management plan as a guideline and should generally be done by people not involved with the project who can independently assess whether the required processes are in place and whether or not they are being followed.

Real World

On one particularly large project that I was managing, we had it as part of the contract that regular audits would occur on all our project processes. We had an independent assessor appointed from one of the large global auditing companies, and every six months, that assessor would show up in person and spend several days requesting proof that we had processes in place and that we followed those processes correctly. The assessor would then produce a report detailing both areas of compliance and noncompliance. As the project manager, it was my responsibility to ensure that any areas of noncompliance were addressed promptly. The costs for completing these quality audits were part of the overall project budget.

EXAM TIP

Wherever you find an audit being used as a tool, it will be checking that processes are in place, that they are being followed as per the requirements, and that any deviation from the processes is documented and dealt with. Audits do not check the quality of any deliverables or products.

DESIGN FOR X

Design for X (DfX) is a proactive approach that can be integrated into the Manage Quality process to optimize specific product attributes, where "X" can be anything from cost and reliability to safety and user experience. By applying DfX principles early in the design phase, a project team can set quality benchmarks that align with both project objectives and stakeholder expectations. These guidelines then inform not only the initial design but also material selection, production methods, and even post-launch maintenance. By emphasizing quality from the outset, DfX helps to mitigate risks, reduce costs associated with rework or defects, and ultimately contribute to a product that meets or exceeds quality standards.

Let's consider a project focused on developing a new line of eco-friendly kitchen appliances. In the Manage Quality process, the team adopts Design for Sustainability (a specific form of DfX) as a guiding principle. This sets clear benchmarks for energy efficiency, recyclable materials, and long-term durability right from the design phase. Engineers and designers work together to select energy-efficient motors and sustainable materials like recycled stainless steel. As the project progresses, each prototype undergoes rigorous quality checks against these sustainability criteria. By embedding these DfX principles from the outset, the team not only meets but exceeds

quality expectations, resulting in a product line that is both eco-friendly and durable, while reducing the risk of costly redesigns or modifications later in the project lifecycle.

PROBLEM SOLVING

Problem-solving is a versatile tool in the Manage Quality process, acting as a catch-all mechanism for identifying, analyzing, and resolving quality issues that may arise during the project lifecycle. When a quality problem is detected, whether it's a product defect or a bottleneck in the process, the problem-solving approach kicks in to diagnose the issue comprehensively. Techniques like brainstorming, root cause analysis, and the 5 Whys can be employed to get to the heart of the problem. Once the underlying cause is understood, various solutions can be evaluated, perhaps using Multi-Criteria Decision Analysis for complex issues. Finally, corrective actions are implemented and monitored to ensure that the problem is fully resolved and that the quality of the project is maintained or improved.

QUALITY IMPROVEMENT METHODS

Quality Improvement methods serve as powerful tools in the Manage Quality process, providing structured approaches to achieve superior quality standards. Methods like Six Sigma, Lean, and Total Quality Management (TQM) offer various techniques for enhancing quality through process optimization, waste reduction, and customer satisfaction. For example, a project team implementing Six Sigma might use DMAIC (Define, Measure, Analyze, Improve, Control) to systematically improve a manufacturing process, aiming to reduce the rate of defective products. In a software development project, Lean principles could be applied to eliminate 'waste' in the form of redundant code or processes, thereby speeding up development and improving code quality. TQM, meanwhile, could be used in a customer service project to establish key performance indicators and customer surveys, thereby continually elevating service quality. By selecting and applying these methods judiciously, the Manage Quality process becomes more effective and targeted in its aim to uphold and enhance quality standards.

OUTPUTS

The Manage Quality process produces some or all of the following outputs.

QUALITY REPORTS

Quality Reports are key outputs from the Manage Quality process, serving as compiled summaries that offer insights into the overall quality performance of a project. These reports typically include metrics such as defect rates, compliance levels, and results of quality audits, providing stakeholders with a comprehensive view of how well the project is meeting its quality objectives. For instance, in a construction project, a Quality Report might feature results from material tests, safety inspections, and adherence to building codes. In a healthcare project, the report could focus on patient satisfaction scores, treatment outcomes, and adherence to healthcare standards. These reports are invaluable for decision-making, as they help project managers and stakeholders identify areas of improvement, allocate resources, and determine whether corrective actions are needed to maintain or enhance the quality standards set for the project.

TEST AND EVALUATION DOCUMENTS

Test and Evaluation documents serve as critical outputs from the Manage Quality process, providing tangible records of quality assessments and their results. These documents typically include detailed information on the types of tests conducted, the metrics used, the results obtained, and any corrective actions taken. For example, in a software development project, the Test and Evaluation document might contain results from unit tests, integration tests, and user acceptance tests, along with bug reports and fixes. In a manufacturing context, these documents could include results from stress tests, safety evaluations, and quality audits, complete with data on tolerance levels and any identified defects. By creating comprehensive Test and Evaluation documents, project teams not only have a historical record for future reference but also a robust basis for ongoing quality improvement, stakeholder reporting, and compliance verification.

CHANGE REQUESTS

The *change requests* are generated as a result of information discovered by audits and process analysis that then requires changes to be considered as per the agreed change management process. The *change requests* are used as an input into the Perform Integrated Change Control process.

PROJECT MANAGEMENT PLAN UPDATES

The specific parts of the project management plan that may be updated as a result of the Manage Quality process are the quality management plan, scope baseline, schedule baseline and cost baseline as these are the most affected by any issues with quality on the project.

PROJECT DOCUMENTS UPDATES

The specific project documents that may be updated as a result of the Manage Quality process include such things as the issue log, lesson learned register and risk register as these are the most affected by any issues with quality on the project.

ORGANIZATIONAL PROCESS ASSETS UPDATES

The specific organizational process assets that may be updated as a result of the Manage Quality process are any templates, policies, or guidelines relating to quality audits, and training and appointment of independent auditors.

Quick Check

1. What is the difference between quality assurance and quality control?
2. What is it that both the seven basic quality tools and the seven new quality tools are attempting to do?
3. What is the purpose of a quality audit?

Quick Check Answers

1. The difference between quality assurance and quality control is that quality assurance is focused upon the processes of the project, whereas quality control is focused upon the project deliverables.
2. All of the quality tools described seek to take what can be quite complex text, verbal, or numerical information and collate and present it in an easy-to-understand graphical form.
3. The purpose of the quality audit is to independently check that required processes are in place and are being followed.

6.4 CONTROL QUALITY

TABLE 6-3 Control Quality process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Quality management plan</i> ▪ Project documents ▪ <i>Lessons learned register</i> ▪ <i>Quality metrics</i> ▪ <i>Test and evaluation documents</i> ▪ Approved change requests ▪ Deliverables ▪ Work performance data ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Data gathering <ul style="list-style-type: none"> ▪ <i>Checklists</i> ▪ <i>Checksheets</i> ▪ <i>Statistical sampling</i> ▪ <i>Questionnaires and surveys</i> ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Performance reviews</i> ▪ <i>Root cause analysis</i> ▪ Inspection ▪ Testing/product evaluations ▪ Data representation <ul style="list-style-type: none"> ▪ <i>Cause-and-effect diagrams</i> ▪ <i>Control charts</i> ▪ <i>Histogram</i> ▪ <i>Scatter diagrams</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Quality control measurements ▪ Verified deliverables ▪ Work performance information ▪ Change requests ▪ Project management plan updates ▪ <i>Quality management plan</i> ▪ Project documents updates ▪ Issue log ▪ Lessons learned register ▪ Risk register ▪ Test and evaluation documents

The Control Quality process is a monitoring and controlling process that uses the quality management plan and checks that the project deliverables will meet the documented requirements and stakeholder expectations.

INPUTS

The following inputs are used in the Control Quality process.

PROJECT MANAGEMENT PLAN

The quality management plan is a critical input into the Control Quality process because it sets out and describes how this process will occur. The quality management plan is an output from the Plan Quality Management process

PROJECT DOCUMENTS

The lessons learned register will provide valuable and insightful information about ways you can improve your project quality.

The quality metrics are a required input into the Control Quality process because they describe the attributes that are expected in the project deliverables and how these attributes will be measured. Quality metrics are an output from the Plan Quality Management process

Test and evaluation documents provide a documented and structured list of steps, attributes, and guidelines that can be used to ensure that all the quality control work is done correctly.

APPROVED CHANGE REQUESTS

Approved change requests can have an impact upon the project deliverables and may require modifications, such as defect repairs, and thus are an important input into this process. Approved change requests are an output from the Perform Integrated Change Control process.

DELIVERABLES

Given that the control quality process is focused upon checking the quality of the deliverables, having the deliverables as an input into the process can be viewed as quite critical.

WORK PERFORMANCE DATA

In order to measure whether or not the project is being delivered as per the desired quality requirements, you will need the work performance data. Work performance data is an output from the Direct and Manage Project Work process.

ENTERPRISE ENVIRONMENTAL FACTORS

When considering the Control Quality process in a project, several Enterprise Environmental Factors (EEFs) can provide useful inputs:

- **Organizational Culture:** The attitude towards quality can impact the process significantly.
- **Industry Standards:** Guidelines or benchmarks that outline quality expectations.
- **Regulations:** Legal requirements related to quality that must be met.
- **Resource Availability:** Human and material resources available for quality control.
- **Technology Infrastructure:** Tools available for quality measurement and monitoring.
- **Historical Information:** Past performance data on similar projects to guide current efforts.
- **Market Conditions:** Trends in the marketplace that may influence quality requirements.
- **Stakeholder Tolerance:** Level of quality deemed acceptable by stakeholders.
- **Competitive Analysis:** Data on competitors' quality levels can offer an external benchmark.
- **Skill Levels:** The capability of team members to perform quality control activities.

These factors can affect how you define, measure, and manage quality, making them crucial inputs for effective quality control.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that can assist with the Control Quality process are any guidelines, processes, policies, or blank templates that the organization has relating to quality control.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the process outputs.

DATA GATHERING

In order to control quality on your project you will need accurate and reliable data about quality. You can get this data from check lists and check sheets.

As part of completing a check on the quality of the deliverables, you may choose to use statistical sampling as a tool or technique, if the number of deliverables is too great to test each one individually, or if the sampling would involve destructive testing.

You can also use questionnaires and surveys from the appropriate stakeholders to get the data you require.

DATA ANALYSIS

Data Analysis helps identify trends, inefficiencies, or issues in the Control Quality process.

Performance Reviews: These can show how well processes are working. If a team consistently misses quality targets, a performance review could reveal if the issue is due to inadequate resources or poor training. For example, if product defects spike every quarter, performance reviews might show that this corresponds with an increase in production volume, indicating a need for better resource allocation during peak times.

Root Cause Analysis: This digs deep to find the origin of a problem, allowing for targeted solutions rather than surface-level fixes. For example, if a software application has frequent crashes, root cause analysis might reveal that the issue is not with the software itself but with an outdated operating system on which it runs. Thus, instead of spending time "fixing" the stable software, the focus would shift to updating the OS.

Both tools allow for targeted action to improve quality, making them valuable in the Control Quality process.

INSPECTION

Inspection is one of the key tools of the control quality process. It is a physical examination of the deliverable to measure and determine whether it complies with the required standards. As a result of completing inspection, you

will generally produce a variety of measurements indicating compliance or noncompliance with the required deliverable standards.

TESTING/PRODUCT EVALUATIONS

Testing or product evaluations serve as a direct method to measure the quality of the output against predefined standards. They help identify defects early, enabling timely corrections. For example, if you're manufacturing smartphones, a touch-screen sensitivity test could be conducted on a sample unit. If the test reveals that the screen doesn't respond well, immediate adjustments can be made in the production line to fix the issue for subsequent units.

By catching issues early, testing saves time and resources in the long run and ensures the final product meets quality expectations.

DATA REPRESENTATION

Data representation tools visually display data to make patterns and issues easier to identify, facilitating better decision-making.

- Cause-and-Effect Diagrams: Helps identify potential root causes of a problem. For example: If a project is delayed, a cause-and-effect diagram might show that poor communication is a root cause, prompting the team to focus on improving communication channels.
- Control Charts: Monitor performance over time and flag anomalies. For example: A control chart tracking the number of software bugs reported per week can quickly show if the rate is stable or if there are spikes that need investigation.
- Histograms: Show distribution of a set of data points. For example: If you're testing battery life in laptops, a histogram might reveal that a significant number of units have a shorter life span than advertised, indicating a quality issue.
- Scatter Diagrams: Show relationships between variables. For example: A scatter diagram plotting time spent on quality assurance against the number of defects could reveal that more time spent on QA correlates with fewer defects.

These tools allow for a more informed and targeted approach to quality control.

MEETINGS

Well run meetings with team members and appropriate stakeholders such as subject matter experts will be a useful tool here.

OUTPUTS

The major outputs from the Control Quality process are the following.

QUALITY CONTROL MEASUREMENTS

The quality control measurements are the documents that you produce as a result of carrying out the Quality Control processes and activities. They should be concise and presented in an appropriate format for easy communication, presentation, and tracking. Quality control measurements go on to be used as an input into the Manage Quality process.

VERIFIED DELIVERABLES

You will recall that deliverables were one of the inputs into the Control Quality process. After they have been subjected to the appropriate tools and techniques to check that they conform to the required standards, and if they are accepted, *verified deliverables* will become an output from the process. Verified deliverables go on to be used as an input into the Validate Scope process.

EXAM TIP

The process of validation occurs after the process of verification. The process of validation is an important one to understand, as well as how it is different from the process of verification. Verification is about confirmation that the product, service, or result produced complies with agreed specifications or requirements. It is primarily an internal process performed by the delivering organization prior to submitting the product, service, or result for validation, which involves the customer as well. Validation also involves a check that the product, service, or result meets stakeholder requirements. Verification occurs before validation.

WORK PERFORMANCE INFORMATION

You will recall that work performance data was used as an input into the Control Quality process. This is the raw data collected about work performance to date. After it is subjected to the appropriate tools and techniques, it becomes work performance information. Work performance information then goes on to be used as an input into the Monitor and Control Project Work process.

CHANGE REQUESTS

As a result of carrying out the Control Quality process, there may be a reason to raise a change request to deal with defect repairs, required modifications, or corrective or preventive actions. All change requests should be prepared, submitted, and assessed as per the documented and defined change control process. Change requests go on to be used as an input into the Perform Integrated Change Control process.

PROJECT MANAGEMENT PLAN UPDATES

Specific parts of the project management plan that may be updated as a result of the Control Quality process are the quality management plan and the process improvement plan.

PROJECT DOCUMENTS UPDATES

Specific project documents that may be updated as a result of the Control Quality process are the issue log, lessons learned register, risk register, and test and evaluation documents.

Quick Check

1. What is the main focus of the Control Quality process?
2. Which three inputs into the Control Quality process are further refined and are outputs from the same process in a more refined state?
3. How does inspection differ from audits?

Quick Check Answers

1. The main focus of the Control Quality process is to check that the project deliverables meet the required and documented standards. This is in contrast to the Manage Quality process, which is focused on the processes of the project.
2. The three inputs are approved change requests, deliverables, and work performance data. Each is used as an input into the Control Quality process and after the application of appropriate tools is further refined so that approved change requests become validated changes, deliverables become verified deliverables, and work performance data becomes work performance information.
3. Inspection is one of the tools of the Control Quality process and involves physical examination of the deliverables produced by the project to determine whether they conform to the required standards. On the other hand, audits are used as a tool in the Manage Quality process to check whether processes are in place and that they are being followed correctly.

6.5 CHAPTER SUMMARY

The Quality Management knowledge area is focused upon the development of the quality management plan, then using this quality management plan to carry out quality assurance to check the project processes, and quality control to check the project deliverables.

- The quality tools and techniques are common to all three quality processes.
- The Plan Quality Management process produces the quality management plan for the project, which sets out guidelines and processes for checking both the processes and deliverables for the project.
- The Manage Quality process focuses on checking that processes are in place and are being followed. It uses a variety of tools and techniques, including audits.
- The Control Quality process is focused upon checking project deliverables and approved change requests for conformity to requirements.

6.6 EXERCISE

The answer for this exercise is located in the “Answers” section at the end of this chapter.

1. Match up the quality tool on the left with the description on the right.

Quality Tool	Definition
1. Histogram	A. A diagramming technique showing relationships and sequencing of quality activities so you can determine the critical path of activities
2. Tree diagram	B. A diagram that groups similar concepts under relevant headings that can then be used to generate cause-and-effect diagrams
3. Pareto diagram	C. A process of comparing your quality activities to those of other projects or organizations
4. Flowchart	D. A standardized and documented list of quality activities to be carried out and confirmed as completed
5. Prioritization matrix	E. A graphical representation of data points measured against an expected mean with control limits set three standard deviations either side of the mean
6. Affinity diagram	F. A diagram showing the sequence of steps within a process using standardized shapes to represent different activities
7. Matrix diagram	G. A bar chart showing frequency of discrete data
8. Scatter diagram	H. A graphical representation showing multiple cause-and-effect relationships between various factors
9. Ishikawa diagram	I. A diagrammatic way of representing effects and their possible causes
10. Activity network diagram	J. A diagram that shows how multiple variables interact with each other
11. Control chart	K. A diagram showing the individual and cumulative frequency of events to determine which 20% of events cause 80% of the problems
12. Process decision program chart	L. A diagram showing the weighted scoring of variables to determine the priority of activities
13. Interrelationship digraph	M. A graphical way to show the hierarchy of steps in a process in order to understand the sequence of activities to reach a goal
14. Benchmarking	N. A diagram with data points showing the correlation between two variables, each represented on a vertical or horizontal axis
15. Statistical sampling	O. A process of testing that takes a small population and extrapolates the result to a larger population
16. Checksheet	P. A diagram of hierarchical relationships and parent-to-child relationships

6.7 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 6 by answering these questions. The answers to these questions, and the explanations of why each answer choice is correct or incorrect, are located in the “Answers” section at the end of this chapter.

2. What are the three processes in the Quality Management knowledge area?
- A. Control Quality, Manage Quality, Plan Quality Management
 - B. Plan Quality Management, Control Assurance, Perform Quality Control
 - C. Perform Quality Control, Determine Quality, Plan Quality Management
 - D. Plan Quality Management, Assure Quality, Control Quality

3. Which of the following is *not* one of the seven basic quality tools?
 - A. Benchmarking
 - B. Scatter diagram
 - C. Control chart
 - D. Pareto diagram

4. What does it mean if a single data point appears above the upper specification limit on a control chart?
 - A. The process is in control and the customer is happy.
 - B. The process may be out of control, and consideration should be given to checking the process in the near future.
 - C. A single data point outside the upper specification is okay. You only need to be concerned if there are seven consecutive data points outside either of the specification limits.
 - D. The process is out of control and requires immediate action, because the customer will not accept any deliverables outside the specification limit.

5. What is the best definition of quality?
 - A. Quality is whatever the customer says is right.
 - B. Quality is the degree to which a product can be used for its intended purpose.
 - C. Quality is the degree to which a set of inherent characteristics fulfills requirements.
 - D. Quality is the number features that the product has.

6. What is the best definition of the principle of kaizen?
 - A. Defining quality processes and checking that they are being used
 - B. Continuously improving
 - C. Checking the quality of the product
 - D. Having a quality management plan

7. If you are considering the impact of potential future warranty claims as part of your quality management plan, what are you considering?
 - A. Cost of quality
 - B. Quality assurance
 - C. Benchmarking
 - D. Prevention over inspection

8. If you are using a diagram to determine the potential causes of quality issues, what would you be using?
 - A. Control chart
 - B. Histogram
 - C. Checksheet
 - D. Fishbone diagram

9. If you are testing and measuring a small sample and extrapolating those results to be indicative of a total population, what tool or technique are you using?
 - A. Benchmarking
 - B. Statistical sampling
 - C. Design of experiments
 - D. Brainstorming

10. If you are conducting an audit to check whether processes are being followed correctly, what process are

you involved in?

- A. Plan Quality Management
- B. Control Quality
- C. Manage Quality
- D. Perform Quality Audit

11. What are the variables and allowable variations called that should be measured as part of the Manage Quality and Control Quality processes?

- A. Quality control measurements
- B. Quality checklists
- C. Quality metrics
- D. Cost of quality

12. Which quality process uses inspection as a tool or technique?

- A. Plan Quality Management
- B. Control Quality
- C. Manage Quality
- D. Perform Quality Inspection

6.8 ANSWERS

This section contains the answers for the Exercises and Review Questions in this chapter.

EXERCISES

- Match up the quality tool on the left with the description on the right.

Quality Tool	Definition
1. Histogram	G. A bar chart showing frequency of discrete data
2. Tree diagram	P. A diagram of hierarchical relationships and parent-to-child relationships
3. Pareto diagram	K. A diagram showing the individual and cumulative frequency of events to determine which 20% of events cause 80% of the problems
4. Flowchart	F. A diagram showing the sequence of steps within a process using standardized shapes to represent different activities
5. Prioritization matrix	L. A diagram showing the weighted scoring of variables to determine the priority of activities
6. Affinity diagram	B. A diagram that groups similar concepts under relevant headings that can then be used to generate cause-and-effect diagrams
7. Matrix diagram	J. A diagram that shows how multiple variables interact with each other
8. Scatter diagram	N. A diagram with data points showing the correlation between two variables, each represented on a vertical or horizontal axis
9. Ishikawa diagram	I. A diagrammatic way of representing effects and their possible causes
10. Activity network diagram	A. A diagramming technique showing relationships and sequencing of quality activities so you can determine the critical path of activities
11. Control chart	E. A graphical representation of data points measured against an expected mean with control limits set three standard deviations either side of the mean
12. Process decision program chart	M. A graphical way to show the hierarchy of steps in a process in order to understand the sequence of activities to reach a goal
13. Interrelationship digraph	H. A graphical representation showing multiple cause-and-effect relationships between various factors
14. Benchmarking	C. A process of comparing your quality activities to those of other projects or organizations
15. Statistical sampling	O. A process of testing that takes a small population and extrapolates the result to a larger population
16. Checksheet	D. A standardized and documented list of quality activities to be carried out and confirmed as completed

REVIEW QUESTIONS

- Correct Answer: A**

 - Correct:** The three processes in the Quality Management knowledge area are Plan Quality Management, Manage Quality, and Control Quality.
 - Incorrect:** There is no process called Control Assurance.
 - Incorrect:** There is no process called Perform Quality Control or Determine Quality.
 - Incorrect:** There is no process called Assure Quality.
- Correct Answer: A**

 - Correct:** Benchmarking is a tool that is used in quality management, but it is not one of the seven basic

quality tools.

- B. **Incorrect:** The scatter diagram is one of the seven basic quality tools, which include cause-and-effect diagrams, flowcharts, checksheets, Pareto diagrams, histograms, control charts, and scatter diagrams.
- C. **Incorrect:** The control chart is one of the seven basic quality tools.
- D. **Incorrect:** The Pareto diagram is one of the seven basic quality tools.

3. **Correct Answer: D**

- A. **Incorrect:** A data point outside the specification limit does not mean that the process is in control; the customer will not pay for anything that is outside the specification limit.
- B. **Incorrect:** A data point outside the specification limit indicates that the process is definitely out of control.
- C. **Incorrect:** A single data point outside the specification limit indicates that something is wrong. The rule of seven applies to consecutive data points within the control limits.
- D. **Correct:** Any data point outside the specification limits indicates that the process is out of control and should be investigated immediately.

4. **Correct Answer: C**

- A. **Incorrect:** Quality doesn't necessarily relate to what the customer says is right, unless what the customer says is right is captured in the requirements.
- B. **Incorrect:** Quality is more than the degree to which a product can be used for its intended purpose.
- C. **Correct:** Quality is the degree to which a set of inherent characteristics fulfills requirements—remember this definition for the exam.
- D. **Incorrect:** The amount of features product has, or does not have, refers to grade, not quality.

5. **Correct Answer: B**

- A. **Incorrect:** Defining quality processes and checking that they are being used is the process of quality assurance.
- B. **Correct:** Kaizen is the loose Japanese translation of the term continuously improving.
- C. **Incorrect:** Checking the quality of the product is the process of quality control.
- D. **Incorrect:** Have a quality management plan is the process of planning quality management.

6. **Correct Answer: A**

- A. **Correct:** Cost of quality, mirrored by the cost of low quality, considers the impacts of quality decisions over the entire life of the product.
- B. **Incorrect:** Quality assurance is the process of defining processes and checking that you are using them as planned.
- C. **Incorrect:** Benchmarking is the process of comparing your efforts against other projects or organizations.
- D. **Incorrect:** Prevention over inspection is a key concept of the overall approach to project quality management.

7. **Correct Answer: D**

- A. **Incorrect:** A control chart maps data points against an expected mean, upper and lower control limits set three standard deviations either side of the mean, and upper and lower specification limits.
- B. **Incorrect:** A histogram, or bar chart, is a graphical way of representing frequency or total occurrences of data.
- C. **Incorrect:** A checksheet is a standardized description of processes, steps and information to be completed or gathered.
- D. **Correct:** A fishbone diagram, also called an Ishikawa diagram or cause-and-effect diagram, shows a graphical representation of potential causes of a particular event.

8. **Correct Answer: B**

- A. **Incorrect:** Benchmarking is the process of comparing your efforts against other projects or organizations.
 - B. **Correct:** Statistical sampling means taking a small sample of a total population for testing and then assuming those results apply to the entire population. It is used when there are simply too many tests to be done or when the testing involves destructive testing.
 - C. **Incorrect:** Design of experiments is the process of designing, and considering the implications and effects upon the results, of experiments to determine quality.
 - D. **Incorrect:** Brainstorming is a technique that gathers a group of people together and encourages them to think laterally about a particular issue.
9. **Correct Answer: C**
- A. **Incorrect:** Plan Quality Management is the initial planning process and delivers the quality management plan.
 - B. **Incorrect:** Control Quality uses inspection to determine the quality of the product.
 - C. **Correct:** Manage Quality is the process of establishing processes and checking that you are following them by conducting audits.
 - D. **Incorrect:** Perform Quality Audit is a made-up process name.
10. **Correct Answer: C**
- A. **Incorrect:** Quality control measurements are the measurements taken that allow you to assess whether quality metrics are being achieved.
 - B. **Incorrect:** A quality checklist is a standardized description of processes, steps, and information to be completed or gathered.
 - C. **Correct:** Quality metrics are defined during the Plan Quality Management process and set out the variables and allowable variations that should be measured as part of the Manage Quality and Control Quality processes.
 - D. **Incorrect:** Cost of quality considers the impact of quality decisions over the entire life of the product.
11. **Correct Answer: B**
- A. **Incorrect:** Plan Quality Management is the initial planning process and delivers the quality management plan. It does not use inspection as a tool or technique.
 - B. **Correct:** The Control Quality process is focused on checking the quality of the product or deliverable and uses inspection as a tool.
 - C. **Incorrect:** Manage Quality is the process of establishing processes and checking that you are following them by conducting audits. It does not use inspection as a tool or technique.
 - D. **Incorrect:** Perform Quality Inspection is a made-up process name.

7. Resource Management

This chapter focuses on Project Resource Management. Similar to the other knowledge areas, it begins with a planning process, which in this case produces a resource management plan. It also has a second planning process, Estimate Activity resources that produces resource estimates. It then has three executing processes that focus on carrying out the contents of the Resource Management Plan. The three executing processes focus on acquiring your project team members, developing your project team members, and managing your project team members. There is a single controlling process, Control Resources.

You may need to pay particular attention in this chapter to the many different theories relating to management, and interpersonal skills.

The six processes in the Project Resource Management knowledge area are:

- Plan Resource Management (Planning process)
- Estimate Activity Resources (Planning process)
- Acquire Resources (Executing process)
- Develop Team (Executing process)
- Manage Team (Executing process)
- Control Resources (Monitoring and Controlling process)

7.1 WHAT IS PROJECT RESOURCE MANAGEMENT?

Project Resource Management is focused upon the processes of developing a Resource Management Plan, which allows you to identify how you will recognize which people you want as part of your project team, when you will require them and for how long, and how you will get those people, develop those people, and reward, motivate, and manage those people. It covers all the aspects relating to your project team, including you as a project manager.

Real World

I have always found the term “human resource” to be a little too technical and clinical for my liking. Machines are resources, and there is an element of expected decay, obsolescence, and replacement with the term. People are not resources. So, if you are having the same trouble, I suggest using the much friendlier term “project people management” for this section. Of course, for the exam, you will use “Project Resource Management.”

EXAM TIP

In considering all the issues and topics relevant to human resource management, there are a host of ancillary topics around interpersonal skills, leadership, ethics, and organizational and motivational theories that you must also know for the exam. This chapter will cover a wide range of topics relating to all these different aspects of Project Resource Management.

7.2 PLAN RESOURCE MANAGEMENT

TABLE 7-1 Plan Resource Management process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project Charter ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Quality management plan</i> ▪ <i>Scope baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Project schedule</i> ▪ <i>Requirements documentation</i> ▪ <i>Risk Register</i> ▪ <i>Stakeholder register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data representations <ul style="list-style-type: none"> ▪ <i>Hierarchical charts</i> ▪ <i>Responsibility assignment matrix</i> ▪ <i>Text-oriented formats</i> ▪ Organizational theory ▪ Meetings 	<ul style="list-style-type: none"> ▪ Resource Management Plan ▪ Team charter ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Assumption log</i> ▪ <i>Risk register</i>

The Plan Resource Management process is a planning process with a single output, the Resource Management Plan.

INPUTS

The Plan Resource Management process uses some or all of the following inputs as part of the development of the Resource Management Plan for the project.

PROJECT CHARTER

The project charter will contain all the information you know about project resources at the time of the initiation and approval of the project and therefore it is a useful document to plan project resources.

PROJECT MANAGEMENT PLAN

The key elements of the project management plan that will be useful as inputs into the Plan Resource Management process are a description of the work to be completed captured in the scope baseline to determine what skills will be required, and elements from the quality management plan, which are useful for determining quality constraints. The project management plan is an output from the Develop Project Management Plan process.

PROJECT DOCUMENTS

Various project documents will provide important information that will impact planning for your project resources and as such you should have the following documents available as inputs into this process:

- Project schedule
- Requirements documentation
- Risk Register
- Stakeholder register

ENTERPRISE ENVIRONMENTAL FACTORS

The specific enterprise environmental factors that will be useful as inputs into this process are the external organization culture, existing employees, existing organizational employment and personnel policies, and external marketplace conditions affecting availability and cost of hiring people.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that may be important inputs into the development of your Resource Management Plan include any specific organizational policies, process, or guidelines for the recruitment, reward, and retention of people, and any historical information on what has and has not worked on previous projects.

TOOLS AND TECHNIQUES

The following tools and techniques are available to be used to develop the inputs into this process in order to produce the Resource Management Plan.

EXPERT JUDGMENT

Expert judgment from functional managers, current and potential team members, the project sponsor, and other stakeholders will be useful as you put together your Resource Management Plan.

DATA REPRESENTATION

A foundational concept of the Plan Resource Management process is the need to define a role for everyone on the project and define the responsibilities for each role. In order to do this, you can use hierarchical charts and text-oriented formats for roles and responsibilities. Examples of these are *organizational charts and position descriptions* which clearly show what roles there are, how they are linked by reporting lines, and what their expected experience, technical skills, duties, and responsibilities are.

Before we go any further, let's focus on describing all the roles that can exist in a typical project. In addition to the individual and defined project team member roles, the primary roles in the world of project management are the project manager, sponsor, functional manager, program manager, and portfolio manager.

The *project manager* is one of the key roles in the successful delivery of any product, service, or result because this role takes full responsibility for the project. The project manager works closely with the program manager, because the project manager's project may be part of a program, and he or she also works closely with the portfolio manager, because the project will be part of a portfolio. The role of project manager is obviously central to the profession of project management. The project manager is the person assigned to lead the project team and take responsibility for the delivery of the project's objectives. This is different from the work of a *functional manager*, who takes responsibility for a functional unit within an organizational structure. In some instances, a project manager may report to a functional manager, but at other times the role may report to a program or portfolio manager.

EXAM TIP

Not all organizations have program managers or portfolio managers, nor should they. Those roles are generally reserved for large, mature organizations. For the exam, unless you are specifically told otherwise in the question, you should, however, assume that the scenario has all three roles in an organization.

A competent project manager must have a wide range of skills and experience to be successful. These include specific skills for the industry in which the manager is working, and general management skills; the manager must also demonstrate a high degree of expertise in and knowledge about project management, the ability to self-motivate and achieve results through high performance, and great personal effectiveness while leading the project. It is key to the success of the project manager that this person not only possess the right technical skills but also the right interpersonal skills, which will be covered in a later section.

EXAM TIP

In the exam, you must always assume that the role of the project manager is proactive and in control of the project. The project manager takes responsibility entirely for the project, which may differ from your experience.

Real World

In my opinion, the easiest way to describe the role of the project manager is to simply replace the title "project manager" with "general manager of a project." We all know what a general manager does, and a project manager really is the general manager of a project and must take the same senior role.

In addition to the role of project manager, there are also the roles of *project coordinator* and *project expeditor*. A project coordinator has less power and authority than a project manager, and a project expeditor has little or no power and authority.

EXAM TIP

For the exam, look for any project role description that differs on the basis of the amount of power and authority. High levels of both refer to a project manager; mid-levels refer to a project coordinator; and low levels refer to a project expeditor.

The project team is made up of the staff that have been assigned, or recruited, to the project to provide technical skills. It includes at its core the project manager, the direct members of the project team, and also the members of the wider project team. The difference between direct members of the project team and members of the wider project team relate to whether they are assigned full-time or part-time to the project. If you are working within a matrix organizational structure, team members will come from different functional areas. If it is a strong matrix organization, the team members will report solely to the project manager; if it is a weak matrix organization, the team members will still report to the functional managers.

The exact composition of any project team is dependent upon the organizational culture, organizational structure, the scope of work, the geographic location of the work to be done, and the availability of team members. There are four categories of project team. The first is the dedicated project team, where the majority of the team members are working full-time on the project. A second type of project team is the part-time project team, where generally the functional managers have more power and authority and assignment to the project is generally part-time for both the project manager and the project team members. A third type of project team is created from the partnership between two or more organizations who agree to assign staff to the project team. This offers great flexibility and the ability to secure resources and technical experience that any one organization may not have. The fourth and final form of project team is the virtual team, which is increasingly used with the broadening geographical spread of team members throughout the world. Bringing together and getting a virtual team to perform well is a challenge for any project manager and will require special attention to overcome some of the potential obstacles.

Real World

It is increasingly common in the real world that team members are drawn from differing geographical locations. These locations can be different parts of the same city, the same country, or even from different countries. In addition to the problems faced in developing a high-performing team presented by a lack of colocation and face-to-face communication, there are also a number of other problems that can potentially adversely affect the outcome of the project. A project manager working in or with a virtual team needs to be mindful and aware of the potential problems that can arise, and address them early and consistently throughout the life of the project.

A *program manager* leads a program of projects. A program of projects is a group of projects that are linked in some way. They may share resources or they may be contributing to a greater deliverable. The role of the program manager is to manage competing interests between the projects. A *portfolio manager* has responsibility for all the projects an organization is undertaking and is usually in charge of project selection processes to ensure that all projects align with organizational strategy and meet documented financial and nonfinancial criteria. A portfolio of projects includes all projects that an organization is undertaking.

A project *sponsor* is the person responsible for providing the initial statement of work, approving the financial spend on the project, signing the project charter and approving any changes to it, and being the project champion. The person in this role is internal to the organization and will sit on the *project steering committee* or group. The role of the project steering committee or group is to provide high-level support, oversight, and if required, governance.

EXAM TIP

Don't get the roles of the project sponsor and client mixed up. The project sponsor is always internal, whereas the client may be internal or external but is the recipient of the deliverable.

Real World

Many people assume that the client is responsible for financing a project. This isn't true. The client pays the bills after the costs have been incurred. Someone within the organization, usually the project sponsor, must approve the organization's incurring the costs, such as wages or salaries and materials purchased to complete the work, and financing these costs until such time as the client pays the bills.

Figure 7-1 shows the hierarchy of roles from project steering committee down to members of the wider project team.

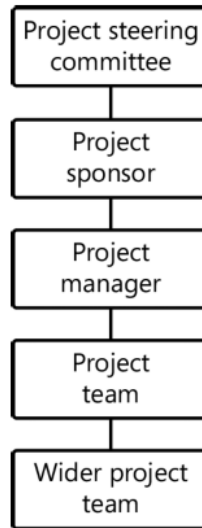


FIGURE 7-1 The descending hierarchy of groups and individuals in a project.

The functional manager is a role that a project manager needs to be mindful of because the majority of organizations are organized around functional areas, even if they are acting as matrix organizations. The functional manager is usually a general manager or team leader of a particular group of technical experts, and this manager will assign his or her staff members to the project for the duration of the project. The project manager must negotiate with the functional manager for the people and, depending on who has the most power in the relationship, this will affect availability of people for the project. This issue is discussed in more depth in an upcoming section.

Now that the typical roles in an organization have been covered, you can use the organizational charts and position descriptions to help produce the Resource Management Plan. There are several graphical and text-based formats for doing this. The most popular of these are organizational charts, matrix charts such as the RACI chart, or text-based descriptions, such as those often used for job descriptions.

The *organizational chart* is another example of a breakdown structure such as the work breakdown structure (WBS). It takes high-level concept, in this case the organization, and breaks it down into its component roles. It starts at the top with the chief executive officer (CEO) or general manager, and breaks it down into lower-level roles such as line manager, team leader, team member, and specific technical roles. In addition to using the chart to break down organization-wide roles, you can also use it to break down project roles, in which case you would have the project manager at the top, and lower-level project roles beneath this. Figure 7-2 shows an example of an organization chart.

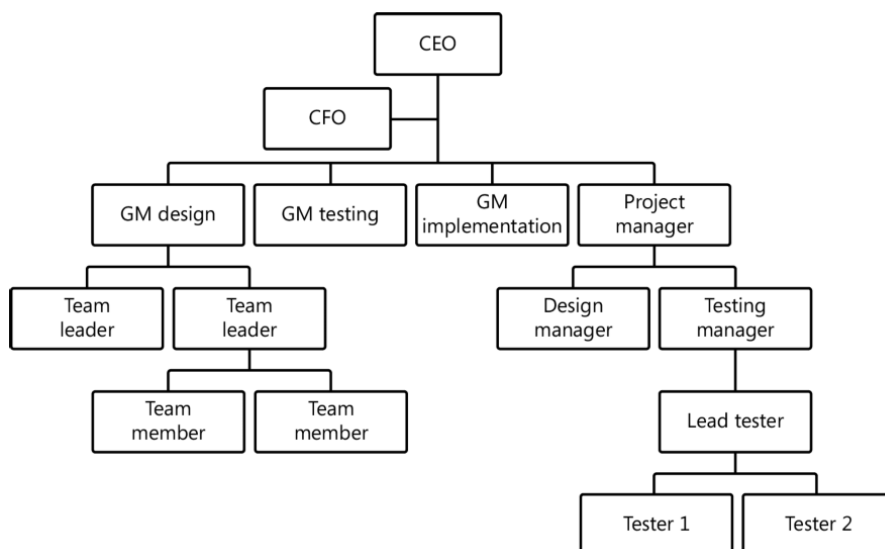


FIGURE 7-2 An example of an organizational chart.

Another popular way of displaying not only roles but also the responsibility different roles have is a matrix-based chart called a RACI chart. A RACI chart is a type of *responsibility assignment matrix* (RAM). A RACI chart describes who is responsible, who is accountable, who will be consulted, and who will be informed on different activities. The

difference between the “responsible” and “accountable” designations is that being responsible for an activity means producing or actually completing the work, whereas being accountable for an activity means having to answer for the work being done or not being done on time. A single person can be both responsible and accountable for an activity, and if your project is large enough to have many team members, you can split the responsibility and accountability as a means of ensuring better management of activities. Figure 7-3 shows an example of a RACI chart.

Activity	Team member			
	David	Thomas	Jayne	Mark
Collect requirements	R/A	C	C	I
Design prototype	C	A	R	
Test		I	R	A

FIGURE 7-3 An example of a RACI chart showing team member responsibility and accountability.

Real World

I have used several forms of the RACI chart on different projects. Some smaller projects simply have an RA chart. I also did some work for a large company that had their own variant, an RASCI chart, with the “S” standing for “Support,” to indicate which team members were providing technical support.

ORGANIZATIONAL THEORY

As part of your efforts to produce an appropriate Resource Management Plan for your project you will need to have a good grasp of organizational theory and how it impacts upon human resource management and project success. The way in which an organization is structured can influence its culture, strategy, personnel recruitment, and the projects it chooses to do. Different organizational structures have different strengths and weaknesses when it comes to successful project management. The main types of organizational structures are the functional organization, the matrix organization, and the projectized organization. The organizational structure is usually demonstrated in the organizational breakdown structure or organization chart.

In a *functional organizational* structure, there is a chief executive officer (CEO), or similar, at the top. Underneath the CEO are general managers, or functional managers, of each functional area. Below the general managers are team leaders. There may also be shared services, such as human resources and finance, directly reporting to the CEO as well. In this sort of organizational structure, staff report directly to the functional manager, who is responsible for assigning them to work or deciding on their remuneration packages and ensuring that they are part of the team; thus, the functional manager has all the power and authority. If an organization wants to undertake a project, generally the project is staffed by members from one functional area, and there can be little cooperation and coordination between the different functional areas. A project manager working in this sort of organizational structure will have great difficulty in obtaining the people and finances needed to complete the project without first getting approval from the functional manager. Figure 7-4 shows an example of a functional organizational structure.

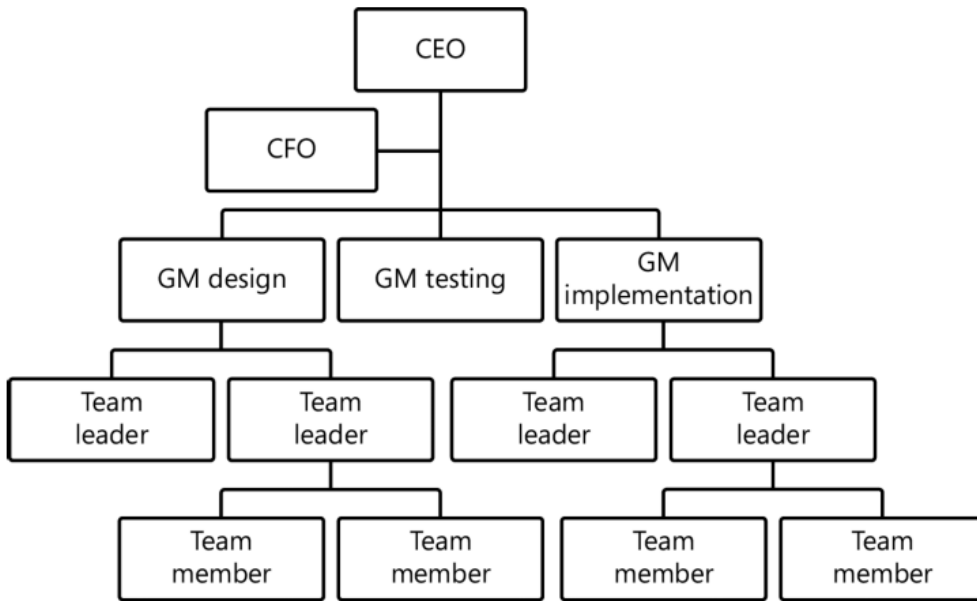


FIGURE 7-4 An organizational chart showing a functional organizational structure.

A *matrix organization* is one in which a functional structure exists, but the organization has decided to do projects by using people and resources from different functional areas. The project manager is assigned a team and access to resources from these different functional areas, and both the project manager and functional manager have power and authority in deciding the allocation and use of people.

In a *weak matrix* organization, most of the power and authority resides with the functional manager, and due to the low levels of power and authority that the project manager has in a weak matrix organizational structure, the role may more appropriately be described as a project expeditor or project coordinator. In a *strong matrix* organization, most of the power and authority is with the project manager. Between strong and weak forms of the matrix organization is the *balanced matrix*, where power and authority is shared between functional managers and project managers. Figure 7-5 shows an example of a matrix organization with the dotted lines around roles indicating which people are assigned to the project.

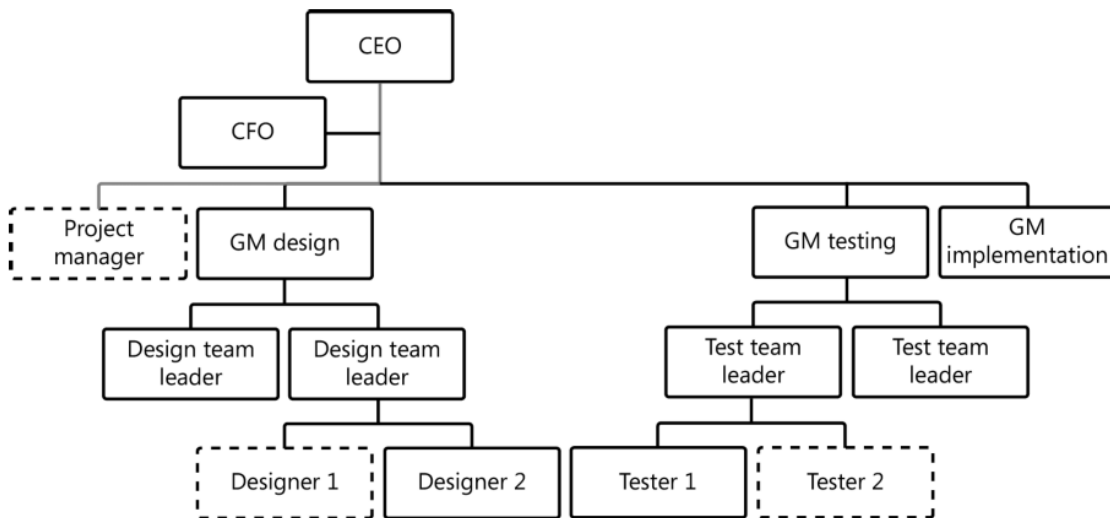


FIGURE 7-5 An organization chart showing a matrix organizational structure.

Projectized organizations are organized according to the projects they undertake. In this instance, the project manager acts almost as a functional manager, but instead of having a team of specialists and a functional area reporting to him or her, the project manager has the project team, which may consist of several different technical specialties. In this instance, the project manager acts as general manager of the project and has full power and authority. Figure 7-6 shows an example of a projectized organization.

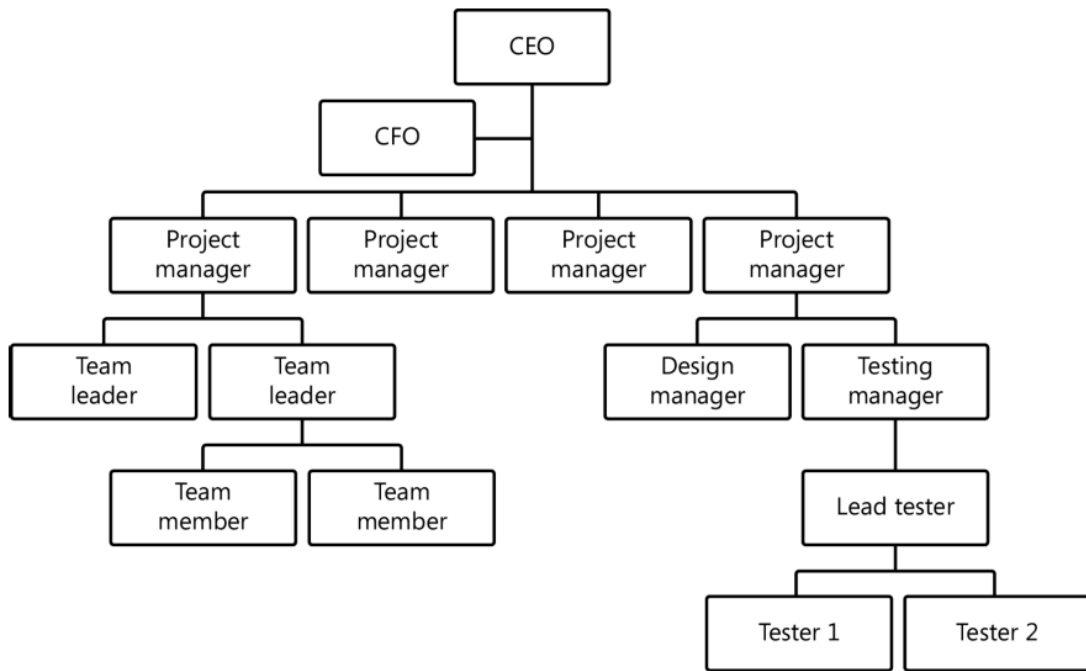


FIGURE 7-6 Projectized organizational structure.

Real World

In the real world, you are often going to have to negotiate with functional managers for access to resources and money. Your ability to be a skilled communicator, influencer, and negotiator will come to the fore in this instance to enable you to get the resources you require when you need them.

Table 7-2 shows the allocation of power and authority between functional managers and project managers in the different types of organizational structures.

TABLE 7-2 Organizational structures, authority, and power

Functional	Weak Matrix	Balanced Matrix	Strong Matrix	Projectized
<ul style="list-style-type: none"> Project manager may be part-time and has very little power and authority Functional manager has most authority over people and budget 	<ul style="list-style-type: none"> Project manager may be part-time and has low levels of power and authority Functional manager has most authority over people and budget 	<ul style="list-style-type: none"> Project manager may be part-time or full-time and has equal levels of power and authority with functional manager Functional manager has equal levels of authority with project manager over people and budget 	<ul style="list-style-type: none"> Project manager will be full-time and has more power and authority than functional manager Functional manager has less authority over people and budget than project manager 	<ul style="list-style-type: none"> Project manager will be full-time and have high to almost total power and authority Functional manager has very little, if any, authority over people and budget

EXAM TIP

It is important for the exam that you understand the differences in power and authority in each of the different organizational structures. In the absence of any further information provided in the question, any questions in relation to this topic will assume first that you are working in a matrix form of organizational structure, and second that it is a strong matrix.

MEETINGS

Meetings are a useful way to bring together members of the project team and other stakeholders so that they can contribute to the development of the Resource Management Plan.

OUTPUTS

After applying the appropriate tools and techniques to the selected inputs, the Plan Resource Management process has the following outputs.

RESOURCE MANAGEMENT PLAN

The Plan Resource Management process has the Resource Management Plan as its sole output. Similar to other management plans, the Resource Management Plan provides a description of the overall approach to human resource management, and details specific guidelines on acquiring, developing, training, motivating, rewarding, and managing your project team members. In addition to the text describing all of these aspects, the Resource Management Plan will also include diagrams such as organizational charts and RACI charts.

An important sub-plan of the Resource Management Plan is the *staffing management plan*, which describes when and how project team members are to be recruited. The staffing management plan will identify whether project team members are to be recruited from internal or external sources, and the process by which they will be described, contacted, assessed, and appointed.

The Resource Management Plan is a subsidiary of the project management plan and is used as an input into the three human resource management executing processes. It is also used as an input into the Estimate Costs process, because it provides information about personnel costs, and it is also used as an input into the Identify Risks process.

TEAM CHARTER

The team charter is an output of the Plan Resource Management process because it formalizes team rules, roles, and responsibilities. It acts as a guideline for team interaction and sets expectations for behavior and performance.

For example: In a software development project, the team charter might specify the Scrum Master's responsibilities, define the team's working hours, list decision-making protocols, and outline conflict resolution procedures. This charter serves as a roadmap for the team, helping to avoid misunderstandings and streamline operations.

PROJECT DOCUMENTS UPDATES

As a result of completing your resource plan you may wish to update the assumption log and risk register to reflect any constraints of the project resources.

Quick Check

1. What is the purpose of the Resource Management Plan?
2. What is the primary role of the project sponsor?
3. If you always have to ask the functional manager for permission to use staff to work on your project, what sort of matrix organization are you working in?

Quick Check Answers

1. The main purpose of the Resource Management Plan is to guide your actions in identifying, obtaining, rewarding, training, motivating, and managing your project team members.
2. The primary role of the project sponsor is to provide financial support, provide project charter approval, appoint the project manager, and provide political support for the project.
3. In this instance you would be working in a weak matrix, because the functional manager has the power and authority.

7.3 ESTIMATE ACTIVITY RESOURCES

TABLE 7-4 Estimate Activity Resources process

INPUTS →	TOOLS AND TECHNIQUES →	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Resource management plan</i> ▪ <i>Scope baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Activity attributes</i> ▪ <i>Activity list</i> ▪ <i>Assumption log</i> ▪ <i>Cost estimates</i> ▪ <i>Resource calendars</i> ▪ <i>Risk register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Bottom-up estimating ▪ Analogous estimating ▪ Parametric estimating ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Alternative analysis</i> ▪ Project management information system ▪ Meetings 	<ul style="list-style-type: none"> ▪ Resource requirements ▪ Basis of estimates ▪ Resource breakdown structure ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Activity attributes</i> ▪ <i>Assumption log</i> ▪ <i>Lessons learned register</i>

The key area of focus in the Estimate Activity Resources process is to consider the defined activities and carry out the process of estimating what resources will be required to complete the work.

NOTE Defining resources

A resource can be defined as any person, team, machinery, equipment, material, or funds used to do work on the project.

INPUTS

There are four inputs into the Estimate Activity Resources process, all specifically designed to assist you in producing the outputs.

PROJECT MANAGEMENT PLAN

The parts of the project management plan you will find most useful to help you estimate activity resource will be the resource management plan as it outlines all the available resources and what is known about them, and the scope baseline because it describes all the work to be done on the project.

PROJECT DOCUMENTS

The activity attributes document provides additional information about each activity on your activity list. This information can refer to which resources are available. The activity attributes document is an output from the Define Activities process.

The activity list provides information about all the activities that you have defined. You will use this information to estimate individual resources assigned to each activity. The activity list is an output from the Define Activities process.

Assumption logs provide details about the assumptions you have made in the project and it is important to know these as they will directly impact the level of uncertainty in your activity resource estimates.

You are able to use *cost estimates* to determine the cost of the resources you might be considering for each activity. Activity cost estimates are an output from the Estimate Costs process in the Cost Management knowledge area.

Resource calendars are a key input into this process because they define constraints on when resources are available to work. They define such things as normal working times, holidays, and any other constraints on when resources may be available. Resource calendars are an output from the Acquire Resources process in the Human Resource Management knowledge area.

The *risk register* is used to assist with estimating activity resources because it documents any known risks that might affect resources that you plan to use on the project. The risk register is an output from the Identify Risks process in the Risk Management knowledge area.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific types of enterprise environmental factors that can be used in this process include any constraints imposed upon resource availability for the project, such as government regulations on mandatory types of resources that must be used, or perhaps regulations of health and safety that affect the number of people who must be present in a workplace.

ORGANIZATIONAL PROCESS ASSETS

The specific types of organizational process assets that can be used as inputs into this process include any existing processes and templates, any relevant human resource policies, and any relevant policies in relation to procurement of supplies and equipment that the organization has. Additionally, a key organizational process asset is always historical information from previous projects.

TOOLS AND TECHNIQUES

The following tools and techniques are available, if appropriate, to use on the selected inputs.

EXPERT JUDGMENT

Expert judgment is a key tool, because you will use the judgment of experts to help produce the activity resource estimates. The types of experts you should consult are those people with prior, and specialized, knowledge in resource planning on a project similar to your own.

BOTTOM-UP ESTIMATING

Bottom-up estimating is an estimating process that begins at a low level of the WBS, such as at individual work packages or even at activity level, and works upward by aggregating, or adding up, resource estimates in each level

of the WBS to arrive at a high-level estimate. Bottom-up estimating is generally considered to be more accurate than top-down estimating, but it involves more time and effort to complete. We covered this in detail earlier in the book.

ANALOGOUS ESTIMATING

Analogous estimating is a technique where you take a similar situation from the recent past and you extrapolate from that the current estimate would be. For example, on a recent project you used three business analysts to complete the work and this project is twice as big, so your analogous estimate would be that you require six business analysts. We've covered this detail earlier in the book.

PARAMETRIC ESTIMATING

Parametric estimating involves multiplying two numbers by each other. So in this instance you could determine that a single business analyst can complete 30 hours of work per week, and you need 90 hours of work completed, so you need three business analyst.

DATA ANALYSIS

The process of *alternative analysis* considers all the different permutations of delivering an activity by using different combinations of resources, quantities of resources, and types of resources, and whether you will rent or buy the resources you require.

PROJECT MANAGEMENT INFORMATION SYSTEM

Most projects plan to use many different types of resources, and therefore it is neither effective nor efficient to do this process manually. This is where using *project management software* provides a definite advantage, because it can process information more quickly.

MEETINGS

As with other processes, a well run and facilitated meeting with the right people present will assist you to develop better activity resource estimates.

OUTPUTS

The following outputs are generated by the Estimate Activity Resources process.

RESOURCE REQUIREMENTS

The *resource requirements* list is the documented list of the resources that you will require to complete every activity on your activity list. The resource requirements list goes on to be used as an input into the Plan Resource Management process and the Plan Procurement Management process.

BASIS OF ESTIMATES

It is always a good idea to take time to document all of the underlying assumptions and information that you have used to develop your estimates. This means that at any point in the future you can come back and check the basis for your estimates and see if they are still valid or whether your estimates need to change.

RESOURCE BREAKDOWN STRUCTURE

The *resource breakdown structure*, like other breakdown structures, is used to decompose the categories of resource required and the specific resources required for the project. The resource breakdown structure then goes on to be used as an input into the Estimate Activity Durations process and the Develop Schedule process. Figure 4-9 shows an example of a resource breakdown structure.

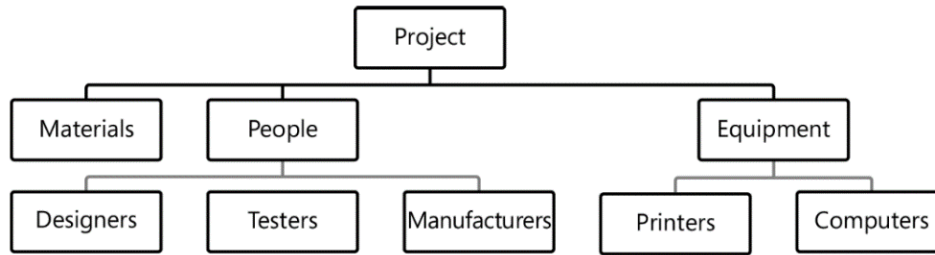


FIGURE 4-9 Resource breakdown structure.

EXAM TIP

The resource breakdown structure is one of four breakdown structures that you should know for the exam. The other three are the organizational breakdown structure, the risk breakdown structure, and of course, perhaps the most important, the work breakdown structure (WBS).

PROJECT DOCUMENTS UPDATES

Types of project documents that might be updated as a result of the Estimate Activity Resources process are the activity list, activity attributes, resource calendars, and lessons learned register.

Quick Check

1. What is the definition of a project resource?
2. What is the benefit of using analogous estimating?
3. What is the advantage of using bottom-up estimating techniques?
4. Why is it important to use resource calendars as an input into the Estimate Activity Resources process?

Quick Check Answers

1. A project resource is any person, material, funding, or piece of equipment that is being used to complete activities, and subsequently work, on a project.
2. The benefit of using analogous estimating data is that it can be done quickly and can be accurate if the information being used is recent and detailed.
3. Bottom-up estimating techniques are generally more accurate than top-down techniques because they aggregate estimates at a low level in the WBS and roll them up.
4. Resource calendars provide information about resource availability and, as such, they are an essential input into the Estimate Activity Resources process because they let you know when resources are available and when resources are not available to work on a project.

7.4 ACQUIRE RESOURCES

TABLE 7-5 Acquire Resources process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Resource Management Plan</i> ▪ <i>Procurement management plan</i> ▪ Cost baseline ▪ Project documents ▪ <i>Project schedule</i> ▪ <i>Resource calendars</i> ▪ <i>Resource requirements</i> ▪ <i>Stakeholder register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Decision making ▪ <i>Multicriteria decision analysis</i> ▪ Interpersonal and team skills ▪ <i>Negotiation</i> ▪ Pre-assignment ▪ Virtual teams 	<ul style="list-style-type: none"> ▪ Physical resource assignments ▪ Project team assignments ▪ Resource calendars ▪ Change requests ▪ Project management plan updates ▪ <i>Resource management plan</i> ▪ <i>Cost baseline</i> ▪ Project documents updates ▪ <i>Lessons learned register</i> ▪ <i>Project schedule</i> ▪ <i>Resource breakdown structure</i> ▪ <i>Resource requirements</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Enterprise environmental factors updates ▪ Organizational process assets updates

The Acquire Resources process is an executing process that uses the Resource Management Plan for guidance to check and confirm the availability of project team members and have them assigned to, or recruited to, the project for the period of time their services are required. If you can't get the human resources you require, with the skills you need them to have, at the time you need them, this will greatly affect the chances of project success. Additionally, in acquiring project team members you will need to be aware of any local or national employment legislation, collective bargaining agreements, typical employment contracts, and any other relevant guidelines.

INPUTS

The Acquire Resources process uses some or all of the following inputs.

PROJECT MANAGEMENT PLAN

The Resource Management Plan is obviously a key input into the Acquire Resources process because it provides a description of how you will carry out acquiring the people that you need for your project team. More specifically, the Resource Management Plan includes a description of the roles and responsibilities required during the life of the project to complete the project activities, and the project organizational chart showing the number and reporting lines of people on the project team.

One of the most important parts of the Resource Management Plan to be used as an input into the Acquire Resources process is the staffing management plan, because it specifically addresses how project team members are to be acquired. The Resource Management Plan is an output from the Plan Resource Management process. The staffing management plan is a subsidiary plan of the Resource Management Plan.

You will also find the procurement management plan useful as it may outline the expected ways you have to follow in order to procure your resources.

The cost baseline will provide you with the data about how much you have forecast to spend to acquire the resources.

PROJECT DOCUMENTS

The following documents will be useful to you as you acquire the necessary resources to complete the project work:

- Project schedule - this will tell you when you require the resources

- Resource calendars - this will tell you the expected working time of the resources
- Resource requirements - this will tell you specific information about the resource attributes
- Stakeholder register - this will enable you to identify those stakeholders who can assist you with acquiring resources

ENTERPRISE ENVIRONMENTAL FACTORS

The specific types of enterprise environmental factors that will be useful in acquiring your project team are any local government or industry regulations affecting the employment of project personnel. Other enterprise environmental factors may also include general organizational structure issues.

ORGANIZATIONAL PROCESS ASSETS

The specific types of organizational process assets that will assist you in acquiring your project team members include any relevant organizational policies, processes, and guidelines relating to the acquisition and employment of people. Additionally, historical information and lessons learned from previous projects are also useful organizational process assets.

TOOLS AND TECHNIQUES

The following tools and techniques are used upon the inputs to deliver the Acquire Resources process outputs.

DECISION MAKING

The process of acquiring project team members can also use *multicriteria decision analysis* so that you can take into account a variety of criteria in order to make the best decision about who should be selected to work on the project. In this instance, you would choose the criteria that were relevant; these criteria could be such things as cost, experience, and availability. You would give each of these a weight, and then score individual candidates, multiply their scores by the weightings, and arrive at a total score. By ranking each candidate by their total scores you will be able to determine your preferred candidates.

INTERPERSONAL AND TEAM SKILLS

Negotiation for your project team members will occur in several ways. First, you will need to negotiate with functional managers to get the staff you want, when you want them. Your ability to negotiate in the circumstances reflects the power and authority that you have. If you are working in a weak matrix environment, you will have little power and authority, and the allocation of project team members to your project will be at the discretion of the functional manager. However, if you are working in a strong matrix organization, you will have the power and authority to get the project team members you need, when you need them.

The process of negotiation also occurs with external providers of project team members, or during the process of recruiting a project team member and the negotiation of a particular employment contract.

Given the importance of negotiation in acquiring project team members in a timely and cost-effective manner, it is important that you have good negotiation skills.

PREASSIGNMENT

Preassignment is the advanced allocation of project team members to your project. This can happen as a result of both internal and external processes in which specific people are assigned to the project as a result of the skills and experience they may have, or because of particular contractual arrangements.

Real World

I've often found that as a general rule, up to half of my project team members are allocated on a preassigned basis due to the particular skills and knowledge they have. This can be quite a good thing, because you know that you have people with the right skills allocated to your project from the beginning. There can be a high degree of uncertainty in the process of trying to acquire people for your project via either negotiation with functional managers or by some external recruitment process.

Virtual teams

The use of *virtual teams* is becoming increasingly common throughout the world as technology allows people to work together in ways they previously couldn't. These virtual teams can be separated by different floors in building, can be in different cities, or can even be in different countries. The advantages of the virtual team are that it allows you to use the skills and experience of people who may not be able to co-locate in the same area, and also to cater to individual preferences in terms of work hours or work locations. The use of virtual teams is also a legitimate option when a project may incur large travel expenses in order to host face-to-face meetings. A drawback to virtual teams is that it is difficult to maintain effective communication by using any sort of technology, such as e-mail, telephone, or video conference.

OUTPUTS

The Acquire Resources process produces some or all of the following outputs.

PHYSICAL RESOURCE ASSIGNMENTS

This will provide a list of where any physical resources you have to acquire will be assigned throughout the project.

PROJECT TEAM ASSIGNMENTS

A key output from the Acquire Resources process is, of course, the *project team assignments*. Project team assignments provide documentation of project team members' names, their roles and responsibilities, contact details, and other relevant information that allows all interested stakeholders to view who is part of the project team, their roles, and how to contact them. The project team assignments go on to be used as an input into the Manage Team and Develop Team processes.

RESOURCE CALENDARS

The resource calendars are a useful output from the Acquire Resources process because they document when people are available to work on the project. At a high level, they will include such things as weekends or public holidays; at a lower and more specific level they will include when personnel actually work according to their individual work agreements, and any known holidays they are taking. The resource calendars go on to be used as an input into the Develop Team process, as well as the Estimate Activity Resources, Estimate Activity Durations, Develop Schedule, and Determine Budget processes.

PROJECT MANAGEMENT PLAN UPDATES

The specific parts of the project management plan that may be updated as a result of the Acquire Resources process are the Resource Management Plan, and the cost baseline.

PROJECT DOCUMENTS UPDATES

During the ongoing process of acquiring your project resources, because remember that it is not just a one off activity, but it is something that you will probably do throughout the life of the project, you will possibly want to update a variety of project documents to reflect how the acquisition of project resources has impacted upon them. These will include the following:

- Lessons learned register
- Project schedule
- Resource breakdown structure
- Resource requirements
- Risk register
- Stakeholder register

ENTERPRISE ENVIRONMENTAL FACTORS UPDATES

The specific enterprise environmental factors that you may wish to update include the following:

- Resource Availability: Details of newly acquired resources, like skill levels and availability periods, could be updated in organizational databases.
- Market Conditions: Updated information on vendor availability, costs, or labor rates might be reflected.

- Technology Infrastructure: Acquired technology or software may require updates to an organizational tech inventory.

ORGANIZATIONAL PROCESS ASSETS UPDATES

The specific organizational process assets that you may want to update include the following:

- Templates and Forms: If new resource acquisition methods are used, templates for contracts or request forms may be updated.
- Resource Calendars: Updated to reflect the schedules of new team members or equipment availability.
- Procurement Policies: If vendor contracts are involved, updates to standard contract terms or vendor lists might occur.

Quick Check

1. Why is the Resource Management Plan an important input into the Acquire Resources process?
2. What is meant by the term “preassignment”?
3. Why are negotiation skills useful during the Acquire Resources process?
4. What is the advantage gained in using multicriteria decision analysis?

Quick Check Answers

1. The Resource Management Plan and the staffing management plan provide specific guidance on how the process of acquiring your project team members will be carried out.
2. Preassignment involves having team members allocated to your project before the project begins as a result of specific skills and experience or as a result of contractual negotiations.
3. Negotiation skills are important because, when you are recruiting project team members, you may have to negotiate with their functional managers or, if you are recruiting team members from the open employment marketplace, you will have to negotiate employment contracts with them directly.
4. Using multicriteria decision analysis allows you to rank prospective team members based upon important attributes to decide who should be recruited.

7.5 DEVELOP TEAM

TABLE 7-4 Develop Team process

INPUTS →	TOOLS AND TECHNIQUES →	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Resource Management Plan</i> ▪ Project documents ▪ <i>Lessons learned register</i> ▪ <i>Project schedule</i> ▪ <i>Project team assignments</i> ▪ <i>Resource calendars</i> ▪ <i>Team charter</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Colocation ▪ Virtual teams ▪ Communication technology ▪ Interpersonal skills ▪ <i>Conflict management</i> ▪ <i>Influencing</i> ▪ <i>Motivation</i> ▪ <i>Negotiation</i> ▪ <i>Team building</i> ▪ Recognition and rewards ▪ Training ▪ Individual and team assessment ▪ Meetings 	<ul style="list-style-type: none"> ▪ Team performance assessments ▪ Change requests ▪ Project management plan updates ▪ <i>Resource management plan</i> ▪ Project documents updates ▪ <i>Lessons learned register</i> ▪ <i>Project schedule</i> ▪ <i>Project team assignments</i> ▪ <i>Resource calendars</i> ▪ <i>Team charter</i> ▪ Enterprise environmental factors updates ▪ Organizational process assets updates

The Develop Team process is an executing process that uses the Resource Management Plan to improve individual and team performance so that the team members will be able to contribute to a greater chance of project success. The goal is to develop a high-performing team, and a key concept is that the project manager has responsibility for this, must lead by example, and must actively seek to continuously develop the team. Thus, it is important that any project manager actively develop and practice his or her leadership skills and knowledge of how to build a high-performing team.

INPUTS

The following inputs are used in the Develop Team process.

PROJECT MANAGEMENT PLAN

The Resource Management Plan is a critical input into the Develop Team process because it sets out and describes how the process of developing a high-performing team will occur. The Resource Management Plan is an output from the Plan Resource Management process.

PROJECT DOCUMENTS

Lessons learned register will provide you with a valuable lessons learned on previous projects and you will be able to apply those to more successfully develop your team.

The project schedule is an important project document because it will provide you with milestones and sequencing of activities so that you know exactly when you will need the team.

The project team assignments describe who the individual project team members are and their current roles, experience, and ability. This information is useful for identifying team members and deciding who needs training. Project team assignments are an output from the Acquire Resources process.

Resource calendars, which identify when the project team members are available to work, are an important input into the Develop Team process because they let you know when people are available to participate in team-building activities. Resource calendars are an output from the Acquire Resources process.

The team charter will outline the ground rules and expected ways of working for the team.

ENTERPRISE ENVIRONMENTAL FACTORS:

Useful enterprise environmental factors to develop the team will include the following:

- Organizational Culture: Provides context for team behavior and interaction.
- HR Policies: Guidelines for training, evaluations, and team development.
- Skill Inventory: A database of employee skills can guide team formation.

ORGANIZATIONAL PROCESS ASSETS:

Useful organizational process assets to help you develop the team will include the following:

- Team-building Practices: Established methods for building cohesive teams.
- Training Programs: Existing organizational training materials or courses.
- Lessons Learned: Past experiences documented from similar projects to guide team development.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the process outputs.

COLOCATION

Colocation means trying to get as many of the project team members in face-to-face contact with each other as possible by placing them in the same physical location permanently or on a regular basis, such as in team meeting rooms. The purpose of co-location is to enhance team building through better and more effective communication and relationship building. People do these things better when they can see each other. The practice of co-locating people in the same space is often called the creation of a *war room*.

VIRTUAL TEAMS

Virtual teams can be useful in certain circumstances but they also come with a lot of limitations which will directly affect team development. It is very difficult to get a high performing team that is exclusively a virtual team because of the issues around team communication.

COMMUNICATIONS TECHNOLOGY

As part of developing the team you will choose a range of appropriate communication technology and you will train everybody in its use. You are probably already using examples of this in your day-to-day job at the moment.

INTERPERSONAL SKILLS

Interpersonal skills are key skills for any project manager to have so that the manager can effectively contribute to the development of the team. Team development is not a mechanical exercise; it is one built upon relationships between people. Thus, interpersonal skills, or soft skills, are useful in building these relationships and contributing toward a high-performing project team.

There are a wide range of interpersonal skills that a project manager must develop and learn to use at the appropriate time. These include the following eleven skills:

1. Leadership
2. Team building
3. Motivation
4. Communication
5. Influencing
6. Decision making
7. Political and cultural awareness
8. Negotiation
9. Trust building
10. Conflict management
11. Coaching

We will now look at each of these eleven skills in more detail.

1. Leadership is the purposeful influencing of followers. A leader must have a clear vision of where he or she wants to take the followers. In relation to a project, a vision can be a successful project in terms of time, cost, and quality. Because leadership is essentially a relationship between the leader and follower, it must be built like any other human relationship, upon respect and trust, which are key elements of effective leadership. Project managers are responsible for developing their own leadership abilities, and must realize that different situations call for different leadership styles or the demonstration of a different set of leadership competencies. Because leadership is situational, the type of leadership required over time can change. Figure 7-7 shows how different leadership styles can change from a more autocratic style at the beginning of a project to a more participatory, or supporting, style of leadership toward the end of the project. This model indicates that a leader trusts the team members and gives away some of his or her power. Both trust and the ability to give away power are important attributes of a good leader.

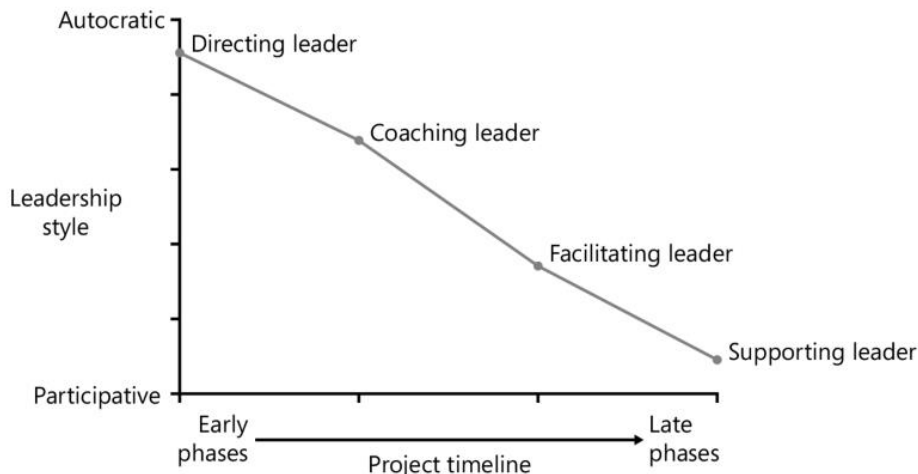


FIGURE 7-7 The types of project leadership required at different points of a project.

Fielder's Contingency theory states that a leader's effectiveness is contingent on two sets of factors: whether the leader is task-oriented or relationship-oriented and whether the environment is stressful or calm. A task-oriented leader is more effective in stressful situations, and a relationship-oriented leader is more effective in calm situations.

Being in a position of leadership gives power to the project manager, and a good project manager will recognize the responsibility that comes with power. If used well, power can be a great way to lead project team members, inspire people, and motivate people. If used incorrectly by a project manager, power can create hostility, demotivate an entire team, and cause staff to leave. There are five forms of power that a project manager can use to assist both in his or her leadership of, and negotiation for, the project team. The five leadership styles are:

- i. Formal or legitimate power, which is based on the position that you hold as a manager. It should be viewed as an interim form of power, because people may respect you initially because of the fact that you are the manager, but your subsequent actions could cause this form of power to become invalid; therefore, it is not the best form of power to use.
 - ii. The power to reward people, which is a good form of power to use because you are using it to incentivize good performance and discourage poor performance. It should not be used to blackmail or manipulate people.
 - iii. The power to impose penalties or punishment upon people, which is never the best form of power to use, because it will always generate negative feedback in both explicit and subtle ways.
 - iv. Expert power, which is an excellent form of power to use because it is one that is ascribed to you by others because of your respected position as a technical expert. You are viewed as the expert in a particular area and, as such, people look up to you.
 - v. Referent power, which is a result of your own personality and whether or not you are liked and respected by other people.
2. The ability to build teams is a key interpersonal skill for any project manager and leader. This topic is covered in more detail in a later section in this chapter. Team-building activities go together with good leadership to build a high-performing team.
 3. The ability to motivate people, and understand what motivates different people, is a key interpersonal skill for a project manager to have. Different people are motivated by different things, and it is important that a project manager have an understanding of different motivation theories. The following are the most popular motivation theories that a project manager should be aware of:
 - *Maslow's hierarchy of needs* describes a situation whereby people perform at their best when they have the opportunity to be what Maslow refers to as "self-actualized." This is the top of the needs pyramid he describes. However, people want to fulfill the bottom needs first and cannot fulfill higher needs until lower ones are fulfilled, and the current need will always take precedence. So if people are concerned about their physiological well-being—for instance, if they can't afford groceries—then they will not be able to gain acceptance and esteem. Figure 7-8 shows the levels in Maslow's hierarchy of needs.

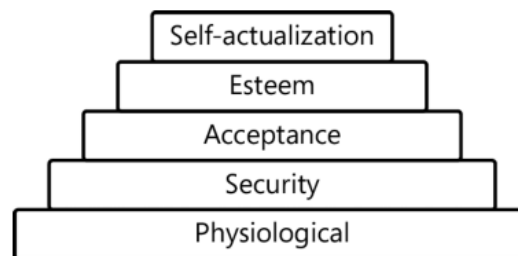


FIGURE 7-8 Maslow's hierarchy of needs.

- *Vroom's Expectancy Theory* states that the expectation of receiving a reward for a certain accomplishment will motivate people to work harder, but it only works if the accomplishment is perceived to be achievable. People will make a conscious decision to work harder if they believe there are achievable outcomes. For a project manager, this means that some people will respond to rewards offered in return for higher productivity, but that those rewards need to be available, specific, measurable, and relevant to the individual. If not, they can prove to be a disincentive.

- *Herzberg's Motivation-Hygiene Theory* states that hygiene factors (such as company policies, good supervision, and safe and pleasant working conditions) will not motivate, but their absence will make staff unsatisfied. Motivation factors (such as achievement, work, responsibility, and advancement) will motivate, but only if hygiene factors are in place. For the project manager leading a project team, this means that if the working conditions are unpleasant or unsafe, then offering up greater responsibility to people in return for more work will not succeed. They will first want the basic workplace environment conditions improved.
- *McClelland's Human Motivation, Achievement, or Three Needs Theory* states that people will work not for more money but instead for achievement, power, and affiliation, and a manager should use these three needs to motivate employees.

Real World

It is often thought that money is the prime motivator for people. This is only true up to the point where you pay people enough to take the issue of money off the table. The specific amount differs between regions and countries, but at a certain point, people have enough money to take care of their essential and basic needs and have some discretionary income to be able to afford nonessential things. Above a certain amount of money, people will be motivated by more intrinsic things such as prestige, responsibility, recognition, and authority. I have always found that when working with experienced, educated professionals as I often do in a project, these latter factors are much more productive ways to motivate people.

- *McGregor's Theory X and Theory Y* describe a manager's attitude towards staff or team members. A theory X manager believes that team members are inherently unmotivated to work, require constant supervision, and can't be trusted. A theory Y manager believes that people want to work, can be trusted, and are naturally ambitious and self-motivated.
- Following on from McGregor's Theory X and Theory Y comes *Ouchi's theory Z*, which tries to increase worker loyalty and raise worker productivity by offering a job for life and providing support for the employee both in and out of the workplace.

Real World

I'm sure we have all dealt with managers who exhibit some theory X attributes. It is important to realize that it has been proven that management in a theory X style is extremely counterproductive and will lead to lower productivity, decrease staff morale, and increased staff turnover. As you develop your own managerial style, I encourage you to model yourself after those managers you have admired most; they probably displayed theory Y attributes.

NOTE Motivation Theories

As part of your own professional development, you may want to read both the seminal works by the authors mentioned in this section and the works of authors influenced by these people.

EXAM TIP

Make sure you know the basics of each of these theories for the exam. Don't get confused by an answer with just any old surname in it. If you know the basics, you will be able to differentiate between a right answer, a wrong answer, and a made-up answer.

4. Excellent communication skills are an essential interpersonal skill for a project manager to have, because communication forms the basis of any relationship. We will cover communication skills in more detail in Chapter 8, "Communications Management."
5. The ability to proactively influence people is an important interpersonal skill that a project manager must have. It is achieved through being genuine, leading by example, establishing networks, and adjusting communication styles to suit the audience.

EXAM TIP

A project manager must always be proactively influencing all aspects of the project, potential change requests, and stakeholder expectations.

Real World

There is a fine line between influencing and manipulation. Manipulation usually has a secret agenda and seeks to force people to do something they wouldn't normally do. Influencing is a political act that is built on relationships, mutual understanding, and an attempt to elicit cooperation from others.

6. Decision-making skills are essential for any project manager. In making a decision, there are four basic decision styles normally used by project managers depending on the time constraints present, trust between team members, quality of information, and ability to get acceptance. They are command, consultation, consensus, and if all else fails, coin flip. In addition to these reactive means of making a decision, there is a more formal six-phase decision-making model developed by Morris and Sashkin. In this model, the six phases in making a decision are:
 - i. Problem definition
 - ii. Problem solution generation
 - iii. Ideas to action
 - iv. Solution action planning
 - v. Solution evaluation planning
 - vi. Evaluations of the outcome and process
7. Political and cultural awareness should be a focus for a project manager because he or she will need to develop and demonstrate the skillful use of politics and power in order to be successful. Additionally, having an awareness of different cultures and the differences each has will enable a project manager to operate more effectively.
8. Advanced negotiation skills are key skills used in several areas in the profession of project management. The goal of any negotiation is an agreement that all parties to the agreement will benefit from. A win-win outcome is the optimal outcome from a negotiation. Complex negotiations may require specialist skills that the project manager may want to learn, or the project manager may want to bring in experts to complete the negotiations.
9. Trust building within the team and also with stakeholders is a key interpersonal skill of any project manager. Building trust is a reciprocal relationship built on authenticity. A lack of trust in your relationships with team members and other stakeholders will adversely affect your chances of project success.
10. Conflict management is covered in more detail in the Manage Team process in the next section. The key goal of conflict management is to resolve it permanently and openly wherever possible.
11. Coaching is an important interpersonal skill for the project manager to have and display. It involves providing wisdom and experience to others to enable them to develop professionally and personally.

EXAM TIP

All negotiations should be entered into in good faith. It is never acceptable to coerce weaker parties in a negotiation into an agreement that may be against their best interests.

Team-building activities can take many forms, but all have the goal of enhancing the sense of a single team among everyone working on the project. They can be informal or formal, planned or spontaneous, structured or free-flowing. It is important to realize that team-building activities are not a one-time event; they are instead a continual and ongoing process.

Real World

I have always found that having a constant series of both organized and spontaneous team-building activities that appeal to the team members is not only an important way to increase a sense of camaraderie and productivity, but also a great way to develop a unique sense of a team identity and culture.

The *Tuckman five-stage model* is a convenient way to describe the stages a team of people will go through: forming, storming, norming, performing, and adjourning. Although many models show these as linear stages in team

development, this isn't always the case; any of the behaviors can be observed at any time. Also, teams can cycle between and within an area, and providing awareness of the model and stages to team members can help propel your team to the performing stage faster. The key point about the model is that your goal is to get your team to the performing stage and keep them there with proactive team management.

Figure 7-9 shows the different stages of the Tuckman five-stage model against performance and time. Although the diagram may indicate an unstoppable linear progression, the reality is that team dynamics can be highly unstable and teams will always be in danger of slipping backward into storming behaviors.

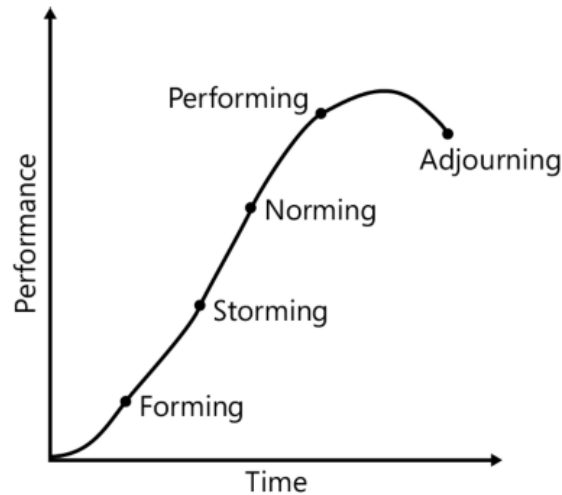


FIGURE 7-9 The Tuckman five-stage model of team development.

When a group meets for the first time, or when new people join a group, there is a period of forming as everybody tries to figure out who the other members are, what common interests they share, where they sit in the hierarchy, and what their role in the team will be.

Fairly soon after a new team forms or a new person joins the team, you will witness storming behaviors. This is the phase in which the team has to work out what direction they will all be going in, which ideas take priority, and which ideas will be cast aside. This phase is often one of conflict and argument; it can also include passive-aggressive behavior as people within the team jostle for position and power. You will also find storming behaviors in the life of an established team when conditions change. Though storming is essential, the core issues must be resolved to allow the team to fully move beyond it.

Norming is the process when the team members explicitly and implicitly define and accept team behaviors and norms. Norming should be the outcome of the storming phase. During the process of norming, if the issues from the storming phase haven't been dealt with, it will be very hard for people to settle down into a normalized culture.

Performing describes the state where the team has moved through the other phases and begins to achieve a high sense of synergy. This is not a static state, however; it's threatened by things such as conflict, team stability, team culture, and external influences. The goal is to keep the team at this stage with constant attention and effort.

Adjourning is the final stage for groups, particularly in project management. It occurs when individuals leave the project as their jobs end, or when the team finally disbands after completing the project. Recognizing and planning for this stage is an important part of the job of the project manager.

Real World

As a project manager I have been lucky enough to have an awareness of teams and their development and have often watched as people go through the stages described in the Tuckman five-stage model of team development. My main focus as project manager has been to make people aware of what was going on and assist them to move to the performing stage. However, I must admit to also being involved in storming behaviors and being totally oblivious to it until the benefit of hindsight revealed it to me. This is one of the main reasons I now often use an independent outsider to assist with regular team-building and assessment activities.

RECOGNITION AND REWARDS

The purpose of *recognition* and *rewards* is to promote acceptable behaviors and discourage unacceptable behaviors from project team members. As covered already, there are several motivation theories that point out that money is

not the best way to recognize or reward performance or behavior. There are other ways of recognizing and rewarding people that are much more effective. Team members will appreciate recognition, either publicly or privately, for good work, and they will feel valued when the right rewards are given. It is up to the project manager to ensure that he or she is catering to individual needs with appropriate recognition and rewards.

TRAINING

In order to fully develop individuals on your team, you will have to offer *training* in both technical and nontechnical, or soft skills. Training can occur using internal or external trainers and can occur in a classroom environment, on the job, or, increasingly, via remote or online means. Training needs can be agreed upon with team members at regular intervals such as during their performance appraisals, or training can be provided reactively in response to observed needs.

EXAM TIP

You should always assume that you will have to provide training to team members and that you have made a commitment to providing training at all times. This is particularly important if you come across a question in the exam where a team member does not have the right skills to complete an activity. Your first option is always to get them the required training.

INDIVIDUAL AND TEAM ASSESSMENTS

A key element of any effort to develop individual team members is a defined way to assess individual performances and training needs. *Individual and team assessments* will assist in formalizing the process of assessing an individual and planning for their future professional development. A common means of doing this is via the regular performance appraisal meeting and the use of the 360-degree feedback method. In this method, feedback from an individual's peers, superiors, and those who report to that individual is sought, and then provided in a structured setting in a positive way.

Real World

A poorly carried out 360-degree review can backfire very badly. I recall witnessing a junior manager carrying out his first 360-degree review on a project manager. As part of the team, I was sent a questionnaire that only asked what the project manager's weaknesses were and what that manager had done wrong that had to be improved. The very way the questions were phrased set a poor tone, and I did hear that the project manager walked out of the assessment and refused to take part in another with that manager due to the stream of negative feedback.

OUTPUTS

The major outputs from the Develop Team process are the following.

TEAM PERFORMANCE ASSESSMENTS

The primary output from the Develop Team process are the *team performance assessments*, which are prepared by the project manager and document the training activities undertaken and still to be undertaken, any team-building activities undertaken or planned and their outcome, and individual performance assessments. These assessments will be measured against any predefined performance expectations. These predefined performance expectations can include such metrics as staff turnover, length of employment, improvement in individual and team competency, and measures of team cohesiveness.

Team performance assessments go on to be used as an input into the Manage Team process.

CHANGE REQUESTS

Given that developing your team is ongoing throughout much of the lifecycle of the project there may be times where you need to lodge change requests to your resource management documents, your cost documents, your schedule documents or your risk register. Any change requests will be used as an input into the Perform Integrated Change Control process.

PROJECT MANAGEMENT PLAN UPDATES

Hopefully so far we have tried to impress upon you that developing your team is not a one off activity but it is instead an activity that goes on throughout the life of the project. As a result of this you may wish to make updates

to your resource management plan to reflect any changes in your approach to acquiring and developing your people resources.

PROJECT DOCUMENTS UPDATES

once again, and at the risk of repetition, given that developing your team is an ongoing activity throughout the life of the project you may wish to update a variety of project documents.

ENTERPRISE ENVIRONMENTAL FACTORS UPDATES

The *enterprise environmental factors updates* that will occur as a result of the Develop Team process include general organizational personnel employment policies and guidelines. They may include the following:

- Skill Inventory: Updated to reflect new skills or proficiencies gained by team members during the project.
- Employee Performance Data: Records might be updated based on team performance metrics or evaluations.

ORGANIZATIONAL PROCESS ASSETS UPDATES

If appropriate you may wish to update the following organizational process assets:

- Team-building Practices: If new team-building exercises were effective, they could be added to the repository for future use.
- Training Programs: Updates or additions may be made to internal training programs based on what was effective in team development.
- Lessons Learned: Insights into what worked or didn't work in team development can be documented for future projects.
- Templates and Tools: Any new tools or documentation templates used for team assessments might be added to the organizational toolkit.

Quick Check

1. Who has responsibility for the ongoing development of the team and individuals within the team?
2. Why is it important that the project manager have a well-developed set of interpersonal skills?
3. If you are witnessing arguments between team members, what phase of the Tuckman five-stage team development model is the team at?
4. What is the most important aspect to recognize when rewarding people for work done or offering rewards as the incentive to do work?
5. What are the two best forms of power a project manager can use?

Quick Check Answers

1. The project manager has ultimate responsibility for leading the team and taking care of group and individual development needs.
2. The successful development of a team requires a range of interpersonal skills to be utilized by the project manager.
3. The team is at the storming stage.
4. The most important thing to recognize when using rewards is to make them appropriate and meaningful to the individual or team.
5. The two best forms of power the project manager can use are expert, in which the manager is viewed as an expert because of his or her technical ability, and reward, in which he or she is able to provide incentives for good work.

7.6 MANAGE TEAM

TABLE 7-5 Manage Team process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Resource Management Plan</i> ▪ Project documents ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Project team assignments</i> ▪ <i>Team Charter</i> ▪ Work performance reports ▪ Team performance assessments ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Interpersonal skills ▪ <i>Conflict management</i> ▪ <i>Decision making</i> ▪ <i>Emotional intelligence</i> ▪ <i>Influencing</i> ▪ <i>Leadership</i> ▪ Project management information systems 	<ul style="list-style-type: none"> ▪ Change requests ▪ <i>Project management plan updates</i> ▪ <i>Resource management plan</i> ▪ <i>Schedule baseline</i> ▪ <i>Cost baseline</i> ▪ Project documents updates ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Project team assignments</i> ▪ Enterprise environmental factors updates

The Manage Team process is an executing process that uses the Resource Management Plan, team performance assessments, and work performance reports to monitor team and individual performance, resolve conflicts, and optimize team performance. If, as a result of carrying out this process any changes are required, then a change request will be generated.

INPUTS

The following inputs are used in the Manage Team process.

PROJECT MANAGEMENT PLAN

The Resource Management Plan is a critical input into the Manage Team process because it provides critical information on how human resources, or people, will be managed, controlled, and assessed. The Resource Management Plan is an output from the Plan Resource Management process.

PROJECT DOCUMENTS

The *issue log* is used as an input into this process because it may describe and document relevant issues relating to management of individual team members or the team as a whole. The issue log is an output from the Manage Stakeholder Engagement process.

The lessons learned register will provide valuable information about lessons already learned that relate to team development, as a well as lessons learned from other projects.

Project team assignments provide a list of the project team members, their roles, and contact details, all of which are important when managing project team members. Project team assignments are an output from the Acquire Resources process.

The team charter serves as a foundational document that outlines roles, responsibilities, and guidelines for team interaction. Using it as an input into the Manage Team process offers several advantages:

- **Role Clarification:** The charter clearly defines who is responsible for what, aiding in conflict resolution and decision-making.
- **Behavior Guidelines:** The charter sets expectations for team behavior, making it easier to address issues like poor communication or lack of cooperation.
- **Decision-making Framework:** The charter often outlines how decisions should be made, which can guide the team in resolving disagreements or making project-related choices.
- **Conflict Resolution:** If conflicts arise, the charter may contain agreed-upon methods for resolving them, providing a basis for intervention.

By providing a pre-established framework for roles and behavior, the team charter simplifies the task of managing the team, making the process more efficient and effective.

WORK PERFORMANCE REPORTS

Work performance reports, which are an output from the Monitor and Control Project Work process, provide information about how the project team members are actually performing compared to the forecasts made about their performance. As it is the project team members who are responsible for all aspects of the project that generate other success metrics such as time, cost, quality, and scope, it is important that the work that they are expected to do that generates these performance measurements. The work performance reports focus on the performance of the team and individuals.

TEAM PERFORMANCE ASSESSMENTS

Team performance assessments, which are an output from the Develop Team process, contain information about the performance of both individuals and the whole project team. They can include an assessment of how well the team is performing as a whole and also individual assessments, such as key performance indicators (KPIs) from a person's job description, an assessment of interpersonal skills, and an assessment of contribution to the organization's goals. They can identify future training needs and contribute to professional development both while the team members are on the project and also after they leave.

ENTERPRISE ENVIRONMENTAL FACTORS

Enterprise Environmental Factors (EEFs) provide the contextual backdrop for the Manage Team process, shaping how team management should be approached. Relevant examples include the following:

- **Market Conditions:** Awareness of market trends can influence team goals and performance metrics.
- **Resource Availability:** Knowing the available resources can help in task delegation and problem-solving.
- **Stakeholder Expectations:** These may influence team objectives and the urgency of tasks.

By being aware of these factors, project managers can adapt their team management strategies to better fit within the constraints and opportunities provided by the organizational environment.

ORGANIZATIONAL PROCESS ASSETS

The specific types of organizational process assets that may be useful in managing the project team include any processes or guidelines for acknowledging good work or dealing with poor performance, any financial incentive structures that may be applied to high performance, and any other relevant organizational guidelines on managing team members.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the process outputs.

INTERPERSONAL AND TEAM SKILLS

Although conflict can at times be a positive and beneficial tool for soliciting lateral thinking, in most instances conflict is perceived as a negative influence upon team performance and needs to be addressed promptly, openly, and with a view to resolving the core issues in order to ensure that it does not adversely affect team performance. The most common causes of conflict between project team members are time constraints, project priorities, resource availability, differences in technical opinions, administrative processes, project cost and budget, and individual personalities.

It is the role of the project manager to take responsibility first of all for setting in place ground rules for the accepted and expected behaviors in working with the team. If conflict does arise, the project manager must take responsibility for dealing with the conflict. There are five main ways of dealing with conflict, each with a different outcome. They are described in the following list.

- i. Withdrawal or avoiding simply avoids dealing with conflict. This is definitely not the best way to deal with conflict.
- ii. Smoothing, or accommodating, tries to resolve conflict by getting parties to agree to disagree and put work ahead of conflict. This approach doesn't deal with the root causes, and therefore the conflict may flare up again at any time.
- iii. Compromise, or reconciliation, is a conflict resolution technique that involves each party giving something up in order to resolve the conflict. Thus, instead of being a win-win solution, the result can often be a lose-lose situation. This approach should be viewed as a second-best option to confronting or problem-

- solving.
- iv. Forcing, or directing, involves one party to the conflict pushing his or her viewpoint on another person and trying to have that person adopt it, through the use of various forms of power.
 - v. Collaboration, or problem-solving, is the best option for dealing with any conflict, because it seeks to deal with the conflict in a permanent manner involving multiple viewpoints and resolve it openly through consensus.

EXAM TIP

You should always assume that conflict is inevitable in any project and that you will have to deal with it. As the project manager, it is your responsibility to always deal with conflict in an open manner that seeks to resolve the core reasons for the conflict. Simply ignoring or sweeping conflict under the carpet is not an acceptable solution, because this will eventually manifest in a number of ways, all of which are detrimental to your team's performance and ultimately to the success of the project.

Other important interpersonal and team skills include decision making, emotional intelligence, influencing and leadership. We covered each of these in depth in the previous process group.

PROJECT MANAGEMENT INFORMATION SYSTEM

Keeping track of team performance and managing individual will require the use of software.

OUTPUTS

The major outputs from the Manage Team process are the following.

CHANGE REQUESTS

As a result of carrying out the Manage Team process, you may discover variations between what you had planned in terms of team performance and what is actually occurring. Additionally, you may wish to amend any planned acquisition or development activities in order to optimize team performance. Any of these options will involve the creation of a change request and the change request will be an input into the Perform Integrated Change Control process where it will be considered as part of the documented change control process.

PROJECT MANAGEMENT PLAN UPDATES

The specific parts of the project management plan that may be updated as a result of the Manage Team process are the Resource Management Plan, schedule baseline, and cost baseline.

PROJECT DOCUMENTS UPDATES

Specific project documents that may be updated as a result of carrying out this process are such things as the issue log, lessons learned register, and project team assignments.

ENTERPRISE ENVIRONMENTAL FACTORS UPDATES

The specific enterprise environmental factors that may be updated include any organizational employee performance appraisal and feedback policies and guidelines.

Quick Check

1. What is the main focus of the Manage Team process?
2. Why are observation and conversation important tools in successfully managing a project team?
3. What is the best method to use for successful conflict management?

Quick Check Answers

1. The main focus of the Manage Team process is to analyze team performance against forecast team performance and undertake actions to ensure high team performance by providing feedback and, if necessary, submitting change requests to optimize team performance.
2. Because the management of team performance relies heavily on a project manager's ability to accurately observe what is occurring with individual and team performance, the two tools of observation and conversation are excellent means of gathering information from team members.
3. The best method to ensure successful conflict management is to take a confronting or problem-solving approach that will permanently resolve any conflict being dealt with.

7.7 CONTROL RESOURCES

TABLE 7-7 Control Resources process

INPUTS ⇌	TOOLS AND TECHNIQUES ⇌	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Resource management plan</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Issue log</i> ▪ <i>Lesson learned register</i> ▪ <i>Physical resource assignments</i> ▪ <i>Project schedule</i> ▪ <i>Resource breakdown structure</i> ▪ <i>Resource requirements</i> ▪ <i>Risk register</i> ▪ Work performance data ▪ Agreements ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Alternatives analysis</i> ▪ <i>Cost-benefit analysis</i> ▪ <i>Performance reviews</i> ▪ <i>Trend analysis</i> ▪ Problem solving ▪ Interpersonal and team skills <ul style="list-style-type: none"> ▪ <i>Negotiation</i> ▪ <i>Influencing</i> ▪ Project management information system 	<ul style="list-style-type: none"> ▪ Work performance information ▪ Change requests ▪ Project management plan updates <ul style="list-style-type: none"> ▪ <i>Resource management plan</i> ▪ <i>Schedule baseline</i> ▪ <i>Cost baseline</i> ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Assumption log</i> ▪ <i>Issue log</i> ▪ <i>Lesson learned register</i> ▪ <i>Physical resource assignments</i> ▪ <i>Resource breakdown structure</i> ▪ <i>Risk Register</i>

The Control Resources process is a Monitoring and Controlling process that uses the Resource Management Plan, performance assessments, and work performance reports to monitor team and individual performance, resolve conflicts, and optimize team performance. If as a result of carrying out this process any changes are required, then a change request will be generated.

INPUTS

The following inputs are used in the Control Resources process.

PROJECT MANAGEMENT PLAN

The Resource Management Plan is a critical input into the Control Resources process because it provides critical information on how human resources, or people, will be managed, controlled, and assessed. The Resource Management Plan is an output from the Plan Resource Management process.

PROJECT DOCUMENTS

Each of these documents and tools offers specific information that can be crucial for the Control Resources process:

- **Issue Log:** Helps identify resource-related issues that need to be addressed, like conflicts over shared resources or unavailability of critical assets.
- **Lessons Learned Register:** Provides insights from past projects on effective resource control strategies or common pitfalls.
- **Physical Resources Assignments:** Gives a clear picture of where physical resources like equipment or materials are allocated, aiding in optimization and reallocation as needed.
- **Project Schedule:** Indicates when certain resources are needed, helping to anticipate and prevent scheduling conflicts.
- **Resource Breakdown Structure:** Outlines the hierarchy and categories of resources, facilitating tracking and control.
- **Resource Requirements:** Specifies the types and quantities of resources needed, offering a baseline for control activities.
- **Risk Register:** Highlights potential risks related to resources, like shortages or delays, allowing for preemptive action.

By using these inputs, project managers can make more informed decisions, anticipate issues, and allocate resources more efficiently in the Control Resources process.

WORK PERFORMANCE DATA

Work performance data, which are an output from the Monitor and Control Project Work process, provide information about how the project team members are actually performing compared to the forecasts made about their performance. As it is the project team members who are responsible for all aspects of the project that generate other success metrics such as time, cost, quality, and scope, it is important that the work that they are expected to do that generates these performance measurements. The work performance data provides reports that focus on the performance of the team and individuals.

ORGANIZATIONAL PROCESS ASSETS

The specific types of organizational process assets that may be useful in controlling resources include any processes or guidelines for acknowledging good work or dealing with poor performance, any financial incentive structures that may be applied to high performance, and any other relevant organizational guidelines on managing team members.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the process outputs.

DATA ANALYSIS

Each of these tools and techniques can offer specific insights into the efficient and effective control of resources:

- **Alternatives Analysis:** Evaluates different options for resource allocation or resolution of resource conflicts. Helps choose the most efficient path. For example, deciding between hiring temporary staff or redistributing tasks among existing team members.
- **Cost-Benefit Analysis:** Weighs the financial aspects of different resource management actions against their expected benefits. For example, calculating whether the cost of expedited shipping for a critical component

is justified by the benefit of staying on schedule.

- Performance Reviews: Measures the efficiency and effectiveness of resource utilization. Helps identify areas for improvement. For example, reviewing the uptime and downtime of a machine to assess if it's being used optimally.
- Trend Analysis: Examines patterns over time to predict future resource needs or identify looming issues. For example, analyzing past labor hours to predict if more staff will be needed in upcoming project phases.

Using these tools and techniques, project managers can more effectively monitor and control resources, optimizing both allocation and usage.

PROBLEM SOLVING

This technique involves identifying issues, analyzing them, and finding the most effective solutions. It's essential for resolving resource conflicts, shortages, or other issues. For example, if two tasks require the same machine at the same time, problem-solving techniques could be used to reschedule tasks or find an alternative machine.

INTERPERSONAL AND TEAM SKILLS

The specific interpersonal skills that would be most useful to you here would be negotiation and influencing, both of which we covered earlier in this chapter.

PROJECT MANAGEMENT INFORMATION SYSTEM

This is software that helps manage project data. It's useful for tracking resource allocation, utilization, and performance in real-time, facilitating quicker decision-making. For example, a PMIS could alert you when a particular resource is over-allocated, allowing for immediate adjustments.

OUTPUTS

The major outputs from the Control Resources process are the following.

WORK PERFORMANCE INFORMATION

This will be information specifically related to how individuals and teams are performing.

CHANGE REQUESTS

As a result of carrying out the Control Resources process, you may discover variations between what you had planned in terms of team performance and what is actually occurring. The change request will be an input into the Perform Integrated Change Control process where it will be considered as part of the documented change control process.

PROJECT MANAGEMENT PLAN UPDATES

The specific parts of the project management plan that may be updated as a result of the Control Resources process are the Resource Management Plan, schedule baseline, and cost baseline because they are most directly impacted by resource issues.

PROJECT DOCUMENTS UPDATES

Specific project documents that may be updated as a result of carrying out this process are such things as the issue log, lessons learned, physical resource assignments, and the risk register.

Quick Check

1. What is the main focus of the Control Resources process?
2. Why are negotiation and influencing important tools in successfully managing a project team?
3. Who should take responsibility for the work involved in the Control Resources process?

Quick Check Answers

1. The main focus of the Control Resources process is to ensure that the physical resources assigned and allocated to the project are available as planned, as well as monitoring the planned versus actual utilization of resources and taking corrective actions as necessary.
2. Successfully managing a project often involves multiple stakeholders with different priorities. Effective negotiation skills can help align these varying interests for optimal resource allocation. Influencing involves persuading or motivating team members and stakeholders to align with project objectives. Effective influencing can help overcome resistance, improve team cohesion, and enhance resource utilization. Both negotiation and influencing are crucial for resolving conflicts, aligning stakeholders, and optimizing resource use, making them invaluable tools in the Control Resources process.
3. The project manager should take responsibility for work involved in the Control Resources process.

7.8 CHAPTER SUMMARY

- The Human Resource Management knowledge area is focused upon the areas around planning which people you need, obtaining the people that you need when you need them, taking responsibility to continually train and develop your project team members, and monitoring individual and team performance.
 - The Plan Resource Management and Estimate Activity Resources processes produces the Resource Management Plan and activity estimates respectively, which guides the three subsequent executing processes.
 - The first of the three executing processes in the Human Resource Management knowledge area, the Acquire Resources process, uses the Resource Management Plan to obtain the project team members you require, with the appropriate skills, at the time that you need them.
 - The Develop Team process, which is an executing process, reflects a commitment to understanding the professional development and ongoing training needs of individual team members and the overall team. The goal of this process is to achieve a high-performing project team via a variety of tools and techniques.
 - The Manage Team process is focused upon using the Resource Management Plan, which outlines the expected levels of individual and team performance, and checking team performance against it. Providing feedback and making changes and corrective actions is an important part of the Manage Team process.
 - The Control Resources process is focused on ensuring that resource usage and utilization is proceeding as planned, and dealing with any required changes.
-

7.9 EXERCISES

The answers for these exercises are located in the “Answers” section at the end of this chapter.

- Match the management theory on the left with the description on the right.

Human Resource Management Tool	Definition
1. McGregor’s theory X and theory Y	A. A theory that states that certain basic workplace factors must be in place before less tangible factors can be used to motivate staff
2. Tuckman five-stage model of team development	B. A theory that describe the attitude of managers toward staff and separates them into those who believe staff are self-motivated and trustworthy and those who belief staff are lazy and untrustworthy
3. Vroom’s Expectancy Theory	C. A theory that states that people will perform at their best when self-actualized but people will want to fulfill the lower-level needs first
4. Herzberg's Motivation-Hygiene Theory	D. A theory that states that the expectation of receiving a reward for a certain accomplishment will motivate people to work harder, but it only works if the accomplishment is perceived to be achievable
5. McClelland's Human Motivation, Achievement, or Three Needs Theory	E. A theory that people will work not for more money, but instead for achievement, power, and affiliation
6. Maslow’s hierarchy of needs	F. A process of describing phases that a team can pass through on the way to becoming a high-performing team

- Arrange the following organizational structures in relation to the power and authority of the project manager, from weakest to strongest.
 - Strong matrix
 - Functional
 - Balanced matrix
 - Weak matrix
 - Projectized
- Take a look at the following list of words. They represent either a type of power a project manager can have, a decision-making style a project manager can use, or a conflict management style that can be used. Sort each of them into one of these three categories.
 - Consensus
 - Forcing
 - Referent
 - Punishment
 - Coin flip
 - Command
 - Compromise
 - Consultation
 - Withdrawal
 - Reward
 - Collaboration
 - Problem-solving
 - Formal
 - Expert
 - Smoothing

7.10 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 7 by answering these questions. The answers to these questions, and the explanations of why each answer choice is correct or incorrect, are located in the “Answers” section at the end of this chapter.

1. Which of the following is not an executing process in the Human Resource Management knowledge area?
 - A. Manage Team
 - B. Develop Team
 - C. Acquire Resources
 - D. Plan Resource Management
2. What is the correct order of project role descriptions when ranking from most to least power?
 - A. Project manager, project coordinator, project expediter
 - B. Project manager, project expediter, project coordinator
 - C. Project coordinator, project manager, project expediter
 - D. Project coordinator, project expediter, project manager
3. If you are working in an organization where you continually have to ask another manager if you can spend money allocated to your project, and obtain personnel to work on your project, what sort of organizational structure are you working in?
 - A. Projectized organization
 - B. Functional organization
 - C. Strong matrix organization
 - D. Balanced matrix organization
4. What is the best definition of a program of projects?
 - A. All projects that the organization is undertaking
 - B. An individual project
 - C. A group of projects that a portfolio manager oversees
 - D. A group of projects that are related in some way
5. What is the primary role of the project sponsor?
 - A. To be ultimately accountable for the project
 - B. To directly manage the performance of the project manager
 - C. To provide financial and political support for the project
 - D. To be the primary liaison with the client
6. If you are placing advertisements in local newspapers seeking to recruit project team members, which tool or technique are you using?
 - A. Negotiation
 - B. Preassignment
 - C. Acquisition
 - D. Recruitment

7. What information does a resource calendar contain?
 - A. The pay rates of project team members
 - B. A description of the role of each team member and contact details
 - C. The days and times when the project team members are available to work on the project
 - D. A description of the work to be done on the project

8. As a project manager, you will have access to different forms of power. When managing your team, what is the worst form of power to use?
 - A. Punishment
 - B. Expert
 - C. Referent
 - D. Legitimate

9. What is the generally correct order of stages, or phases, a team will go through according to the Tuckman five-stage model of team development?
 - A. Forming, storming, norming, performing, adjourning
 - B. Norming, storming, forming, performing, adjourning
 - C. Storming, norming, forming, performing, adjourning
 - D. Storming, forming, norming, performing, adjourning

10. Which of the following is the lowest of the levels in Maslow's hierarchy of needs?
 - A. Physiological
 - B. Security
 - C. Esteem
 - D. Self-actualization

11. You have exhausted all other techniques for making a decision and are making a random decision between two possible options. What style of decision-making technique are you using?
 - A. Dice throw
 - B. Coin flip
 - C. Random assignment
 - D. Lucky guess

12. Two project team members are disagreeing strongly about the relevant engineering standards to apply to the design of a particular element in your project. You ask them to carry on working and ignore the problem. What conflict resolution technique are you using?
 - A. Problem-solving
 - B. Collaboration
 - C. Forcing
 - D. Avoiding

7.11 ANSWERS

This section contains the answers for the Exercises and Review Questions in this chapter.

EXERCISES

- Match the management theory on the left with the description on the right.

HR Management Tool	Definition
1. McGregor's theory X and theory Y	B. A theory that describe the attitude of managers toward staff and separates them into those who believe staff are self-motivated and trustworthy and those who belief staff are lazy and untrustworthy
2. Tuckman five-stage model of team development	F. A process of describing phases that a team can pass through on the way to becoming a high-performing team
3. Vroom's Expectancy Theory	D. A theory that states that the expectation of receiving a reward for a certain accomplishment will motivate people to work harder, but it only works if the accomplishment is perceived to be achievable
4. Herzberg's Motivation-Hygiene Theory	A. A theory that states that certain basic workplace factors must be in place before less tangible factors can be used to motivate staff
5. McClelland's Human Motivation, Achievement, or Three Needs Theory	E. A theory that people will work not for more money, but instead for achievement, power, and affiliation
6. Maslow's hierarchy of needs	C. A theory that states that people will perform at their best when self-actualized but people will want to fulfill the lower-level needs first

- Arrange the following organizational structures in relation to the power and authority of the project manager, from weakest to strongest.
 - Functional
 - Weak matrix
 - Balanced matrix
 - Strong matrix
 - Projectized
- Take a look at the following list of words. They represent either a type of power a project manager can have, a decision-making style a project manager can use, or a conflict management style that can be used. Sort each of them into one of these three categories.

Types Of Power	Decision-Making Styles	Conflict Management
Formal	Command	Withdrawal
Reward	Consultation	Forcing
Punishment	Consensus	Smoothing
Expert	Coin flip	Collaboration
Referent		Compromise
		Problem-solving

CHAPTER REVIEW

1. **Correct Answer: D**
 - A. **Incorrect:** The Manage Team process is an executing process.
 - B. **Incorrect:** The Develop Team process is an executing process.
 - C. **Incorrect:** The Acquire Resources process is an executing process.
 - D. **Correct:** The Plan Resource Management process is a planning process.

2. **Correct Answer: A**
 - A. **Correct:** A project manager has the most power, followed by a project coordinator and then a project expediter.
 - B. **Incorrect:** A project coordinator has more power than a project expediter.
 - C. **Incorrect:** A project manager has more power than a project coordinator.
 - D. **Incorrect:** A project manager has more power than both a project coordinator and a project expediter.

3. **Correct Answer: B**
 - A. **Incorrect:** In a projectized organization, a project manager has all the power and authority in relation to control of people and budgets.
 - B. **Correct:** In a functional organization, it is the functional manager who controls project costs and personnel.
 - C. **Incorrect:** In a strong matrix organization, the project manager would have more power than a **functional manager**.
 - D. **Incorrect:** In a balanced matrix organization, the project manager and functional manager would have equal amounts of power over staff and budget.

4. **Correct Answer: D**
 - A. **Incorrect:** A portfolio best describes all the projects an organization is undertaking.
 - B. **Incorrect:** A program is more than just a single project.
 - C. **Incorrect:** A portfolio manager oversees a portfolio.
 - D. **Correct:** A program of projects is related in some way, and it is the role of the program manager to sort out potential conflicts between projects in a program.

5. **Correct Answer: C**
 - A. **Incorrect:** The project manager is ultimately accountable for the project, not the project sponsor.
 - B. **Incorrect:** It is not generally the project sponsor's role to manage the performance of the project manager, although this can occasionally occur.
 - C. **Correct:** The primary role of the project sponsor is to provide financial and political support for the **project from initiation through closure**.
 - D. **Incorrect:** The primary liaison with the client will generally be the project manager, unless there are contractual reasons for it to be somebody else.

6. **Correct Answer: C**
 - A. **Incorrect:** Negotiation is the process of negotiating with other managers for people to work on your project, or negotiation as part of employment contracts.
 - B. **Incorrect:** Preassignment is the process of having people directly allocated to your project.
 - C. **Correct:** Acquisition is the tool or technique that actively seeks to recruit project team members.
 - D. **Incorrect:** Recruitment may be a particular term used by some in the industry, but it is not the standardized PMBOK® Guide term.

7. **Correct Answer: C**
 - A. **Incorrect:** The resource calendar will not contain the pay rates of project team members.

- B. **Incorrect:** It is not the resource calendar, but the project staff assignments, that will contain a description of the role of each team member and their contact details.
- C. **Correct:** A resource calendar outlines when project team members are available to work on the project.
- D. **Incorrect:** A description of the work to be done on the project will be found in the scope statement.
8. **Correct Answer: A**
- A. **Correct:** The use of punishment will generally result in negative consequences upon team performance; thus it is the worst form of power to use.
- B. **Incorrect:** Expert power is gained from being an acknowledged technical expert in a particular area, and it is a positive form of power to use.
- C. **Incorrect:** Referent power is gained from your personality and charisma, and it is a positive form of power to use.
- D. **Incorrect:** Legitimate power is attributed to the person due to the job description. It is not a long-lasting form of power.
9. **Correct Answer: A**
- A. **Correct:** First people come together in the forming phase, then they go through storming behaviors before settling on norming. Then a team can enter the performing stage and finally the adjourning stage.
- B. **Incorrect:** Norming behaviors come after storming behaviors, and forming behaviors come before storming behaviors.
- C. **Incorrect:** Norming behaviors come after storming behaviors.
- D. **Incorrect:** Storming behaviors come after forming and before norming.
10. **Correct Answer: A**
- A. **Correct:** Physiological needs like food and water must be satisfied first.
- B. **Incorrect:** Security is the second-lowest level in Maslow's hierarchy of needs.
- C. **Incorrect:** Esteem is the second-highest level in Maslow's hierarchy of needs.
- D. **Incorrect:** Self-actualization is the highest level in Maslow's hierarchy of needs and can only be realized after lower-level needs have been filled.
11. **Correct Answer: B**
- A. **Incorrect:** Dice throw is a made-up term and not one of the four basic decision-making techniques.
- B. **Correct:** Coin flip is one of the four basic decision-making techniques.
- C. **Incorrect:** Random assignment does not relate to decision-making techniques.
- D. **Incorrect:** Lucky guess is a made-up term and not one of the four basic decision-making techniques.
12. **Correct Answer: D**
- A. **Incorrect:** If you are using problem-solving, you would require the team members to work it out and resolve the dispute, not simply ignore it.
- B. **Incorrect:** If you are using collaboration as a conflict resolution technique, you are asking the team members to work constructively together and, as necessary, to make compromises to achieve an agreeable outcome.
- C. **Incorrect:** Forcing would at least impose a solution and would be an attempt to resolve the conflict.
- D. **Correct:** This is a classic example of avoiding resolving the conflict.

8. Communications Management

This chapter focuses on project communications management. Similar to the other knowledge areas, it begins with a process of planning, which produces a communications management plan. It then has an executing process, Manage Communications, focusing on carrying out the communications management plan, and a monitoring and controlling process, Monitor Communications, focused on checking whether or not project communications are meeting stakeholder communication requirements.

The three processes in the Project Communications Management knowledge area are:

- Plan Communications Management (Planning process)
- Manage Communications (Executing process)
- Monitor Communications (Monitoring and Controlling process)

8.1 WHAT IS PROJECT COMMUNICATIONS MANAGEMENT?

Project communications management is focused upon the processes of developing a communications management plan, gathering and distributing project information according to the communications management plan, and checking that you are completing the communications activities in accordance with the plan.

Project communications are absolutely critical for a smooth and successful running of any project, whether you are gathering information or disseminating information. You should assume that a project manager will, in fact, spend 90 percent of his or her time communicating in different ways, different forms, and to different stakeholders. Of this time spent communicating, 50 percent will be spent communicating with project team members because they are the most important of the stakeholders.

EXAM TIP

You should always assume that communication in its many forms is at the heart of many issues in project management. If you get a question outlining a problem, and one of the potential answers involves better or improved communication, this may be the correct choice.

Real World

I managed a construction project that I soon realized was actually a communications project. At the outset we started off focusing on building the deliverable and reporting on time and cost progress. Very few of the stakeholders were interested in the construction project itself; they were interested in how it would affect their business, and the intended outcome. After about four months of work, on what was a two-and-a-half-year-long project, I was taken aside by the project sponsor and told that despite the project being under budget and ahead of time, many stakeholders considered that the project was a failure because I wasn't communicating effectively with them. I discovered that many of these stakeholders weren't interested in updates about time and cost. They had other communication needs. The project sponsor was correct, and overnight we changed our focus from a construction project to a communications project. We started focusing on what people actually wanted to hear, how they wanted to hear it, when they wanted to hear it, and who they wanted to hear it from. Within a relatively short period of time the project was judged a success.

EXAM TIP

The project manager should not be in control of every communication, but the project manager should control the communications process.

8.2 PLAN COMMUNICATIONS MANAGEMENT

TABLE 8-1 Plan Communications Management process

INPUTS ⇌	TOOLS AND TECHNIQUES ⇌	OUTPUTS
<ul style="list-style-type: none"> ▪ Project charter ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Resource management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Requirements documentation</i> ▪ <i>Stakeholder register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Communications requirements analysis ▪ Communications technology ▪ Communications models ▪ Communications methods ▪ Interpersonal and team skills <ul style="list-style-type: none"> ▪ <i>Communication styles assessment</i> ▪ <i>Political awareness</i> ▪ <i>Cultural awareness</i> ▪ Data representation <ul style="list-style-type: none"> ▪ <i>Stakeholder engagement assessment matrix</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Communications management plan ▪ Project management plan updates <ul style="list-style-type: none"> ▪ <i>Stakeholder engagement plan</i> ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Project schedule</i> ▪ <i>Stakeholder register</i>

The Plan Communications Management process is a planning process with the communications management plan as its primary output. In order to develop a successful communications management plan, you will need to gather and analyze information about individual stakeholders and their communication needs in order to be successful.

INPUTS

The Plan Communications Management process uses some or all of the following inputs as part of the development of the communications management plan for the project.

PROJECT CHARTER

Like with most other planning processes, the project charter provides a lot of useful information to begin planning as it contains the relevant information known at the time of project initiation and approval.

PROJECT MANAGEMENT PLAN

The key elements of the project management plan that will be useful as inputs into the Plan Communications Management process are information about resources contained in the resource management plan and also stakeholder expectations in the stakeholder engagement plan. The project management plan is an output from the Develop Project Management Plan process.

PROJECT DOCUMENTS

Requirements documentation is crucial for the Plan Communications Management process because it outlines what is needed for the project to succeed, including stakeholder requirements. Knowing these requirements helps in several ways:

- **Stakeholder Identification:** Helps you know who needs what information.
- **Information Content:** Tells you what kind of data stakeholders are interested in, so you can tailor your communications.
- **Frequency and Methods:** Allows you to determine how often and through which channels stakeholders prefer to receive updates.
- **Prioritization:** Helps you prioritize communication based on the importance of requirements to different stakeholders.

By aligning the communication plan with stakeholder requirements, you increase the likelihood of project success and stakeholder satisfaction.

The stakeholder register is an essential input into the Plan Communications Management process. It will provide information about stakeholders and most likely an assessment of their power, interest, impact or influence on the project. This information can be used to assist in the development of a robust and appropriate communications management plan that is able to contribute the effective management of stakeholder engagement and expectations. The stakeholder register is an output from the Identify Stakeholders process.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific enterprise environmental factor that will be useful as an input into this process is the broader organizational structure, because that will affect how well communications are managed.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that may be an important input into the development of your communications management plan include any lessons learned and historical information about successful or unsuccessful communications from past projects, and any blank templates or guidelines for the preparation of the communications management plan.

TOOLS AND TECHNIQUES

The following tools and techniques are available to be used to develop the inputs into this process in order to produce the communications management plan.

EXPERT JUDGMENT

Expert judgment is useful in the Plan Communications Management process because experienced professionals can provide valuable insights on:

- **Communication Channels:** Best practices for selecting appropriate methods and technologies for communication.
- **Stakeholder Preferences:** Insight into what has worked well in past projects to engage different stakeholder groups.
- **Risk Mitigation:** Expertise on how to communicate sensitive or complex issues to prevent misunderstandings.
- **Regulatory Compliance:** Guidance on meeting any communication-related legal or industry standards.

Using expert judgment helps in creating a more effective and efficient communication plan, tailored to the unique needs and risks of the project.

COMMUNICATIONS REQUIREMENTS ANALYSIS

The purpose of *communications requirements analysis* is to obtain a detailed description of individual stakeholders and their communications needs. In order to identify the communications requirements of individual stakeholders, you can use a variety of techniques to identify the stakeholders. These techniques will allow you to either solicit their requirements from them directly or gather information from other sources about their requirements. The important thing is to gather and document the stakeholder communication requirements so you can then plan how you will meet them.

In order to appreciate the number of potential communications channels that can exist as part of identifying stakeholders on a project, you can use a formula that shows the exponential growth and total number of potential communications channels with every additional stakeholder that is identified. The formula is:

$$n(n-1)/2$$

where n equals the number of stakeholders, including yourself.

For example, if you have 4 stakeholders in your project, you would have 6 potential communications channels.

$$\frac{4 \times (4-1)}{2} = 6$$

If you have 5 stakeholders in your project, you would have 10 potential communications channels.

$$\frac{5 \times (5-1)}{2} = 10$$

If you have 20 stakeholders, you will have 190 potential communication channels.

$$\frac{20 \times (20-1)}{2} = 190$$

The number of communications channels will be an important consideration in your communications requirements analysis. Figure 8-1 shows how these communication channels are formed between stakeholders.

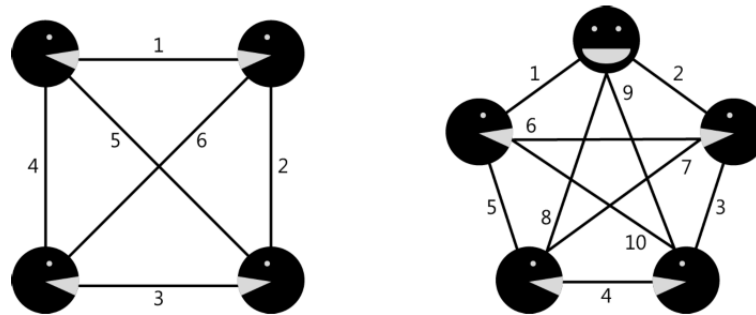


FIGURE 8-1 How to show the number of communications channels in a project.

COMMUNICATIONS TECHNOLOGY

The choice of *communications technology* will depend on several different factors, including urgency, the availability of specific forms of technology and the ease of use of that technology, the project environment and whether the project team members and stakeholders are able to communicate face to face or virtually by using technology, and the sensitivity and confidentiality of information. All of these factors will influence which technologies you choose to use and favor in your communications management plan. It is becoming increasingly common to rely on virtual forms of technology, but nothing is as good as face-to-face communication.

COMMUNICATIONS MODELS

Having an awareness of a *communications model*, which outlines how communications can work, is an important skill for a project manager to have. Communication is not just a simple matter of your deciding which information you want to communicate, and assuming that those you want to communicate with will understand what you are actually trying to say. According to the Shannon and Weaver communication model, there is a continual looping process in action, as Figure 8-2 shows. The sender encodes a message according to his or her own preferences, prejudices, and particular worldview. The sender then transmits this message via whichever communications technology, or medium, he or she has selected to use. As the message is transmitted, it must pass through a particular medium, and in doing so it will encounter noise. In this instance, noise does not always relate just to acoustic noise, but also includes any other aspects present in the selected medium that may interfere with or change the message being transmitted. It can include the physical environment, participant energy levels, cultural differences, accents, and individual prejudices.

The receiver then receives the message and decodes it according to his or her own preferences and prejudices. If the receiver then attempts to send the message on to another person, or back to the original sender, it must go through the same obstacles again.

You can begin to recognize how errors in communication can happen very easily even with the best of intent. It is absolutely important that project managers recognize the challenges to effective communication and to try to minimize the potential disruption to the messages they are trying to send.

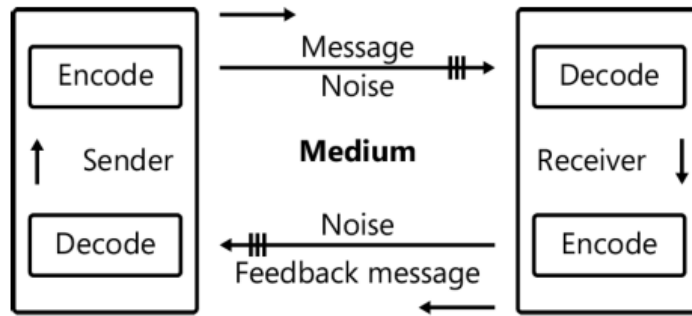


FIGURE 8-2 A communications model showing how a sender encodes and sends a message through a medium to a receiver.

You can mitigate some of the potential negative effects on communication in this model by practicing, and being aware of, the following five techniques:

1. **Active listening** With this technique, the listener takes active steps to ensure that the message was understood correctly. The result of this is that the listener is more engaged and there is a much better transfer of information between sender and receiver.

Real World

Throughout my career as a project manager, the ability to listen and understand what it is that people are actually communicating has played an important role in the success of projects I have managed. I remember when I was younger and perhaps a little more headstrong, and I would simply take shortcuts when receiving information from people, assuming I understood what they were trying to communicate. This, of course, led to many misunderstandings and many inefficiencies and mistakes that affected the chances of project success. I have since learned that being an active listener is more important than being an active talker.

2. **Effective Listening** Similar to active listening, this technique also involves the listener or receiver monitoring non-verbal and physical communication.
3. **Feedback** This consists of cues from the receiver to the sender that indicate whether or not the message has been understood.
4. **Nonverbal** This is communication in the form of body language, posture, and similar. You may be surprised to know that most communication is nonverbal and that we are very skilled at picking up nonverbal communication.
5. **Paralingual** This type of communication is vocal but not verbal, and includes tone of voice, inflections, and volume—how the words are said rather than what is said.

COMMUNICATIONS METHODS

There are three broad categories of the types of *communications methods* that you can employ:

1. **Interactive communication** Where all parties in the communications conduct a multidirectional exchange of information concurrently. The most common examples of interactive communication include team meetings, phone calls, and videoconferencing.
2. **Push communication** A form of communication that is sent to recipients. It is an effective means of communication to ensure that information is distributed as planned and includes email messages, reports, memos, press releases, and letters.
3. **Pull communication** Used when recipients can choose to access information at their own discretion. Common examples of pull communication include intranet and Internet sites and e-learning sites.

In addition to these categories of communications, there are also different ways in which the communications can be delivered. These can be formal or informal and verbal or written. Table 8-2 shows the possible combinations of these communications forms and examples of each.

TABLE 8-2 Types of communication

METHOD	EXAMPLES
Informal written	Notes, email messages, memos
Formal written	Contracts, legal notices
Informal verbal	Meetings, discussions, phone calls, conversations
Formal verbal	Speeches, mass communications, presentations

INTERPERSONAL AND TEAM SKILLS

Communication Styles Assessment: Understanding the preferred communication styles of team members and stakeholders can help tailor messages for better comprehension and engagement. For example, knowing that a key stakeholder prefers concise, data-driven updates allows for more effective communication.

Political Awareness: Being cognizant of the internal politics within an organization can guide the communication strategy to navigate sensitive issues or power dynamics. For example, and awareness of a rivalry between departments could shape how project updates are shared to avoid conflicts.

Cultural Awareness: Recognizing and respecting cultural differences is crucial when working with a diverse team or stakeholders from different backgrounds. For example, understanding that some cultures value formal communication can prevent unintentional slights or misunderstandings.

Using these tools and techniques enables a more nuanced and effective communication plan, facilitating smoother project execution.

DATA REPRESENTATION

The Stakeholder Engagement Matrix helps in the Plan Communications Management process by mapping out the current and desired levels of stakeholder engagement. This serves several purposes:

- **Prioritization:** Helps you focus on stakeholders who need more attention to move from their current to desired levels of engagement.
- **Tailored Communication:** Allows you to create communication plans specific to each category of stakeholders (e.g., uninformed, resistant, neutral, supportive, leading).
- **Resource Allocation:** Helps in deciding where to allocate communication resources for maximum impact.
- **Risk Mitigation:** Identifying stakeholders who are currently disengaged but need to be supportive can help in proactively addressing potential risks.

By providing a structured way to assess and plan for stakeholder engagement, the matrix makes the communication plan more targeted and effective.

MEETINGS

Meetings are generally a useful way to bring together members of the project team and other stakeholders so that they can contribute to the development of the communications management plan. Effective meetings feature the use of pre-distributed agendas, defined start and finish times, agreed ground rules, and a focus on decision-making.

A particular type of meeting that is useful for communicating the end of project planning and the beginning of project execution is the kick-off meeting. The kick-off meeting is held with project team members and relevant stakeholders in attendance, usually on site, and it signifies the start of execution. It is a particularly effective form of communication because it signals to the team and stakeholders that the project is progressing, and contributes to increased team morale.

OUTPUTS

After applying the appropriate tools and techniques to the selected inputs, the Plan Communications Management process has the following outputs.

COMMUNICATIONS MANAGEMENT PLAN

The Plan Communications Management process has the *communications management plan* as its primary output. Similar to other management plans, the communications management plan provides a guide for completing the communications management activities in the project.

Your communications management plan will identify individual stakeholders, what information they require, when they require that information, how they will receive information, from whom the information will be received, and any other issues affecting communications. Your communications management plan may also outline key messages, general communication strategies, how you will review and update the plan, and an overview of the intended outcomes from the communications management plan. The communications management plan is a subsidiary of the project management plan and is used as an input into the other two communications management processes.

Real World

Keep in mind that a lack of communication is in fact a communication in itself. Some stakeholders will take a lack of communication as a sign of arrogance and indifference. I have always found that the absence of communication leads to opinions based on assumptions and gossip. Correcting these opinions takes more energy and time than it would have taken to distribute the correct information in the first place.

PROJECT MANAGEMENT PLAN UPDATES

The specific part of the project management plan that you may wish to update will be the stakeholder engagement plan with new information developed as a result of this communications planning process.

PROJECT DOCUMENTS UPDATES

The specific project documents that may be updated as a result of the Plan Communications Management process are the project schedule and stakeholder register.

Quick Check

1. What is the primary purpose of the communications management plan?
2. If you are working in an organization with nine stakeholders, including yourself, how many potential communications channels would there be?
3. What is the significance of the kick-off meeting?

Quick Check Answers

1. The main purpose of the communications management plan is to guide your actions in defining what communications the project is going to receive and send, how it is going to identify stakeholders communications requirements, and how information will be tracked and measured.
2. If you have 9 stakeholders, including yourself, there are 36 potential communications channels.
3. The kick-off meeting is used to gather project team members and other relevant stakeholders together and communicate to them that enough planning has occurred for project execution to begin.

8.3 MANAGE COMMUNICATIONS

TABLE 8-3 Manage Communications process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Resource management plan</i> ▪ <i>Communications management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ Project documents ▪ <i>Change log</i> ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Quality report</i> ▪ <i>Risk report</i> ▪ <i>Stakeholder register</i> ▪ Work performance reports ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Communications technology ▪ Communications models ▪ Communications skills ▪ <i>Communication competence</i> ▪ <i>Feedback</i> ▪ <i>Nonverbal</i> ▪ <i>Presentations</i> ▪ Project management information systems ▪ Project reporting ▪ Interpersonal and team skills ▪ <i>Active listening</i> ▪ <i>Conflict management</i> ▪ <i>Cultural awareness</i> ▪ <i>Meeting management</i> ▪ <i>Networking</i> ▪ <i>Political awareness</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Project communications ▪ Project management plan updates ▪ <i>Communications management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ Project documents update ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Project schedule</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Organizational process assets updates

The Manage Communications process is an executing process that gathers the project information so that it can be distributed and stored according to the communications management plan.

INPUTS

The Manage Communications process uses some or all of the following inputs.

PROJECT MANAGEMENT PLAN

The resource management plan will provide information of project resources and their communications needs and preferred methods.

The communications management plan is an essential component of the Manage Communications process because it provides direction and guidelines on how to complete this process. The communications management plan is an output from the Plan Communications Management process.

The stakeholder engagement plan will provide information on all identified stakeholders, and their communication and information needs and preferences.

PROJECT DOCUMENTS

Each of the following project documents provides useful information about the planned communications so that a project manager can ensure project communications are occurring as planned:

- Change log
- Issue log
- Lessons learned register
- Quality report
- Risk report
- Stakeholder register

WORK PERFORMANCE REPORTS

Work performance reports are a specific presentation of work performance information. The timely dissemination of work performance reports to the right stakeholders is one of the factors influencing project success. All project reports should be tailored to be suitable to their intended audience. Work performance reports are an output from the Monitor and Control Project Work process.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific types of enterprise environmental factor that will be useful in managing project communications are any broad organizational cultural issues, any relevant government or industry standards, and any licensed software being used to gather and disseminate information.

ORGANIZATIONAL PROCESS ASSETS

The specific types of organizational process assets that will assist in managing project communications are any blank templates, historical information and lessons learned, and project-specific policies and guidelines relating to communications management.

TOOLS AND TECHNIQUES

The following tools and techniques are used upon the inputs to deliver the Manage Communications process outputs.

COMMUNICATIONS TECHNOLOGY

The particular type of communication technology you choose to use to facilitate project communication is an important consideration because each stakeholder will respond differently to the technology chosen. It is up to the project manager to ensure that the correct type of communication technology is selected to ensure that individual project communication requirements can be met. Remember that what works well for one stakeholder may not work for another stakeholder.

Real World

On a project I was managing, we generally disseminated project progress information by way of written and graphical reports. There was one particular senior manager who continued to ask questions about information that was clearly contained in these reports. Answering these questions took up time, so we gave this issue some thought. Ultimately we realized that instead of written reports, this person preferred brief face-to-face updates. So we initiated a regular process of “accidentally” stopping by this manager's office and giving him a brief update.

COMMUNICATIONS MODELS

An awareness of how communications work, according to a basic communications model, is important for a project manager to understand so that he or she can avoid the potential obstacles and difficulties in transmitting messages. A more thorough description of communications models was covered earlier in this chapter in the Plan Communications Management process.

COMMUNICATIONS SKILLS

Effective communication skills are essential in the Manage Communications process to ensure that the right information is conveyed accurately and understood by all stakeholders. These are the most important factors:

- **Communication Competence:** Having a well-rounded set of communication abilities ensures messages are clear, concise, and appropriate. For example, writing a clear and concise email update that effectively conveys project status.
- **Feedback:** Being open to and seeking feedback ensures that communication is a two-way process, improving accuracy and engagement. For example, conducting a quick survey after a project meeting to gauge effectiveness and areas for improvement.
- **Nonverbal Skills:** Mastery of body language, facial expressions, and tone can complement verbal messages and enhance understanding. For example, using open body language in a stakeholder meeting to encourage openness and collaboration.
- **Presentations:** Effective presentation skills can synthesize complex information into digestible formats for various audiences. For example, creating a visual dashboard for executives that highlights key performance indicators.

These skills facilitate effective information exchange, stakeholder engagement, and ultimately, project success.

PROJECT MANAGEMENT INFORMATION SYSTEMS

Project management information systems are ways of managing and distributing your project information in hard copy and electronic form. Examples of hard copy distribution formats include press releases, memos, and project documents and plans. Increasingly, management and distribution of project information is handled by electronic means such as websites, web publishing, and intranet portals.

PROJECT REPORTING

Effective *project reporting* is a key element in ensuring that a project is successful and that stakeholder communication requirements are met. The way in which you collect and report performance information should be in response to how individual stakeholders want to receive that information. All project reports should be concise, succinct, and targeted at their intended audience. Project reports may include simple text reports, or they may be more complex reports featuring a lot of narrative and descriptive text, diagrams, and tables. The content of a project report can be on any relevant element and metric of the project. You may also choose to report certain elements such as cost and time to one group of stakeholders, while reporting aspects of quality to another group of stakeholders.

INTERPERSONAL AND TEAM SKILLS

From the suite of interpersonal and team skills you are proficient at, you would find the following most useful in managing communications.

- **Active Listening:** Ensures you fully understand stakeholder needs and concerns, improving the quality of your communications. For example, picking up on a team member's concerns about a project deadline and addressing it promptly.
- **Conflict Management:** Helps to resolve disagreements or misunderstandings that can arise due to miscommunication. For example, mediating a disagreement between departments over project priorities.
- **Cultural Awareness:** Recognizes and respects the diverse backgrounds of team members, which is vital for effective communication. For example, adapting the communication style to respect high-context or low-context communication cultures.
- **Meeting Management:** Ensures that meetings are efficient and productive, a critical aspect of project communications. For example, creating clear agendas and time-boxing discussions to stay on topic.
- **Networking:** Builds relationships that can be useful for gathering or disseminating information. For example, using established connections to quickly resolve a resource allocation issue.
- **Political Awareness:** Helps navigate organizational politics, allowing you to communicate more effectively with different stakeholders. For example, knowing whom to involve in a decision-making process to get quicker approval.

Each of these tools and techniques has its unique value in improving the effectiveness and efficiency of the Manage Communications process.

MEETINGS

Well run and facilitated meetings with a clear and direct purpose attended by the right people can be a very useful tool in managing communications. Here are some guidelines for running effective meetings.

1. **Clear Agenda:** Circulate an agenda beforehand so participants know what to expect and can prepare.
2. **Timeliness:** Start and end on time to show respect for everyone's schedules.
3. **Objectives:** State the meeting's objectives clearly at the beginning, reinforcing the meeting's purpose.
4. **Facilitation:** Actively guide the conversation to stay on topic and meet the meeting's goals.
5. **Active Participation:** Encourage input from all members, making sure that quieter voices are also heard.
6. **Time Management:** Use a timer or a timekeeper to ensure each agenda item gets adequate time but doesn't overrun.
7. **Conflict Resolution:** Address conflicts or disagreements professionally, and steer the conversation back to constructive discourse.
8. **Action Items:** End the meeting by summarizing decisions made, action items, and who is responsible for what by when.
9. **Documentation:** Keep minutes or have someone else do it, and distribute them promptly after the meeting.

10. **Follow-Up:** Make sure that action items are tracked and that their progress is reported in subsequent meetings or updates.

By implementing these steps, a project manager can make meetings more productive, focused, and beneficial for everyone involved.

OUTPUTS

The Manage Communications process produces some or all of the following outputs.

PROJECT COMMUNICATIONS

Project communications are the key output from the Manage Communications process. They can take many forms, based on the communications management plan. You may choose to send project communications in different formats, at different times and frequencies, and with different content, according to individual stakeholder communication requirements. Project communications go on to be used as an input into the Monitor Communications process.

PROJECT MANAGEMENT PLAN UPDATES

The specific part of the project management plan that may be updated as a result of the Manage Communications process is the communications management plan, and any document affected by the communications management plan, such as the stakeholder engagement plan.

PROJECT DOCUMENTS UPDATES

The specific types of project documents that may be updated as a result of completing the Manage Communications process will be issues logs, stakeholder registers, lessons learned register, project schedules, and risk register.

ORGANIZATIONAL PROCESS ASSETS UPDATES

The specific organizational process assets that may be updated as a result of this process include any generic project performance reports, templates, stored project records, and lessons learned documentation.

Quick Check

1. What is the main purpose of the Manage Communications process?
2. What format should be selected, and what content should be included, when reporting project performance?
3. In the basic communication model, what can happen to an intended communication between sender and receiver?

Quick Check Answers

1. The main purpose of the Manage Communications process is to gather project information and distribute and store it in accordance with the communications management plan, which will also reflect individual stakeholder communication requirements.
2. When reporting project performance, your choice of format and content will be directly influenced by the intended audience and their communication needs.
3. In the basic communication model, a message that is sent can encounter noise in the chosen medium. This noise could be actual audio sound, or it could be any other aspect that impedes, or interferes with, the message being sent.

8.4 MONITOR COMMUNICATIONS

TABLE 8-4 Monitor Communications process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Resource management plan</i> ▪ <i>Communications management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ Project documents ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Project communications</i> ▪ Work performance data ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Project management information systems ▪ Data representation ▪ <i>Stakeholder engagement assessment matrix</i> ▪ Interpersonal and team skills ▪ <i>Observation/conversation</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Work performance information ▪ Change requests ▪ Project management plan updates ▪ <i>Communications management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ Project documents updates ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Stakeholder register</i>

The Monitor Communications process is focused on monitoring and controlling the project communications to ensure that they are in accordance with the communications management plan and individual stakeholder communication requirements.

INPUTS

The following inputs are used in the Monitor Communications process.

PROJECT MANAGEMENT PLAN

The project management plan, specifically the resource management plan, the communications management plan, and the stakeholder engagement plan, all contain information about how each part of the project communications will be executed, monitored, and closed, and as such it provides a valuable input into any monitoring and controlling process. The project management plan is an output from the Develop Project Management Plan process, and the communications management plan is an output from the Plan Communications Management process.

PROJECT DOCUMENTS

The issue log is a useful input into the Monitor Communications process because it documents and describes issues relating to communication. Additionally, the issue log provides information about who is responsible for resolving and monitoring the issue. Therefore, the issue log is useful both as a repository of project issues and as a communications tool itself that shows stakeholders that issues are being dealt with. The issue log is an output from the Manage Stakeholder Engagement process.

The lessons learned register will assist because it provided documentation of:

- **Best practices:** You can adopt effective communication methods used in the past.
- **How to avoid mistakes:** Previous errors in communications can be avoided.
- **Any feedback loops:** Learning what worked or didn't in earlier phases can help adjust current communication plans.

Project communications include all forms of communication about project progress, and also any communications that seek to generate political support from stakeholders for the project. As such, project communications can be in many forms and can contain different amounts and types of information. The most common forms of project communications relate to project performance reports about the most popular project metrics: cost, time, and quality. Project communications are an output from the Manage Communications process.

WORK PERFORMANCE DATA

Work performance data is the raw information gathered about how well the project is doing in relation to cost, time, quality, and any other relevant metrics that are being measured. Work performance data will be turned into

work performance information in the Monitor Communications process, and this work performance information in turn will be turned into work performance reports in the Monitor and Control Project Work process. Work performance data is an output from the Direct and Manage Project Work process.

EXAM TIP

Remember the sequence that work performance data becomes work performance information, which becomes work performance reports.

ENTERPRISE ENVIRONMENTAL FACTORS

Enterprise Environmental Factors (EEF) can offer valuable context and guidance for the Monitor Communications process in project management. Here's how:

- **Organizational Culture:** Understanding the communication norms within the enterprise helps tailor your communication methods.
- **Technology Infrastructure:** Knowing what communication tools are available can influence how to monitor and manage communications effectively.
- **Stakeholder Relationships:** Information on stakeholder politics or alliances can guide the focus of your communications monitoring.
- **Regulatory Requirements:** If there are legal constraints on communication, they need to be factored into the monitoring process.
- **Market Conditions:** Knowing market dynamics can inform what kind of information needs more rigorous monitoring.
- **Historical Information:** Past projects or organizational metrics can provide benchmarks for communication performance.

By incorporating these factors, the Monitor Communications process can be more aligned with both the internal and external conditions of the enterprise, making it more effective and context-sensitive.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that will be of use in the Monitor Communications process are any templates, policies, and guidelines for project communications that the organization has.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the Monitor Communications process outputs.

EXPERT JUDGMENT

The use of expert judgment in monitoring and controlling communications is a valuable tool, because it makes available to you the experience, wisdom, and skills of groups or individuals within the project team or within the wider group of project stakeholders, or those of external consultants or subject matter experts. It is often important to bring in people external to the project who can bring a sense of objectivity to how well the communications on the project are being monitored and controlled, and how effective and appropriate they are. This is the real strength in using expert judgment as a tool in this process.

PROJECT MANAGEMENT INFORMATION SYSTEMS

A project management information system is any method that you choose to gather, store, and distribute or disseminate information. Reporting systems can be manual, although they are increasingly electronic and based on software. Reporting systems can be based on text or graphs and pictures. Whatever method you choose, it must be appropriate to the needs of you and your project team, as well as the stakeholders.

DATA REPRESENTATION

The stakeholder engagement assessment matrix enables you to:

- **Check status of engagement levels:** This matrix helps you understand the current engagement levels of stakeholders. Are they resistant, neutral, supportive, or leading?
- **Check Target vs Actual:** By comparing the desired level of engagement with the current level, you can identify gaps in communication that need to be addressed.

- **Focus Communication:** Knowing stakeholders' engagement levels allows you to tailor your communications to better meet their needs and expectations.

INTERPERSONAL AND TEAM SKILLS

The specific tool of observation and conversation allow you to:

- **Get real-time insights:** Direct observation and conversations with team members or stakeholders can give you immediate feedback on the effectiveness of communications.
- **Gather qualitative data:** These methods provide context and nuance that might not be captured in more formal, quantitative assessments.
- **Build trust:** Direct interaction can also build or reinforce trust, making future communications more effective.

MEETINGS

The Monitor Communications process is a monitoring and controlling process and, as such, requires careful attention. One of the better ways of giving it the attention that it deserves is through the use of meetings as a tool, where the project team is able to discuss progress with project communications and make decisions on any improvements. Meetings are a form of communication themselves and so should always be run in an effective way to encourage attendance and involvement.

OUTPUTS

The outputs from the Monitor Communications process are the following.

WORK PERFORMANCE INFORMATION

Work performance information is work performance data that has been organized and summarized in a way that can be used for work performance reports. Work performance information typically organizes raw data and reports on project status in relation to time and cost progress on the project. Work performance information is used as an input into the Monitor and Control Project Work process.

CHANGE REQUESTS

As a result of carrying out any monitoring and controlling process, including the Monitor Communications process, you may come across variations between what you planned to do in the communications management plan and what is actually occurring. You may also come across situations for which corrective or preventive actions are required to ensure that you stay on track. The best way to ensure that any variations or preventive or corrective actions are captured is through a change request. Change requests will then go on to be processed according to your approved change control process in the Perform Integrated Change Control process.

PROJECT MANAGEMENT PLAN UPDATES

As a result of monitoring and controlling project communications you may choose to update parts of your project management plan, specifically the communications management plan and the stakeholder engagement plan, to ensure that all of your planning efforts result in great communication and support your communication efforts.

PROJECT DOCUMENTS UPDATES

The specific project documents that may be updated as a result of the Monitor Communications process include any issues logs, lessons learned register, and the stakeholder register.

ORGANIZATIONAL PROCESS ASSETS UPDATES

The specific organizational process assets that will be updated include any existing templates, guidelines, lessons learned, or historical databases relating to project communications management.

Quick Check

1. What is the main purpose of the Monitor Communications process?
2. Why are reporting systems an important tool or technique in the Monitor Communications process?
3. What is the relationship between work performance data, work performance information, and work performance reports?

Quick Check Answers

1. The main purpose of the Monitor Communications process is to assess whether the project communications are being carried out as per the communications management plan and whether or not variations or corrective or preventive actions need to be taken to ensure that you stay on track.
2. Reporting systems are the primary tool used in the Monitor Communications process because they are the manual or electronic means by which you choose to gather and distribute information about project progress to stakeholders.
3. Work performance data is the raw data that gets refined and becomes work performance information, which in turn gets further refined to become work performance reports.

8.5 CHAPTER SUMMARY

- The Communications Management knowledge area is focused upon the successful use of project communications to report project performance, gain political support, and provide stakeholders with their communications requirements.
- The Plan Communications Management process produces the communications management plan, which guides the subsequent communications management processes.
- The Manage Communications process, which is an executing process, uses the communications management plan to gather, store, and distribute project information to stakeholders in the most effective way.
- The Monitor Communications process, which is a monitoring and controlling process, is like other monitoring and controlling processes in that it assesses actual performance against that forecast in the communications management plan and, if variations or corrective or preventive actions are required, raises a change request.

8.6 EXERCISES

The answers for these exercises are located in the “Answers” section at the end of this chapter.

1. Match up the communication tool on the left with the description on the right.

Communication tool	Definition
1. Communications technology	A. A tool that recognizes that communications can be interactive, push, or pull
2. Communications requirements analysis	B. A tool that describes how communications moves from sender to receiver through a particular medium
3. Communications models	C. A tool for gathering and documenting the communication requirements of project stakeholders
4. Communications methods	D. A tool that decides the particular form of technology to be used to disseminate information
5. Performance reporting	E. A tool for collecting and disseminating appropriate reporting on project progress to stakeholders
6. Information management systems	F. A tool for the management, storage, and distribution of project information in either hard copy or electronic form

2. You are the project manager on a project that initially identified seven stakeholders, including yourself. You have since identified an additional six stakeholders. How many extra potential communication channels are there?

8.7 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 8 by answering these questions. The answers to these questions, and the explanations of why each answer choice is correct or incorrect, are located in the “Answers” section at the end of this chapter.

1. Which of the following processes produces the communications management plan?
 - A. Develop Project Management Plan
 - B. Plan Communications Management
 - C. Manage Communications
 - D. Develop Communications Management Plan
2. The decision to use a written document to provide project updates is an example of what sort of tool or technique?
 - A. Communication technology
 - B. Communication models
 - C. Expert judgment
 - D. Meetings
3. What is the name of the tool that analyzes the individual communication requirements for each of the stakeholders?
 - A. Communication models
 - B. Information management systems
 - C. Communications requirements analysis
 - D. Communications technology
4. You are managing a project with 17 stakeholders, including yourself. How many potential communication

channels are there?

- A. 17
- B. 136
- C. 272
- D. 34

5. You have decided to send a handwritten update to project stakeholders on the project progress. Some stakeholders complained that they are unable to read your handwriting. This is an example of what?
- A. Bad handwriting
 - B. Noise
 - C. Interference
 - D. Feedback
6. You have set up an intranet site for project team members to be able to download project progress updates. This is an example of which method of communication?
- A. Interactive
 - B. Push
 - C. Pull
 - D. Manual
7. How does the project kick-off meeting act as a means of communication?
- A. The kick-off meeting does not act as a means of communication.
 - B. The kick-off meeting signals to the team that enough planning has been completed to begin execution.
 - C. The kick-off meeting is completed to start project initiation, and therefore it informs the team that the project is about to start.
 - D. The kick-off meeting signals the beginning of project closure and communicates to the team that the job is done.
8. What is the correct sequence of the following terms?
- A. Work performance report, work performance data, work performance information
 - B. Work performance information, work performance data, work performance report
 - C. Work performance data, work performance report, work performance information
 - D. Work performance data, work performance information, work performance report
9. If you are engaged in consciously paying attention to body language and trying to understand the communication from a sender, what are you involved in?
- A. Active listening
 - B. Effective listening
 - C. Providing feedback
 - D. Paralingual communication

8.8 ANSWERS

This section contains the answers for the Exercises and Review Questions in this chapter.

EXERCISES

1. Match up the communication tool on the left with the description on the right.

Communication tool	Definition
1. Communications technology	D. A tool that decides the particular form of technology to be used to disseminate information
2. Communications requirements analysis	C. A tool for gathering and documenting the communication requirements of project stakeholders
3. Communications models	B. A tool that describes how communications moves from sender to receiver through a particular medium
4. Communications methods	A. A tool that recognizes that communications can be interactive, push, or pull
5. Performance reporting	E. A tool for collecting and disseminating appropriate reporting on project progress to stakeholders
6. Information management systems	F. a tool for the management, storage, and distribution of project information in either hard copy or electronic form

2. You are the project manager on a project that initially identified seven stakeholders, including yourself. You have since identified an additional six stakeholders. How many extra potential communication channels are there?

This question is asking you what the difference is between 7 stakeholders and 13 stakeholders in relation to the number of potential communication channels. You will need to calculate $n(n-1)/2$ for each and find what the difference is. The answer is not simply subtracting 7 from 13 and applying the formula to it—that would give you a very wrong answer, but be aware that in the exam that answer may be one of the options.

For seven stakeholders you have 21 communication channels and for 13 stakeholders you have 78 communication channels. Therefore, the correct answer is the difference between these two numbers which is 57 extra potential communication channels

CHAPTER REVIEW

1. **Correct Answer: B**

- A. **Incorrect:** The Develop Project Management Plan process produces the project management plan.
- B. **Correct:** The main output from the Plan Communications Management process is the communications management plan.
- C. **Incorrect:** The Manage Communications process uses the communications management plan to gather, store, and distribute project information and communications.
- D. **Incorrect:** Develop Communications Management Plan is a made-up process name.

2. **Correct Answer: A**

- A. **Correct:** Any decision you make about the technology used, whether manual or electronic, for the dissemination of project information, is a decision about communication technology.
- B. **Incorrect:** Communication models explain what might happen between sender and receiver.
- C. **Incorrect:** Expert judgment is a tool used to assist with monitoring how well communications are going.
- D. **Incorrect:** Meetings are a tool used to help the project team understand, and contribute to, effective project communications.

3. **Correct Answer: C**

- A. **Incorrect:** Communications models explain what may happen to communications between sender and

receiver.

- B. **Incorrect:** Information management systems are used to gather and store project information.
- C. **Correct:** Communications requirements analysis is the technique used to determine individual stakeholder communication requirements.
- D. **Incorrect:** Communications technology is a technique used to determine what form the communication will take.

4. **Correct Answer: B**

- A. **Incorrect:** This is simply the number of stakeholders, not the number of potential communication channels.
- B. **Correct:** If you use the formula $n(n-1)/2$, you will calculate that there are 136 potential communications channels.
- C. **Incorrect:** This is the answer you get if you only used the first part of the correct formula.
- D. **Incorrect:** This is simply the number of stakeholders multiplied by 2.

5. **Correct Answer: B**

- A. **Incorrect:** In the strictest sense of the word, it is an example of bad handwriting, but according to the basic communications model it is an example of interference with the message, and that is the definition of noise.
- B. **Correct:** Any element that can interfere with the message is considered to be noise.
- C. **Incorrect:** This is not the correct answer because noise creates interference.
- D. **Incorrect:** Feedback is used by the receiver to send confirmation of the message received back to the sender.

6. **Correct Answer: C**

- A. **Incorrect:** Interactive communication is where there is more than one person involved in the communication at the same time.
- B. **Incorrect:** Push communication involves the sender sending the communication to the receiver.
- C. **Correct:** This is an example of pull communication, because the receivers download the information at their discretion.
- D. **Incorrect:** Manual communication refers to forms of communication that are not conducted electronically.

7. **Correct Answer: B**

- A. **Incorrect:** The kick-off meeting does act as a means of communication by communicating to the team that enough planning has been done to begin execution.
- B. **Correct:** The use of the kick-off meeting as both a functional meeting to discuss execution and as a team morale-building exercise means that it is an effective form of communication.
- C. **Incorrect:** The kick-off meeting is completed after enough planning has been done to begin project execution, and not at the beginning of project initiation.
- D. **Incorrect:** The kick-off meeting does not begin the process of project closure.

8. **Correct Answer: D**

- A. **Incorrect:** Work performance reports come after work performance data and work performance information.
- B. **Incorrect:** Work performance data comes before work performance information.
- C. **Incorrect:** Work performance information comes before work performance reports.
- D. **Correct:** This is the correct order: work performance data, which is the raw data gathered about project performance, in turn gets filtered and refined as understandable work performance information, which in turn is selected to be included in work performance reports.

9. **Correct Answer: B**

- A. **Incorrect:** Active listening means that the receiver is actively engaged in trying to understand the message

from the sender and does not necessarily involve paying attention to things like body language.

- B. **Correct:** Effective listening takes active listening one step further and has the receiver monitoring nonverbal cues such as body language.
- C. **Incorrect:** Feedback doesn't necessarily involve the interpretation of body language.
- D. **Incorrect:** Paralingual communication involves recognizing and observing vocal but nonverbal communication clues such as expressions, inflections, tone, and volume of voice.

9. Risk Management

This chapter focuses on the topic of Project Risk Management which, like the other knowledge areas, begins with a process of planning, which produces a risk management plan. It then has four further planning process—Identify Risks, Perform Qualitative Risk Analysis, Perform Quantitative Risk Analysis, and Plan Risk Responses—that iteratively develop and refine the risk register. It has an executing process, Implement Risk Response, and a single monitoring and controlling process, Monitor Risks, which measures the actual risks versus the forecast risks and, if required, generates change requests.

The seven processes in the Project Risk Management knowledge area are:

- Plan Risk Management (Planning process)
- Identify Risks (Planning process)
- Perform Qualitative Risk Analysis (Planning process)
- Perform Quantitative Risk Analysis (Planning process)
- Plan Risk Responses (Planning process)
- Implement Risk Responses (Executing process)
- Monitor Risks (Monitoring and Controlling process)

9.1 WHAT IS PROJECT RISK MANAGEMENT?

Project risk management is focused upon the processes of developing a risk management plan and a risk register that outlines and identifies how you will deal with project risks or uncertainties. In order to do this effectively, you need to be able to define all potential risks, their causes, and their potential impact, and formulate strategies for dealing with them. After they are identified, you then monitor what you had forecast would occur in relation to risk and what is actually occurring, while looking out for new or changed risks.

Figure 9-1 shows the general linear and highly iterative process of planning for risk and developing the risk register.

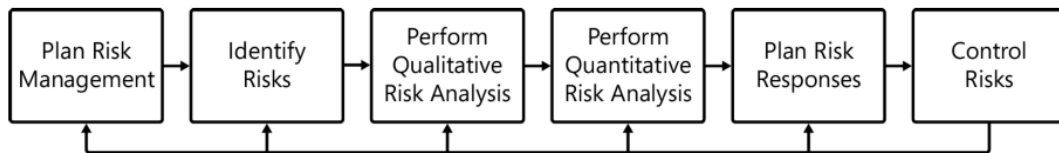


FIGURE 9-1 A sequential and iterative reprocess for risk management

All projects will experience some degree of risk throughout the project life cycle. How you choose to identify and respond to risk will reflect the level of *risk tolerance* that your project team, or the wider organization, has. If you have a low tolerance for risk, then you either will devote more time and energy to dealing with all risks or choose to not undertake projects with high levels of risk in them. Conversely, if you have a high tolerance for risks, you will either devote less time to proactively planning for risks or choose to take on projects with high degrees of risk, perhaps seeking a high return. It is very important that the project manager spend time assessing the level of risk tolerance key stakeholders such as your organization and the customer have, because this will affect how much time and effort goes into your risk management planning.

EXAM TIP

If you are familiar with ISO 31000 Standard for Risk Management, much of this section will be familiar to you.

Risk is simply a measure of uncertainty that can affect the project either positively or negatively. For example, all of the estimates you have done have some degree of uncertainty—either positive or negative—in them, and this uncertainty represents risk that you need to account for and seek to manage.

EXAM TIP

If you are having trouble understanding exactly what risk management is all about, simply substitute the word “risk” with the word “uncertainty”. Risk management focuses on acknowledging that there is uncertainty throughout the entire project, and on planning how to deal with that uncertainty.

If you come across a question in the exam that hints at any amount of uncertainty, you should assume that you will have to perform some level of risk identification and analysis on it.

Risk, or uncertainty, can be positive or negative. If a factor is a potential positive risk, then it is viewed as an opportunity to be maximized through proper selection of risk response strategies. If it is a negative risk, then it is a threat to the project, and your risk response strategies will seek ways to minimize it. Most people tend to think of risks as purely negative events, and though it may be the case that the majority of risks are indeed potentially negative, there are many positive risks. For example, there can be a risk that you will deliver the project under budget by careful procurement of goods and services, in which case you should seek to ensure that you maximize the chances of this risk occurring.

Real World

As a very general rule of thumb, I try to have about two-thirds of my project risk register focused on negative risks, or threats, and about one-third focused upon positive risks, or opportunities. This is a very loose rule, and you may find that your projects are different depending on their industry, size, and complexity. The key point is to make sure that you consider both negative and positive risks on your project.

9.2 PLAN RISK MANAGEMENT

TABLE 9-1 Plan Risk Management process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project charter ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>All components</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Stakeholder register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Stakeholder analysis</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Risk management plan

The Plan Risk Management process is a planning process with the risk management plan as its sole output. In order to develop a successful risk management plan, you will first need to understand the general level of risks your project faces, as well as the project team or organizational tolerance for risk. Because risk or uncertainty can occur in any part of the project, you will need all the other management plans contained in the project management plan to ensure that you assess and consider all potential sources of risk.

INPUTS

The Plan Risk Management process uses some or all of the following inputs as part of the development of the risk management plan for the project.

PROJECT CHARTER

The project charter, depending on the form it takes, may contain initial descriptions and assessments of known or anticipated risks of the project that provide valuable information for the development of the risk management plan. The project charter is an output from the Develop Project Charter process.

PROJECT MANAGEMENT PLAN

All components of the project management plan will be useful as an input into the Plan Risk Management process because risk can occur at any point from any other aspect of the project. Thus, the already-developed subsidiary plans and baselines contained in the project management plan will highlight areas of uncertainty that can be used to develop the risk management plan. The project management plan is an output from the Develop Project Management Plan process.

PROJECT DOCUMENTS

The stakeholder register identifies stakeholders in the project, records their roles and contact details, and documents their expectations, all of which are important in including stakeholders in the process of managing risk. The stakeholder register is an output from the Identify Stakeholders process.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific enterprise environmental factor that will be useful as an input into this process is the broader organizational tolerance for risk. Organizations with a low tolerance for risk will put a lot more effort and energy into managing risk on a project, whereas organizations with a higher tolerance for risk and uncertainty will expend less effort in managing risk and may take on higher-risk projects. International standards such as ISO 31000 may also affect how this process will be carried out and, as such, constitute enterprise environmental factors.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that may play an important input in the development of your risk management plan include any templates, processes, or guidelines that the organization has for the development of a risk management plan and managing risk. Other important organizational process assets are, of course, lessons learned and historical information about successful or unsuccessful risk identification and management from past projects.

TOOLS AND TECHNIQUES

The following tools and techniques are available to be used to develop the inputs in this process in order to produce the risk management plan.

EXPERT JUDGMENT

Expert judgment is an excellent tool to use when planning your approach to risk management. Utilizing the knowledge and experience of subject matter experts will be invaluable not only in your overall risk management plan, but also in identifying and completing an analysis of risks. Suitable experts who may provide judgment include senior management, stakeholders with relevant experience, and external subject matter experts such as risk professionals, industry groups, and professional associations.

Real World

If your project is likely to be subject to a high number of complex risks, you may want to consider employing the services of a risk management professional. Just as the profession of project management requires a particular skill set, the profession of risk management also employs a particular skill set. I highly recommend the use of risk management professionals for dealing with complex risk issues.

DATA ANALYSIS

The main purpose of stakeholder analysis is to determine what the particular approach to risk management on your project will be. This involves checking with stakeholders about their particular appetite and attitude towards risk on the project, and also completing a high-level assessment of risk exposure of the project. Typical analytical techniques are a *stakeholder risk profile analysis*, which can be completed by interviewing individual stakeholders about their attitude and expectations of risk that are suitable for the project. Strategic risk scoring sheets are also used to provide a high-level view of the types and level of risk that the project will encounter.

MEETINGS

Meetings are a great way to bring together project team members, stakeholders, and other experts in order to consider how risk will be managed on the project. There are a number of ways you can run these meetings in order to efficiently get the information that you require. They can be run formally with defined agendas and examination of reports, or they can be run as creative brainstorming sessions. The style of meeting you choose will reflect the participants and your intended outcomes.

Real World

I have often found that meetings are a great way to not only solicit technical input from people with relevant experience but also to generate buy-in and commitment. This is especially important in the area of risk management, because giving team members and relevant stakeholders the opportunity to contribute to the management of project risk helps keep them involved and also allows them to understand the importance of being proactive rather than reactive when managing risk.

OUTPUTS

After applying the appropriate tools and techniques to the selected inputs, the Plan Risk Management process has the following output.

RISK MANAGEMENT PLAN

The Plan Risk Management process has the *risk management plan* as its sole output. Similar to other management plans, the risk management plan provides a guide for completing the risk management activities in the project. The risk management plan will probably contain information on the following:

- The particular risk methodology and approach to be taken on the project.
- The individual roles and responsibilities within the team and the wider group of stakeholders.
- Any approved budgets for managing risk, which should then be included in the cost performance baseline.
- An initial analysis of the individual risk categories using a *risk breakdown structure (RBS)*. Figure 9-2 shows an example of a risk breakdown structure.

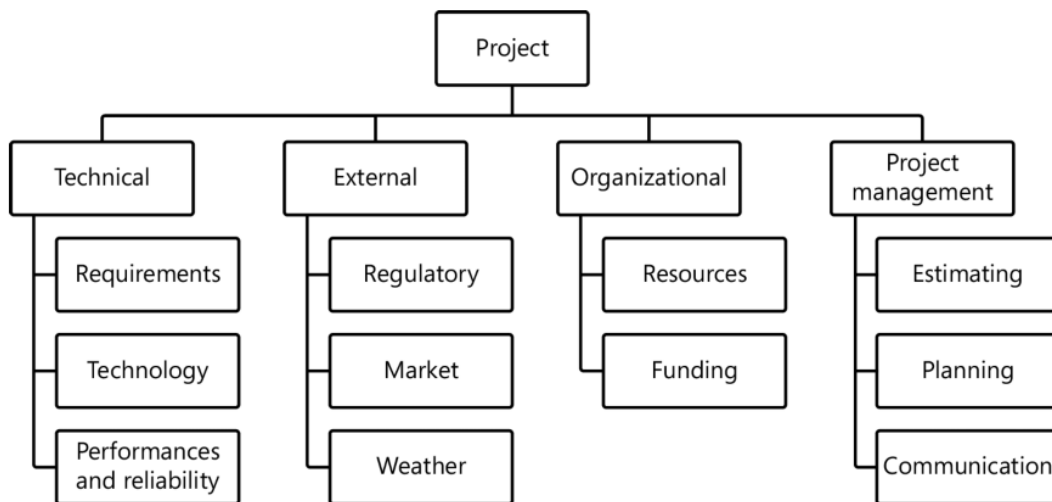


FIGURE 9-2 The development of risk categories using a risk breakdown structure.

EXAM TIP

The risk breakdown structure is one of four breakdown structures. The other three are the organizational breakdown structure, work breakdown structure, and resource breakdown structure. Each of the breakdown structures takes a high level concept and breaks it down into its component parts.

- A standardized definition of risk probability and impact, which is particularly useful for qualitative analysis because the analysis can be quite subjective. Figure 9-3 shows an example of a standardized definition of risk probability and impact.

	Very low or 1	Low or 2	Moderate or 3	High or 4	Very high or 5
Scope	No noticeable change to scope	Minor changes to scope	Significant change to scope	Changes to scope unacceptable to sponsor or client	Changes the complete purpose of the project
Time	No noticeable change to time	Less than 10% increase in time	10–20% increase in time	20–30% increase in time	Greater than 30% increase in time
Cost	No noticeable change to cost	Less than 10% increase in cost	10–20% increase in cost	20–30% increase in cost	Greater than 30% increase in cost

FIGURE 9-3 Standardized definitions of risk probability and impact.

- A probability and impact matrix is useful again for qualitative risk analysis, because it allows you to focus on risk activities on those positive or negative risks that present the greatest opportunity or threat. Figure 9-4 shows an example of a probability and impact matrix showing that the highest risks are any with a combined probability and impact greater than 45 percent; these are colored dark grey.

Impact	10%	30%	50%	70%	90%
Probability					
90%	9%	27%	45%	63%	81%
70%	7%	21%	35%	49%	63%
50%	5%	15%	25%	35%	45%
30%	3%	9%	15%	21%	27%
10%	1%	3%	5%	7%	9%

FIGURE 9-4 Probability and impact matrix.

- Any predefined formats, processes, guidelines, or templates for risk registers or tracking or reporting of risks.

The risk management plan is a subsidiary of the project management plan and is used as an input into the other five risk management processes.

Quick Check

1. What is the main focus of the Plan Risk Management process?
2. Why is it important to also consider positive risk?
3. What other areas of the project management plan can risk affect?

Quick Check Answers

1. The main focus of the Plan Risk Management Process is to formulate your particular approach to how you will manage risks on your project. This is documented in your risk management plan.
2. Many people naturally consider risk as a negative event; however, there are many positive risks, which can lead to a project being under budget, ahead of time, delivering greater quality, and delivering higher-than-expected stakeholder expectations.
3. Risk management can affect every other aspect of the project, because there is generally always uncertainty in all elements of your project.

9.3 IDENTIFY RISKS

TABLE 9-2 Identify Risks process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Requirements management plan</i> ▪ <i>Schedule management plan</i> ▪ <i>Cost management plan</i> ▪ <i>Quality management plan</i> ▪ <i>Resource management plan</i> ▪ <i>Scope baseline</i> ▪ <i>Schedule baseline</i> ▪ <i>Cost baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Assumption log</i> ▪ <i>Cost estimates</i> ▪ <i>Duration estimates</i> ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Requirements documentation</i> ▪ <i>Resource requirements</i> ▪ <i>Stakeholder register</i> ▪ Agreements ▪ Procurement documents ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data gathering <ul style="list-style-type: none"> ▪ <i>Brainstorming</i> ▪ <i>Checklists</i> ▪ <i>Interviews</i> ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Root cause analysis</i> ▪ <i>Assumption and constraint analysis</i> ▪ <i>SWOT analysis</i> ▪ <i>Document analysis</i> ▪ Interpersonal and team skills <ul style="list-style-type: none"> ▪ <i>Facilitation</i> ▪ Prompt lists ▪ Meetings 	<ul style="list-style-type: none"> ▪ Risk register ▪ Risk report ▪ Project document updates <ul style="list-style-type: none"> ▪ <i>Assumption log</i> ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i>

The Identify Risks process is a planning process that uses a wide variety of inputs and tools and techniques to identify all the risks to the project. It is performed through the life of the project, and the risk register is always updated with newly identified risks or current risks that are reassessed by using the other risk planning processes.

The Identify Risks process covers the following planning domain task:

- Task 10: Develop the risk management plan by identifying, analyzing, and prioritizing project risks, and defining risk response strategies, in order to manage uncertainty and opportunity throughout the project life cycle.

In addition to being performed throughout the life of the project, risk identification should be completed by all project team members and stakeholders with experience in the area. This enables you to draw on their skills and experience, and it also creates buy-in to the process of risk management. It is important to realize that the process of identifying risks is not a standalone process but one that involves many stakeholders in a constant state of communication to get their expertise and experience.

Real World

Despite your best efforts, you will probably miss certain risks. On a project I was working on, we spent a lot of time and money on identifying risks for a particularly complex piece of work that was to occur over a five-day period. We used historical information, consulted experts, reviewed documents and plans, involved the project team members, and conducted tests to prepare what we thought was a completely comprehensive risk register. Within the first two hours of the five-day piece of work, a problem arose that we had not identified. We were able to respond to the situation well in this instance, and we used this information for a new risk register for a similar piece of work to be completed 12 months later. The main lesson we learned is that you need to be ready for the unexpected and not assume that your risk register captures every risk.

You should recognize from the range of inputs into the Identify Risks process that risk can occur in any other part of the project.

INPUTS

The Identify Risks process uses some or all of the following inputs.

PROJECT MANAGEMENT PLAN

Because risks can impact any and every part of your project, nearly every subsidiary of the project management plan will be useful to you here as an input into identifying risks. Of course, the risk management plan is an essential input into the Identify Risks process because it will contain information on your particular approach, or methodology, to identifying risks generally, and more specifically it will contain information derived from the risk breakdown structure on already-identified risk categories. It will also contain a description of the particular risk tolerance for the project, which will assist you in determining the effort that you put into identifying particular risks. The risk management plan is an output from the Plan Risk Management process.

The cost management plan will contain cost estimates for all elements of the project, and these estimates should reflect the amount of uncertainty in the estimating process. Each of these areas of uncertainties, either negative or positive, represents a risk on the project. The cost management plan is an output from the Plan Cost Management process.

EXAM TIP

All estimates are by their very nature uncertain. They are educated guesses at what the future will be, based on information at hand today. As such, any baselines, such as cost and time, which are built up using estimates will have a range of uncertainty within them, both negative and positive. In the exam, if you find the word “uncertainty” or “estimate,” you should assume that risk will be present.

The schedule management plan will refer to areas of uncertainty or risk in the development of the project schedule. This information can be used to identify risks associated with the project time frame. The schedule management plan is an output from the Plan Schedule Management process.

The quality management plan will identify areas of uncertainty in the delivery of quality on the project. The quality management plan is an output from the Plan Quality Management process.

The Resource Management Plan will identify areas of uncertainty with the definition, recruitment, retention, and development of project team members, all of which represent risks on the project and should be taken into account during the Identify Risks process. The Resource Management Plan is an output from the Plan Resource Management process.

The scope baseline, made up of the scope statement, the work breakdown structure (WBS), and the WBS dictionary, defines the work to be done on the project and also outlines any areas of uncertainty in the project scope that require further definition. These areas of uncertainty represent risk on the project and should be used to identify individual risks related to the project scope. The scope baseline is an output from the Create WBS process.

PROJECT DOCUMENTS

Much like the above section with a myriad of useful documents coming from the project management plan, there are also a wide range of useful project documents used in identifying risks.

The assumption log will document all of the assumptions you have made and each of these represent uncertainty on the project and therefore risk.

Individual cost estimates include cost estimates for individual project activities. In addition to the actual dollar amount of the estimate, there will be information about the information used and assumptions made in preparing the estimates, which provides an insight into the range of uncertainty in the estimate. This uncertainty represents risks on the project and should be included in the development of the risk register. Cost estimates are an output from the Estimate Costs process.

Duration estimates contain information about the individual time estimates prepared for project activities. This estimating information should contain an indication of the range of uncertainty surrounding the estimate, which represents risk to the project. Duration estimates are an output from the Estimate Activity Duration process.

The issue log will record known issues at the time you are identifying risk, which is of course throughout the life of the project and not just at the beginning. You may want to consider issues as risks if they grow large enough. Conversely, if a risk has happened it may also be in the issues log.

The lessons learned register records the things you know already on this project and other projects that will help you do better in the future.

The requirements documentation and resource requirements both outline parts of the project susceptible to risks.

The stakeholder register is extremely useful in identifying individual risks for two reasons. The first is that the stakeholder register allows you to interview individual stakeholders about their particular attitude towards risk. The second is that each stakeholder will be able to assist from his or her own unique point of view with the identification of project risks. The stakeholder register is an output from the Identify Stakeholders process.

AGREEMENTS

You will want to consider any agreement you have in place, or intend to put in place, because they will have a description of the allocation of risk between the parties to the agreements.

PROCUREMENT DOCUMENTATION

Procurement documents are a key input into the Identify Risks process because they will outline any contractual obligations that may contribute to uncertainty, and the value of this uncertainty. Procurement documents are an output from the Plan Procurement Management process.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific types of enterprise environmental factors that will be useful in managing project risk are any broader organizational attitude and tolerance for risk, and any external risk standards that the organization is using.

ORGANIZATIONAL PROCESS ASSETS

The specific types of organizational process assets that will assist in managing project risk are any blank templates, historical information and lessons learned, and any project-specific policies and guidelines relating to risk management.

TOOLS AND TECHNIQUES

The following tools and techniques are used upon the inputs to deliver the Identify Risks process outputs.

EXPERT JUDGMENT

The use of experts and their experience and skills in identifying risks is a key tool to be used during this process, because the identification of risks can be quite a complex process. By using the experience of project team members who may have done this sort of project before, or external consultants with expertise in this particular area, you will have a greater chance of identifying all of the risks on the project.

DOCUMENTATION REVIEWS

Documentation reviews refer to a structured analysis and review of all relevant project documents and the information they contain to detect any areas of uncertainty or risk on the project. The types of documents reviewed are any part of the project management plan or baselines, documents providing descriptions of any part of the project, and documents outlining the assumptions made in preparing estimates. Documentation reviews are generally carried out by the project manager and project team members.

DATA GATHERING

There are many different ways to gather information in relation to project risk. Each has its own benefits and will deliver varying degrees of accuracy and thoroughness. Examples of useful *data gathering techniques* for the Identify Risks process include:

- **Brainstorming** This is an excellent way to encourage creative thinking about particular risk issues. The intended outcome is a comprehensive list of all the potential risks.
- **Checklists** These can provide guidance that you have done all the necessary steps and activities to identify risks
- **Interviewing** Interviewing experts and people with experience in similar projects and the associated risks is an excellent way to quickly obtain relevant information.

DATA ANALYSIS

Root cause analysis such as the Ishikawa diagram or the 5 Whys technique allow you to get to the heart of any risks identified. You saw the use of this particular diagramming technique in Chapter 6, “Quality management,” to determine the root cause of quality issues. Figure 9-5 shows a cause-and-effect diagram being used to identify risks associated with cost overruns on a project.

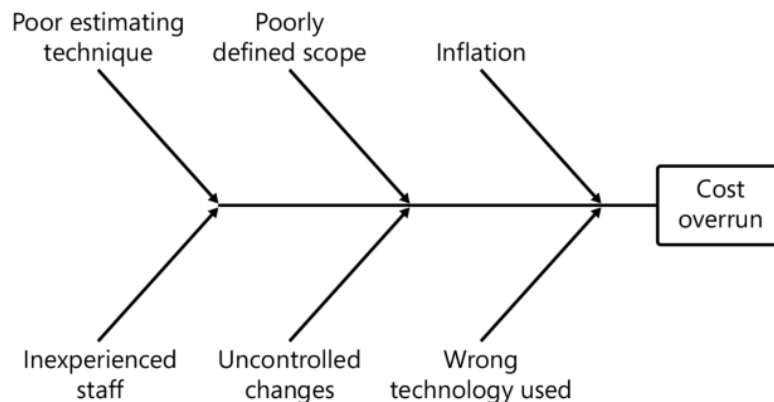


FIGURE 9-5 A Cause-and-effect diagram for risk identification.

Any and all assumptions made about any aspect of the project will represent uncertainty and therefore risk for the project. Therefore, gathering the assumptions and constraint analysis and testing its accuracy, stability, consistency, and completeness are essential parts of identifying project risks.

A key element of any risk identification process is the use of *SWOT analysis*. *SWOT* stands for *strengths, weaknesses, opportunities, and threats*. The idea is to identify and document each of these four areas and then focus on your strengths while making provision for your weaknesses, prepare to take advantage of the opportunities that present themselves, and plan how to respond to identified threats. All of these are key elements in identifying risks.

Real World

I have successfully used SWOT analysis on many occasions to put a framework around a brainstorming session. By getting people to focus on what the current strengths, weaknesses, opportunities, and threats are is an extremely easy way to start people thinking about uncertainty in the project.

Taking time to assess and analyze any other documents that provide information about potential risks on the project is useful in identifying risks.

INTERPERSONAL AND TEAM SKILLS

Facilitation helps structure the risk identification process and ensures active participation, and facilitators guide the team to think broadly and deeply about risks, enhancing the quality of risk identification.

PROMPT LISTS

Prompt lists serve as checklists of potential risks based on categories to ensure that common risks are not overlooked and spark thoughts about less obvious risks.

MEETINGS

Meetings provide a structured setting for team members to discuss and identify risks. This collective brainstorming can uncover risks that individual team members might not have considered.

OUTPUTS

The Identify Risks process has the following outputs.

RISK REGISTER

The risk register is the single output from the Identify Risks process. The development of the risk register is highly iterative, and the risk register itself should be treated as a live document and reviewed regularly. It should be reviewed at all levels from testing the assumptions made right through to the qualitative and quantitative analysis applied to the identified risks. The actual risk register will take many forms depending on your organizational risk tolerance and any existing templates and guidelines. Figure 9-6 shows a generic form of risk register showing risk identification, qualitative analysis, quantitative analysis, and risk responses.

Risk Identification				Qualitative Analysis			Quantitative Analysis			Risk Response Planning
Category	Event	Consequence	+/-	P	I	P x I	P	I\$	P x I\$	Response

FIGURE 9-6 A generic risk register.

Real World

As well as providing extremely valuable technical information about your assessment of risk on the project, the preparation and constant revisiting of the risk register keeps risk at the forefront of your project team's minds. I have found time and effort invested in risk management useful not only from a technical point of view in managing risk, but also for obtaining buy-in and helping people to recognize the importance of proactive risk management.

EXAM TIP

The risk register is perhaps the most iterative document in the project, because it is constantly undergoing review and being updated. In the exam, you should always assume that the risk register is being referred to often.

RISK REPORT

A risk report will be a summary of the current status of known risks and also provide information for interested stakeholders about the way in which risks are being managed.

PROJECT DOCUMENTS UPDATES

As a result of identifying risks you may wish to update the assumption log, issue log, and lessons learned register with any new information you have discovered during this process.

Quick Check

1. Why is the risk register considered a highly iterative document?
2. Who should be involved in the identification of risks?
3. What are three types of information-gathering techniques that can be used to identify risks?

Quick Check Answers

1. The risk register is a highly iterative document because you will always be updating it as information becomes available, assumptions made are tested and refined, and new risks are identified and old ones closed.
2. The project manager will take ultimate responsibility for the Identify Risks process. But the whole project team and relevant external experts should also be involved in the process.
3. There are many types of information-gathering techniques useful for many aspects of project management. Techniques specifically mentioned as useful for the Identify Risks process include brainstorming, the Delphi technique, interviewing, and root cause analysis.

9.4 PERFORM QUALITATIVE RISK ANALYSIS

TABLE 9-3 Perform Qualitative Risk Analysis process

INPUTS ⇌	TOOLS AND TECHNIQUES ⇌	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Risk management plan</i> ▪ Project documents ▪ <i>Assumption log</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data gathering ▪ <i>Interviews</i> ▪ Data analysis ▪ <i>Risk data quality assessment</i> ▪ <i>Risk probability and impact assessment</i> ▪ <i>Assessment of other risk parameters</i> ▪ Interpersonal and team skills ▪ <i>Facilitation</i> ▪ Risk categorization ▪ Data representation ▪ <i>Probability and impact matrix</i> ▪ <i>Hierarchical charts</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Project documents updates ▪ <i>Assumptions log</i> ▪ <i>Issue log</i> ▪ <i>Risk register</i> ▪ <i>Risk report</i>

The Perform Qualitative Risk Analysis process is a planning process focused on assigning a qualitative, or subjective, analysis of probability and impact to all identified risks.

EXAM TIP

The key difference between qualitative and quantitative assessment is that qualitative assessment is subjective—that is, it uses opinion and experience—and is done quickly. On the other hand, quantitative assessment involves actual data and figures to support a more objective assessment. For example, you may do a qualitative assessment that the chance of it snowing in winter during your construction project is 7 out of 10 (1 being that it definitely will not snow, and 10 being that it definitely will snow), and that the impact if it does snow is 6 out of 10 (1 being no impact at all, and 10 being a catastrophic impact). This gives a total qualitative assessment of 42 out of a possible 100. You may then decide to spend some time and money doing quantitative risk analysis on this risk and contact the local weather bureau, which tells you that there is a 0.831 chance of it snowing on those dates and your team members tell you that if it does snow you will suffer a \$10,000 loss. This gives you a total quantitative assessment of \$8310. You can see that quantitative assessment takes more time and money to get this information, but it is more accurate.

The process of qualitative risk analysis is generally done on all identified risks because it is quick and easy to do. It is simply a matter of assigning a subjective assessment of the probability of the risk occurring and also assigning a subjective assessment of the impact of the risk, using defined scales. The scales used can be numerical, such as 1-10, or text based, such as low, very low, high, and so on.

When these two factors are multiplied together, the result is an individual qualitative risk score for each identified risk, which you can use to prioritize the risks and choose to focus on those that ranked the highest. Additionally, you will go on to perform quantitative risk analysis only on those risks that score the highest.

INPUTS

The following inputs are used in the Perform Qualitative Risk Analysis process.

PROJECT MANAGEMENT PLAN

Obviously one of the key inputs into any of the other risk management planning processes will be the risk management plan because it contains information about how each risk management process, including the Perform Qualitative Risk Analysis process, will be performed. The risk management plan is an output from the Plan Risk Management process.

PROJECT DOCUMENTS

The assumption log will provide information about assumptions made in the project and each of these represents an element of uncertainty so should be considered when performing qualitative risk analysis.

The risk register is a key input into the Perform Qualitative Risk Analysis process because, in its first iteration, it is a list of all the risks that have been identified, and the continual development of the risk register includes qualitative risk analysis performed not only once, but on an ongoing basis as new information, new risks, and assumptions are refined. The risk register is an output from the Identify Risks process.

The stakeholder register will provide information about stakeholders with an interest in project risks.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific types of enterprise environmental factors that will be useful as inputs into the Perform Qualitative Risk Analysis process are any external industry standards, such as ISO 31000, and any external information held by risk professionals, such as risk databases and information about the analysis of individual risks.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that will be of use in the Perform Qualitative Risk Analysis process are any historical information that the organization has on similar risks and their probability and impact, and any pre-prepared templates and processes to assist in the qualitative analysis of individually identified risks.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the Perform Qualitative Risk Analysis process outputs.

EXPERT JUDGMENT

Again the use of expert judgment is an exceptionally good way to bring a robust level of analysis to your Perform Qualitative Risk Analysis process. Your choice of experts, and the way in which you choose to solicit information from them, will be an important factor in the quality of the advice given.

Real World

It is always important to give a high degree of consideration when selecting those people you will choose to consult with as experts. The types of things you may want to consider are the level of experience, the willingness to share this experience, the availability, the ability to share information concisely, and any costs associated with the use of those experts.

DATA GATHERING

Interviewing people with knowledge, skills, and experience will be essential to completing this work.

DATA ANALYSIS

Once you have gathered the data you can apply a variety of analysis techniques to it in order to complete the qualitative analysis of risks.

A key element when performing any sort of risk assessment is the quality of the information being used. Obviously, if the quality of information being used is poor, your subsequent assessment will be poor. Therefore, it is important to use a *risk data quality assessment* technique to evaluate the quality of the data being used to make the assessment.

Real World

In my experience, the quality of information that you use to identify and analyze risks definitely does get better over time, especially if you are doing particular types of work for the first time and you are constantly learning and refining the information you have at hand.

A primary tool used in the Perform Qualitative Risk Analysis process is *risk probability and impact assessment*. The key here is to assess each identified risk and assign to it a probability of the risk occurring, and an assessment of the

impact if the risk does occur, by using a standardized scale that should be included in the risk management plan. Because it is a qualitative analysis, there are several kinds of numerical scales or text descriptions that can be used to standardize the responses assessing probability and impact.

Because the assessments of probability and impact being made are qualitative and therefore somewhat subjective, it is important during this process to document the assumptions that were made based on the information available at the time the assessment was done. Throughout the course of the project you will revisit these assumptions, and you will gain further information, which may change either the assessment of risk probability or impact.

Real World

There are many different ways of assessing qualitative probability and impact on projects. In my career I have used simple numerical scales from 1 to 5, or text-based descriptions such as likely, unlikely, and highly likely.

Other risk parameters you may wish to include a *risk urgency assessment* which is a tool that takes into account not only an assessment of the probability and impact of the risk, but the urgency of the risk. Urgency has to do with whether the risk is likely to occur in the near future, in which case you will have a high degree of urgency, compared to risks that may or may not manifest until some further point in time. Those risks that may occur in the near future are those that need the greatest attention paid to them. Risks that may occur further off in the project timeframe can have less attention paid to them.

INTERPERSONAL AND TEAM SKILLS

Once again facilitation is a primary interpersonal and team skill to be able to use in this process. We have covered it in other processes earlier in this book and it is a valuable tool to use to get good information from a range of stakeholders.

RISK CATEGORIZATION

A useful way of representing and presenting the qualitative risk analysis is with *risk categorization* techniques, which you can use to sort the risks into different categories for easy monitoring and reporting. An excellent example of risk categorization is the risk breakdown structure (RBS) shown earlier in Figure 9-2. You may also choose to categorize your risks by project phase or by relevance to particular stakeholders. However you choose to categorize your risks, you should be able to present them in a document or graphically.

DATA REPRESENTATION

A *probability and impact matrix* standardizes and identifies the risks after they have had a probability and impact assessment performed on them so that individual risks can be ranked very quickly. Figure 9-4, shown earlier in this chapter in the “Plan Risk Management” section, presented an example of a probability and impact matrix as a key component of the risk management plan.

An example of a useful hierarchical chart would be the Risk Breakdown Structure, which like other breakdown structures (e.g. Work Breakdown Structure, Organisational Breakdown Structure, or Resource Breakdown Structure), takes the risks on the project and breaks them down into categories and specific risk events.

MEETINGS

Once again, as with many other planning processes, well facilitated meetings with the right people present can greatly assist you with this process.

OUTPUTS

The output from the Perform Qualitative Risk Analysis process is the following.

PROJECT DOCUMENTS UPDATES

The specific project documents that will be updated are the issue log, risk report, risk register and the assumptions log. Any time you complete any new qualitative risk assessments or revise existing qualitative risk assessment based on refined or new information; you will need to update these documents. As well as updating the risk register with new or revised information is the requirement to update the assumptions log to reflect the new assumptions that have been made.

Quick Check

1. What is the main difference between qualitative risk assessment and quantitative risk assessment?
2. What sort of probability and impact assessment is best used for the Perform Qualitative Risk Analysis process?
3. How does risk urgency assessment differ from risk probability and impact assessment?

Quick Check Answers

1. The main difference between qualitative risk assessment and quantitative risk assessment is that qualitative risk assessment uses subjective assessments of probability and impact, whereas quantitative risk assessment uses objective assessments of probability and impact, usually quantifying it in terms of money or time.
2. There is no one best type of probability and impact assessment to use in the Perform Qualitative Risk Analysis process. The decision whether to use numerical scales or text-based descriptions of qualitative risk analysis is entirely up to you and depends on what is appropriate for your project.
3. Risk urgency assessment takes into account the timeframe in which the risk may manifest, with risks that may manifest in the near future having a higher urgency than risks that may occur in the longer term. Risk probability and impact assessment is applied to all risk and simply assesses the probability of the risk occurring, and the impact if it does occur.

9.5 PERFORM QUANTITATIVE RISK ANALYSIS

TABLE 9-4 Perform Quantitative Risk Analysis process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Risk management plan</i> ▪ <i>Scope baseline</i> ▪ <i>Schedule baseline</i> ▪ <i>Cost baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Assumption log</i> ▪ <i>Basis of estimates</i> ▪ <i>Cost estimates</i> ▪ <i>Cost forecasts</i> ▪ <i>Duration estimates</i> ▪ <i>Milestone list</i> ▪ <i>Resource requirements</i> ▪ <i>Risk register</i> ▪ <i>Risk report</i> ▪ <i>Schedule forecasts</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data gathering <ul style="list-style-type: none"> ▪ <i>Interviews</i> ▪ Interpersonal and team skills ▪ <i>Facilitation</i> ▪ Representations of uncertainty ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Simulations</i> ▪ <i>Sensitivity analysis</i> ▪ <i>Decision tree analysis</i> ▪ <i>Influence diagrams</i> 	<ul style="list-style-type: none"> ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Risk report</i>

The Perform Quantitative Risk Analysis process is a planning process focused on the development of a quantitative, or objective, assessment of individual risk probability and impact, often by using a metric based on money or time.

Performing quantitative risk analysis generally takes more effort than performing qualitative risk analysis and assessment, and therefore it is generally performed on those risks that are identified as having a higher probability and impact on the project. The intended outcome of the quantitative risk assessment process is to assign a dollar or time amount to specific risks if they occur. You can then aggregate all these individual quantitative estimates to build contingency reserves for time or cost. Because of the complexity of the tools and techniques, and information required for successful quantitative risk analysis, it is often done by risk professionals with experience, and access to relevant historical information that can be used in the analysis.

INPUTS

The following inputs are used in the Perform Quantitative Risk Analysis process.

PROJECT MANAGEMENT PLAN

The risk management plan outlines the particular way in which you will approach the process of quantitative risk analysis and, as such, it is an extremely important input to assist in the completion of this process. The risk management plan is an output from the Plan Risk Management process.

The scope baseline provides a comprehensive description of all the work to be done on the project. This will include descriptions of uncertainty, and also outline limitations on resources which may affect your ability to respond to quantitative risks.

The schedule baseline provides guidelines for the development and management of schedule reserve, which is calculated with quantitative risk analysis by using time as a metric. The schedule baseline is an output from the Plan Schedule Management process.

The cost baseline is a useful input into the Perform Quantitative Risk Analysis process because it outlines how financial reserves will be developed and managed. One of the key metrics used in quantitative risk analysis is the use of dollar amounts as a quantity, and cumulatively the individual dollar amounts can be added up to become a cost reserve for the project. The cost baseline is an output from the Plan Cost Management process.

PROJECT DOCUMENTS

Here's how each of these project documents can be useful in the Perform Quantitative Risk Analysis process:

- **Assumption Log:** Helps to quantify uncertainties tied to assumptions made in the project. For example, if you assume a supplier will deliver within 7 days, what's the risk if it takes 10?
- **Basis of Estimates:** Provides the data used to derive cost and duration estimates, which can be risk-adjusted for a more realistic view. For instance, if labor costs are estimated based on a 40-hour workweek, what happens if overtime is required?
- **Cost Estimates:** Direct inputs for financial risk analysis. For example, if a project is estimated to cost \$100,000, a Monte Carlo simulation might be used to predict how likely it is to stay within budget.
- **Cost Forecasts:** Help in analyzing how variations in costs could impact the project's financial health. If cost forecasts show a trend of increasing expenses, what are the associated risks?
- **Duration Estimates:** These are used to assess schedule risks. For example, if a task is estimated to take 20 days, what is the risk impact if it actually takes 25 or 30 days?
- **Milestone List:** Helps in identifying crucial project phases that are risk-sensitive. For example, if a milestone involves regulatory approval, what is the risk of delays?
- **Resource Requirements:** Enables risk analysis of resource constraints. For example, if you need five engineers but only have three, what are the associated schedule or quality risks?
- **Risk Register:** The primary source for risks to analyze quantitatively. It lists identified risks, their impacts, and likelihoods.
- **Risk Report:** Provides an overview of the risk landscape, helping to choose which risks to analyze quantitatively. For example, the report may highlight high-impact risks that warrant detailed quantitative analysis.
- **Schedule Forecasts:** Help to quantify the likelihood of meeting project deadlines. For instance, if the schedule forecast predicts a 20% chance of delay, risk responses can be developed accordingly.

Each of these inputs brings its own set of information that can be modeled and analyzed to better understand various risks in a quantitative manner.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific enterprise environmental factors that will be useful in the Perform Quantitative Risk Analysis process are any external industry standards such as ISO 31000 and any risk databases held by risk professionals.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that will be of use in the Perform Quantitative Risk Analysis process are any historical information that the organization holds on previous experience with performing quantitative risk analysis and, of course, any blank templates or guidelines the organization has for completing the Perform Quantitative Risk Analysis process.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the Perform Quantitative Risk Analysis process outputs.

EXPERT JUDGMENT

Given the complexity of performing accurate quantitative risk analysis, the use of subject matter experts with relevant experience in this area is very important. Expert judgment is important not only for the quantitative calculations but also for the interpretation of the data produced.

DATA GATHERING

A key technique to assist with the execution of the Perform Quantitative Risk Analysis process is the use of *data gathering* techniques. The purpose of using these techniques is to obtain relevant and accurate data that can then be assessed to develop the quantitative metrics of risk probability and impact. These data gathering techniques include the interviewing techniques that draw on the experience and skills of experts. The type of information that you will be seeking from experts is their own quantitative assessment of probability and impact of particular risks. You may end up with a range of responses and thus may want to consider the use of three-point estimating, which was covered in the cost and time estimating processes in Chapter 4, "Time management" and Chapter 5, "Cost management."

INTERPERSONAL AND TEAM SKILLS

Being able to competently facilitate a meeting with experts of stakeholders will ensure that you are able to get a good range of information from a wide variety of people.

REPRESENTATIONS OF UNCERTAINTY

Representations of uncertainty can be invaluable tools for the Perform Quantitative Risk Analysis process. They allow you to quantify the range of possibilities for various project variables, such as cost, time, and resource availability. Here's how:

- **Probability Distributions:** By using distributions like the Normal, Triangular, or PERT, you can represent the uncertainty in variables. For example, a task might take anywhere from 10 to 20 days, but is most likely to take 15 days. This can be modeled using a Triangular distribution.
- **Monte Carlo Simulation:** This technique uses random sampling and statistical models to estimate the probability of different outcomes. It provides a range of possible results and the likelihood of each, which is a robust way to represent uncertainty.
- **Sensitivity Analysis:** This helps identify which variables have the most impact on project objectives. For instance, if labor costs have a wide range of uncertainty, but have little impact on the overall project cost, you may choose to focus on other, more sensitive areas.
- **Decision Trees:** These graphical models help you visualize different scenarios and their associated risks and rewards. Each branch of the tree represents a possible decision or outcome, complete with probabilities and impacts.
- **Confidence Intervals:** These give a range within which an unknown project parameter is expected to fall a certain percentage of the time. For example, you might say there's a 95% chance the project will be completed within 30 to 40 days.

- **Scenario Analysis:** Different "what-if" scenarios can be modeled to understand the range of possible outcomes. This can be particularly useful for assessing the best-case, most-likely, and worst-case scenarios for project variables like cost and time.

By employing these tools and techniques, you can better understand the nature and extent of uncertainties, allowing for more informed decision-making and risk response planning.

DATA ANALYSIS

In quantitative risk analysis and modeling techniques, sophisticated statistical and mathematical approaches are applied to the calculation and range of risk probability and impact. There are a variety of techniques that can be used, but because of their sophistication, they are usually carried out by using software. Of the available types of quantitative risk analysis and modeling techniques, the following are the most popular and useful for quantitative risk analysis:

Modeling and simulation Includes Monte Carlo analysis, which is the most common type. In the Monte Carlo technique, all the potential outcomes are modeled and computed many times, with different input values, to assess the most likely outcomes—that is, those with the highest probability—and to come up with a probability distribution, (normal, uniform, or beta) associated with each of these outcomes. By using Monte Carlo analysis you can find the likely probability of many different risks, and this allows you and your team to determine which risks will have the greatest or least chance of occurring. It is a highly sophisticated form of mathematical modeling and requires the use of software.

Sensitivity analysis A technique that looks at different aspects of the project and how they have an impact upon project risk, to determine which parts of the project are most sensitive to risk. It may, for example, determine that issues around cost are more sensitive to risk, and more specifically that cost issues related to inflationary pressures on materials over time are most at risk. Sensitivity analysis is a highly complex set of calculations using software and, as such, generally requires specialized knowledge and expertise to carry out.

Tornado diagrams Often used to present the results of sensitivity analysis. A tornado diagram is a histogram or bar chart where the data categories are listed vertically instead of horizontally, with the largest category at the top and then the other categories in order of descending size, giving the diagram the appearance of a tornado. Figure 9-7 shows an example of a tornado diagram presenting the results of sensitivity analysis to show which parts of the project are most sensitive to risk, judged by the quantitative impact they will have on the net present value (NPV) of the project.

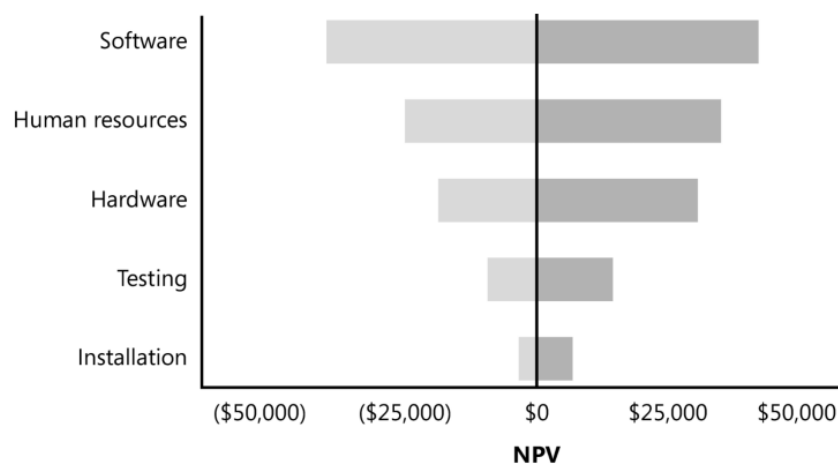


FIGURE 9-7 An example of tornado diagram showing how different risk may impact upon project net present value.

Decision tree analysis A way to allocate quantitative numerical probability and impact to particular options and from this to arrive at what the expected monetary value of each option is. Depending on the calculated outcome, you would then be able to quantify your decision. The usual way of graphically representing the expected monetary value analysis is with the use of decision trees. In Figure 9-8, a decision tree shows the calculation of expected monetary value analysis regarding whether to upgrade existing customer ordering software or to develop a completely new piece of software.

Decision Definition	Decision node	Chance node	Net path value
Decision to be made	Input: cost of each option Output: decision made (true, false)	Input: scenario probability, reward if it occurs Output: expected monetary value (EMV)	Computed: (Payoffs minus Costs) along path

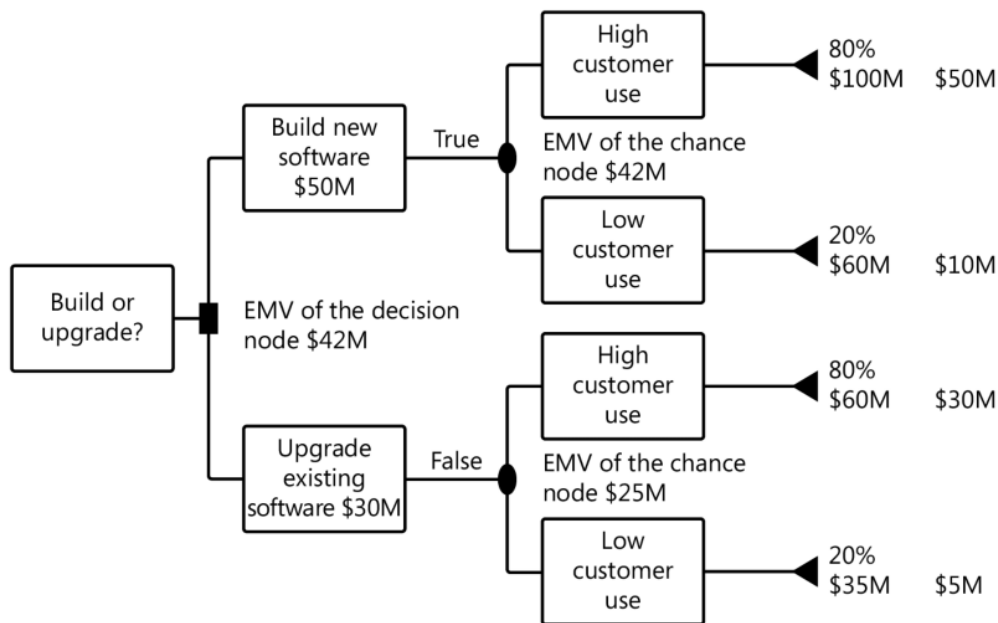


FIGURE 9-8 A decision tree analysis for assessing the expected monetary value of building new software or upgrading existing software.

Figure 9-8 shows that for either decision there is an 80 percent chance of high customer use and a 20 percent chance of low customer use. If you decide to build new software, it will cost \$50 million, and if there is high customer use, you will make \$100 million, so there is an 80 percent chance of making a net figure of \$50 million. By the same token, if you decide to build new software at a cost of \$50 million, and there is low customer use, you will only make \$60 million, so there is a 20 percent chance of making a net figure of \$10 million. You would then add these two calculations together

$$(0.8 \times \$50m) + (0.2 \times \$10m)$$

to get an expected monetary value (EMV) of \$42 million.

The other option is to upgrade the existing software, which will cost \$30 million and has an 80 percent chance of making a net figure of \$30 million, and a 20 percent chance of making a net figure of \$5 million. Therefore, the expected monetary value for this decision is

$$(0.8 \times \$30m) + (0.2 \times \$5m) = \$25m$$

By using this form of quantitative risk analysis, you can recognize that the best decision is to take the option with the greater expected monetary value, which is to build new software. What is also apparent in this example is that the quality of the calculated outcome is only as good as the quality of the information going into the model. Here is another example of why it is important to document the assumptions that you've made, so that if any of this changes in the future you can quickly recalculate.

EXAM TIP

You may have to calculate a decision tree in the exam, so just remember to calculate the probability of each by the net value—cost minus income.

Influence diagrams are graphical tools that help visualize complex relationships among various factors, decisions, and outcomes in a project. These diagrams are useful in the Perform Quantitative Risk Analysis process for several reasons:

- **Identifying Dependencies:** Influence diagrams show how different elements are interconnected, helping you understand which factors influence your key project objectives, like cost and time.
- **Simplifying Complexity:** Complex projects have many variables and possible outcomes. Influence diagrams help break this complexity down into a more manageable form, allowing for easier analysis.
- **Facilitating Team Understanding:** They serve as a common framework for project team members to understand the interconnected nature of risks and how they influence key project variables.
- **Decision Analysis:** Influence diagrams can highlight decision nodes, giving project managers a clear idea of points in the project where crucial decisions need to be made and what factors should be considered.
- **Quantitative Modeling:** Once the diagram is constructed, you can assign probabilities and values to various nodes. This quantitative data can then be used in risk analysis methods like Monte Carlo simulations to generate more precise risk assessments.
- **Identifying Risk Responses:** By understanding how different factors influence each other, you can more effectively pinpoint where risk responses will be most effective.
- **Comparing Alternatives:** Influence diagrams can help you assess the impact of different strategies or decisions on project outcomes, enabling better decision-making.

For example, let's say you're managing a construction project. An influence diagram might include nodes for labor costs, material costs, weather conditions, and permit approvals, all of which influence the final completion date. By understanding these relationships and assigning probabilities, you can better assess how risks in one area (like delays in permit approvals) might impact the overall project timeline.

In summary, influence diagrams offer a structured way to analyze and quantify the complex web of factors that contribute to project risk, making them a valuable tool in quantitative risk analysis.

EXAM TIP

If you find a question in the exam referring to mathematical modeling of risks, it will be referring to one of these techniques.

OUTPUTS

The single output from the Perform Quantitative Risk Analysis process is the following.

PROJECT DOCUMENTS UPDATES

The specific project documents that will be updated include the risk report. The types of information that will feature in the risk report updates will include all the calculations generated by the quantitative risk analysis, which includes quantitative probabilities of individual risks, quantitative impacts of individual risks in terms of both cost and time, and subsequently a prioritized list of quantified risks.

Quick Check

1. What is the main purpose of quantitative risk analysis?
2. Why is it important to consider the use of experts during the Perform Quantitative Risk Analysis process?
3. What is the main value of using quantitative risk analysis and modeling techniques such as sensitivity analysis and expected monetary value analysis?

Quick Check Answers

1. The main purpose of quantitative risk analysis is to quantify in either cost or time values the particular probability and impact of individual risks, and the development of reserves for both cost and time.
2. The Perform Quantitative Risk Analysis process can be a highly sophisticated process using complex statistical and mathematical modeling and, as such, in order to extract maximum benefit from quantitative risk analysis it may be necessary to use people with experience in both the preparation and interpretation of quantitative risk data.
3. The main value in using quantitative risk analysis and modeling techniques is that it gives you a standardized and defined means of analyzing and presenting data in a way that can be understood easily.

9.6 PLAN RISK RESPONSES

TABLE 9-5 Plan Risk Responses process

INPUTS →	TOOLS AND TECHNIQUES →	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Resource management plan</i> ▪ <i>Risk management plan</i> ▪ <i>Cost baseline</i> ▪ Project documents ▪ <i>Lesson learned register</i> ▪ <i>Project schedule</i> ▪ <i>Project team assignments</i> ▪ <i>Resource calendars</i> ▪ <i>Risk register</i> ▪ <i>Risk report</i> ▪ <i>Stakeholder register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgement ▪ Data gathering <ul style="list-style-type: none"> ▪ <i>Interviews</i> ▪ Interpersonal and team skills ▪ <i>Facilitation</i> ▪ Strategies for threats ▪ Strategies for opportunities ▪ Contingent response strategies ▪ Strategies for overall project risk ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Alternatives analysis</i> ▪ <i>Cost-benefit analysis</i> ▪ Decision making <ul style="list-style-type: none"> ▪ <i>Multicriteria decision analysis</i> 	<ul style="list-style-type: none"> ▪ Change requests ▪ Project management plan updates ▪ <i>Schedule management plan</i> ▪ <i>Cost management plan</i> ▪ <i>Quality management plan</i> ▪ <i>Resource management plan</i> ▪ <i>Procurement management plan</i> ▪ <i>Scope baseline</i> ▪ <i>Schedule baseline</i> ▪ <i>Cost baseline</i> ▪ Project documents updates ▪ <i>Assumption log</i> ▪ <i>Cost forecasts</i> ▪ <i>Lesson learned register</i> ▪ <i>Project schedule</i> ▪ <i>Project team assignments</i> ▪ <i>Risk register</i> ▪ <i>Risk report</i>

The Plan Risk Responses process is a planning process that is focused on the development of proactive responses to risks.

The development of proactive responses is a very effective way of both minimizing the potential effects of negative risk and maximizing the potential benefits of positive risk on a project. Each of the risk responses will seek to influence the risk prior to its possible occurrence, and also to influence the risk if it does occur. In addition to planning responses to identified risk, the Plan Risk Responses process also proactively considers responses to unplanned or unforeseen risks.

INPUTS

The following inputs are used in the Plan Risk Responses process.

PROJECT MANAGEMENT PLAN

The resource management plan will inform you of resource availability and any constraints that may impact your planned risk responses.

The risk management plan contains information about the processes you have decided are most appropriate for the development of risk responses and, as such, it is an essential input into the Plan Risk Responses process. The risk management plan is an output from the Plan Risk Management process.

The cost baseline will provide information about financial constraints and uncertainty that may impact your planned risk responses.

PROJECT DOCUMENTS

Let's delve into how each of these can serve as inputs into the Plan Risk Responses process.

- Lesson Learned Register: A repository of knowledge gained from previous phases or projects. For example, if previous projects showed that a certain vendor was unreliable, alternate vendors could be identified as a risk response.
- Project Schedule: Contains timelines and milestones. For example, if there's little wiggle room in the schedule, then the response plan might focus on risks that could cause delays and prioritize those.
- Project Team Assignments: Specifies who is responsible for what. For example, knowing that Jane is skilled in crisis management can inform the delegation of risk response tasks related to potential crises.
- Resource Calendars: Availability of team members and equipment. For example, if key personnel are unavailable during critical project phases, contingency plans could be made to mitigate the risk of delays.
- Risk Register: Lists identified risks, their probabilities, and impacts. For example, if there's a high chance of budget overrun, strategies like reserve allocation could be included in the plan.
- Risk Report: Provides a summary and analysis of the overall project risk. For example, if the report indicates a high level of financial risk, then hedging strategies could be incorporated.
- Stakeholder Register: Contains information about stakeholders. For example, if a stakeholder has low tolerance for schedule delays, fast-tracking might be a suitable risk response for schedule-related risks.

ENTERPRISE ENVIRONMENTAL FACTORS

EEFs refer to the external and internal conditions that surround or influence a project's success, such as market trends, regulations, and company culture. For example, if a new environmental regulation is introduced, then the Plan Risk Responses process would need to account for compliance risks and possibly allocate budget or time for meeting these requirements. Alternatively, if the company culture is risk-averse, the risk response strategy might lean towards avoiding or transferring risks rather than accepting or mitigating them.

ORGANIZATIONAL PROCESS ASSETS

OPAs are internal company resources that can aid project management, such as templates, procedures, and historical information. For example, a previous project might have had a successful risk response template that can be reused or adapted for the current project. Similarly, lessons learned from past projects can inform the current Plan Risk Responses process by providing insights into what responses were effective or ineffective in similar situations.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the Plan Risk Responses process output.

EXPERT JUDGMENT

Given the complexity of executing a well-defined series of planned risk responses, it is prudent to use expert judgment as a tool in developing your risk responses. The experts that you choose to use will be those people with experience and skills in anticipating and dealing with the identified risks.

DATA GATHERING

The primary form of data gathering to plan risk responses will be interviews. Interviews involve one-on-one conversations with project stakeholders, team members, or subject matter experts to gain insights into potential risks and possible responses. For example, you might interview a finance expert to understand the potential financial risks your project faces. The expert could provide various options for mitigating financial risks, like hedging against currency fluctuations or setting up contingency funds.

INTERPERSONAL AND TEAM SKILLS

The primary interpersonal and team skills you will use here is facilitation. Facilitation employs a neutral facilitator to guide a group of stakeholders or project team members in discussions or workshops to identify, assess, and plan risk responses collaboratively. For example, a facilitated workshop could involve key team members and stakeholders coming together to discuss identified risks. Through brainstorming and group discussions, the team could develop a shared understanding of the risks and collectively decide on the best risk responses.

STRATEGIES FOR THREATS

There are four key strategies for negative risks or threats in relation to the development of appropriate risk responses. They are:

Avoid Making plans to avoid the risk occurring. For example, if you have identified that there is a risk of earthquake damage in a building that you plan to construct, an avoid strategy would be to relocate the building to an area that was more geologically stable.

Transfer Making the responsibility and ultimately the consequences of the risk somebody else's responsibility. The most common form of transfer is insurance. For example, after identifying that your building may be subject to damage from an earthquake, you may decide to take out insurance for this event.

Mitigate Accepting that the risk may occur but attempting to put in place a risk response that minimizes the negative effects of the risk. For example, you may decide to build your multistory building in a known earthquake zone, but choose to mitigate the effects of an earthquake upon the building with the use of base isolators and materials that are impact resistant.

Accept Simply accepting the consequence of the risk occurring. For example, you may choose not to take out insurance, nor to shift a planned building, nor to use earthquake-resistant building technology, and simply accept that if an earthquake hits you will take responsibility for repairs.

You can have multiple strategies for each risk; often this is the wisest approach because different strategies can be enacted at different times in the timeline of a risk potentially occurring. You will also choose the most appropriate risk strategy, or strategies, for your particular risk and your particular risk tolerance.

STRATEGIES FOR OPPORTUNITIES

There are four key strategies for positive risks or opportunities which seek to maximize the chance of the positive risk occurring, and if it does occur, to maximize the positive impact upon the project. They are:

Exploit A strategy that seeks to ensure that the positive risk has the maximum chance of occurring. For example, you may decide to allocate your top designers to a particular client's project to ensure that the positive risk of a happy client is enhanced.

Share Taking on board a third party with particular skills and experience to help maximize the occurrence and the impact of a positive risk. For example, you may choose to go into a joint venture with a company with complementary skills in order to increase the chances of securing a particular contract.

Enhance Being prepared to increase the chances of the positive risk occurring and, if it does occur, the positive impact that it has. For example, you may choose to buy more lottery tickets in order to enhance the chances of your winning.

Accept There will be no changes made to the project management plan and you will simply accept the chances of the positive risk occurring and the impact that it has.

CONTINGENT RESPONSE STRATEGIES

Each of the strategies for negative risk or positive risk discussed previously is developed for clearly identified risks. However, it is highly unlikely that despite your best efforts you will end up identifying all of the risks that

may occur on a project, and thus it is prudent to have in place *contingent response strategies*, which are your planned responses to unplanned risk. The contingent response strategies will outline the actions your project team will take if a set of predefined conditions occurs. This set of predefined conditions can refer to particular metrics relating to the project budget or project schedule. Your contingent response strategies will be included in your *contingency plan*.

A further means of dealing with unplanned risks occurring is a *workaround*. The difference between a workaround and contingent response strategies is that a workaround is an unplanned and reactive response to an unplanned risk occurring, whereas a contingent response strategy is a planned and prepared response to an unplanned risk occurring. A workaround is a plan to get around a problem or risk that has arisen and not necessarily fix it. A great way to implement a workaround is to gather experienced people in a single location and get them to brainstorm a solution as fast as possible. The workaround may be a temporary solution to allow you to continue working on the project and, therefore, you should be prepared to revisit the situation with a more permanent solution. Always include your experience of workarounds in your lessons learned so that future projects may anticipate the risk and include it in their risk register.

STRATEGIES FOR OVERALL PROJECT RISK

Strategies for overall project risk aim to address the collective effect of individual risks on the project, rather than focusing on single risks in isolation. They can serve as a holistic approach in the Plan Risk Responses process to balance out and manage risk at the project level.

Strategies for overall project risk might involve:

- **Risk Positioning:** Deciding the overall level of risk that the project team is willing to take on.
- **Portfolio Balancing:** Evaluating the project in the context of other organizational initiatives to manage overall exposure.
- **Financial Tools:** Utilizing financial strategies like contingency reserves or insurance to manage overall project risks.

For example, suppose a construction project faces multiple risks such as weather delays, fluctuating material costs, and labor shortages. Instead of treating each risk individually, an overall project risk strategy could involve:

- Setting up a contingency fund that covers multiple types of risks.
- Ensuring that the project timeline has some flexibility built-in to handle both weather delays and labor shortages.
- Deciding upfront how much risk in terms of cost and time overruns the organization is willing to tolerate for the entire project.

By adopting such an integrated approach, the Plan Risk Responses process can more effectively anticipate and prepare for uncertainties that could affect the project as a whole.

DATA ANALYSIS

Both alternative analysis and cost-benefit analysis are tools used to evaluate different options for risk responses. They help in making informed decisions by assessing the advantages, disadvantages, and implications of each option.

Alternatives analysis involves examining different ways to approach risk responses. By comparing multiple alternatives, you can identify the most effective strategy for mitigating or exploiting a risk. For example, if there's a risk of a key component being unavailable, alternatives might include sourcing from different suppliers, using a different component, or redesigning the product to not need that component. Each alternative will have its own set of implications for cost, timeline, and quality.

Cost-benefit analysis involves evaluating the benefits of a risk response against the costs involved in implementing it. Essentially, it answers the question, "Is this risk response worth the cost?" For example, let's say there's a risk of system downtime in a software project. One response could be to build a redundant system. The benefit is high availability, but the cost of setting up and maintaining a redundant system will be significant. A cost-benefit analysis will help decide if the reduced risk of downtime is worth the expenditure.

Both of these tools are valuable in the Plan Risk Responses process because they guide the team in selecting the most appropriate and effective responses. Alternatives Analysis broadens the set of available options, while Cost-Benefit Analysis helps in choosing the most economically sensible among them.

DECISION MAKING

Multicriteria Decision Analysis (MCDA) is a technique that allows you to evaluate various risk response options based on multiple criteria rather than just one, such as cost or time. MCDA helps you make more balanced and informed decisions by looking at the bigger picture. These are the steps you will take to complete this:

- **Identify Criteria:** First, you define the criteria you'll use to evaluate the risk responses. These could range from cost, time, and resource availability to impact on stakeholders or alignment with business objectives.
- **Weight the Criteria:** Not all criteria may have equal importance. You assign weights to each based on their significance to the project.
- **Score the Options:** For each risk response option, you give scores based on how well they meet each criterion.
- **Calculate:** Multiply the scores by the weights and sum them up for each option.
- **Compare and Decide:** The option with the highest total score is usually the most favorable one, considering all the criteria.

For example, imagine a project has a risk of delayed deliveries that can be mitigated by either paying for expedited shipping or increasing inventory levels. Your criteria might include Cost, Time, and Impact on Cash Flow. If Cost is most important, it might get a weight of 0.6, Time 0.3, and Cash Flow 0.1. Expedited shipping might score poorly on Cost but high on Time, while increasing inventory levels might score the opposite. Using MCDA, you can calculate a total score for each option based on these weighted criteria.

By using Multicriteria Decision Analysis in the Plan Risk Responses process, you can better evaluate the trade-offs between different risk response strategies and choose the one that best aligns with the project's overall objectives.

OUTPUTS

The outputs from the Plan Risk Responses process are the following.

CHANGE REQUESTS

Change Requests are formal proposals to modify any aspect of the project, such as its scope, schedule, or resources. These are generated when the Plan Risk Responses process identifies that adjustments to the project plan are needed to manage risks effectively. While planning risk responses, you may realize that changes are needed to mitigate or avoid a risk. For example, you may find that an additional review stage is required to catch potential errors.

A formal change request is then prepared, detailing what the change is, why it's necessary, and what its implications are for the project. The change request usually goes through a change control board or project manager for review and approval. If approved, the project plan is updated, and the change is implemented.

For example, imagine you're managing a software development project, and you identify a high risk of security vulnerabilities. Your Plan Risk Responses process may produce a change request to incorporate additional security testing. This change request would detail the type of testing, the additional time and resources needed, and the expected impact on the project's other objectives like its timeline or budget.

Thus, change requests serve as a formal mechanism to adapt and update the project in light of newly identified risks or opportunities, making them a crucial output of the Plan Risk Responses process.

PROJECT MANAGEMENT PLAN UPDATES

The specific parts of the project management plan that will be updated as a result of your consideration of potential risk responses will include all aspects of the project management plan, such as the schedule, cost, quality, and procurement management plans, as well as the Resource Management Plan and scope, schedule, and cost baselines. The consideration of different, and appropriate, risk responses will often require you to revisit these foundational documents as a result of the risks identified and the planned responses.

PROJECT DOCUMENTS UPDATES

There are many project documents that will be updated as a result of the planned risk responses. These can include the assumption log, cost forecasts, lesson learned register, project schedule, project team assignments, risk register and risk report. It is essential that these documents are kept up to date and reflect the latest information about particular risks, the analysis of individual risks, and the planned risk responses.

Quick Check

1. What is the main purpose of the Plan Risk Responses process?
2. What are the four risk response strategies for positive risks?
3. What are the four risk response strategies for negative risks?
4. What is the purpose of having contingent response strategies in place?

Quick Check Answers

1. The main purpose of the Plan Risk Responses process is to give proactive consideration to the actions you will put in place prior to a risk occurring, and actions you will take as a risk occurs, in order to minimize the impact from negative risks and maximize the impact from positive risks.
2. The four risk response strategies for positive risks are enhance, share, exploit, and accept.
3. The four risk response strategies for negative risks are transfer, mitigate, avoid, and accept.
4. The purpose of contingent response strategies is to ensure that you have a proactive response planned to unplanned risk occurring.

9.7 IMPLEMENT RISK RESPONSES

TABLE 9-5 Implement Risk Responses process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none">▪ Project management plan<ul style="list-style-type: none">▪ <i>Risk management plan</i>▪ Project documents<ul style="list-style-type: none">▪ <i>Lessons learned register</i>▪ <i>Risk register</i>▪ <i>Risk report</i>▪ Organizational process assets	<ul style="list-style-type: none">▪ Expert judgment▪ Interpersonal and team skills▪ <i>Influencing</i>▪ Project management information system	<ul style="list-style-type: none">▪ Change requests▪ Project documents updates<ul style="list-style-type: none">▪ <i>Issue log</i>▪ <i>Lessons learned register</i>▪ <i>Project team assignments</i>▪ <i>Risk register</i>▪ <i>Risk report</i>

The Implement Risk Responses process is an executing planning process that is focused on carrying out the planned risk responses.

The Implement Risk Responses process involves executing the risk response plans that have been developed during the Plan Risk Responses phase. This includes allocating resources, assigning responsibilities, and taking the specific actions outlined to address each risk. The process is iterative, involving monitoring and adjustments, to ensure that the risk responses are effective in mitigating threats and maximizing opportunities.

INPUTS

The following inputs are used in the Implement Risk Responses process.

PROJECT MANAGEMENT PLAN

The risk management plan contains information about the responses you have decided are most appropriate for the identified risks in your project and, as such, it is an essential input into the Implement Risk Responses process. The risk management plan is an output from the Plan Risk Management process.

PROJECT DOCUMENTS

The lessons learned register contains past experiences and solutions that can guide the current project. This information helps to avoid repeating past mistakes and leverages successful strategies in implementing risk responses.

The risk register lists all identified risks, their characteristics, and planned responses. This serves as the primary guide for what risks are being addressed, who is responsible for them, and what strategies will be used.

The risk report summarizes the overall risk profile, including the severity and impact of each risk. This provides a broader context, helping the team prioritize which risks to address first and how much resource to allocate.

ORGANIZATIONAL PROCESS ASSETS

Organizational Process Assets (OPAs) are internal resources that include documentation, processes, and historical information. They can be extremely valuable inputs in the Implement Risk Responses process for several reasons:

- **Standard Procedures and Templates:** OPAs often include templates or guidelines for how to manage and implement risk responses. This can speed up the process and ensure consistency.
- **Historical Information:** Past projects may have encountered similar risks, and their data can provide insights into effective implementation strategies.
- **Best Practices and Lessons Learned:** OPAs usually contain best practices and lessons learned from previous projects, which can offer proven strategies for risk mitigation or exploitation.
- **Risk Control Measures:** OPAs may contain specific measures or controls used in past projects to handle risks, providing a tested framework for current actions.

In essence, OPAs offer a rich set of tools, knowledge, and experiences that can help the project team navigate risk response implementation more effectively.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the Plan Risk Responses process output.

EXPERT JUDGMENT

Experts in relevant fields such as finance, engineering, or regulatory compliance are consulted to provide specialized insights into how best to implement risk responses. For example, if a project is facing a technical risk, an engineering expert might be consulted to offer the best practices for mitigating that specific risk.

INTERPERSONAL AND TEAM SKILLS

Influencing involves using interpersonal skills and negotiation to gain the support or resources needed to implement risk responses effectively. For example, if a risk requires reallocating resources, influencing techniques might be used to gain stakeholder buy-in for the change.

PROJECT MANAGEMENT INFORMATION SYSTEM

PMIS is a software system that helps in the tracking and management of projects, including risk responses. For example, the PMIS can be used to monitor the progress of implemented risk responses, helping to ensure they are completed on schedule and within budget.

OUTPUTS

The outputs from the Plan Risk Responses process are the following.

CHANGE REQUESTS

Change Requests are generated as an output from the Implement Risk Responses process when the team identifies a need to alter the project plan, scope, or approach in order to effectively manage risks. These formal proposals specify the changes needed, the reasons behind them, and their potential impact on the project.

For example, during implementation of risk responses, the team may discover that existing plans are inadequate or that new risks have emerged. A formal change request is prepared to detail the proposed changes, such as a schedule adjustment or resource reallocation. These change requests are submitted for approval through the

project's established change control process, often involving a change control board or project manager. If approved, the change is executed, and the project management plan and other project documents are updated accordingly.

In short, change requests are an essential output from the Implement Risk Responses process, serving as a formal mechanism to adapt and refine the project as it progresses.

PROJECT DOCUMENTS UPDATES

The specific project documents that will be updated will be of the risk register, lessons learned register, project team assignments, risk report, and the issue log. It is essential that these documents are kept up to date and reflect the latest information about particular risks, the analysis of individual risks, and the planned risk responses.

Quick Check

1. What is the main purpose of the Implement Risk Responses process?
2. Name one tool or technique commonly used in the Implement Risk Responses process.?
3. What is a common output from the Implement Risk Responses process when changes to the project plan are necessary?

Quick Check Answers

1. The primary purpose is to execute the risk response plans developed during the Plan Risk Responses phase. This involves allocating resources, assigning responsibilities, and taking specific actions to address each identified risk.
2. Expert Judgement is a common tool used, where experts in relevant fields provide specialized insights into how best to implement risk responses.
3. The Change Requests are the common output. They are formal proposals to alter the project plan, scope, or approach, usually generated when the existing plans prove inadequate for effective risk management.

9.8 MONITOR RISKS

TABLE 9-7 Monitor Risks process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Risk management plan</i> ▪ Project documents ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Risk register</i> ▪ <i>Risk report</i> ▪ Work performance data ▪ Work performance reports 	<ul style="list-style-type: none"> ▪ Data analysis ▪ <i>Technical performance analysis</i> ▪ <i>Reserve analysis</i> ▪ Audits ▪ Meetings 	<ul style="list-style-type: none"> ▪ Work performance information ▪ Change requests ▪ Project management plan updates ▪ <i>Any component</i> ▪ Project documents updates ▪ <i>Assumption log</i> ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Risk register</i> ▪ <i>Risk report</i> ▪ Organizational process assets updates

The Monitor Risks process is focused on monitoring and controlling the project risk management activities being undertaken to ensure that they are in accordance with the risk management plan and the information contained within the risk register.

Like all the other monitoring and controlling processes, the Monitor Risks process checks the implementation of the plan. In this case, you are checking what is occurring against what you planned to occur in relation to risk management. You will be looking out for any variance between what risks you had planned and what risks are occurring, any new risks, and any new information affecting already identified risks, and evaluating the overall risk process.

INPUTS

The following inputs are used in the Monitor Risks process.

PROJECT MANAGEMENT PLAN

The project management plan, and more specifically the risk management plan, contains information about how each part of the project will be executed, monitored, and closed, in relation to risk. The specific part of the project management plan that is most useful for the Control Risk process is the risk management plan. The project management plan is an output from the Develop Project Management Plan process, and the risk management plan is an output from the Plan Risk Management process.

PROJECT DOCUMENTS

The issue log tracks problems and obstacles that have been encountered during the project. These may be related to risks that have become issues or could turn into new risks. By reviewing the Issue Log, the project team can identify new risks or assess the effectiveness of current risk response plans.

The lessons learned register contains valuable insights gained from the project thus far, including what has worked well or poorly in risk management. The lessons learned register helps the team refine their monitoring efforts and avoid mistakes, as they can consult it to see how similar risks were handled or mitigated in the past.

The risk register is the key document in this process, because you are checking the information contained in the risk register against what is actually occurring. You are checking that you identified all the risks; that you correctly estimated their consequences, probability, and impact; and that your documented responses were appropriate. You are also using the risk register to check for any risks you may have missed. The risk register is an output from the Identify Risks process.

The risk report summarizes the risk profile of the project, including which risks are most critical. The risk report helps to prioritize monitoring efforts by highlighting which risks have the highest impact and likelihood, ensuring that focus is kept on the most consequential risks.

WORK PERFORMANCE DATA

In order to assess how you are doing against what you had planned to do, you will require work performance data. Work performance data will in turn become work performance reports in the Monitor and Control Project Work process. Work performance data is an output from the Direct and Manage Project Work process.

EXAM TIP

Remember the sequence that work performance data becomes work performance information, which becomes work performance reports.

WORK PERFORMANCE REPORTS

Work performance reports are the results of analyzing the work performance information and presenting it in a coherent and easy-to-understand manner in order to give you a comprehensive picture on how well, or how poorly, the project is doing. Work performance reports are an output from the Monitor and Control Project Work process.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the Monitor Risks process outputs.

DATA ANALYSIS

Technical performance analysis means putting in place acceptable parameters around potentially negative risk events, generally those affecting scope, time, and cost, and then checking that the work being performed is within these technical performance measurements. Work being performed outside the defined technical performance

measurements represents risk on the project and may require change requests to be prepared and considered, to change parameters if the planned risk response cannot bring the performance back into line. For example, you may have set a range of acceptable costs for development of a new product, but when measuring the actual costs you may find them to be greater than what was planned, and therefore the risk of a cost overrun on the project is greater.

During the Perform Quantitative Risk Analysis process you used objective measurements to develop contingency reserves for either cost or time. During the Monitor Risks process you will use reserve analysis to check whether these calculations are still accurate and the reserves you have planned for are still appropriate. It may be that new information has come to hand that means that the reserve for either cost or time needs to be changed. It is quite typical that, as a project progresses and estimates become more accurate, the range of contingency calculated by using qualitative risk analysis drops. For example, you may find that extra information gained about an estimate for the range of time taken to perform a certain activity can now be refined and reduced because you have now performed the activity several times. You can then reduce the amount of time reserve allocated to this activity.

AUDITS

Generally, audits are a great way to check that processes are working as planned and if there is any room for improvement. In the Monitor Risks process, risk audits are used to check whether the planned risk responses are appropriate and how well the risk management processes are being implemented and if they are appropriate. It is the project manager's responsibility to ensure that risk audits are carried out at appropriate times and with defined objectives. The results of the risk audit will contribute to the ongoing continuous improvement of your project processes.

MEETINGS

You should either make risk management a normal part of regular project meetings or schedule meetings with a special focus on risk management to ensure that you and the team remain focused on risk management activities throughout the life of the project. The purpose of these *status meetings* is to examine all aspects of risk management on the project and ensure they are still appropriate and effective. Additionally, having regular meetings where risk management is a topic of discussion creates greater awareness and buy-in from team members, which in turn results in better risk management.

OUTPUTS

The outputs from the Monitor Risks process include the following.

WORK PERFORMANCE INFORMATION

As a result of carrying out the Monitor Risks process you will end up with valuable work performance information about risk management activities. This information will take the form of revised information about risk responses and their effectiveness, the use of planned time and cost contingency reserves, and any defined technical performance measurements. Work performance information is used as an input into the Monitor and Control Project Work process.

CHANGE REQUESTS

As a result of completing the Monitor Risks process and conducting risk audits, variance and trend analysis, technical performance measurements, or reserve analysis, you may discover information that requires a formal change to be made to a part of the project; this will be done via a change request. Change requests will then go on to be processed according to your approved change control process in the Perform Integrated Change Control process.

PROJECT MANAGEMENT PLAN UPDATES

Due to the fact that risk management affects all other areas of the project, you may update many different parts of the project management plan and its baselines. You will most definitely update the risk management plan.

PROJECT DOCUMENTS UPDATES

The specific project documents that will be updated include the risk register, issue log, lessons learned register, risk report, and the assumptions log.

ORGANIZATIONAL PROCESS ASSETS UPDATES

The specific organizational process assets that will be updated include any historical information about risk management and any templates, processes, or guidelines that the organization has in relation to project management.

Quick Check

1. What is the main purpose of the Monitor Risks process?
2. Why is risk reassessment an important tool or technique in the Monitor Risks process?
3. How does the Monitor Risks process contribute to the development of contingency reserves for time and cost?

Quick Check Answers

1. The main purpose of the Monitor Risks process is to determine if the risk management activities as planned in the risk management plan are being completed as per the plan, if the risks identified in the risk register are manifesting as forecast, and whether the qualitative and quantitative assessments and planned risk responses are still appropriate.
2. In addition to checking whether risk management activities are being completed as per the plan, a key element of the Monitor Risks process is a complete reassessment of the assumptions made, the risks identified, and whether any new risks have been identified.
3. The Monitor Risks process allows you to examine the time and cost contingency reserves you have developed and, as part of the reassessment of risks, you may choose to redefine the reserves allowed for time and cost. Usually this process results in a reduction in the reserves for both time and cost. As more information is known, the better the estimate is, and less risk or uncertainty is associated with them.

9.9 CHAPTER SUMMARY

- The Risk Management knowledge area is focused upon the successful use of project risk to report project performance, gain political support, and provide stakeholders with their risk requirements.
- The Plan Risk Management process produces the risk management plan, which guides the subsequent risk management processes.
- The Identify Risks process, which is a planning process, uses the risk management plan to begin the iterative process of developing the risk register by using a variety of tools and techniques to identify all potential negative and positive risks.
- The Perform Qualitative Risk Analysis process is a planning process that seeks to assign a subjective probability and impact assessment to each of the identified risks so that they can be prioritized.
- The Perform Quantitative Risk Analysis process is a planning process that assigns a quantitative and objective analysis, usually based on statistics and factual data, to the individual probability and impact of identified risks, which can lead to the creation of contingency reserves for time and cost.
- The Plan Risk Responses process is a planning process that outlines a proactive response to all identified risks on the project.
- The Implement Risk Responses process is an executing process that completes the intended risk responses.
- The Monitor Risks process, which is a monitoring and controlling process, is like other monitoring and controlling processes in that it assesses actual performance against that forecast in the risk management plan, checks whether the risks identified and assessed in the risk register are still accurate, and checks whether there are any new risks.

9.10 EXERCISES

The answers for these exercises are located in the “Answers” section at the end of this chapter.

1. Match up the risk response strategy on the left with the correct description on the right.

Risk Response strategy	Definition
1. Avoid	A. You are working on an IT project and decide that you will bear the consequences if something goes wrong on the project.
2. Enhance	B. You decide to partner with another organization that has skills and experience that you don't, in order to present a better response to a contract on offer.
3. Transfer	C. You have considered several options for the location of a new manufacturing plant and decide to locate it in a region with plenty of experienced workers, to get around the risk of not having enough people to do the work.
4. Mitigate	D. You are working on a complex IT project and decide to put in place backup data storage so that you can quickly restart should anything occur to the data you are working on during the project.
5. Accept	E. You take out insurance against wet weather delaying your construction project.
6. Exploit	F. You pull your top project manager off other projects and assign her to a new bridge construction project to ensure that it has the greatest chance of success.
7. Share	G. You put all your project staff through a workshop to improve their communications management strategy to minimize the risk of not managing stakeholder expectations effectively.
2.	Consider the following five examples of risk analysis and decide whether they are qualitative or quantitative risk analysis methods.
A.	You ask your team members to provide their opinion about whether or not the chance of a storm affecting your construction project next April is very low, low, neither low nor high, high, or very high.
B.	You pay the local meteorological bureau to provide you with the exact probability of there being a storm in April of a magnitude that would affect your construction project.
C.	You gather a team of seven subject matter experts and ask them to provide their opinion of probability and impact of the risk of the selected technology on your IT project. You ask them to select from a standardized scale of probabilities ranging from 0.1, meaning very low probability or impact, up to 0.9, meaning very high probability and impact. You then multiply these two numbers together to obtain a risk score.
D.	The quantity surveyor working for your cost estimating team has calculated that over the next two years of your project there is a risk of a 10.3 percent increase in hardware costs, and that this increase could cost you a total of \$173,000. He recommends purchasing this hardware now and finding a place to store it to avoid this risk.
E.	You have calculated that there is a very high chance that a senior staff member will leave your project within the next three months, and that replacing her will cost \$25,000. You decide to offer her a salary increase of \$15,000 to get her to stay with the project.

3. Consider the decision tree shown in Figure 9-9 outlining a choice about whether to build a new factory or upgrade an existing factory to take advantage of increased demand for your product. Using expected monetary value analysis, what is the best decision to make?

Decision Definition	Decision node	Chance node	Net path value
Decision to be made	Input: cost of each option Output: decision made (true, false)	Input: scenario probability, reward if it occurs Output: expected monetary value (EMV)	Computed: (Payoffs minus Costs) along path

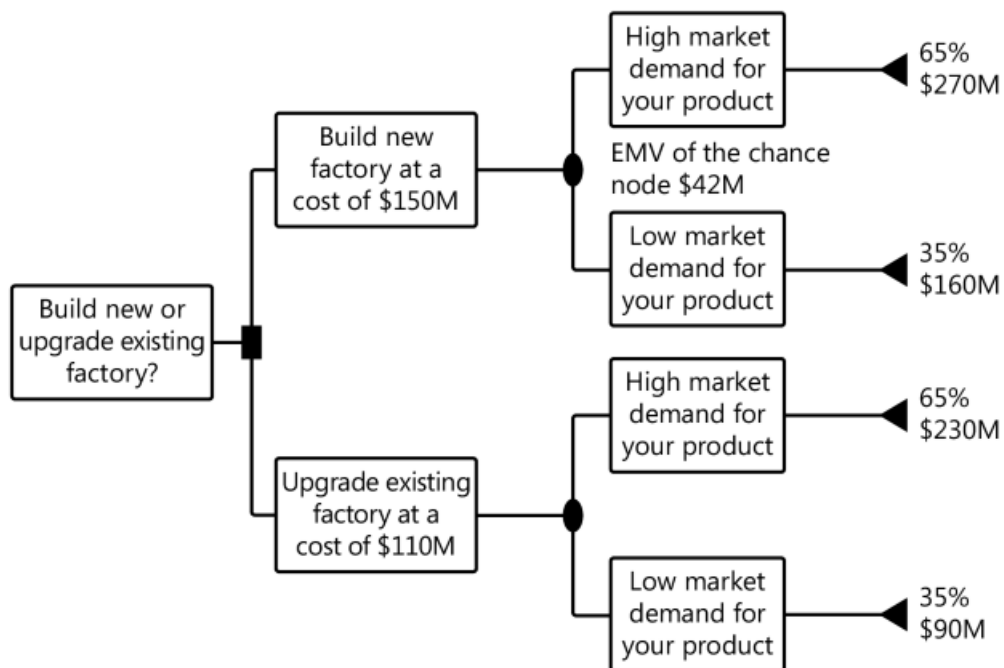


FIGURE 9-9 A decision tree showing the expected monetary value of a new factory or an upgrade to an existing factory.

9.11 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 9 by answering these questions. The answers to these questions, and the explanations of why each answer choice is correct or incorrect, are located in the "Answers" section at the end of this chapter.

- Which of the following processes produces the risk management plan?
 - Develop Project Management Plan
 - Plan Risk Management
 - Manage Risk
 - Develop Risk Management Plan
- The particular attitude that an organization has to the amount of risk it is prepared to accept for the project is known as what?
 - Risk analysis
 - Risk tolerance
 - Risk aversion
 - Risk avoidance

3. Uncertainty that presents opportunities to deliver a project ahead of time is known as what?
 - A. Risk threshold
 - B. Positive risk
 - C. Negative risk
 - D. Risk analysis

4. Which of the following documents will contain a description of risk categories?
 - A. Risk register
 - B. Risk analysis
 - C. Risk management plan
 - D. Risk progress report

5. You have prepared a grid that shows a standardized representation of probability and impact in order to prioritize individual risks. What is this known as?
 - A. Risk breakdown structure
 - B. Ishikawa diagram
 - C. Probability and impact matrix
 - D. Risk register

6. You are in the process of identifying individual risks to your project and are using a technique to discover the underlying causes that lead to a particular risk. What technique are you using?
 - A. Brainstorming
 - B. Delphi technique
 - C. Interviewing
 - D. Root cause analysis

7. You have called your team together for a meeting in which you ask them to analyze the strengths, weaknesses, opportunities, and threats your project faces. What tool or technique are you using?
 - A. Delphi technique
 - B. Brainstorming
 - C. SWOT analysis
 - D. Root cause analysis

8. After carrying out a particular risk process you end up with a prioritized list of risks, ranking them from highest to lowest priority. Which of the following risk processes produces this list?
 - A. Plan Risk Management
 - B. Identify Risks
 - C. Perform Qualitative Risk Analysis
 - D. Perform Quantitative Risk Analysis

9. In carrying out the risk management processes, you will often update particular project documents. What is the most common project document to be updated as a result of completing risk management processes?
 - A. Risk register
 - B. Risk management plan
 - C. Assumptions log
 - D. Project management plan

10. You have developed a range of statistical data that demonstrates the characteristics of a beta distribution and

are using this information to analyze the probability of a risk occurring. Which risk management process are you carrying out?

- A. Identify Risks
- B. Perform Qualitative Risk Analysis
- C. Perform Quantitative Risk Analysis
- D. Plan Risk Responses

11. If you are using a piece of software to carry out the simulation of the probability of a particular risk occurring over many iterations, what tool are you using?
- A. Expected monetary value analysis
 - B. Interviewing
 - C. Sensitivity analysis
 - D. Monte Carlo analysis
12. The decision to delay the beginning of construction until the end of winter to ensure that team members do not have to contend with the risk of dangerous working conditions is what sort of risk response strategy?
- A. Mitigation
 - B. Transference
 - C. Avoidance
 - D. Acceptance
13. You have identified a potential risk to your project but have decided that you will not conduct an assessment of the probability or impact, or have a proactive response in place. What sort of risk response strategy is this?
- A. Mitigation
 - B. Enhancement
 - C. Transference
 - D. Acceptance
14. You are carrying out a reassessment of the cost reserves built up by using quantitative risk assessment for the procurement of materials for your project, due to new information that reduces the uncertainty in the initial estimates. Which risk management process are you carrying out?
- A. Identify Risks
 - B. Perform Quantitative Risk Analysis
 - C. Plan Risk Responses
 - D. Monitor Risks

9.12 ANSWERS

This section contains the answers for the Exercises and Review Questions in this chapter.

EXERCISES

1. Match up the risk response strategy on the left with the description on the right.

Risk Response Strategy	Definition
1. Avoid	C. You have considered several options for the location of a new manufacturing plant and decide to locate it in a region with plenty of experienced workers, to get around the risk of not having enough people to do the work.
2. Enhance	G. You put all your project staff through a workshop to improve their communications management strategy to minimize the risk of not managing stakeholder expectations effectively.
3. Transfer	E. You take out insurance against wet weather delaying your construction project.
4. Mitigate	D. You are working on a complex IT project and decide to put in place backup data storage so that you can quickly restart should anything occur to the data you are working on during the project.
5. Accept	A. You are working on an IT project and decide that you will bear the consequences if something goes wrong on the project.
6. Exploit	F. You pull your top project manager off other projects and assign her to a new bridge construction project to ensure that it has the greatest chance of success.
7. Share	B. You decide to partner with another organization that has skills and experience that you don't, in order to present a better response to a contract on offer.

2. Consider the following five examples of risk analysis and decide whether they are qualitative or quantitative risk analysis methods.

- A. You ask your team members to provide their opinion about whether or not the chance of a storm affecting your construction project next April is very low, low, neither low nor high, high, or very high.
Answer: This is an example of qualitative risk analysis because it is using subjective assessment and opinion on a fixed scale.
- B. You pay the local meteorological bureau to provide you with the exact probability of there being a storm in April of a magnitude that would affect your construction project.
Answer: This is an example of quantitative risk analysis because you are using actual statistical data instead of subjective opinion to calculate probability.
- C. You gather a team of seven subject matter experts and ask them to provide their opinion of probability and impact of the risk of the selected technology on your IT project. You ask them to select from a standardized scale of probabilities ranging from 0.1, meaning very low probability or impact, up to 0.9, meaning very high probability and impact. You then multiply these two numbers together to obtain a risk score.
Answer: This is an example of qualitative risk analysis because, despite the use of experts using numbers with decimal points in them, it is still an opinion-based assessment on a fixed, predetermined scale.
- D. The quantity surveyor working for your cost estimating team has calculated that over the next two years of your project there is a risk of a 10.3 percent increase in hardware costs, and that this increase could cost you a total of \$173,000. He recommends purchasing this hardware now and finding a place to store it to avoid

this risk.

Answer: This is an example of quantitative risk analysis because it uses clear, calculated numbers based on facts to determine probability and impact.

- E. You have calculated that there is a very high chance that a senior staff member will leave your project within the next three months, and that replacing her will cost \$25,000. You decide to offer her a salary increase of \$15,000 to get her to stay with the project.

Answer: This is an example of qualitative risk analysis because you have made a subjective assessment of the probability.

3. Consider the decision tree outlining a choice about whether to build a new factory or upgrade an existing factory to take advantage of increased demand for your product. Using expected monetary value analysis, what is the best decision to make? (See the updated decision tree in Figure 9-10.)

Decision	Decision node	Chance node	Net path value
Decision to be made	Input: cost of each option Output: decision made (true, false)	Input: scenario probability, reward if it occurs Output: expected monetary value (EMV)	Computed: (Payoffs minus Costs) along path

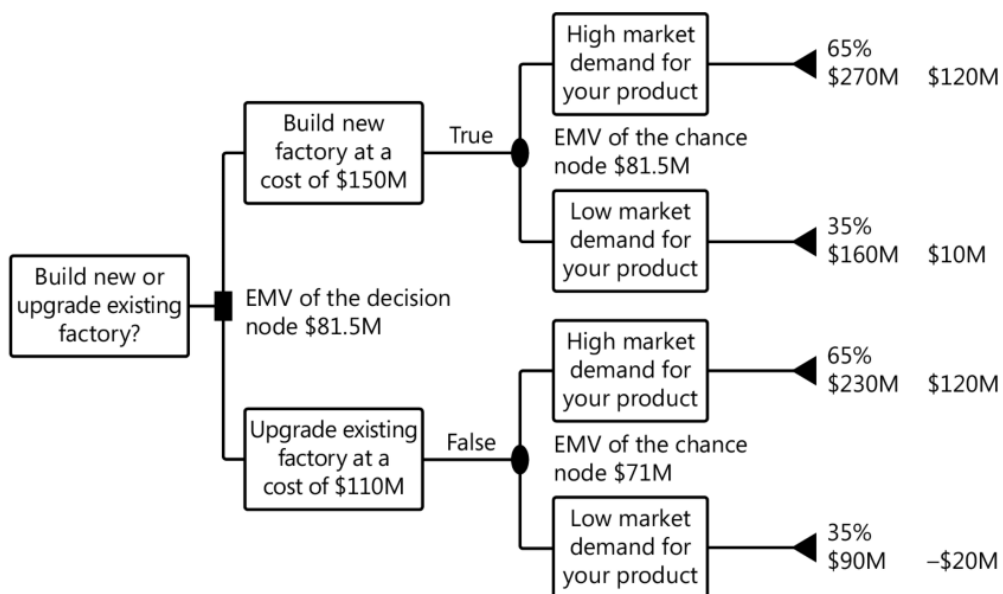


FIGURE 9-10 < A decision tree showing the expected monetary value of a new factory or an upgrade to an existing factory >

Expected monetary value of building a new factory:

$$(0.65 \times \$120M) + (0.35 \times \$10M) = \$81.5M$$

Expected monetary value of upgrading the existing factory:

$$(0.65 \times \$120M) + (0.35 \times -\$20M) = \$71M$$

Therefore, you would choose the build a new factory because it has the higher expected monetary value analysis.

CHAPTER REVIEW

1. Correct Answer: B

- A. **Incorrect:** The Develop Project Management Plan produces the project management plan.
 B. **Correct:** The Plan Risk Management process has the risk management plan as its primary output.

- C. **Incorrect:** Manage Risk is a made-up process name.
- D. **Incorrect:** Develop Risk Management plan is a made-up process name.
2. **Correct Answer: B**
- A. **Incorrect:** Risk analysis is the process of analyzing either quantitatively or qualitatively the probability and impact of particular risks.
- B. **Correct:** Risk tolerance describes the amount of risk an organization is prepared to accept on a project.
- C. **Incorrect:** Risk aversion is a state of mind whereby an organization would prefer not to undertake high-risk activities.
- D. **Incorrect:** Risk avoidance is similar to risk aversion and indicates an outcome of assessing risk tolerance.
3. **Correct Answer: B**
- A. **Incorrect:** The risk threshold is the level of risk tolerance that an organization is comfortable with.
- B. **Correct:** Any uncertainty that presents opportunities constitutes positive risk.
- C. **Incorrect:** Negative risk is any uncertainty that represents a threat to the project.
- D. **Incorrect:** Risk analysis is the process of analyzing either quantitatively or qualitatively the probability and impact of particular risks.
4. **Correct Answer: C**
- A. **Incorrect:** The risk register contains a list of the identified risks, probability and impact assessment, and any planned risk responses. It may use risk categories to group individual risks together, but it does not generally contain a description of the risk categories.
- B. **Incorrect:** Risk analysis is the process of analyzing either quantitatively or qualitatively the probability and impact of particular risks.
- C. **Correct:** The risk management plan contains a lot of information about the particular approach you will take to managing risk on your project; included in this information is a description of the risk categories.
- D. **Incorrect:** Any risk progress reports prepared will focus on risk activities completed against risk activities planned, not on a description of risk categories.
5. **Correct Answer: C**
- A. **Incorrect:** The risk breakdown structure shows the risk categories in graphical form.
- B. **Incorrect:** An Ishikawa diagram shows the probable causes of particular risk effects.
- C. **Correct:** The probability and impact matrix is a grid that shows a standardized list of both probability, on one axis and impact on another axis, and after the two values are multiplied together, presents a graphical analysis of risk priorities.
- D. **Incorrect:** The risk register presents a list of identified risks, probability and impact assessment, and the proactive risk responses.
6. **Correct Answer: D**
- A. **Incorrect:** Brainstorming is a technique to gather as much information as possible from project team members or subject matter experts.
- B. **Incorrect:** The Delphi technique is a method of anonymously interviewing and gathering data from experts.
- C. **Incorrect:** Interviewing is a technique used to formally gather data from subject matter experts in a structured format.
- D. **Correct:** Root cause analysis seeks to discover the underlying cause or causes of a particular risk.
7. **Correct Answer: C**
- A. **Incorrect:** The Delphi technique is a method of anonymously interviewing and gathering data from experts.
- B. **Incorrect:** Brainstorming is a technique to gather as much information as possible from project team

members or subject matter experts.

- C. **Correct:** SWOT stands for *strength, weaknesses, opportunities, and threats*.
- D. **Incorrect:** Root cause analysis seeks to discover the underlying cause or causes of a particular risk.

8. **Correct Answer: C**

- A. **Incorrect:** The Plan Risk Management process produces the risk management plan.
- B. **Incorrect:** The Identify Risks process produces an iteration of the risk register
- C. **Correct:** The Perform Qualitative Risk Analysis process uses subjective assessment of probability and impact to give each identified risk a score to enable it to be ranked and prioritized.
- D. **Incorrect:** The Perform Quantitative Risk Analysis uses actual statistical data to calculate probability and impact and produces contingency reserves for either time or cost.

9. **Correct Answer: A**

- A. **Correct:** The risk register is a highly iterative document that is constantly updated by most of the risk management planning processes.
- B. **Incorrect:** The risk management plan may be updated as a result of completing risk management activities, particularly the Monitor Risks process, but the frequency of updates will be less than the updates to the risk register.
- C. **Incorrect:** The assumptions log will be checked and reassessed often, but not as often as the risk register.
- D. **Incorrect:** The project management plan, its subsidiary plans, and its baselines may be updated, but certainly not as often as the risk register.

10. **Correct Answer: C**

- A. **Incorrect:** The Identify Risks process does not use any form of either qualitative or quantitative risk analysis.
- B. **Incorrect:** The Perform Qualitative Risk Analysis process uses subjective data rather than statistical data to complete its assessment of probability and impact.
- C. **Correct:** The Perform Quantitative Risk Analysis process uses statistical data and probability distributions such as the beta distribution to calculate quantitative risk.
- D. **Incorrect:** The Plan Risk Responses process is focused upon the development of appropriate responses to identified risks.

11. **Correct Answer: D**

- A. **Incorrect:** The expected monetary value analysis analyzes particular options, and the probability and net impact of those options, to determine which has the higher expected monetary value.
- B. **Incorrect:** Interviewing is a technique for gathering information from team members and subject matter experts in a formal setting.
- C. **Incorrect:** Sensitivity analysis is a way of determining which parts of the project are most sensitive to risk.
- D. **Correct:** Monte Carlo analysis is a sophisticated type of mathematical and statistical analysis. It carries out simulations of events occurring, to determine the likely probability and impact.

12. **Correct Answer: C**

- A. **Incorrect:** Mitigation is a response that seeks to minimize the impact of risk if it occurs.
- B. **Incorrect:** Transference makes the impact of the risk someone else's responsibility.
- C. **Correct:** The example represents a strategy of avoiding an identified risk.
- D. **Incorrect:** Acceptance would mean doing nothing and accepting the consequences.

13. **Correct Answer: D**

- A. **Incorrect:** Mitigation is a response that seeks to minimize the impact of risk if it occurs.
- B. **Incorrect:** Enhancement is a risk response strategy for positive risks that seeks to enhance the probability

and impact of the risk.

- C. **Incorrect:** Transference makes the impact of the risk someone else's responsibility.
- D. **Correct:** Acceptance is a strategy whereby you make no provision at all should the risk occur and simply accept the consequences.

14. Correct Answer: D

- A. **Incorrect:** The Identify Risks process seeks to identify individual risks for inclusion on the risk register.
- B. **Incorrect:** The Perform Quantitative Risk Analysis process conducts a quantitative assessment of probability and impact of individual risks.
- C. **Incorrect:** The Plan Risk Responses process prepares a proactive response to identified risks.
- D. **Correct:** The Monitor Risks process includes the reassessment of reserves to determine if the uncertainty within them has changed.

10. Procurement Management

This chapter focuses on the topic of project procurement management which, like the other knowledge areas, begins with a process of planning, which in this case produces a procurement management plan. It then uses this plan to carry out the procurement work, which involves making decisions about whether or not to procure goods, services, or resources from external sources and if so, how to advertise and award the contract, and what form of contract to use. Procurement management also involves monitoring contractual terms for performance and also includes a process for making sure all contracts are formally closed.

The three processes in the Project Procurement Management knowledge area are:

- Plan Procurement Management (Planning process)
- Conduct Procurements (Executing process)
- Control Procurements (Monitoring and Controlling process)

10.1 WHAT IS PROJECT PROCUREMENT MANAGEMENT?

Project procurement management is focused upon planning for and making decisions about whether or not to procure goods and services needed on the project from external sources, which form of contact to choose, how to select sellers to deliver the work, and how to check that the work is being done in accordance with the agreed contracts.

The Plan Procurement Management process results in a procurement management plan, which guides the other procurement management processes. The organization looking to procure goods or services then performs a make-or-buy analysis to determine if it should complete the work internally or source the goods and services from external sources. After the decision has been made to go to external sources, the buying organization then decides what form of contract it will use, how it will inform potential sellers of its needs, and how it will select the successful seller.

When the contract has been signed, then both parties take responsibility for checking that the agreed contract terms are being followed and that any changes to the contract are formally documented.

Finally, all contracts must be closed. Contractual closure does not mean project closure, because contracts can be closed at any time in a project. Remember, contractual closure must be performed before project closure.

In any contract there are *buyers*, the party looking to acquire the goods or services, and there are *sellers*, the parties with goods or services to sell. There can be multiple sellers, but generally there is a single buyer.

EXAM TIP

In the exam, unless otherwise stated, you should assume that you are the buyer in any contract. But read the question thoroughly to ensure that you understand whether you are the buyer or seller, because your answer to the question may be different depending on which position you are in. You can also be both buyer and seller at different points in the project. So take your time reading the question to understand what perspective you are answering the question from.

10.2 PLAN PROCUREMENT MANAGEMENT

TABLE 10-1 Plan Procurement Management process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project charter ▪ Business documents <ul style="list-style-type: none"> ▪ <i>Business case</i> ▪ <i>Benefits management plan</i> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Scope management plan</i> ▪ <i>Quality management plan</i> ▪ <i>Resource management plan</i> ▪ <i>Scope baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Milestone list</i> ▪ <i>Project team assignments</i> ▪ <i>Requirements documentation</i> ▪ <i>Requirements traceability matrix</i> ▪ <i>Resource requirements</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data gathering <ul style="list-style-type: none"> ▪ <i>Market research</i> ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Make-or-buy analysis</i> ▪ Source selection analysis ▪ Meetings 	<ul style="list-style-type: none"> ▪ Procurement management plan ▪ Procurement strategy ▪ Bid documents ▪ Procurement statement of work ▪ Source selection criteria ▪ Make or buy decisions ▪ Independent cost estimates ▪ Change requests ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Lessons learned register</i> ▪ <i>Milestone list</i> ▪ <i>Requirements documentation</i> ▪ <i>Requirements traceability matrix</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Organizational process assets updates

The Plan Procurement Management process is a planning process with the procurement management plan and procurement statement of work as its main outputs. The purpose of this process is, as with other planning processes, to enable you and your team to proactively plan your particular approach to procurement requirements on the project.

INPUTS

The Plan Procurement Management process uses some or all of the following inputs as part of the development of the procurement management plan for the project.

PROJECT CHARTER

The Project Charter outlines the overall scope, objectives, and constraints of the project. This helps in identifying what goods, services, or results may need to be procured from outside the organization to achieve project goals.

BUSINESS DOCUMENTS

The Business Case provides the financial justification and expected benefits of the project. It helps assess whether the cost of procuring from external vendors is justified by the project's expected ROI (Return on Investment).

The Benefits management plan outlines the expected benefits the project will deliver and how these will be measured. It helps in ensuring that the procured goods or services align with the project's intended benefits. For instance, if a software tool is to be procured, does it contribute to the targeted benefits like efficiency or customer satisfaction.

PROJECT MANAGEMENT PLAN

This scope management plan outlines how the project scope will be defined, managed, and controlled. Knowing the scope helps to identify which elements might require external procurement. For instance, if part of the scope is beyond the team's expertise, outsourcing might be necessary.

The quality management plan describes how quality will be managed and achieved in the project. This informs the criteria that vendors or suppliers must meet. If high quality is essential, then procurement documents need to reflect these standards.

The resource management plan outlines how resources will be allocated and managed throughout the project. This helps identify what resources need to be procured externally. For example, if specialized labor is needed for a short period, it might be more cost-effective to contract that out.

The scope baseline is a component of the project management plan and consists of the project scope statement, Work Breakdown Structure (WBS), and WBS dictionary. It provides a detailed view of what is to be accomplished in the project, aiding in identifying the goods, services, or results that must be procured.

In a nutshell, these inputs shape the procurement strategy by providing guidelines on what needs to be procured, the quality standards to be met, and the resources available for managing procurement.

These elements of the project management plan are an output from their respective planning processes.

PROJECT DOCUMENTS

These documents provide a wealth of information that can aid in effectively planning for procurement.

The milestone list outlines significant project events or phases. Knowing these milestones helps in scheduling procurement activities to align with critical project phases, ensuring timely deliveries.

Project team assignments outline who is responsible for what within the project team. Knowing the skills and responsibilities of the internal team helps identify gaps that may need to be filled through external procurement, such as specialized expertise or additional labor.

Requirements documentation details the needs and expectations of stakeholders. By understanding what is required, you can identify which requirements may necessitate external procurement to fulfill. Requirements documentation is an output from the Collect Requirements process.

Requirements traceability matrix links requirements back to their origin, showing the flow of each requirement through the project's phases. This aids in ensuring that procured goods or services meet specific stakeholder requirements and can be traced back for validation and acceptance.

Resource requirements contain information about the resources required to complete individually identified activities, and this information can be useful when making decisions about whether or not to procure goods and services externally and the type of contract to use. Activity resource requirements are an output from the Estimate Activity Resources process.

The risk register is an important input into the Plan Procurement Management process because it identifies specific risks around the decision to make goods or services internally versus the decision to procure them from external sources, and the risks associated with individual contract types. The risk register is an output from the Identify Risks process.

The stakeholder register identifies individual stakeholders and their interest in the project. Thus it is useful in terms of managing stakeholder expectations around which goods and services will be procured externally and the type of contract selected. The stakeholder register is an output from the Identify Stakeholders process.

Real World

The type of contract selected will have an impact on the stakeholders, particularly if stakeholders are to be intimately involved in the administration and execution of the contract. Many types of contracts set up an adversarial relationship with stakeholders, whereas other more modern forms of contract establish a relationship based on trust between stakeholders. Thus, having an in-depth knowledge of how your stakeholders will perceive and react to different contractual decisions is an important consideration in your procurement management process. A style of contract that works for one group of stakeholders may not work for another group of stakeholders. Also, keep in mind that many stakeholders will already have preferred vendors and long-established types of contracts with them.

Enterprise environmental factors

The specific enterprise environmental factors that will be useful as inputs into the Plan Procurement Management process include any marketplace conditions that will determine whether or not there will be a lot of interest in your procurement decisions, the specific types of products and services that will be available in a particular marketplace, the size of the marketplace and whether you can stay local or have to go wider in your search for suppliers, and the expected terms and conditions for contract types with particular industries.

Organizational process assets

The specific organizational process assets that may be an important input into the Plan Procurement Management process include any formal procurement policies that the organization has stating what goods and services will be procured, how the decisions will be made, what sort of contract types are preferred, and who has responsibility in negotiating and administering the contracts.

Real World

I have often found that most organizations have clear procurement policies that specify when external procurement can be or must be used, and the type of contract that the organization prefers. You should always endeavor to familiarize yourself with any procurement policies that your organization has.

EXAM TIP

At all times you must conduct your procurement in accordance with the relevant organizational procurement guidelines. Don't be tempted to act outside of the guidelines; if the guidelines are wrong you can seek to change them, but until they are changed you must adhere to them.

TOOLS AND TECHNIQUES

The following tools and techniques are available to be used to develop the inputs in this process in order to produce the procurement management plan.

EXPERT JUDGMENT

Expert judgment is an excellent tool to use when planning your approach to procurement management, because utilizing the knowledge and experience of subject matter experts will be invaluable not only in your overall procurement management plan, but also in identifying and completing an analysis of procurements. Suitable experts who may provide judgment include senior management, stakeholders with relevant experience, external subject matter experts such as procurement professionals, industry groups, and professional associations.

One particularly useful type of expert that you should consider using in your procurement management decisions is the legal expert, because your procurement decisions will be supported by legally enforceable contracts and, therefore, it is highly recommended that you involve experts with legal experience in the formation, negotiation, execution, and administration of any procurement contracts.

Real World

I have always found that referring any decisions about contracts to legal experts is a good investment. The wording of contracts can be quite complicated, and it often takes somebody with particular experience in an area to be able to effectively negotiate a contract that is easy to understand and enforce and doesn't place an undue amount of work upon one or the other of the parties involved. Certainly any changes or variations to contracts should involve people with legal expertise.

DATA GATHERING

Market research is carried out in order to determine the capability and availability of potential sellers in the market and their particular interest in responding to your procurement requests. Additionally, any market research that you carry out may reveal additional ways of delivering goods and services and, as such, it is an important tool in the Plan Procurement Management process.

DATA ANALYSIS

The *make or buy analysis* is a comprehensive description of the decision-making process that an organization goes through when deciding whether it should make the goods or services it requires itself, or seek to acquire goods or services from external sources. There are a number of ways of making the decision, and a number of factors to take into account.

Of the factors that can be taken into account when making a make or buy decision, the following are the most important:

- The risk profile and risk tolerance of the organization

- Ownership of intellectual property
- Availability of suitable sellers
- Availability of internal resources capable of delivering a good or service
- Timeframes for delivery of a good or service
- Length of time that the resource required for the good or service is needed on the project
- Ability to support ongoing changes and technical support

The make or buy process should follow established procedures that take into account the relevant factors, and even assign different weights for different factors to enable you to score factors differently.

In making the make or buy decisions, you may also want to use more quantitative methods such as the decision tree analysis used in Chapter 9, “Risk management,” in the Quantitative Risk analysis section.

SOURCE SELECTION ANALYSIS

Source selection analysis is useful for establishing the criteria and methods to evaluate and select vendors. This ensures that chosen vendors meet project requirements and quality standards, potentially reducing project risks related to procurement.

MEETINGS

Meetings are a great way to bring together project team members, stakeholders, and other experts in order to consider how procurement will be managed on the project. They can be meetings among team members, and sometimes with potential vendors, to discuss procurement needs, strategies, and decisions. The goal is to facilitate collective decision-making, ensuring that all angles are considered and that the procurement plan aligns with project objectives. There are a number of ways you can run these meetings in order to efficiently get the information that you require. They can be run formally with defined agendas and examination of reports, or they can be run as creative brainstorming sessions. The style of meeting you choose to use will reflect the participants and your intended outcomes.

OUTPUTS

After the appropriate tools and techniques have been applied to the selected inputs, the Plan Procurement Management process has the following outputs.

PROCUREMENT MANAGEMENT PLAN

The Plan Procurement Management process has the *procurement management plan* as its major output. Similar to other management plans, the procurement management plan provides a guide for completing the procurement management activities in the project. The procurement management plan will probably contain information on the types of contracts to be used, whether or not independent estimates will be used to check responses received, any methods for identifying and selecting sellers, and any other important procurement information that can be used in the other three procurement processes. The procurement management plan goes on to be used as an input into the Conduct Procurements process. Given that it is also a subsidiary plan of the project management plan, is also used as an input into the Control Procurements process and Close Procurements process.

PROCUREMENT STRATEGY

The procurement strategy is your overall approach and objectives related to procurement. This helps align procurement actions with project goals.

BID DOCUMENTS

Bid documents like Request for Proposal (RFP), Request for Quote (RFQ), etc. are produced along with guidelines on the correct process to use alongside them. You will need to comply with your organisation's overall procurement policy as well as any relevant local and central government rules or laws around procurement. These documents will be used to solicit proposals from potential vendors. Some of the more common types of procurement documents include the following:

- Request for Information (RFI): An RFI is a preliminary document used to gather general information about products, services, or vendors. It's often the first step in the procurement process to identify potential suppliers.

- Expression of Interest (EOI): An EOI serves as a declaration from potential vendors that they are interested in providing a service or product. It's used to create a shortlist of suppliers for more formal bidding processes.
- Invitation for Bid (IFB): An IFB is a formal invitation that asks vendors to submit a bid for goods or services. It is usually very specific in terms of scope and requirements, focusing on price as the main evaluation criteria.
- Request for Proposal (RFP): An RFP is a comprehensive document that outlines the project's needs and asks for proposed solutions from vendors. It considers factors like approach, experience, and price for evaluation.
- Request for Quotation (RFQ): An RFQ asks vendors to provide a quote for specific goods or services. It's often used when the requirements are clear and the main deciding factor is cost.
- Tender: A tender is a formal, structured invitation to suppliers to submit a bid to supply products or services. It's a broad term that can encompass RFI, EOI, IFB, RFP, and RFQ, depending on the context.

Real World

If you have ever been involved in any formal seller selection process, you will find this section very straightforward. However, if you have not been involved in the formal contractual negotiation processes, then pay particular attention to this process. It is not uncommon for a project manager to receive negotiated contracts without being involved in the make or buy decisions, seller selection, and contractual negotiations.

PROCUREMENT STATEMENT OF WORK

The *procurement statement of work* is an output that describes each good or service that will be procured externally in enough detail to allow potential sellers to determine whether they are interested in, and able to, provide the goods or services sought. You should spend as much time as possible in defining the procurement statement of work because it will form the basis of your procurement contracts, and any omissions or areas that are not sufficiently defined may cause conflict in the administration of the contract.

EXAM TIP

You can think of the procurement statement of work as a type or subset of the project scope of work specifically focused on the work to be done as part of a contract for goods and services.

SOURCE SELECTION CRITERIA

The point of *source selection criteria* is to enable the buyer to be able to rate individual seller responses. They can include both objective and subjective criteria. The source selection criteria will reflect the criteria that are important to you and your decision-making process for selecting sellers. In addition to the prices submitted, you may also want to take into account a variety of other factors and give them a particular weighting to reflect their importance. Examples of the types of criteria that you may want to take into account include how well the seller understands your needs beyond what you may have described in the procurement statement of work, their technical ability to deliver the requested solution, the financial stability of the organization, their previous experience in doing this type of work, and references from other buyers who may have used this particular seller. You will be able to use the source selection criteria during the Conduct Procurements process.

Real World

There are certain occasions when your only source selection criterion will simply be lowest price; however, there are many other instances when you will want to take into account other criteria in selecting a seller. Typically, you will want to look at what experience they have already had, their financial stability, the particular staff members who are allocated to do the work, and other factors such as health and safety and environmental record.

MAKE-OR-BUY DECISIONS

The output from the make or buy analysis will be *make or buy decisions*. These documented decisions outline how you decided to either make the goods or services internally or go to external sources. Make or buy decisions are used as an input into the Conduct Procurements process.

INDEPENDENT ESTIMATES

Independent cost estimates are an impartial cost estimate for the work to be procured serve as a benchmark for evaluating vendor bids so you can determine whether the pricing response you are get are fair and reasonable, and also that vendors have properly understood the full scope of work. A range of prices lower than your independent estimates could indicate once again that the procurement statement of work and procurement documents provided are inaccurate, or that an organization is deliberately bidding low in order to win the work. The risk in this case is that the organization may go out of business trying to complete the work or that it is relying on variations to the contract to make the job profitable.

CHANGE REQUESTS

As a result of carrying out the Plan Procurement Management process, you may want to change some elements and subsidiary plans or baselines of the project management plan via a change request. All change requests go on to be used as inputs into the Perform Integrated Change Control process.

PROJECT DOCUMENTS UPDATES

The lessons learned register IS A compilation of procurement-related lessons learned during the project. Updating them informs future projects or phases.

The milestone list, requirements documentation, requirements traceability matrix, risk register, stakeholder register are existing documents might be updated based on the procurement planning. This ensures alignment between procurement activities and other project aspects.

ORGANIZATIONAL PROCESS ASSETS UPDATES

Organizational process assets updates include updates to company-wide assets like templates or lessons learned from other projects. This contributes to organizational learning and effectiveness.

Quick Check

1. What is the main focus of the Plan Procurement Management process?
2. What are some of the factors that you take into account when conducting a make or buy analysis?
3. What are some typical factors included in source selection criteria?

Quick Check Answers

1. The main focus of the Plan Procurement Management process is to make decisions and provide a documented guideline for the rest of the procurement management processes. This information is contained within the procurement management plan, which is a subsidiary of the project management plan.
2. The types of factors that can be taken into account when conducting a make or buy analysis include the risk profile of the organization, the issue of ownership of intellectual property, the timeframe in which the work must be done, the current capability of internal resources, and the cost differential between choosing to make a good or service internally and procuring it externally.
3. In addition to the price being included in source selection criteria, you may choose to also include how well the seller understands your actual need, their proposed response and the life-cycle cost, their technical ability to deliver the solution, the staff they have allocated to do the work and their experience, any warranties they offer on the work being completed, the financial capacity and stability of the performing organization, their past performance in doing this type of work, references from others who have used them, and who owns the rights to the work done.

10.3 CONDUCT PROCUREMENTS

TABLE 10-2 Conduct Procurements process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Scope management plan</i> ▪ <i>Requirements management plan</i> ▪ <i>Communications management plan</i> ▪ <i>Risk management plan</i> ▪ <i>Procurement management plan</i> ▪ <i>Configuration management plan</i> ▪ <i>Cost baseline</i> ▪ Project documents ▪ <i>Lesson learned register</i> ▪ <i>Project schedule</i> ▪ <i>Requirements documentation</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Procurement documentation ▪ Seller proposals ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Bidder conference ▪ Advertising ▪ Data analysis ▪ <i>Proposal evaluation</i> ▪ Interpersonal and team skills ▪ <i>Negotiation</i> 	<ul style="list-style-type: none"> ▪ Selected sellers ▪ Agreements ▪ Change requests ▪ Project management plan updates ▪ <i>Requirements management plan</i> ▪ <i>Quality management plan</i> ▪ <i>Communications management plan</i> ▪ <i>Risk management plan</i> ▪ <i>Procurement management plan</i> ▪ <i>Scope baselines</i> ▪ <i>Schedule baseline</i> ▪ <i>Cost baseline</i> ▪ Project documents updates ▪ <i>Lesson learned register</i> ▪ <i>Requirements documentation</i> ▪ <i>Requirements traceability matrix</i> ▪ <i>Resource calendars</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Organizational process assets updates

The Conduct Procurements process is an executing process that seeks to carry out the initial identification of prospective sellers, effectively pass on information about the work required to them, get responses from the sellers, evaluate and select the best seller for the job, and sign an agreement or contract.

INPUTS

The Conduct Procurements process uses some or all of the following inputs.

PROJECT MANAGEMENT PLAN

Here's how each part of the project management plan and baselines serves as a useful input in the Conduct Procurements process:

This scope management plan outlines how the project's scope will be defined, controlled, and verified. It's crucial for procurement as it helps in identifying precisely what needs to be procured, thereby informing what goes into procurement documents. Ensuring alignment between scope and procurement reduces the likelihood of scope creep.

The requirements management plan details how project requirements will be gathered, managed, and fulfilled. In procurement, it helps to ensure that the procured goods or services meet the specific requirements set forth for the project. This increases the chances of successful project completion and stakeholder satisfaction.

The communications management plan outlines how, when, and where information will be shared. Effective communication is crucial during procurement to ensure clarity between all parties involved, making transactions smoother and more transparent. It can specify the types of communication expected during vendor interactions.

The risk management plan outlines how risks will be identified, assessed, and responded to throughout the project. It's essential for procurement as it helps identify potential risks associated with external vendors and puts in place strategies for managing those risks. This contributes to a more resilient and adaptable procurement process.

The procurement management plan acts as a guideline for how procurement will be managed, and therefore this plan is directly relevant. It includes the types of contracts to be used, procurement metrics, and roles and

responsibilities, among other things. It's the playbook for conducting all procurement activities, making it a crucial input.

The configuration management plan outlines how changes to the project's deliverables and documentation will be managed. In the context of procurement, it helps ensure that any goods or services procured align with the project's configuration requirements, enabling better integration with existing systems or project elements.

The cost baseline is an approved budget usually in time-phased delivery, often represented as an S-curve. For procurement, it provides the financial guidelines within which procurement decisions must be made. Understanding the cost constraints can guide negotiations and vendor selection, preventing budget overruns.

PROJECT DOCUMENTS

The lessons learned register contains insights and knowledge gained from previous phases of the project or other projects. For procurement, it can provide valuable information on vendor performance, quality of deliverables, or challenges faced, thereby informing current procurement decisions. It acts as a resource for avoiding past mistakes and leveraging successful strategies.

The project schedule outlines the timeline for project activities, including procurement. Understanding when certain goods or services are needed helps in setting appropriate deadlines for procurement activities, such as bid submission or contract signing. This ensures that procurement actions align with the project's overall timeline, aiding in timely project completion.

The requirements documentation lists the project's functional and non-functional requirements. In procurement, this helps ensure that the goods or services to be procured meet the specific needs and constraints of the project. By providing vendors with clear requirements, it helps in obtaining accurate bids and proposals, thus improving the likelihood of project success.

The risk register identifies potential risks, their impacts, and response strategies. In the context of procurement, it can include risks associated with potential vendors, contract types, or external market conditions. Being aware of these risks can help in making informed procurement decisions, including vendor selection and contract terms.

The stakeholder register lists all individuals or groups with an interest in the project, including their needs and expectations. Some stakeholders may have specific requirements or constraints that impact procurement decisions, such as preferring certain vendors or having past experience with similar procurements. Their input can be valuable in shaping the procurement process to align with broader stakeholder expectations.

PROCUREMENT DOCUMENTATION

The procurement documentation are an output from the Plan Procurement Management process and include a range of different documents such as RFP, Tender, ROI etc for soliciting information from prospective sellers. As such, they are an important input into the Conduct Procurements process.

SELLER PROPOSALS

Seller proposals are documentation received from interested sellers in response to a particular procurement documents package that you have put out to the market. They will be in the form prescribed in the procurement documents and will contain enough information for the buyer to evaluate the response and decide whether the seller is to go on to the next stage in the procurement process.

EXAM TIP

Did you notice that seller proposals are not actually an output from any other process? Instead, they are an independent input into this process.

ENTERPRISE ENVIRONMENTAL FACTORS

Enterprise Environmental Factors (EEFs) can significantly influence how procurement is conducted in a project. Here are some examples:

- **Market Conditions:** Understanding the supply-demand dynamics helps you know what can be procured and at what cost.
- **Legal Restrictions:** Laws and regulations can limit options for sourcing, contracting, and payment methods.
- **Organizational Culture:** The way your organization values and approaches procurement can set the tone for the process.

- **Economic Climate:** Factors like inflation rates, currency exchange rates, and economic stability can influence cost and availability.
- **Geopolitical Factors:** Political stability, trade sanctions, or import/export restrictions can limit procurement options.
- **Technology Infrastructure:** The existing technological framework can influence whether to procure custom solutions or off-the-shelf products.
- **Resource Availability:** Local versus global sourcing options may be influenced by the availability of required resources.
- **Industry Standards:** Specific standards in your industry may dictate the type of products or services you should procure.
- **Competitive Analysis:** Understanding of competitors' strengths and weaknesses could guide strategic procurement decisions.
- **Vendor Database:** A database of approved vendors can fast-track the procurement process by narrowing down options quickly.

Understanding these factors can provide valuable context for procurement decisions, from vendor selection to contract type to risk management strategies.

ORGANIZATIONAL PROCESS ASSETS

The specific types of organizational process assets that will assist in the Conduct Procurements process include any historical information about market conditions, databases of prospective or prequalified sellers, and any other information about previous experience with sellers.

Real World

Many organizations keep lists or databases of prequalified sellers who have already gone through a selection process and met defined requirements to be able to provide goods or services to the organization. Usually the organization will simply issue procurement requests to these prequalified sellers and only go to the wider market when none of the prequalified sellers is able to provide the required good or service.

TOOLS AND TECHNIQUES

The following tools and techniques are used upon the inputs to deliver the Conduct Procurements process outputs.

EXPERT JUDGMENT

Expert judgment is an excellent tool to use in evaluating seller proposals. The range of experts that you will use during this process will include people with experience in the procurement response process, contract negotiation and administration process, legal process, finance process, and any other relevant areas of expertise.

ADVERTISING

Advertising is a tool that you may choose to use in order to take your procurement proposals to a wider market. You may choose to advertise in specific industry publications or more broadly in public newspapers. The type of advertising that you choose will reflect the audience you are trying to reach.

BIDDER CONFERENCE

A *bidder conference* is any type of formal meeting between the buyer and all prospective sellers for the purpose of exchanging further information and answering any questions. Bidder conferences are generally fairly formal with rules to ensure fairness to all sellers participating in the process. They are also increasingly held virtually, with Internet forums being used to solicit questions and provide answers.

It is extremely important that you keep all bidder conferences fair and equitable to all sellers involved in the process. This means that if a seller asks you a question, you must provide the answer to all bidders. As a general rule, you should refuse to go into private talks with any seller during this process unless it is for commercially confidential information. This is not merely a good suggestion but also often a legal, commercial, or organizational requirement in many countries, and failure to follow it could result in your decision being challenged in court.

DATA ANALYSIS

Proposal evaluation includes a range of methods for evaluating and scoring the different responses received from individual sellers. They can make use of the source selection criteria to provide a weighted attribute selection model. They can also take into account any other important elements useful in differentiating and distinguishing between different seller responses.

INTERPERSONAL AND TEAM SKILLS

Negotiations can be simple and straightforward, or they can be highly complex affairs requiring teams of experts and a long period of time to work out. The end result is a contract that both parties are happy to commit themselves to. Effective and ethical negotiations are crucial for a successful Conduct Procurement Process. Remember, negotiation is not just about getting the best deal, but creating a win-win situation that fosters a positive, long-term relationship between you and the vendor.

EXAM TIP

For the exam you will be expected to act ethically in all of your contract negotiations and you should read the relevant parts of the PMI Code of Ethics to understand all facets of ethical behavior when negotiation contracts. Of course, you must also act legally and in accordance with the relevant legislation of the country you are doing business in.

Real World

Like project management, the world of contract negotiation requires a distinct set of skills and experience. I have found that if you are entering into complex negotiations, you should enlist the help of experts with both technical expertise and also negotiation expertise.

OUTPUTS

The Conduct Procurements process has the following outputs.

SELECTED SELLERS

After carrying out the Conduct Procurements process and advertising for sellers, carrying out bidder conferences, evaluating seller responses, and negotiating contracts, you will have the *selected sellers* chosen to provide the goods or services required for the project. The selection marks the end of the evaluation phase, and these vendors will now move into the contractual stage. Documentation about why they were chosen may also be produced.

AGREEMENTS

A procurement *agreement* will generally be reflected in a contract between the organizations involved in either buying or selling the goods or services for the project. It is important to keep in mind that a contract is a legally binding document with conditions that must be understood by both parties. Most agreements, or contracts, feature the following content in their terms and conditions:

- Description of the parties to the contract
- The outline of the work to be done as part of the contract. The timeframe for delivery
- How and where the work is to be performed
- The agreed price
- A description of incentives used
- The terms of payment
- Penalties for nonperformance
- Termination clauses
- Dispute resolution procedures
- Ownership of intellectual property
- Audit, inspection, and acceptance criteria
- How variations will be handled

Real World

I've often found that many project managers do not take the time to read a contract in its entirety. I strongly recommend that if you have any contracts for work on a project, either as a buyer or seller you take the time to read the contract in its entirety and understand the terms and conditions contained within it. If you do not understand certain parts of the contract, you should seek clarification from experts who do.

There are several forms of contract that you can use. The difference between the various forms reflects the risk apportioned to the buyer or the seller. Table 10-3 lists the types of contract, and indicates where risk is apportioned.

TABLE 10-3 Types of contracts

Type of contract	Description	Risk Apportionment
Fixed-price contract (also known as lump sum contract)	<p>A form of contract that includes an agreed, fixed price for the delivery of goods and services. There are several variations, as follows:</p> <ol style="list-style-type: none"> 1. Firm fixed-price contract (FFP) with no provision at all for cost overruns 2. Fixed-price incentive fee contract (FPIF), which offers an incentive fee for meeting cost or time targets 3. Fixed-price with economic price adjustment contract (FP-EPA), which is often used on longer contracts and allows prices to be amended to reflect changes in inflation rates or exchange rates 	Seller has the risk; if the cost to deliver the goods or services is greater than the fixed price, the seller bears the extra costs.
Cost-reimbursable contract	<p>A form of contract that requires the seller to pass on the actual cost of the work to be done. There are several variations, including the following:</p> <ul style="list-style-type: none"> ▪ Cost plus fixed-fee contract (CPFF), which reimburses the seller for actual costs incurred and provides an additional fixed fee ▪ Cost plus incentive fee contract (CPIF), which reimburses the seller for actual costs incurred and offers an incentive fee for meeting or exceeding agreed cost or time targets 	Risk split between buyer and seller, depending on the actual form and wording of the contract.
Time and material contract (T&M)	A form of contract where the seller charges for all time spent and materials used with no agreed maximum. This form of contract is typically used on projects that are either small and of low complexity or emergency works, or where there is a poorly defined scope of work.	Buyer has the risk because there is no agreed maximum price.

A method for determining where risk lies between buyer and seller cost is to use the calculation for point of total assumption (PTA), particularly when using fixed-price incentive fee (FPIF) forms of contract. The *point of total assumption* is the point in the contract where the seller assumes total responsibility for all cost increases. In order to calculate this, you need a contract that has an agreed maximum ceiling price, target cost to the seller, target price to the buyer, and an agreed ratio between buyer and seller of the percentages of costs over the target cost each party is responsible for.

For example, consider a fixed-price incentive fee contract with a seller that sets a maximum price that the buyer will pay (ceiling price) for the contract of \$50,000, a target cost to the seller of \$42,000, and a target price to the buyer of \$46,000. There is also an agreement that the buyer will pay 60 percent of the cost overrun above the target cost. Using these figures, you can use the following formula to calculate the point of total assumption.

$$\text{Point of total assumption} = \text{Target cost} + ((\text{Ceiling price} - \text{Target price}) / \text{Buyers \% share of cost overrun})$$

For this example:

$$\begin{aligned} \text{Point of total assumption} &= \$42,000 + ((\$50,000 - \$46,000)/0.6) \\ &= \$42,000 + (\$4,000/0.6) \\ &= \$42,000 + \$6,666.67 \\ &= \$48,666.67 \end{aligned}$$

So the point at which the seller assumes total responsibility for all cost increases is \$48,666.67. After this price is reached, the buyer has no further obligations.

CHANGE REQUESTS

If the procurement process reveals that certain aspects of the project need to change, these requests formalize that need. These could be requests for altering scope, schedule, or costs and must go through the project's change control process.

PROJECT MANAGEMENT PLAN UPDATES

Based on the outcomes of the procurement process, plans like the scope, quality, and risk management plans might need updates. These updates align the plans with the reality post-procurement.

The updates to the requirements management plan could result from changes in vendor specifications or project requirements that are discovered during procurement. This keeps the project aligned with stakeholder expectations and regulatory requirements.

The quality management plan may be updated if procurement activities indicate that certain quality standards will not be met, updates may be needed. This ensures that the procured goods or services meet project quality standards.

Post-procurement, you might find that the communications management plan and the communication mechanisms need revision. This could involve adding vendors to regular communications or altering the information distribution plan.

New risks identified during procurement would necessitate updates to the Risk Management Plan. This keeps the project's risk profile current and relevant.

Based on the selected sellers and finalized agreements, the procurement management plan may need revisions. It outlines any changes in procurement strategy, methods, or documentation requirements.

The scope, schedule, and cost baselines might need updates if procurement activities result in changes to project scope, timing, or costs. They serve as the new reference points for measuring project performance.

PROJECT DOCUMENTS UPDATES

The lessons learned during procurement can be documented for future projects or phases. This can include insights into vendor selection, contract types, or negotiation strategies.

The requirements documentation and traceability matrix may change as a result of procurement activities. The matrix keeps track of changes and helps ensure that the project meets its objectives.

Resource calendars which document the availability and allocation of resources, including procured ones, are updated here. This helps in planning and scheduling future project activities. It is crucial for avoiding conflicts and over-allocation.

Updating the risk register with newly identified risks stemming from procurement decisions would be added here. This keeps the risk register comprehensive and up-to-date.

Updating the stakeholder register with new stakeholders, like selected vendors, might be added. Their requirements, expectations, and influence levels would be documented here.

ORGANIZATIONAL PROCESS ASSETS UPDATES

Templates, procedures, and any learnings can be updated in the organization's process assets for future use. This can improve the effectiveness of future procurement processes.

Quick Check

1. What is the main focus of the Conduct Procurements process?
2. Why is it important to keep bidder conferences fair to all prospective sellers?
3. Why is it important to carry out your own independent estimates?
4. Who should be involved in procurement negotiations?
5. What form of contract most favors a buyer in terms of risk?
6. Under what conditions would you generally choose to use a time and materials contract?

Quick Check Answers

1. The Conduct Procurements process is focused upon carrying out the process documented in the procurement management plan. This involves going to prospective sellers with information about the required goods and services, carrying out a fair and transparent process for selecting the sellers to do the work, and negotiating contracts.
2. In order to solicit professional and fair responses to your procurement process, it is important to treat all potential sellers, or bidders, equitably and provide them all with the same information.
3. There are several benefits to carrying out your own independent estimates. The first is to ensure that the estimates that you are being provided with by potential sellers are neither too high nor too low, perhaps indicating incorrect or insufficient information contained in the procurement statement of work. Another benefit of carrying out your own independent estimates is to independently check the accuracy of responses received from sellers.
4. The project manager should take responsibility for carrying out procurement negotiations, with the assistance of people with both technical, legal, financial, and negotiation skills.
5. The form of contract that most favors a buyer in terms of risk is a fixed-price contract, because in this instance the risk is with the seller, particularly if they have developed estimates upon inaccurate or incomplete information.
6. You would generally choose to use a time and materials form of contract when the work is small and ill defined, or under emergency conditions where the work must be completed quickly and there is not time to negotiate any other form of contract.

10.4 CONTROL PROCUREMENTS

TABLE 10-4 Control Procurements process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan ▪ <i>Requirements management plan</i> ▪ <i>Risk management plan</i> ▪ <i>Procurement management plan</i> ▪ <i>Change management plan</i> ▪ <i>Schedule baseline</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Assumptions log</i> ▪ <i>Lessons learned register</i> ▪ <i>Milestone list</i> ▪ <i>Quality reports</i> ▪ <i>Requirements documentation</i> ▪ <i>Requirements traceability matrix</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Agreements ▪ Procurement documentation ▪ Approved change requests ▪ Work performance data ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Claims administration ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Performance reviews</i> ▪ <i>Earned value analysis</i> ▪ <i>Trend analysis</i> ▪ Inspection ▪ Audits 	<ul style="list-style-type: none"> ▪ Closed procurements ▪ Work performance information ▪ Procurement documentation updates ▪ Change requests ▪ Project management plan updates <ul style="list-style-type: none"> ▪ <i>Risk management plan</i> ▪ <i>Procurement management plan</i> ▪ <i>Schedule baseline</i> ▪ <i>Cost baseline</i> ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Lessons learned register</i> ▪ <i>Resource requirements</i> ▪ <i>Requirements traceability matrix</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Organizational process assets updates

The Control Procurements process is a monitoring and controlling process focused on the sometimes complex process of checking that both your procurement process and contracts entered into comply both with your procurement management plan and also with the terms and conditions contained within the negotiated contracts and agreements.

EXAM TIP

It is the responsibility of all parties to a contract to carry out work to ensure that the terms and conditions of the contract are being fulfilled.

INPUTS

The following inputs are used in the Control Procurements process.

PROJECT MANAGEMENT PLAN

The requirements management plan outlines how requirements will be collected, managed, and met. It aids in verifying whether the procurement meets the project's needs and allows for corrective actions if necessary.

The risk management plan provides guidelines for identifying and controlling procurement risks. It helps in revising risk strategies and responses related to procurement during the project's lifecycle.

The procurement management plan outlines how to manage vendors and contracts. It is crucial for ensuring that the procurement activities align with the project goals.

The change management plan outlines how changes, including those in procurement, will be managed. This ensures that any changes to procurement contracts or deliverables are well-documented and controlled.

The schedule baseline is the approved version of the schedule, against which performance is measured. It helps in monitoring if the procurement activities are happening as planned and triggers corrective action if they are not.

PROJECT DOCUMENTS

The assumptions log contains all the assumptions made during project planning, including those related to procurement. It helps in identifying gaps and mitigating risks in the Control Procurements process.

The lessons learned register includes insights from past procurement activities, helping to identify pitfalls or successful strategies that could influence current procurement control efforts.

The milestone list is a list of important events, including those for procurement. It aids in tracking the timeliness of vendor deliverables and contract milestones.

Quality reports assess the quality of the vendor deliverables. They are crucial for ensuring that the vendor meets the quality requirements specified in the contracts.

Requirements documentation documents what the project aims to achieve, including procurement requirements. It aids in ensuring that the vendor deliverables meet the outlined specifications.

The requirements traceability matrix tracks requirements throughout the project lifecycle. It helps ensure that procurement aligns with the original project requirements.

The risk register contains all identified risks, including those related to procurement. It assists in proactively managing any risks that may affect procurement outcomes.

The stakeholder register lists all stakeholders, including vendors. It helps in identifying who has an interest in the procurement and how they should be managed or communicated with.

AGREEMENTS

You will require any and all binding agreements between parties to all contracts in order to understand what terms and conditions and performance criteria you are monitoring. Agreements are an output from the Conduct Procurements process.

APPROVED CHANGE REQUESTS

Approved change requests can affect and modify any agreed terms and conditions of agreements or contracts. They are often referred to as variations, and it is important that as part of the Control Procurements process you check that not only have the changes been approved, or agreed to, but that they are also being carried out as per the agreed change. Approved change requests are an output from the Perform Integrated Change Control process.

WORK PERFORMANCE DATA

Work performance data, specifically which relates to whether or not quality standards are being met, is important in any assessment of whether or not contractual obligations are being met. Work performance data is an output from the Direct and Manage Project Work process.

ENTERPRISE ENVIRONMENTAL FACTORS

These include market conditions, legal requirements, or commercial databases, affecting how procurements are controlled and managed.

ORGANIZATIONAL PROCESS ASSETS

These will include standard templates, policies, and procurement guidelines that facilitate effective procurement control.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the Control Procurements process outputs.

EXPERT JUDGMENT

Expert judgment involves consulting professionals or subject matter experts in the field of procurement to better understand vendor performance, contract compliance, and risk mitigation. Their insights can provide nuanced perspectives that typical analytics might overlook. For example, an expert might identify that a certain penalty clause in the contract is not standard, helping the team to renegotiate or prepare accordingly. This advice can result in better decision-making and control over procurement.

CLAIMS ADMINISTRATION

Claims administration involves the formal interpretation of the terms and conditions of contracts to resolve any disputes between the buyer and seller. *Claims administration* is used when there is a dispute about the amount charged or the work done as part of a contract. It is generally a result of poorly worded contracts or a poorly defined scope of work. Claims can be made by either the buyer or the seller in a contract and are usually made for something to be done outside of the agreed procurement statement of work. If agreement is reached, then the claim ceases and a change is made to the contract. By effectively administering claims, you can ensure that the project stays on track and that relationships are managed professionally. For example, if a vendor delivers goods late, the claims administration process can be used to enforce the late delivery clause, perhaps reclaiming some costs. This ensures the enforcement of contract terms and keeps the procurement on track.

EXAM TIP

The word “claim” refers to a disputed cost or change. If you use this word in everyday language to mean something else, you must remember that for the exam this is the correct definition.

Real World

The process of claims administration is unfortunately a very common and often complex reality of dealing with contracts, generally arising as a result of poorly negotiated or ambiguously worded contracts. Avoiding this potential minefield is a simple process of taking extra time when writing up the original contract and being as explicit as possible about as many potential scenarios as possible to avoid extra time spent disagreeing about what the costs were and whether or not work performed constituted an agreed change to the contract.

DATA ANALYSIS

Data analysis helps to quantitatively assess a vendor's performance and adherence to contractual obligations. Through metrics and KPIs, project managers can compare expected outcomes with actual outcomes. For example, by analyzing lead time data, you can identify if a supplier is consistently late in their deliverables. This can lead to corrective actions like renegotiating terms or seeking alternative suppliers. The most useful forms of data analysis are:

- Performance reviews which involve a detailed analysis of a vendor's adherence to the contract terms regarding scope, quality, cost, and schedule. Regularly scheduled reviews can flag issues before they become bigger problems. For example, if quarterly performance reviews reveal that a vendor's product often fails quality tests, corrective measures like re-evaluation of the supplier can be taken. This ensures alignment with project goals and stakeholder expectations.
- Earned value analysis (EVA) is a quantitative method for evaluating the performance of a project, and by extension, the procurement process. It can reveal variances between planned and actual performance. For example, if the EVA shows that the procurement spending is more than what was planned without proportional value, it can trigger an investigation to determine the cause and rectify it. This ensures budget adherence and effective utilization of resources.
- Trend analysis involves studying performance data over time to identify patterns or trends. This can be useful for predicting future procurement issues before they occur. For example, if the trend analysis shows that a supplier's delivery times are steadily increasing, you can anticipate delays and plan accordingly. This helps in proactive problem-solving.

INSPECTION

Inspection involves the physical examination of goods received or services performed. It ensures that the deliverables meet the contractual quality and performance requirements. For example, an inspection might find that a batch of components doesn't meet quality standards, triggering a return or rework request to the vendor. This ensures that only contract-compliant goods are accepted and paid for.

AUDITS

Audits involve a thorough review of procurement transactions and adherence to organizational processes and standards. They can verify that both the buyer and seller are meeting their contractual obligations. For example, an

audit might reveal that a subcontractor hasn't been adhering to agreed-upon safety standards, leading to corrective action or even contract termination. This safeguards the project against non-compliance and other associated risks.

OUTPUTS

The Control Procurements process has the following outputs.

CLOSED PROCUREMENTS

Once a vendor has met all contract terms and deliverables, the procurement is officially closed. This ensures that both parties have fulfilled their obligations and allows the project team to focus on other activities. For example, once a software development contract is complete and all milestones are achieved, the procurement is closed, and final payments are made. This action is documented and becomes an output of the Control Procurements process.

WORK PERFORMANCE INFORMATION

This refers to the data on how vendors are performing against contract terms. Updated regularly, this information guides future procurement decisions. For example, a vendor consistently meeting delivery timelines would result in positive work performance information. This output can be used for future reference or current adjustments.

PROCUREMENT DOCUMENTATION UPDATES

As the project progresses, changes to procurement documents may be necessary. These updates reflect any changes in the scope, costs, or deliverables specified in the initial contract. For example, if a vendor faces a delay, the new delivery timelines could be updated in the procurement documents. These updated documents serve as an output of the process.

Real World

It is very important that you document all changes, no matter how small, to any contract.

CHANGE REQUESTS

These are formal requests to alter specific areas of the procurement contract. They can stem from various factors like project scope changes, risk events, or poor vendor performance. For example, a design change in the project may require altering the types of materials procured. Approved change requests then become an output, affecting subsequent procurement activities. These will be assessed in the Perform Integrated Change Control process according to your approved change control process.

PROJECT MANAGEMENT PLAN UPDATES

You may wish to update the following parts of the project management plan.

New risks identified during procurement control must be integrated into the existing risk management plan. This ensures that the plan remains current and effectively addresses all identified risks. For instance, if a vendor's financial stability comes into question, a new risk must be added to the risk management plan. This updated plan becomes an output.

Changes to the procurement management plan will be required due to modifications to procurement strategies, guidelines, or procedures may occur due to changes in the project or from lessons learned. For example, if it is found that a certain evaluation criteria is not effective, the Procurement Management Plan will be updated. This updated document becomes an output of the Control Procurements process.

Changes in vendor timelines may require updates to the project's schedule baseline. This reflects the revised timing estimates and keeps the schedule current. For example, if a key delivery is going to be late, the schedule baseline must be updated. This becomes an output of the process.

Cost adjustments due to procurement activities, such as change orders, can result in updates to the project's cost baseline. For instance, if a vendor increases prices, the cost baseline will need to be revised. The updated cost baseline becomes an output that guides future budget control.

PROJECT DOCUMENTS UPDATES

You may wish to update the following project documents.

Insights and experiences from managing procurements are added to the lessons learned register. This serves as a resource for future projects. For example, if a vendor failed to meet quality standards, this lesson can be documented for future reference. This updated register becomes an output.

The resource requirements may require changes in resource needs resulting from procurement activities are documented. For example, if a vendor provides a more efficient solution requiring fewer internal resources, this changes the resource requirements. This updated information is an output of the process.

The requirements traceability matrix may be updated to reflect changes in project or vendor requirements. For example, if the scope changes, affecting the procurement deliverables, this will be reflected in the matrix. The updated matrix becomes an output.

The risk register will be updated to reflect newly identified procurement risks or updates to existing risks will be reflected in the risk register. For instance, if a vendor's reliability comes into question, a new risk may be added. The updated risk register then serves as an output.

Changes to the stakeholder landscape, such as a new vendor relationship, would require an update to the stakeholder register. For example, if a subcontractor becomes a significant part of the project, they may be added. This updated register becomes an output.

ORGANIZATIONAL PROCESS ASSETS UPDATES

Procedures, guidelines, or templates might be updated based on lessons learned from the procurement process. These updates become part of the organizational process assets. For instance, if a new vendor evaluation template proves useful, it may be added to the organizational process assets for future use.

Quick Check

1. What is the main focus of the Control Procurements process?
2. What is the benefit of having a payment system in place?
3. Why is it important to keep well-documented records of any claims made?

Quick Check Answers

1. The Control Procurements process is focused upon checking that the procurements process is being carried out as per the procurement management plan, and also that the terms and conditions of any contracts being used are being met by both parties.
2. Having a payment system in place ensures that all payments required as part of the agreed contractual terms and conditions are paid on time and records are kept.
3. If a claim has been made, that means that there is a disagreement about performance on a contract. Disagreements can escalate and require dispute resolution. Having well-documented records will assist during any dispute resolution process.

10.5 CHAPTER SUMMARY

- The Procurement Management knowledge area is focused upon the development of a plan to guide decisions around external procurement of goods and services, and the execution, monitoring, and control of this plan.
- The Plan Procurement Management process provides a procurement management plan and the procurement statement of work, both of which provide guidance for the subsequent processes for the work to be done as part of agreements.
- The Conduct Procurements process is an executing process that seeks to carry out the procurement management plan in relation to the identification of sellers, the distribution of information about the procurement statement of work to sellers, the selection of sellers to carry out the work, and the type of contract that will be used.
- The Control Procurements process is a monitoring and control process that seeks to both check that the procurement process is being carried out as per the procurement management plan, and also that the contracts are being carried out as per the agreed terms and conditions.

10.6 EXERCISES

The answers for these exercises are located in the “Answers” section at the end of this chapter.

1. Unscramble the table below to match up the contract type with its description and the description of risk apportionment.

Type of contract	Description	Risk Apportionment
Fixed-price contract	A form of contract that requires the seller to pass on the actual cost of the work to be done	Seller has the risk, and if the cost to deliver the goods or services is greater than the fixed price, the seller bears the extra costs.
Cost-reimbursable contract	A form of contract where the seller charges for all time spent and materials used with no agreed maximum	Buyer has the risk, because there is no agreed maximum price.
Time and material contract(T&M)	A form of contract that includes an agreed, fixed price for the delivery of goods and services	Risk split between buyer and seller, depending on the actual form and wording of the contract.

2. You are the project manager working on a construction project using a fixed-price incentive fee (FPIF) form of contract with a selected seller. The agreed contract sets a total ceiling price of \$325,000, a target cost to the seller of \$280,000, and a target price to you as buyer of \$310,000. There is also an agreement that you will pay 70 percent of the cost overruns above the target cost. What is the point of total assumption?

10.7 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 10 by answering these questions. The answers to these questions, and the explanations of why each answer choice is correct or incorrect, are located in the “Answers” section at the end of this chapter.

1. Which of the following processes produces the procurement management plan?
 - A. Close Procurements
 - B. Plan Procurement Management
 - C. Conduct Procurements
 - D. Develop Procurement Management Plan
2. The organization seeking to procure external resources to provide goods or services on a project is known as what?
 - A. Procurement specialist
 - B. Seller
 - C. Lawyer
 - D. Buyer
3. You are the seller of a potential good or service, and are responding to an RFP document where there is a poorly defined scope of work. What type of contract would you prefer to enter into?
 - A. Fixed-price
 - B. Fixed-price incentive fee
 - C. Cost-reimbursable
 - D. Time and materials

4. The document that describes and defines the portion of the project scope to be included within the related contract is known as what?
 - A. Procurement management plan
 - B. Organizational process assets
 - C. Scope statement
 - D. Procurement statement of work

5. A technique that considers a variety of factors in order to determine whether the particular project work is best done by the project team or done by external sources is known as what?
 - A. Expert judgment
 - B. Market research
 - C. Proposal evaluation techniques
 - D. Make or buy analysis

6. All of the following could be included as part of your source selection criteria except what?
 - A. Intellectual property rights
 - B. Technical capability
 - C. Financial capacity
 - D. Organizational process assets

7. You have decided to engage the services of a quantity surveyor to review the prices received from sellers responding to your procurement requests. What tool or technique are you using?
 - A. Delphi technique
 - B. Independent estimates
 - C. Analytical techniques
 - D. Bidder conferences

8. You and your team are in the process of negotiating a contract for a particular service required on your project. Which process are you in?
 - A. Plan Procurement Management
 - B. Conduct Procurements
 - C. Control Procurements
 - D. Close Procurements

9. The seller you have engaged to carry out a contract for the provision of services on your project has started submitting multiple change requests, which are escalating into claims. What is the most likely cause of this?
 - A. Incomplete risk register
 - B. Poorly worded procurement statement of work
 - C. Incomplete project management plan
 - D. Lack of quality management

10. Who is responsible for carrying out audits on contracts?
 - A. Only the buyer
 - B. Only the seller
 - C. An independent legal professional
 - D. Both buyer and seller

11. Which tool or technique would be most useful for storing information about procurement documentation and records?
 - A. Records management system
 - B. Project management information system
 - C. Contract change control system
 - D. Procurement performance reviews

12. All of the following conditions can lead to early termination of a contract except what?
 - A. Mutual agreement by both parties
 - B. Default of one party
 - C. Convenience of the buyer if provided for in the contract
 - D. An incomplete procurement statement of work

13. Which of the following is not a form of alternative dispute resolution?
 - A. Mediation
 - B. Arbitration
 - C. Litigation
 - D. Audit

10.8 ANSWERS

This section contains the answers for the Exercises and Review Questions in this chapter.

EXERCISES

- Unscramble the table below to match up the contract type with its description and the description of risk apportionment.

Type of contract	Description	Risk Apportionment
Fixed-price contract	A form of contract that includes an agreed, fixed price for the delivery of goods and services	Seller has the risk, and if the cost to deliver the goods or services is greater than the fixed price, the seller bears the extra costs.
Cost-reimbursable contract	A form of contract that requires the seller to pass on the actual cost of the work to be done	Risk split between buyer and seller, depending on the actual form and wording of the contract.
Time and material contract(T&M)	A form of contract where the seller charges for all time spent and materials used with no agreed maximum	Buyer has the risk, because there is no agreed maximum price.

- You are the project manager working on a construction project using a fixed-price incentive fee (FPIF) form of contract with a selected seller. The agreed contract sets a total ceiling price of \$325,000, a target cost to the seller of \$280,000, and a target price to you as buyer of \$310,000. There is also an agreement that you will pay 70 percent of the cost overruns above the target cost. What is the point of total assumption?

Point of total assumption = Target cost + ((Ceiling price – Target price)/Buyers % share of cost overrun)

Therefore, the point of total assumption is:

$$\begin{aligned}
 &= \$280,000 + ((\$325,000 - \$310,000)/0.7) \\
 &= \$280,000 + (\$15,000/0.7) \\
 &= \$280,000 + \$21,428.57 \\
 &= \$301,428.57
 \end{aligned}$$

CHAPTER REVIEW

1. Correct Answer: B

- Incorrect:** The Close Procurements process is focused upon the administrative and legal closure of all contracts.
- Correct:** The Plan Procurement Management process has the procurement management plan as its primary output.
- Incorrect:** Conduct Procurements uses the procurement management plan.
- Incorrect:** Develop Procurement Management Plan is a made-up process name.

2. Correct Answer: D

- Incorrect:** A procurement specialist may be an expert that you choose to use as part of your decision to procure from external sources.
- Incorrect:** The seller is the organization or individual who is responding to a request from a buyer for the provision of goods and services.
- Incorrect:** A lawyer can act for either buyer or seller.
- Correct:** The buyer is the organization that is requiring goods or services to be performed and is asking

for external sources to do the work via a negotiated contract.

3. **Correct Answer: D**

- A. **Incorrect:** A fixed-price contract would represent the greatest risk to the seller in the face of a poorly defined scope of work.
- B. **Incorrect:** A fixed-price incentive fee contracts does little to remove the risk to the seller with a poorly defined scope of work.
- C. **Incorrect:** A cost-reimbursable form of contract may be preferable to a fixed-price form of contract where there is a poorly defined scope of work, but it still represents more risk to the seller than a time and materials contract.
- D. **Correct:** Given that there is a poorly defined scope of work, you would want to enter into the type of contract that represented the least risk to you, the seller, and this is the time and materials contract.

4. **Correct Answer: D**

- A. **Incorrect:** The procurement management plan provides guidelines for carrying out the entire procurement management process.
- B. **Incorrect:** Organizational process assets include templates, historical information, and other guidelines of use in carrying out the procurement management process, but they do not describe or define the work to be done as part of the contract.
- C. **Incorrect:** The project scope statement defines and describes all of the work to be done as part of the project; the procurement statement of work is a subset of the project scope statement specifically related to the work to be done as part of a contract.
- D. **Correct:** The procurement statement of work describes and defines the portion of the project scope to be completed as part of a negotiated contract.

5. **Correct Answer: D**

- A. **Incorrect:** Expert judgment is used as a tool and may contribute to the make or buy analysis, but it is not the best answer.
- B. **Incorrect:** Market research is a technique that examines the number of potential sellers and their interest in responding to your procurement documents.
- C. **Incorrect:** Proposal evaluation techniques are used after sellers have responded to your requests, in order to determine which sellers advance in the procurement process.
- D. **Correct:** Make or buy analysis is the technique that takes into account a variety of factors to determine whether you should complete the work in house or outsource it.

6. **Correct Answer: D**

- A. **Incorrect:** Intellectual property rights are an important consideration in your source selection criteria, to determine who ultimately owns the work performed as part of a contract.
- B. **Incorrect:** Technical capability will be considered as part of your source selection criteria, in order to ensure that the selected seller has the technical capability to perform the required work.
- C. **Incorrect:** Financial capacity will be considered as part of your source selection criteria, to ensure that the sellers selected are of sufficient financial strength to be able to complete the work.
- D. **Correct:** Organizational process assets may help you with the procurement management processes, but they would not be included as part of your source selection criteria.

7. **Correct Answer: B**

- A. **Incorrect:** The Delphi technique is a tool used to solicit information from participants anonymously in order to reach consensus.
- B. **Correct:** Independent estimates are a technique used to determine if prices received from sellers are accurate.
- C. **Incorrect:** Analytical techniques are a particular tool used to evaluate a variety of elements and seller responses, not just prices.

- D. **Incorrect:** Bidder conferences are used to provide information to prospective sellers on a fair and equitable basis.
8. **Correct Answer: B**
- A. **Incorrect:** The Plan Procurement Management process is focused on the production of the procurement management plan the procurement statement of work, which will assist with the Conduct Procurements process, which negotiates contracts.
- B. **Correct:** The Conduct Procurements process uses the project management plan and seeks to negotiate contracts with potential sellers.
- C. **Incorrect:** The Control Procurements process monitors the negotiated contracts but does not actually negotiate them.
- D. **Incorrect:** The Close Procurements process closes contracts after they have been negotiated and the terms and conditions have been fulfilled.
9. **Correct Answer: B**
- A. **Incorrect:** An incomplete risk register may expose your project to unforeseen risks. But that would not contribute to multiple change requests and an escalating number of claims.
- B. **Correct:** The scenario is most likely to be the result of a poorly worded procurement statement of work, creating ambiguity and disagreement about the work to be performed as part of the contract.
- C. **Incorrect:** An incomplete project management plan may affect several other areas of your project but would not be directly responsible for multiple contractual change requests and claims.
- D. **Incorrect:** A lack of quality management on your project may cause a number of problems but would not be the most likely cause of multiple contractual change requests and claims.
10. **Correct Answer: D**
- A. **Incorrect:** The seller is also responsible for carrying out audits on contracts to ensure that both they and the buyer are meeting the agreed terms and conditions.
- B. **Correct:** The buyer also has responsibility for carrying out audits of the contracts because they initiated the process and have obligations as well.
- C. **Incorrect:** An independent legal professional may be engaged by either buyer or seller, but the ultimate responsibility lies with both buyer and seller.
- D. **Incorrect:** Both buyer and seller are responsible for carrying out audits on contracts, because they are both parties to the contract and have responsibilities under the negotiated terms and conditions.
11. **Correct Answer: A**
- A. **Correct:** The records management system is a subset of the project management information system devoted to storing information about procurement documentation and records.
- B. **Incorrect:** The project management information system includes the records management system, which is the better answer this question because it specifically focuses upon storing information about procurement documentation and records.
- C. **Incorrect:** The contract change control system records information about requested contractual changes and the status.
- D. **Incorrect:** Procurement performance reviews gather information about whether each party to a contract is carrying out their obligations and responsibilities. Information gathered from procurement performance reviews will be stored in a records management system.
12. **Correct Answer: D**
- A. **Incorrect:** Both parties can, by way of mutual agreement, agree to terminate the contract early.
- B. **Incorrect:** The default of one party to a contract is considered sufficient cause for early termination of a contract.
- C. **Incorrect:** There are some forms of contract that have written into them that early termination can occur if it is convenient to the buyer. These contracts normally include some form of compensation to the seller.

- D. **Correct:** An incomplete procurement statement of work may lead to disagreements, change requests, and claims, but not generally to an early termination of the contract except under extreme circumstances.

13. **Correct Answer: D**

- A. **Incorrect:** Mediation is a form of alternative dispute resolution that seeks to have both parties reach an agreement.
- B. **Incorrect:** Arbitration is a form of alternative dispute resolution that brings in a third party to make a decision that is binding on both parties.
- C. **Incorrect:** Litigation is a form of alternative dispute resolution that involves some form of court involvement.
- D. **Correct:** An audit is used to determine whether or not parties to a contract are carrying the contract out as per the agreed terms and conditions.

11. Stakeholder Management

This chapter focuses on the topic of project stakeholder management, which begins with an initiating process, Identify Stakeholders, to identify the stakeholders. Next, the process involves developing the stakeholder register that is used in the Plan Stakeholder Engagement process; this additional process involves developing the stakeholder engagement plan. The Manage Stakeholder Engagement process carries out the stakeholder engagement plan, and the Monitor Stakeholder Engagement process checks planned activities against what is actually occurring in relation to stakeholder management.

The four processes in the Project Stakeholder Management knowledge area are:

- Identify Stakeholders (Initiating process)
- Plan Stakeholder Engagement (Planning process)
- Manage Stakeholder Engagement (Executing process)
- Monitor Stakeholder Engagement (Monitoring and Controlling process)

11.1 WHAT IS PROJECT STAKEHOLDER MANAGEMENT?

Project stakeholder management is focused on all the processes involved in identifying as many stakeholders as possible on a project, understanding their expectations and levels of engagement, planning how to proactively engage and influence them, and checking that what you are doing is in accordance with the stakeholder engagement plan and acting on any deviations or variances.

A *stakeholder* is any person, group, or organization who can affect, or be affected by, your project. Stakeholders can have an impact on your project in both positive and negative ways. All projects have stakeholders interested in the outcomes and impact of the project. It is your job as project manager to identify all of these stakeholders and what their expectations are, keep them engaged, and ensure that stakeholder satisfaction becomes a key project deliverable. The easiest way to do this is to ensure that stakeholder management is a continuous dialogue rather than a one-off event or a series of sporadic events.

A main objective of the stakeholder management process is to get stakeholders to support your project or at least not to oppose it.

In order to effectively understand and manage stakeholders' engagement and expectations, you must be both proactive and influencing. Being proactive means anticipating and planning, and it is the opposite of being reactive. By being proactive you will minimize surprises that stakeholders can bring to the project.

To carry out effective influencing you need to first ensure that you understand where stakeholders currently sit in relation to their expectations and engagement and know where you want them to be. *Influencing* means using a variety of skills and techniques to modify, enhance, or reduce particular aspects of stakeholder engagement and expectations. These skills and techniques include effective communication, highly developed interpersonal skills, and the correct display of technical ability. A skilled project manager chooses which combination to use in order to maximize stakeholder influencing.

EXAM TIP

The success or failure of your efforts to identify and manage stakeholders will have a high degree of impact on whether or not your project is a success or failure. In the exam, you should treat any questions that refer to stakeholders as ones that require you to proactively define, manage, and influence their engagement and expectations.

Real World

I have often found that the actual or perceived success or failure of a project rests on how satisfied stakeholders are rather than the technical measurements around cost or time. This is a sign of just how important it is to keep your stakeholders engaged and to ensure that their expectations are managed.

11.2 IDENTIFY STAKEHOLDERS

TABLE 11-1 Identify Stakeholders process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project charter ▪ Business documents <ul style="list-style-type: none"> ▪ <i>Business case</i> ▪ <i>Benefits management plan</i> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Communications management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ <i>Project documents</i> ▪ <i>Change log</i> ▪ <i>Issue log</i> ▪ <i>Requirements documentation</i> ▪ Agreements ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data gathering <ul style="list-style-type: none"> ▪ <i>Questionnaires and surveys</i> ▪ <i>Brainstorming</i> ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Stakeholder analysis</i> ▪ <i>Document analysis</i> ▪ Data representation <ul style="list-style-type: none"> ▪ <i>Stakeholder mapping/representation</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Stakeholder register ▪ Change requests ▪ Project management plan updates <ul style="list-style-type: none"> ▪ <i>Requirements management plan</i> ▪ <i>Communications management plan</i> ▪ <i>Risk management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Assumption log</i> ▪ <i>Issue log</i> ▪ <i>Risk register</i>

The Identify Stakeholders process is an initiating process with the stakeholder register as its primary output. The stakeholder register contains key information about stakeholders that can be used in the other stakeholder management processes.

INPUTS

The Identify Stakeholders process uses some or all of the following inputs as part of the development of the stakeholder register for the project.

PROJECT CHARTER

The project charter will contain information about internal and external stakeholders identified as part of the project initiation, such as the customer, the project sponsor, and any other easily identified stakeholders. The project charter is an output from the Develop Project Charter process.

BUSINESS DOCUMENTS

The business case is useful in identifying stakeholders because it outlines why the project is necessary, which can help identify who would be interested or affected by it, it highlights budget and financial expectations, informing who may have a stake in the project's financial outcome, and it defines what the project aims to achieve, thus indicating groups or individuals who would be concerned with its success or failure.

The benefits management plan specifies who will benefit from the project's outcomes, thus directly pointing to key stakeholders. It also details how benefits will be measured, which can indicate who is accountable or interested in these metrics, describes who is responsible for realizing the benefits, helping to identify internal stakeholders like project team members.

PROJECT MANAGEMENT PLAN

The communications management plan Outlines preferred communication channels and methods, helping identify who needs to be in the loop. It describes the frequency and type of communication, pointing to stakeholders with specific information needs. It is an output from the Plan Communications Management process.

The stakeholder engagement plan Lists current and desired engagement levels of known stakeholders, aiding in recognizing others who may be impacted. It also provides strategies for stakeholder engagement, offering clues as to who else might need to be involved.

Various project documents Contains diverse information like schedules and risks, giving cues about stakeholders linked to specific project elements. They may include preliminary lists of stakeholders, acting as a starting point for further identification.

The change log shows who requested changes and who approved them, highlighting active stakeholders. This reflects the impact of changes, indicating stakeholders concerned with project alterations.

The issue log lists project issues and who is responsible for resolving them, pointing to key internal stakeholders.

The types of issues logged can suggest additional stakeholders concerned with those specific challenges.

The requirements documentation details what the project must achieve, indicating stakeholders tied to particular requirements. This may include prioritization of requirements, signaling stakeholders with significant influence or interest.

Each of these project documents provides insights into who the stakeholders may be, serving as valuable inputs in the Identify Stakeholders process.

AGREEMENTS

Any form of contract or agreement will outline the roles and responsibilities of all the parties to the agreement as well as describing work to be undertaken to identify and manage particular stakeholders.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific enterprise environmental factors that will be useful as inputs into this process are organizational culture and structure, any relevant government or industry standards, and any external cultural aspects of dealing with particular individuals or groups of stakeholders.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that may be an important input into the development of your stakeholder register are any blank stakeholder register templates the organization has and lessons learned that your organization has gathered from previous projects.

TOOLS AND TECHNIQUES

The following tools and techniques are available to be used to develop the inputs in this process in order to produce the stakeholder register.

EXPERT JUDGMENT

Expert judgment is a key tool to be used in the Identify Stakeholders process because the use of experts with experience in the identification and assessment of stakeholders will ensure that you have a more complete stakeholder register. Particular experts that you may want to consult with include the project sponsor, senior management, the key stakeholders themselves, other people who have worked in similar areas with relevant experience, and any subject matter experts in the area in which you are working.

EXAM TIP

You will recall that when soliciting information from experts there are a wide variety of information-gathering techniques that you are able to use such as interviews, consultation, meetings, surveys, workshops, and focus groups.

DATA GATHERING

You will want to involve your team and any related subject matter experts to help identifying your project stakeholders. The best ways to get this data use techniques such as well worded questionnaires and surveys, and also techniques that promote innovation such as brainstorming.

DATA ANALYSIS

There are a number of ways to carry out stakeholder analysis; each of them seeks to identify the stakeholders' interests, expectations, power, influence, and level of engagement in the project. *Stakeholder analysis* begins with the use of information-gathering techniques such as brainstorming, interviewing, and other data-gathering techniques in order to identify stakeholders. The information gathered as part of carrying out stakeholder analysis will enable you to clearly describe the power, interest, influence, impact, and engagement stakeholders have on your project, and then you will be able to develop a robust stakeholder management strategy.

DATA REPRESENTATION

After you have gathered data about stakeholders, there are a number of ways of presenting this data. A very popular way of graphically showing the level of impact, or engagement, a stakeholder has on your project is with a matrix displaying either power and interest, power and influence, or influence and impact on the x-axis and y-axis, respectively. Figure 11-1 shows an example of a power and interest matrix.

		Level of interest	
		Low	High
Power	Low	Monitor	Keep informed
	High	Keep satisfied	Key players, manage closely

FIGURE 11-1 A categorization of stakeholder power and interest using a matrix.

EXAM TIP

Figure 11-1 is often called a Gardner grid or matrix, named after one of the original authors who developed it.

Another way to represent levels of stakeholder influence on your project is to use the salience model, which maps stakeholders' power, urgency, and legitimacy to place stakeholders into one of seven possible categories, each of which begins with the letter "D." Figure 11-2 shows an example of a salience model and the seven possible categories of stakeholder. It shows that a stakeholder with high levels of power and urgency but with a low level of legitimacy is categorized as dangerous, while a stakeholder with legitimacy and power but a low level of urgency is categorized as dominant.

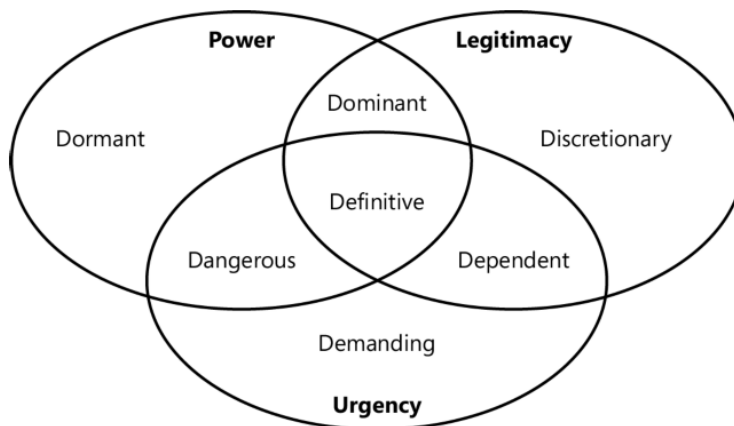


FIGURE 11-2 Salience model

EXAM TIP

The salience model was developed by Ronald Mitchell, Bradley Agle, and Donna Wood. So if you find a question that refers to any form of diagram by these authors, you will know it is referring to the salience model.

MEETINGS

Meetings are an important tool for gathering, exchanging, and analyzing information gathered about stakeholders and their power, interest, influence, impact, engagement, and expectations.

OUTPUTS

After applying the appropriate tools and techniques to the selected inputs, the Identify Stakeholders process has the following outputs.

STAKEHOLDER REGISTER

The Identify Stakeholders process has the stakeholder register as its sole output. The stakeholder register will probably contain information on the following:

- A classification of stakeholder categories so you can distinguish between different stakeholders and their expectations and engagement
- Information about individual stakeholders and their contact details
- A description of the interest that each stakeholder has in the project
- An assessment of the stakeholders' power, impact, influence, engagement, or interest in the project
- A description of the strategy to be employed to gain their support and keep them satisfied
- A description of the frequency and method by which you will revisit the stakeholder register

Real World

Take great care with information that you record in your stakeholder register, and always keep in mind that a stakeholder may one day view the register, so ensure that the information you include about your assessment of the stakeholders' influence, impact, or engagement on the project will not adversely affect your project if the stakeholder reads the register. For example, on a project I worked on, we had one extremely difficult senior manager who was part of the project control group and who constantly failed to read reports, undermined project team members, and had a difficult interpersonal style. He also had the ability to greatly influence the project. As we documented his interest and impact upon the project in the stakeholder register, we had to be careful how we described his interaction with the team, because if we had written what we really thought, it would have caused a lot of problems if he had viewed it.

The stakeholder register is used as an input into a number of processes, including the Collect Requirements process, the Plan Quality Management process, the Plan Risk Management process, the Identify Risks process, the Plan Procurement Management process, and the Plan Stakeholder Engagement process. This shows how important the stakeholder register is to multiple parts of the project.

CHANGE REQUESTS

As a result of identifying stakeholders, you may wish to change aspects of the plans and documents that you have developed to date and this will require a change request which will go on to become an input in the Perform Integrated Change control process and be assessed according to your documented change control process.

PROJECT MANAGEMENT PLAN UPDATES

As you begin to identify stakeholders you may wish to update relevant parts of your project management plan to reflect the new information gathered. The following subsidiary plans are especially prone to being changed because of new stakeholder information – the requirements management plan, the communications management plan, the risk management plan, and the stakeholder engagement plan.

PROJECT DOCUMENTS UPDATES

You may also wish to update the assumption log, Issue log, and risk register with the new stakeholder information,

Quick Check

1. What is the main focus of the Identify Stakeholders process?
2. What is the best definition of a stakeholder?
3. What is your primary objective in identifying and managing stakeholders on your project?
4. How is the Identify Stakeholders process linked to other project management processes?

Quick Check Answers

1. The main focus of the Identify Stakeholders process is to carry out stakeholder analysis to develop your stakeholder register, which identifies stakeholders, their interest in the project, an assessment of the ways in which they can affect your project, and a consideration of the ways in which you can proactively manage and influence their engagement and expectations.
2. A stakeholder is any individual, group, or organization that can affect, or be affected by, your project.
3. Your primary objective when identifying and managing stakeholders on your project is to ensure that they stay engaged and their expectations are managed in order to ensure that they provide support to your project, or alternatively, that they do not oppose the project.
4. The primary output from the Identify Stakeholders process is the stakeholder register, which is used as an input into the Collect Requirements process, the Plan Quality Management process, the Plan Risk Management process, the Identify Risks process, and the Plan Procurement Management process, all of which are outside the stakeholder management area. It is also used as an input into the Plan Stakeholder Engagement process.

11.3 PLAN STAKEHOLDER ENGAGEMENT

TABLE 11-2 Plan Stakeholder Engagement process

INPUTS →	TOOLS AND TECHNIQUES →	OUTPUTS
<ul style="list-style-type: none"> ▪ Project charter ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Resource management plan</i> ▪ <i>Communications management plan</i> ▪ <i>Risk management plan</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Assumption log</i> ▪ <i>Change log</i> ▪ <i>Issue log</i> ▪ <i>Project schedule</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Data gathering <ul style="list-style-type: none"> ▪ <i>Benchmarking</i> ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Assumption and constraint analysis</i> ▪ <i>Root cause analysis</i> ▪ Decision making <ul style="list-style-type: none"> ▪ <i>Prioritization/ranking</i> ▪ Data representation <ul style="list-style-type: none"> ▪ <i>Mind mapping</i> ▪ <i>Stakeholder engagement assessment matrix</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Stakeholder engagement plan

The Plan Stakeholder Engagement process is a planning process that seeks to identify how the project will affect stakeholders, how stakeholders will affect the project, and how the team will proactively manage levels of stakeholder engagement, proactively influence stakeholder expectations, and ensure stakeholder support for the project, its objectives, and deliverables.

Real World

There is a great deal of skill required to be successful in proactively influencing stakeholder engagement and expectations. I strongly recommend that, as part of your own professional development as a project manager, you focus on your ability to proactively influence stakeholders because it is one of the main ways to ensure project success. Conversely, if it is done poorly, it is a surefire way to increase the chances of project failure.

INPUTS

The Plan Stakeholder Engagement process uses some or all of the following inputs.

PROJECT CHARTER

The project charter will provide useful information about the foundational aspects of the project including any known stakeholder engagement issues at the time of project approval. It is an output from the Develop Project Charter process.

PROJECT MANAGEMENT PLAN

The project management plan, and its subsidiary plans, are an input into the Plan Stakeholder Engagement process because they provide a wealth of information about different aspects of the project that is useful in developing a stakeholder engagement plan. Specific information that will be useful includes the project life cycle, the methodology selected to execute the project, the specific objectives and deliverables of the project, and the particular forms of communication to be used. All this information can be found in different parts of the project management plan like the resource management plan, communications management plan, and risk management plan. The project management plan is an output from the Develop Project Management Plan process.

PROJECT DOCUMENTS

The assumption log lists assumptions made about stakeholders' behaviors or expectations, guiding the planning for engagement strategies. This helps identify potential misunderstandings or misconceptions that need to be managed proactively with stakeholders.

The change log highlights stakeholders who are initiators or approvers of change, suggesting their power and interest in the project. This provides a record of past changes, helping predict which stakeholders may initiate similar changes in the future.

The issue log points out stakeholders who are responsible for resolving issues or those impacted by them, assisting in stakeholder categorization. The kinds of issues listed can indicate areas of concern for stakeholders, helping tailor engagement plans accordingly.

The project schedule shows key milestones and deadlines, helping to identify stakeholders who are particularly concerned with certain project phases or deliverables. This may outline resource allocations, thereby spotlighting stakeholders who have a direct operational role in the project.

The risk register lists risks along with their owners and potential impact, signaling which stakeholders are risk-averse or risk-tolerant. This provides a basis for understanding what stakes each stakeholder has in risk management, aiding in the development of engagement strategies.

The stakeholder register is an extremely important input into the development of the stakeholder engagement plan because it outlines each of the stakeholders; their interest in the project; their power, interest, impact, and influence; and any particular identified ways of influencing both their engagement and expectations. The stakeholder register is an output from the Identify Stakeholders process.

AGREEMENTS

Agreements serve as formal documents that outline the commitments between parties involved in a project, often including clients, suppliers, and partners. They are useful in planning stakeholder management because they provide the following:

- **Scope Clarity:** Agreements usually specify the scope of work and deliverables, providing insight into which stakeholders are directly concerned with specific project outcomes.
- **Accountability:** They clearly assign responsibilities and roles, enabling the identification of stakeholders who are either accountable for or have a vested interest in certain project aspects.

- **Financial and Resource Commitment:** Agreements often detail financial terms, resource allocations, or timelines, highlighting stakeholders who are financially invested or operationally engaged in the project.
- **Conflict Resolution:** Most agreements include clauses related to dispute resolution, indicating the stakeholders who have the authority or interest in resolving conflicts, thereby informing stakeholder engagement strategies.

Understanding the stipulations in agreements can help project managers to tailor their stakeholder engagement plans more effectively.

ENTERPRISE ENVIRONMENTAL FACTORS

The specific types of enterprise environmental factors that will be useful in the development of the stakeholder engagement plan will be your particular organizational culture, structures, and internal and external political climate, because all of these will affect the method, frequency, and success or failure of your stakeholder management efforts.

ORGANIZATIONAL PROCESS ASSETS

The specific types of organizational process assets that will assist in development of the stakeholder engagement plan include any lessons learned that your organization has gathered about stakeholder management activities from previous projects, any blank templates for the development of a stakeholder engagement plan, and any other relevant historical information.

TOOLS AND TECHNIQUES

The following tools and techniques are used upon the inputs to deliver the Plan Stakeholder Engagement process outputs.

EXPERT JUDGMENT

Expert judgment is an excellent tool to use in the Plan Stakeholder Engagement process because it allows you to bring together people with experience and skills in the identification of stakeholders and in the development of specific ways in which to manage both their engagement and expectations. You may choose to draw on the expertise of the project sponsor, senior management, other identified key stakeholders, subject matter experts with experience in the area in which your project is operating, and any other relevant experts.

DATA GATHERING

Benchmarking involves comparing your project's stakeholder management practices against industry standards or similar projects. By doing so, you can identify best practices and areas for improvement in your stakeholder management approach. This can help you ensure that your stakeholder engagement plan is not just effective but also aligned with proven methodologies. It serves as a quality check and offers a way to bring the best external practices into your project.

DATA ANALYSIS

In the context of stakeholder management, assumption and constraint analysis helps in identifying and assessing the presumptions made about stakeholder behavior, expectations, and limitations. For instance, you might assume that a certain stakeholder prefers email communication or that they are only available for meetings during specific hours. Understanding these assumptions and constraints is crucial for developing an effective stakeholder engagement plan that accommodates or challenges these factors.

Root cause analysis is used to dig deep into issues that can affect stakeholder engagement and satisfaction. For example, if there is resistance from certain stakeholder groups, root cause analysis can help you understand why this resistance exists in the first place. Once the underlying reasons are clear, strategies can be developed to address these issues effectively, making this technique valuable for proactive stakeholder management. You can use the Fishbone or Ishikawa diagram, and also 5 Whys analysis we covered in the Quality Management chapter to help you with this.

DECISION MAKING

Prioritization and ranking involve assigning levels of importance to different stakeholders based on their influence, impact, or other criteria. This can help you allocate resources and attention more effectively. For instance, stakeholders with high influence and high interest in the project may require more frequent and detailed

communication than those with less influence or interest. Prioritization ensures that the most critical stakeholders are managed effectively, optimizing the use of limited resources in stakeholder engagement.

DATA REPRESENTATION

You may choose to use a variety of analytical techniques in order to assess the level of engagement of individual stakeholders.

Mind mapping can serve as a valuable tool for visualizing and organizing various aspects of stakeholder management. If done well it can help with the following”

- **Identification:** At the center of the mind map, you can place the project's main objective. Branching out from the center, you can list categories of stakeholders like "Internal," "External," "High Influence," etc. This helps in the initial identification of stakeholders.
- **Attributes and Interests:** From each category, you can further branch out to list specific stakeholders. Adjacent to each stakeholder, additional branches can denote their interests, influence level, communication preferences, and other attributes. This aids in understanding stakeholder dynamics.
- **Engagement Strategies:** You can also include branches that outline strategies for engaging with each type of stakeholder. This can range from communication methods to frequency of updates, thereby forming a basis for your engagement plan.
- **Relationships and Dependencies:** Mind maps allow for cross-linking between branches, helping to highlight relationships or dependencies between different stakeholders. Understanding these connections can lead to more effective stakeholder management.
- **Easy Updates:** As the project progresses and new information becomes available, mind maps are easy to update, helping to keep your stakeholder engagement plan current.

Mind mapping in this context essentially provides a visual, easy-to-understand framework that captures a multi-faceted view of stakeholder management, making it easier to plan and implement engagement strategies.

There are several ways of assessing and documenting different stakeholders and the level of engagement they have with the project. Figure 11-3 shows a stakeholder engagement assessment matrix, which is a popular way of showing whether a stakeholder is unaware of the project, resistant to the project, neutral about the project, supportive of the project, or leading and actively engaged in ensuring that the project will be successful. The letter “C” shows where the stakeholder currently is, and the letter “D” shows where you would like them to be, and getting stakeholders to position “D” is the focus of your stakeholder management activities.

	Unaware	Resistant	Neutral	Supportive	Leading
Stakeholder A		C			D
Stakeholder B				C D	
Stakeholder C			C	D	
Stakeholder D				C	D

FIGURE 11-3 A matrix showing an assessment of stakeholder engagement both now and in the future.

MEETINGS

Meetings are an excellent tool for bringing together experts and members of the project team to carry out the process of the development and reassessment of your stakeholder engagement plan throughout the life of your project.

A particularly effective meeting that can be useful in increasing levels of stakeholder engagement and proactively influencing stakeholder expectations is the kick-off meeting. The kick-off meeting is held after enough planning has been completed to enable the first of the project execution work to begin. It is used to bring stakeholders together face to face, to discuss the project and show everyone where the project is going.

OUTPUTS

The Plan Stakeholder Engagement process has the following outputs.

STAKEHOLDER ENGAGEMENT PLAN

The stakeholder engagement plan is the key output from the Plan Stakeholder Engagement process. The stakeholder engagement plan takes the information gathered from the stakeholder register, and from this provides a plan that identifies stakeholder engagement and expectations and sets out a clear strategy for managing and influencing engagement and expectations to ensure that stakeholders are supportive of the project, or at least do not

oppose the project. The stakeholder engagement plan is used as an input into the Manage Stakeholder Engagement process.

EXAM TIP

Any question that appears in the exam about your interaction with stakeholders will require you to take the position of continuously, and proactively, influencing their engagement and expectations. In order to do this you will require a stakeholder engagement plan.

Quick Check

1. What is the main purpose of the Plan Stakeholder Engagement process?
2. What sort of information should a stakeholder engagement plan contain?
3. What does a stakeholder engagement assessment matrix show?
4. How do the activities contained in the Plan Stakeholder Engagement process interact with other project management knowledge areas?

Quick Check Answers

1. The Plan Stakeholder Engagement process seeks to take the information gathered on the stakeholder register and use this to develop a coherent stakeholder engagement plan that proactively manages and influences stakeholder engagement and expectations to ensure stakeholder support of the project and its objectives.
2. The stakeholder engagement plan should build upon the information contained in the stakeholder register and contain information about the current and expected engagement levels of key stakeholders, the communications requirements and methods selected for the stakeholders, and the particular strategies to be employed in managing their engagement and expectations.
3. The stakeholder engagement assessment matrix shows the level of engagement of individual stakeholders in the project.
4. The project management plan, which refers to all other areas of the project, is used as an input into the Plan Stakeholder Engagement process, because any information about stakeholders' expectations, requirements, constraints, and engagement that may be included in the project management plan is essential in developing a robust stakeholder engagement plan.

11.4 MANAGE STAKEHOLDER ENGAGEMENT

TABLE 11-3 Manage Stakeholder Engagement process

INPUTS ⇨	TOOLS AND TECHNIQUES ⇨	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Communications management plan</i> ▪ <i>Risk management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ <i>Change management plan</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Change log</i> ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Stakeholder register</i> ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Expert judgment ▪ Communications skills <ul style="list-style-type: none"> ▪ <i>Feedback</i> ▪ Interpersonal and team skills <ul style="list-style-type: none"> ▪ <i>Conflict management</i> ▪ <i>Cultural awareness</i> ▪ <i>Negotiation</i> ▪ <i>Observation/conservation</i> ▪ <i>Political awareness</i> ▪ <i>Ground rules</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Change requests ▪ Project management plan updates <ul style="list-style-type: none"> ▪ <i>Communications management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Change log</i> ▪ <i>Issue log</i> ▪ <i>Lessons learned register</i> ▪ <i>Stakeholder register</i>

The Manage Stakeholder Engagement process is an executing process focused on the execution of the stakeholder engagement plan in order to ensure that stakeholder engagement and expectations are proactively influenced and managed.

EXAM TIP

By now you will have seen the term “proactive” several times, particularly in the stakeholder management area. In relation to managing stakeholder engagement, being proactive means continuously engaging stakeholders in an appropriate manner to get their support for the project and ensure that you understand their individual expectations of the project and can meet them. Being proactive also means being on constant alert for any concerns that may arise and dealing with them in a manner that stops them from arising or, if they do arise, that minimizes the adverse impact.

INPUTS

The following inputs are used in the Manage Stakeholder Engagement process.

PROJECT MANAGEMENT PLAN

Any of the subsidiary plans that explicitly provide information about management stakeholders such as the communications management plan and the risk management plan will be a useful input into this process. A key input into the Manage Stakeholder Engagement processes will be the stakeholder engagement plan because it contains information about stakeholders, their ability to influence the project, their expectations, their level of engagement, and the documented strategies for proactively influencing all of these. The stakeholder engagement plan is an output from the Plan Stakeholder Engagement process.

The communications management plan is an essential input into the Manage Stakeholder Engagement process because it outlines individual stakeholders and the specific methods, frequency, and content of communication with them. It is via the successful use of the information contained in the communications management plan that you will be able to better execute the stakeholder engagement plan. The communications management plan is an output from the Plan Communications Management process.

PROJECT DOCUMENTS

The change log is an important input to have available because you will want to be able to convey to stakeholders any changes that have occurred. The change log is an output from the Perform Integrated Change Control process.

The issue log will document known issues with stakeholder engagement.

The lessons learned register will record valuable information about what you have learned so far on this project that may assist with stakeholder engagement, and also what has been learned on other projects.

The stakeholder register will provide the list of all of your identified project stakeholders and other information such as an assessment of their power and interest in the project.

ENTERPRISE ENVIRONMENTAL FACTORS

Enterprise Environmental Factors (EEFs) refer to the conditions, not under the immediate control of the team, that influence, constrain, or direct the project. In the context of the Manage Stakeholder Engagement process, EEFs can be particularly valuable for several reasons.

Firstly, EEFs can include the organization's culture and structure, which can profoundly affect how stakeholders perceive and engage with a project. Understanding the organizational context can help project managers tailor their engagement strategies to align with existing norms and expectations, thereby enhancing stakeholder receptivity.

Secondly, EEFs often encompass market conditions and social factors, such as public opinion, that can affect stakeholder attitudes and behaviors. Being aware of these can enable the project team to proactively manage stakeholder expectations and reactions, especially in public-facing projects where community or customer sentiment is crucial.

Lastly, EEFs can include legal and regulatory requirements that may impose specific obligations on stakeholder engagement, such as mandatory disclosures or consultation processes. Knowing these requirements upfront allows the project team to integrate them into the stakeholder engagement plan, ensuring compliance and reducing the risk of legal issues.

In summary, Enterprise Environmental Factors provide essential context and guidelines that can significantly influence the effectiveness of stakeholder engagement strategies. Being aware of and accounting for these factors can make the Manage Stakeholder Engagement process more robust and adaptive.

ORGANIZATIONAL PROCESS ASSETS

The specific organizational process assets that will be of use in the Manage Stakeholder Engagement process are any identified organizational communication methods, change control procedures, lessons learned, and historical information about similar previous projects and how they managed stakeholder engagement.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the Manage Stakeholder Engagement process outputs.

EXPERT JUDGMENT

Expert judgment involves consulting individuals or groups with specialized knowledge or experience in stakeholder management. Their insights can help the project team tailor its engagement strategies, identify potential pitfalls, and offer best practices to improve stakeholder relations. This can be particularly useful when dealing with complex projects or unfamiliar stakeholder landscapes.

COMMUNICATION SKILLS

Feedback mechanisms, such as surveys or direct conversations, are essential tools for gauging stakeholder sentiment and understanding their needs. Regular feedback loops can help the project team adjust its strategies for engagement, address concerns proactively, and build stronger relationships with stakeholders by showing that their input is valued.

The communications management plan will outline the specific methods and content of communication to be used for each stakeholder. As part of the communications model and methods discussed in Chapter 8, “Communications management,” there are several methods of communication that will assist you in managing stakeholder engagement. These methods include interactive communication, which means that all parties to the communication are involved in the exchange of ideas and messages. This is the most common form of communication method for influencing stakeholders, and it relies on all parties involved in the communication having strong interpersonal skills.

Push communication is a one-way sender-driven communications method where one party, the sender, sends information to the other party, the receiver, without necessarily checking that it has been received and interpreted correctly. Email messages, letters, and press releases are all examples of push communication. As a communication method it can be a very effective means of distributing information quickly and widely if care is taken to craft the message well.

Pull communication occurs when information is posted so that the recipients can visit and draw the information down at their leisure. Company or project intranet sites are good examples of pull communication.

EXAM TIP

After reading this section on managing stakeholder engagement, you may want to read the communications management chapter (Chapter 8) again, because the two subjects are very closely linked.

INTERPERSONAL AND TEAM SKILLS

The process of managing stakeholders is one based on building relationships, and a key tool used in establishing a relationship is the interpersonal skills that a project manager must have. The types of interpersonal skills that you will want to use include your leadership skills, decision-making skills, conflict resolution skills, change management skills, and active listening.

EXAM TIP

Interpersonal skills were also used as a tool in the Develop Team and Manage Team processes described in Chapter 7, “Human resource management.”

Here are some useful interpersonal and team skills that may help with managing stakeholder engagement – remember that the exam will place a great deal of importance on these so get to know them well.

Conflict Management: Conflict is almost inevitable in projects with multiple stakeholders. Effective conflict management techniques can help resolve disputes in a way that is satisfactory for all parties involved. This fosters a more collaborative environment and can help keep the project on track by minimizing disruptions due to conflicts.

Cultural Awareness: Being aware of the different cultures, values, and communication styles of stakeholders can drastically improve the effectiveness of engagement strategies. Cultural awareness enables the project team to tailor their messages and engagement methods to resonate with diverse stakeholder groups, making interactions more meaningful and effective.

Negotiation: Negotiation skills are vital when managing stakeholder expectations and agreements. Whether it's negotiating resources, timelines, or project scope, effective negotiation can help find a middle ground that satisfies both the project's objectives and stakeholder expectations.

Observation/Conversation: Sometimes, direct observation or informal conversations can provide invaluable insights into stakeholder attitudes and concerns. This less structured approach can uncover nuances or issues that formal channels might miss, offering a more rounded view of stakeholder perspectives.

Political Awareness: Understanding the internal and external political landscape can help in navigating stakeholder relationships more effectively. Being politically aware can help the project team anticipate potential challenges from power dynamics or competing interests among stakeholders and plan their engagement strategies accordingly.

GROUND RULES

Setting ground rules for stakeholder engagement creates a framework for interaction that is transparent and fair. It ensures that everyone knows what to expect in meetings, how decisions are made, and how communication is handled, which can go a long way in maintaining a harmonious relationship with stakeholders.

MEETINGS

Meetings serve as a direct platform for engaging with stakeholders to discuss project updates, resolve issues, or make decisions. Well-facilitated meetings that are structured yet flexible can foster open communication, encourage stakeholder involvement, and provide an avenue for immediate feedback.

OUTPUTS

The outputs from the Manage Stakeholder Engagement process include the following.

CHANGE REQUESTS

In addition to issues that may arise, there may also be change requests, including corrective or preventive actions, which need to be documented and assessed via the approved change control process. Change requests are an input into the Perform Integrated Change Control process.

PROJECT MANAGEMENT PLAN UPDATES

The specific parts of the project management plan that may be updated as a result of executing the Manage Stakeholder Engagement process include, obviously, the stakeholder engagement plan, as well as the communications management plan, and any other parts of the project management plan that are affected by stakeholder expectations and engagement.

PROJECT DOCUMENTS UPDATES

The specific project documents that may be updated are, obviously, the stakeholder register and any other documents specifically affected by stakeholder engagement issues such as the change log (with the above change requests), the issue log, the lessons learned register, and the stakeholder register.

As you carry out the process of proactively managing stakeholder engagement, particular issues with individual stakeholders may arise that need to be documented so that they can be recorded and worked on. The best place to record these particular issues is the issue log. The issue log is used as an input into the Monitor Stakeholder Engagement process, the Manage Team process, and the Monitor Communications process.

Quick Check

1. What is the main purpose of the Manage Stakeholder Engagement process?
2. What is the difference between push and pull forms of communication?
3. Why is the issue log a main output from the Manage Stakeholder Engagement process?
4. How does the Manage Stakeholder Engagement process interact with other project management knowledge areas?

Quick Check Answers

1. The main purpose of the Manage Stakeholder Engagement process is the execution of the stakeholder management plan, in order to achieve stakeholder support for the project.
2. The difference between push and pull forms of communication is in whether or not the information is sent to specific recipients. In push communication, information is sent from a sender to a recipient, and in pull communication, recipients have to access the information themselves.
3. The issue log is a main output from the Manage Stakeholder Engagement process because, while executing the stakeholder management plan, you may identify particular issues with individual stakeholders that need to be recorded and documented in order to ensure that they are monitored and resolved.
4. The Manage Stakeholder Engagement process uses the change log from the Perform Integrated Change Control process and the communications management plan from the Plan Communications Management process.

11.5 MONITOR STAKEHOLDER ENGAGEMENT

TABLE 11-4 Monitor Stakeholder Engagement process

INPUTS →	TOOLS AND TECHNIQUES →	OUTPUTS
<ul style="list-style-type: none"> ▪ Project management plan <ul style="list-style-type: none"> ▪ <i>Resource management plan</i> ▪ <i>Communications management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ Project documents <ul style="list-style-type: none"> ▪ <i>Issue log</i> ▪ <i>Lesson learned register</i> ▪ <i>Project communications</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i> ▪ Work performance data ▪ Enterprise environmental factors ▪ Organizational process assets 	<ul style="list-style-type: none"> ▪ Data analysis <ul style="list-style-type: none"> ▪ <i>Alternatives analysis</i> ▪ <i>Root cause analysis</i> ▪ <i>Stakeholder analysis</i> ▪ Decision making <ul style="list-style-type: none"> ▪ <i>Multicriteria decision analysis</i> ▪ <i>Voting</i> ▪ Data representation <ul style="list-style-type: none"> ▪ <i>Stakeholder engagement assessment matrix</i> ▪ Communication skills <ul style="list-style-type: none"> ▪ <i>Feedback</i> ▪ <i>Presentations</i> ▪ Interpersonal and team skills <ul style="list-style-type: none"> ▪ <i>Active listening</i> ▪ <i>Cultural awareness</i> ▪ <i>Leadership</i> ▪ <i>Networking</i> ▪ <i>Political awareness</i> ▪ Meetings 	<ul style="list-style-type: none"> ▪ Work performance information ▪ Change requests ▪ Project management plan updates <ul style="list-style-type: none"> ▪ <i>Resource management plan</i> ▪ <i>Communications management plan</i> ▪ <i>Stakeholder engagement plan</i> ▪ Project documents updates <ul style="list-style-type: none"> ▪ <i>Issues log</i> ▪ <i>Lessons learned register</i> ▪ <i>Risk register</i> ▪ <i>Stakeholder register</i>

The Monitor Stakeholder Engagement process is a monitoring and controlling process focused on examining the execution of the stakeholder engagement plan to ensure that it is being executed correctly and appropriately, and to

INPUTS

The following inputs are used in the Monitor Stakeholder Engagement process.

PROJECT MANAGEMENT PLAN

The Resource Management Plan provides guidelines on how resources are allocated and managed. In the context of monitoring stakeholder engagement, it helps ensure that adequate time and resources are devoted to stakeholder activities. It can highlight if any adjustments in resource allocation are necessary for effective stakeholder engagement.

The communications management plan outlines the communication methods, frequency, and content tailored for different stakeholders. By comparing planned communications against actual interactions, the project team can identify discrepancies or inefficiencies that may need adjustments to keep stakeholders engaged effectively.

The stakeholder engagement plan lays out the strategies for engaging each stakeholder or stakeholder group. Monitoring its effectiveness can reveal if the engagement strategies are working as intended or if they need to be modified to better meet stakeholder needs or expectations.

PROJECT DOCUMENTS

The Issue Log records concerns raised by stakeholders that could impact the project. By monitoring this log, the project team can proactively address issues before they escalate, thereby maintaining good relationships with stakeholders.

The lessons learned register provides past lessons that can offer invaluable insights into what worked and what didn't in stakeholder engagement. This register helps in fine-tuning ongoing and future stakeholder engagement strategies, making them more effective.

Project communications are the actual communications that have occurred in the project, like emails or meeting minutes, offer a concrete record of stakeholder interactions. These can be compared with plans to assess if communication has been effective and timely.

The Risk Register lists potential risks, their impact, and response plans, often identifying stakeholders associated with those risks. Monitoring this can help in engaging stakeholders to mitigate risks effectively.

The Stakeholder Register contains a list of all project stakeholders along with their interests, influence, and other attributes. This is a foundational document for monitoring whether engagement activities are appropriately targeted.

WORK PERFORMANCE DATA

This data includes performance indicators that can be directly or indirectly related to stakeholder engagement. Monitoring these can help in identifying the effectiveness of stakeholder-related activities and making necessary adjustments.

ENTERPRISE ENVIRONMENTAL FACTORS

These factors, like organizational culture or market conditions, can influence stakeholder behavior and expectations. Monitoring these allows the project team to adjust their engagement strategies to align with these external variables.

Organizational Process Assets

These include existing templates, procedures, and historical information that can help in the monitoring process. They may contain data on stakeholder engagement from past projects, offering benchmarks or best practices that can be applied in the current project.

TOOLS AND TECHNIQUES

The following tools and techniques of this process are able to be used upon the separate inputs to deliver the Monitor Stakeholder Engagement process outputs.

DATA ANALYSIS

Alternatives analysis allows for the evaluation of different approaches to stakeholder engagement. If current strategies are not working as anticipated, this technique helps identify other potential paths for better engagement, thereby aiding in course correction.

If issues arise with stakeholder engagement, root cause analysis helps to determine the underlying factors behind the problem. This technique enables the project team to address engagement challenges at their source, rather than treating only the symptoms.

Continuous stakeholder analysis is useful for understanding shifts in stakeholder attitudes, influence, or interest over the project's lifecycle. Monitoring these changes helps the project team to adapt their engagement strategies accordingly.

DECISION MAKING

Multicriteria decision analysis helps in making complex decisions related to stakeholder engagement by considering multiple factors like influence, impact, and interest. It ensures that decisions are well-rounded and aligned with project objectives and stakeholder needs.

Voting can be employed to make decisions that require stakeholder input. It not only encourages active participation but also makes stakeholders feel their opinions are valued, thereby improving engagement.

DATA REPRESENTATION

The stakeholder engagement assessment matrix compares current engagement levels of stakeholders against desired levels. It serves as an effective monitoring tool to gauge the success of stakeholder engagement activities and highlight areas for improvement.

COMMUNICATION SKILLS

There are many useful communication skills the project manager could use but the two most important ones are:

- Feedback - Collecting feedback from stakeholders offers direct insights into how they perceive the project and their level of engagement. This real-time data is crucial for making timely adjustments to engagement strategies.
- Presentations - Presenting relevant project information in an easy-to-understand format can significantly aid stakeholder engagement. A well-crafted presentation can clarify complex issues and facilitate productive discussions.

INTERPERSONAL AND TEAM SKILLS

Of the range of interpersonal and team skills a project manager should be able to use, the following are the most useful tools or techniques to use to monitor the level of, and effectiveness of, stakeholder engagement.

- Active listening - This skill involves fully concentrating and understanding the speaker during interactions with stakeholders. Active listening helps in catching subtle cues or concerns that stakeholders may express, which can be critical for monitoring engagement levels.
- Cultural awareness - Understanding and respecting stakeholder cultural differences are essential, especially for global projects. Cultural awareness allows for more nuanced and effective engagement strategies, tailored to diverse stakeholder groups.
- Leadership - Strong leadership skills can inspire trust and confidence among stakeholders. A good leader can navigate challenging stakeholder dynamics and keep everyone aligned with the project goals.
- Networking - Networking helps in building informal relationships with stakeholders. These relationships can provide additional channels for gauging stakeholder sentiment, thereby contributing to better monitoring.
- Political Awareness - Understanding the political landscape within and outside the organization can inform how to best engage with different stakeholders. It can highlight whose support is crucial and how to navigate complex political situations for the benefit of the project.

MEETINGS

Regularly scheduled meetings provide a forum for direct interaction with stakeholders. These meetings can serve as checkpoints to assess stakeholder engagement and make necessary adjustments.

Real World

I have often found that there is a huge disparity between stakeholders when it comes to the types of information that they are actually interested in about the project. Some stakeholders are interested in the traditional cost and time progress of a project, whereas other stakeholders have no interest in these and are more interested in quality measures or issues specific to their interests. It is very important that the project manager determine what particular parts of the project are of importance to individual stakeholders. You also may need to control the amount of information that goes out to certain stakeholders. We had a particular stakeholder on one project who we knew was distributing project information to the media and, because this stakeholder was a senior member of the project control group, he expected to have access to whatever information he desired. We had to ensure that he was only given the information he wanted as a member of the project control group and the same information as everyone else received.

OUTPUTS

The outputs from the Monitor Stakeholder Engagement process are the following.

WORK PERFORMANCE INFORMATION

Work performance information provides a data-backed overview of how well stakeholder engagement activities are meeting their objectives. This output can be a valuable input for other processes and for reporting to upper management, thereby aligning the project with organizational goals.

CHANGE REQUESTS

Change requests may emerge as a result of monitoring stakeholder engagement. If it's observed that current strategies are not effective or if stakeholder requirements change, formal change requests can help in realigning resources or approaches to better serve stakeholder needs.

PROJECT MANAGEMENT PLAN UPDATES

Monitoring can reveal whether the resources allocated for stakeholder engagement are sufficient or need adjustment. Updates to the Resource Management Plan reflect these changes and ensure that future engagement activities are adequately resourced.

Monitoring often sheds light on the effectiveness of communication channels and strategies. Updates to the Communications Management Plan would incorporate these insights, optimizing how and when stakeholders are engaged in the communication process.

By keeping tabs on stakeholder engagement, the project team can identify which strategies are working and which are not. Updates to the Stakeholder Engagement Plan would then refine existing engagement approaches or propose new ones.

PROJECT DOCUMENTS UPDATES

Continuous monitoring can unearth new issues concerning stakeholders or escalate existing ones. Updated Issue Logs capture these, allowing the project team to proactively address them before they turn into major roadblocks.

Monitoring stakeholder engagement can provide new insights into what works and what doesn't.

As stakeholder engagement is monitored, new risks may be identified or existing ones may change in their impact or likelihood. Updates to the Risk Register capture this evolving landscape of risks related to stakeholder engagement.

The landscape of stakeholders can change over the course of a project, with new stakeholders emerging and existing ones changing in their level of influence or interest. An updated Stakeholder Register captures these dynamics and serves as an essential tool for ongoing or future stakeholder management.

Quick Check

1. What is the main purpose of the Monitor Stakeholder Engagement process?
2. Why is the issue log an important input into the Monitor Stakeholder Engagement process?
3. What type of organizational process assets may be updated because of carrying out the Monitor Stakeholder Engagement process?
4. How does the Monitor Stakeholder Engagement process interact with other project management knowledge areas?

Quick Check Answers

1. The main purpose of the Monitor Stakeholder Engagement process is to monitor the overall levels of stakeholder engagement against what is expected and make changes to the stakeholder management plan and the strategies around stakeholder engagement.
2. The issue log describes and documents individual issues raised by stakeholders. Therefore, using it as an input into the Monitor Stakeholder Engagement process allows you to view the number of issues, the complexity of issues, which stakeholders are raising issues, and whether the issues are being resolved to the satisfaction of stakeholders.
3. The types of organizational process assets that may be updated because of the Monitor Stakeholder Engagement process include any existing processes and templates, project records relating to your stakeholder engagement strategies and results, and of course, your collection of lessons-learned documentation.
4. The Monitor Stakeholder Engagement process uses inputs from the Develop Project Management Plan process (the project management plan), and the Direct and Manage Project Work process (work performance data).

11.6 CHAPTER SUMMARY

- The Stakeholder Management knowledge area is focused on the identification, management, and proactive influencing of stakeholders' interests, expectations, and engagement to ensure stakeholders' support for the project.
- The Identify Stakeholders process is an initiating process that produces a stakeholder register, which identifies stakeholders in the project.
- The Plan Stakeholder Engagement process is a planning process that produces a stakeholder engagement plan, which outlines how stakeholder expectations and engagement will be proactively influenced.
- The Manage Stakeholder Engagement process is an executing process that uses the stakeholder engagement plan to carry out the activities required to manage and influence stakeholder expectations and engagement.
- The Monitor Stakeholder Engagement process is a monitoring and control process that reviews the stakeholder management activities against what was planned and updates the stakeholder engagement plan as required.

11.7 EXERCISES

The answers for these exercises are located in the “Answers” section at the end of this chapter.

1. Match the stakeholder management process on the left to a process key output on the right.

Process	Key Output
1. Identify Stakeholders	A. Stakeholder register
2. Plan Stakeholder Engagement	B. Issue log
3. Manage Stakeholder Engagement	C. Work performance information
4. Monitor Stakeholder Engagement	D. Stakeholder engagement plan

2. Categorize each item in the following list as either an interactive, push, or pull method of communication.
 - A. Phone calls
 - B. Letters
 - C. Intranet sites
 - D. Video conferencing
 - E. Project reports
 - F. E-learning site
 - G. Meetings
 - H. Press releases

11.8 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 11 by answering these questions. The answers to these questions, and the explanations of why each answer choice is correct or incorrect, are located in the “Answers” section at the end of this chapter.

1. Which of the following processes produces the stakeholder register?
 - A. Identify Stakeholders
 - B. Plan Stakeholder Engagement
 - C. Manage Stakeholder Engagement
 - D. Monitor Stakeholder Engagement
2. Which of the following is the best definition of a stakeholder?
 - A. Your project team members, project sponsor, and client
 - B. Any person or group who can affect or be affected by your project
 - C. The client, the project sponsor, and external government agencies
 - D. Any person or group
3. If you are using a Gardner grid to show the results of stakeholder analysis, what information about stakeholders would you be showing?
 - A. How much power, urgency, and legitimacy they have
 - B. The amount of risk each stakeholder is willing to share
 - C. The levels of power and interest of each stakeholder
 - D. Their contact details and interest in the project

4. Which of the following documents will contain a description of stakeholder contact details and their requirements for the project?
 - A. Stakeholder analysis
 - B. Stakeholder register
 - C. Gardner grid
 - D. Stakeholder engagement plan

5. At what point in the project should you conduct the kick-off meeting?
 - A. As soon as the project is initiated
 - B. At the end of the project, to assist with project closure
 - C. Only after all the planning work has been completed
 - D. After enough planning work has been completed to begin execution

6. If you are assessing each stakeholder as either unaware, resistant, neutral, supportive, or leading, what technique are you using?
 - A. Brainstorming
 - B. Delphi technique
 - C. Analytical technique
 - D. Root cause analysis

7. If you are engaged in carrying out your project work and need to find out the planned timeframe and frequency for distribution of required information to stakeholders, where would be the best place to look?
 - A. Project management plan
 - B. Stakeholder engagement plan
 - C. Stakeholder register
 - D. Issue log

8. Which of the following is not an input into the Manage Stakeholder Engagement process?
 - A. Stakeholder engagement plan
 - B. Issue log
 - C. Communications management plan
 - D. Change log

9. You are sending out regular project updates to stakeholders via email to a list of project stakeholders. This is an example of what sort of communication method?
 - A. Verbal
 - B. Interactive
 - C. Pull
 - D. Push

10. Which of the following is not an example of a management skill a project manager may use while managing stakeholder engagement?
 - A. Negotiation skills
 - B. Public speaking skills
 - C. Presentation skills
 - D. Conflict resolution skills

11. What is the name of the document that lists any problems that stakeholders may have and records what is

being done about them?

- A. Change log
- B. Issue log
- C. Stakeholder register
- D. Stakeholder engagement plan

12. During which stakeholder management process is work performance data an input, and work performance information an output?

- A. Identify Stakeholders
- B. Plan Stakeholder Engagement
- C. Manage Stakeholder Engagement
- D. Monitor Stakeholder Engagement

11.9 ANSWERS

This section contains the answers for the Exercises and Review Questions in this chapter.

EXERCISES

1. Match the stakeholder management process on the left to a process key output on the right.

Process	Key Output
1. Identify Stakeholders	A. Stakeholder register
2. Plan Stakeholder Engagement	D. Stakeholder engagement plan
3. Manage Stakeholder Engagement	B. Issue log
4. Monitor Stakeholder Engagement	C. Work performance information

2. Categorize each item in the following list as either an interactive, push, or pull method of communication:

Interactive	Push	Pull
A. Phone calls	B. Letters	C. Intranet sites
D. Video conferencing	E. Project reports	F. E-learning site
G. Meetings	H. Press releases	

CHAPTER REVIEW

1. **Correct Answer: A**

- A. **Correct:** The Identify Stakeholders process produces the stakeholder register.
- B. **Incorrect:** The Plan Stakeholder Engagement process has the stakeholder engagement plan as its primary output.
- C. **Incorrect:** Manage Stakeholder Engagement does not produce the stakeholder register.
- D. **Incorrect:** Monitor Stakeholder Engagement does not produce the stakeholder register.

2. **Correct Answer: B**

- A. **Incorrect:** Your project team members, project sponsor, and client certainly are stakeholders, but they are a subset of all possible stakeholders and in this case not the best definition of stakeholders offered.
- B. **Correct:** The best definition of a stakeholder is any person or group who can affect or be affected by your project.
- C. **Incorrect:** The client, the project sponsor, and external government agencies may be stakeholders, but this is not the best definition of stakeholders.
- D. **Incorrect:** In order to be considered a project stakeholder, any person or group must be affected by your project or be able to affect the project.

3. **Correct Answer: C**

- A. **Incorrect:** A diagram showing power, urgency, and legitimacy of stakeholders would use the salience model.
- B. **Incorrect:** The amount of risk stakeholders are willing to share would be shown in the stakeholder analysis.
- C. **Correct:** A Gardner grid shows the respective levels of power and interest of each stakeholder in order to classify them
- D. **Incorrect:** Stakeholder contracts details and interest in the project would be contained in the stakeholder register

4. **Correct Answer: B**
- A. **Incorrect:** Stakeholder analysis is a technique used to gather information about stakeholders, but it is not a document.
 - B. **Correct:** The stakeholder register contains information about stakeholders, including their contact details and their requirements for the project.
 - C. **Incorrect:** A Gardner grid classifies stakeholders by their levels of power and interest.
 - D. **Incorrect:** The stakeholder engagement plan sets out how stakeholder engagement will be managed.
5. **Correct Answer: D**
- A. **Incorrect:** The kick-off meeting does not occur as soon as the project is initiated.
 - B. **Incorrect:** The kick-off meeting, as the name suggests, is not used to assist with project closure.
 - C. **Incorrect:** You do not need to wait until all planning work has been completed to have a kick-off meeting.
 - D. **Correct:** The kick-off meeting is held after enough planning work has been done to begin execution.
6. **Correct Answer: C**
- A. **Incorrect:** Brainstorming is an information-gathering technique.
 - B. **Incorrect:** The Delphi technique is used to gather information anonymously from experts without peer pressure affecting the outcome.
 - C. **Correct:** Categorizing stakeholders in this manner is a sign of using analytical techniques such as a stakeholder engagement assessment matrix.
 - D. **Incorrect:** Root cause analysis is used during quality management activities.
7. **Correct Answer: B**
- A. **Incorrect:** The project management plan includes the stakeholder engagement plan but is not the best answer presented.
 - B. **Correct:** The stakeholder engagement plan contains a lot of information about the ways in which stakeholders engagement and expectations will be managed, including the planned timeframe and frequency for distribution of required information to stakeholders.
 - C. **Incorrect:** The stakeholder register contains information identifying stakeholders and their requirements and is used as an input into the development of the stakeholder engagement plan.
 - D. **Incorrect:** The issue log documents specific issues raised by stakeholders.
8. **Correct Answer: B**
- A. **Incorrect:** The stakeholder engagement plan is an essential input into the Manage Stakeholder Engagement process because it sets out how stakeholders' engagement and expectations will be managed.
 - B. **Correct:** The issue log is an output from, not an input into, the Manage Stakeholder Engagement process.
 - C. **Incorrect:** The communications management plan is an input into the Manage Stakeholders Engagement process because it records the communications methods and strategy to be used.
 - D. **Incorrect:** The change log is used as an input into the Manage Stakeholders Engagement process because the impact of changes is communicated to stakeholders.
9. **Correct Answer: D**
- A. **Incorrect:** Email is not an example of verbal communication.
 - B. **Incorrect:** Because there is no two-way communication occurring, this is not an example of an interactive communication method.
 - C. **Incorrect:** The method, email, is pushing information to stakeholders, not pulling it from them.
 - D. **Correct:** Sending out information without checking whether the receiver understands it is an example of push communication.
10. **Correct Answer: D**

- A. **Incorrect:** Negotiation skills are an example of a project manager's management skills.
- B. **Incorrect:** Public speaking skills are an example of a project manager's management skills.
- C. **Incorrect:** Presentation skills are an example of a project manager's management skills.
- D. **Correct:** Conflict resolution skills are an example of leadership, not management skills.

11. Correct Answer: B

- A. **Incorrect:** The change log records information about change requests and their status.
- B. **Correct:** The issue log records any issues that stakeholders may have and what is being done about them.
- C. **Incorrect:** The stakeholder register records specific information about each stakeholder but does not list any problems or issues they may have.
- D. **Incorrect:** The stakeholder engagement plan sets out how stakeholders' expectations and engagement will be proactively influenced and managed.

12. Correct Answer: D

- A. **Incorrect:** The Identify Stakeholders process does not use either work performance data or work performance information.
- B. **Incorrect:** The Plan Stakeholder Engagement process does not use either work performance data or work performance information.
- C. **Incorrect:** The Management Stakeholder Engagement process does not use either work performance data or work performance information.
- D. **Correct:** The Monitor Stakeholder Engagement process does use work performance data as an input and has work performance information as an output, as part of the monitoring and controlling activities.

12. Agile Approaches, Tools, and Techniques

In the interests of full disclosure, I will admit that this book was first written well before any consideration of Agile was included in the PMP® credential exam. Updating this book to reflect the latest version of the exam takes considerable effort and for the latest updates which include reference to agile approaches, tools, and techniques I have chosen to reference specific agile tools and techniques throughout the book where appropriate but also include a special section on agile here at the end of the book. It is my hope that future versions of this book incorporate much of this content more into the relevant areas throughout the book.

One of the issues for many people sitting the PMP® credential examination is that they are either experienced in predictive approaches or agile approaches but the exam tests you on your knowledge of all of these. So my general advice is to acknowledge which of these two areas you are weaker on and spend extra time studying those areas.

The point of this section is to provide a more in depth introduction to agile, the most common approach is, tools and techniques.

12.1 WHAT IS AGILE?

Agile is a project management and product development approach that aligns with customer needs and company goals. It's an iterative method that focuses on collaboration, customer feedback, and small, rapid releases. Unlike traditional, or predictive, project management (sometimes mistakenly referred to as Waterfall), Agile is flexible and adaptive, well-suited for projects where requirements and solutions evolve through collaborative efforts.

THE AGILE MANIFESTO

The Manifesto for Agile Software Development, formulated in 2001, is the cornerstone of Agile methodology. It consists of four key values:

1. **Individuals and interactions** over processes and tools.
2. **Working software** over comprehensive documentation.
3. **Customer collaboration** over contract negotiation.
4. **Responding to change** over following a plan.

These values are supported by 12 principles, which emphasize customer satisfaction, embracing change, frequent delivery, collaboration, motivation, face-to-face communication, sustainable development, technical excellence, simplicity, self-organizing teams, and regular reflection and adjustment. The 12 principles are:

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Business people and developers must work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
7. Working software is the primary measure of progress.
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
9. Continuous attention to technical excellence and good design enhances agility.
10. Simplicity--the art of maximizing the amount of work not done--is essential.
11. The best architectures, requirements, and designs emerge from self-organizing teams.

12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

[source: <https://agilemanifesto.org/>]

AGILE/ADAPTIVE VS. PREDICTIVE PROJECT MANAGEMENT

- **Flexibility:** Agile is more adaptive to changes, whereas predictive methods follow a linear and sequential approach.
- **Scope:** In Agile, scope can change frequently, but in predictive methods, it is defined at the beginning and changes are discouraged.
- **Delivery:** Agile delivers work in small, consumable increments, while predictive methods often deliver once at the end.
- **Customer Involvement:** Agile involves customers throughout the project, whereas predictive methods have limited customer involvement, usually at the beginning and end.
- **Risk Management:** Agile manages risks continuously, but predictive methods do so at specific stages.

Agile methods allow organizations to respond to the unpredictability of the software development process. It provides a framework for accommodating change and delivering high-quality products that meet evolving customer needs. Agile practices improve visibility, empower teams, encourage collaboration, and allow for more rapid adjustments to work, ensuring a more efficient, effective path to project completion.

Understanding Agile is critical for the PMP® credential exam. It's not just a methodology, but a mindset that prioritizes flexibility, collaboration, and customer satisfaction. As you progress through your PMP® credential studies, keep in mind these Agile fundamentals and consider how they contrast with predictive project management approaches as there will be questions in the exam that are easy to see which approach they are referring to, but also some questions that are a little more ambiguous.

12.2 AGILE FRAMEWORKS AND METHODOLOGIES

Here is a description of the most common Agile frameworks and methodologies but as was already pointed out in the first chapter of this book there are many more.

SCRUM

- **Overview:** Scrum is a popular Agile framework used for developing, delivering, and sustaining complex products. It's characterized by fixed-length iterations called Sprints, typically lasting two to four weeks.
- **Roles:**
 - **Scrum Master:** Facilitates the process, resolves impediments, and helps the team stay true to Scrum practices. Has a focus on servant leadership and facilitating the development of a high performing team.
 - **Product Owner:** Responsible for maximizing the value of the product and managing the Product Backlog.
 - **Team Members:** Cross-functional and self-directed professionals who do the work of delivering the product increment.
- **Artifacts:**
 - **Product Backlog:** A prioritized list of desired product functionality managed by the product owner.
 - **Sprint Backlog:** A list of tasks to be completed in a Sprint developed by the team and scrum master.
 - **Increment:** The sum of product backlog items completed during a Sprint and all previous Sprints.
- **Events:**
 - **Sprint Planning:** Planning the work to be performed in the Sprint.

- **Daily Scrum:** A 15-minute meeting for the team to synchronize activities and create a plan for the next 24 hours.
- **Sprint Review:** Held at the end of a Sprint to inspect the Increment and adapt the Product Backlog.
- **Sprint Retrospective:** A meeting to review and improve processes after each Sprint.

KANBAN

- **Principles:** Visualize the flow of work, limit work in progress, manage flow, make process policies explicit, implement feedback loops, and collaborate to improve continuously.
- **Key Elements:**
 - **Kanban Board:** A visual tool to track work as it moves through stages.
 - **Kanban Cards:** Represent individual work items.
 - **Work in Progress (WIP) Limits:** Limits set on the number of work items in the various stages of the workflow.
- **Usage:** Ideal for projects where work comes in continuously (like support and maintenance).

LEAN

- **Focus:** Eliminating waste (anything that doesn't add value to the end customer), optimizing value delivery, and improving efficiency.
- **Key Principles:** Eliminate waste, amplify learning, decide as late as possible, deliver as fast as possible, empower the team, build integrity in, and see the whole.

EXTREME PROGRAMMING (XP)

- **Overview:** A software development methodology aiming to improve software quality and responsiveness to changing customer requirements.
- **Practices:**
 - **Pair Programming:** Two programmers work together at one workstation.
 - **Test-Driven Development (TDD):** Writing tests before code.
 - **Continuous Integration:** Frequent integration of code into a shared repository.
 - **Refactoring:** Restructuring existing code without changing its external behavior.
 - **Collective Code Ownership:** Anyone can change any part of the code at any time.

EXAM TIP

Visit <https://www.agilealliance.org/> for more information about the most commonly used Agile approaches

Each Agile framework has its own unique focus, practices, and benefits. Understanding these frameworks is crucial for the PMP® credential exam, as they offer different approaches and tools for managing complex projects in an Agile way. The choice of framework often depends on the project's requirements, team structure, and organizational environment. As a PMP® credential candidate, being familiar with these frameworks enhances your versatility and effectiveness in various project management scenarios.

12.3 AGILE PLANNING AND ESTIMATION

Planning and estimating time and cost within Agile approaches is quite different from planning and estimating and predictive approaches. The potential for change within Agile projects means that there is a greater level of uncertainty in planning and estimation and a focus on the short term rather than long term. Agile does not mean a lack of planning or estimating but rather a different approach to it. Here are the most common planning and estimating techniques used in Agile.

ITERATIVE AND INCREMENTAL PLANNING

- **Overview:** Agile planning is both iterative and incremental, involving frequent reassessment and adaptation of plans. This approach contrasts with traditional, linear planning methods.
- **Iterative Planning:** Involves breaking down the project into smaller sections and revisiting and refining plans regularly.
- **Incremental Delivery:** Focuses on delivering small, usable segments of the product regularly, allowing for continuous feedback and adjustments.

USER STORIES AND STORY POINTS

- **User Stories:** A simple, natural language description of a feature told from the perspective of the user. They are the primary means of expressing needed functionality. They follow the format of:

As [a user], I want [to perform this action] so that [I can accomplish this goal].

An example would be:

As a small business owner, I want to easily create and send invoices to my clients, so that I can save time and ensure accurate billing.

In addition to user stories, Agile approached also refer to Features and Epics. A Feature is a distinct element of functionality which can provide value to the customer once it's fully implemented. It's broader than a User Story but more specific than an Epic. Features encompass a group of related User Stories that together deliver a significant piece of functionality or enhancement in the product. They are typically completed over several sprints.

An Epic is a large, high-level body of work that can be broken down into smaller tasks or stories. It represents a significant feature or series of related tasks in a project. Epics are broad and often span multiple sprints or iterations. They are too large to be completed in a single sprint and are divided into multiple User Stories for execution. Epics help in tracking and organizing complex features or large enhancements.

- **Story Points:** A unit of measure for expressing an estimate of the overall effort required to fully implement a product backlog item or any other piece of work. It is the basis for estimating effort for each backlog item. Different pieces of work will have different story points attributed to them using one of the estimating techniques mentioned shortly and the team will know the total number of story point sit can complete in each sprint.

RELATIVE ESTIMATION TECHNIQUES

- **Purpose:** Helps to estimate the size of a user story relative to other stories, rather than giving a specific number of hours or days.
- **Techniques:** Planning Poker, T-shirt sizing, and the Fibonacci sequence are commonly used methods for relative estimation.
 - **Planning Poker:** Planning Poker, also known as Scrum Poker, is a consensus-based technique for estimating, mostly used to estimate effort or relative size of development goals in software development. In Planning Poker, members of the group make estimates by playing numbered cards face-down to the table, instead of speaking them aloud. The cards are then revealed, and the estimates are discussed.
 - **How it Works:**
 - Each member of the team is given a set of cards, each bearing a number that represents an estimate.
 - For each item to be estimated, a moderator presents the item, and the team discusses it briefly.

- Each team member then selects a card that represents their estimate of the effort required.
 - All cards are then revealed simultaneously.
 - If estimates differ significantly, there is a discussion to understand the different perspectives.
 - The process is repeated until a consensus is reached.
 - **Example:** Consider a software team estimating the effort needed to develop a new feature. The moderator presents the feature to be estimated. After a brief discussion, team members select cards from their decks. Suppose the cards revealed are two '5's, one '8', and one '3'. The team would then discuss why their estimates differ, with particular attention to the highest and lowest estimates, and then re-estimate until they reach a consensus.
- **T-shirt Sizing:** T-shirt sizing is a relative estimation technique used to estimate the size (complexity, time, effort, etc.) of a project or task in a less granular way. It uses sizes like XS, S, M, L, XL, XXL to represent the scale of work, similar to T-shirt sizes.
 - **How it Works**
 - Items (like user stories or projects) are discussed and then categorized into sizes.
 - The team compares the item to other items, deciding if it is smaller (XS), small (S), medium (M), large (L), or extra-large (XL).
 - This method helps to quickly group items into broad categories without getting into detailed numerical scoring.
 - **Example:** An Agile team is estimating the effort for a series of user stories. After discussing a user story, they decide it's a medium effort - not too simple, not too complex, and categorize it as 'M'. Another more complex story with lots of unknowns might be categorized as 'XL'.
- **Fibonacci Sequence:** The Fibonacci sequence is a series of numbers where each number is the sum of the two preceding ones, usually starting with 0 and 1. In Agile estimation, this sequence is used because it naturally reflects the inherent uncertainty in estimating larger items.
 - **How it Works**
 - The sequence used in Agile estimation is typically: 0, 1, 2, 3, 5, 8, 13, 21, etc.
 - Team members use these numbers to vote on their estimate of the size, complexity, or effort required for a task or user story.
 - The larger the number, the more complex or time-consuming the task is estimated to be.
 - **Example:** During a sprint planning meeting, a team discusses a new feature. When it comes to estimating the effort, team members use Fibonacci numbers. One member might think the task is moderately complex and votes an '8', while another, considering some complexities, votes '13'. The team would discuss the reasons for these different estimates and re-vote if necessary to reach a consensus.

Each of these techniques is designed to facilitate estimation in a way that is engaging and effective, helping teams to quickly assess the relative size or complexity of tasks in a collaborative manner.

PRIORITIZATION METHODS

- **MoSCoW Method:** Categorizes items into four groups: Must have, Should have, Could have, and Won't have this time.
- **Kano Model:** Prioritizes features based on customer satisfaction and investment required.

RELEASE PLANNING AND ROADMAPS

- **Release Planning:** Identifies a high-level timetable for the release of project functionalities, aligning with the product vision and goals.

- **Roadmaps:** Provide a longer-term view of where the product is headed and the key steps along the way, often used for strategic planning and communication with stakeholders.

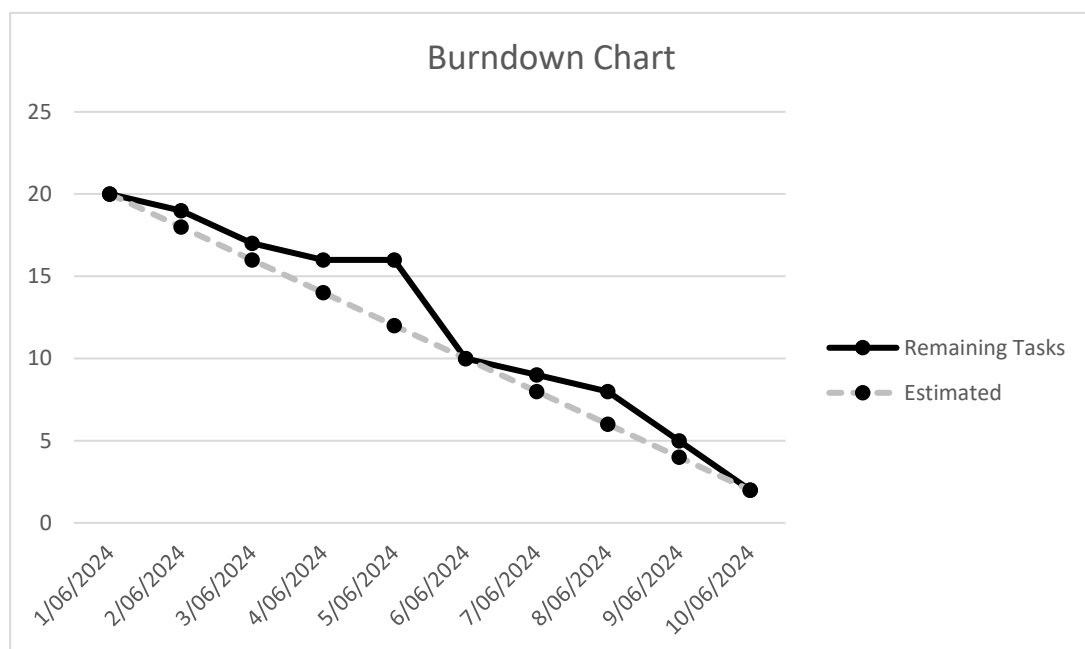
Agile planning and estimation are dynamic processes that require constant re-evaluation and adjustment. Understanding these concepts is crucial for the PMP® credential exam, as they are integral to Agile project management. The Agile approach to planning and estimation ensures flexibility and responsiveness to change, which are key in today's fast-paced and complex project environments.

12.4 AGILE MONITORING AND CONTROLLING

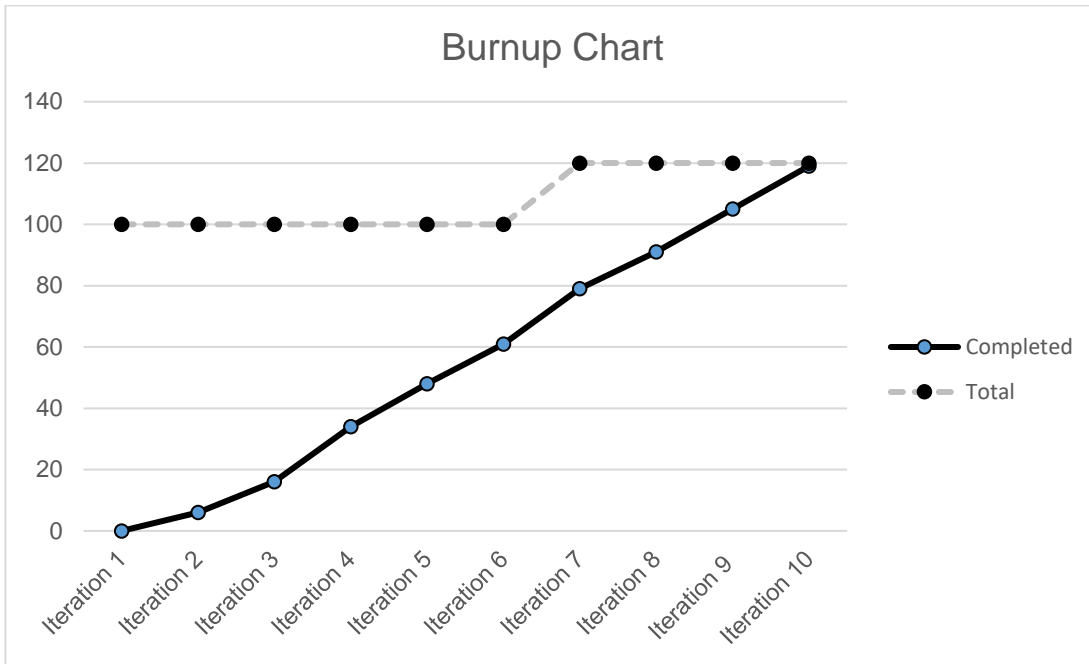
Agile approaches have their own unique way of tracking the amount of work forecast the amount of work completed. Monitoring and controlling the work being done is an important part of any agile approach as it enables teams to communicate how much value they plan to deliver during each iteration or Sprint. Here are descriptions and examples of the most common tools for monitoring and controlling progress.

BURNDOWN AND BURNUP CHARTS

- **Burndown Charts:** These charts show the amount of work remaining in a Sprint or project over time. They are simple and powerful tools for communicating progress and forecasting completion.

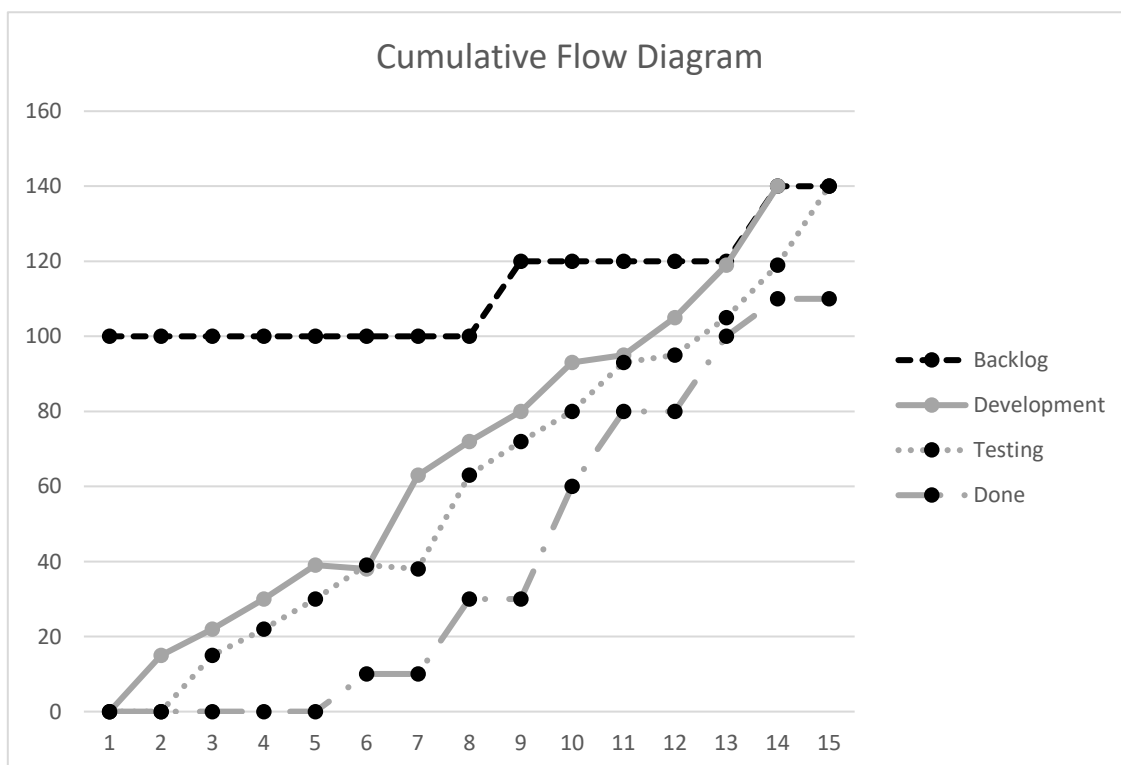


- **Burnup Charts:** Unlike burndown charts, burnup charts show the amount of work completed over time and the total scope of the project, providing a clear picture of progress against the total work scope.



CUMULATIVE FLOW DIAGRAMS

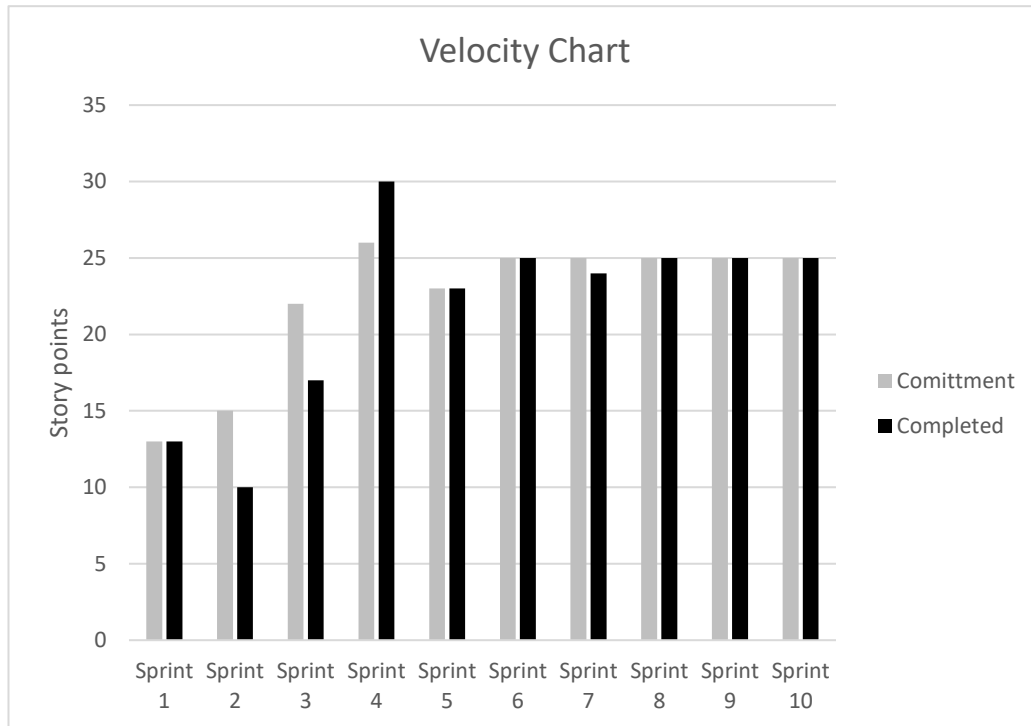
- **Purpose:** Cumulative Flow Diagrams (CFDs) provide a visual representation of work items in various stages of a process (like To Do, In Progress, Done).
- **Benefits:** CFDs help in identifying bottlenecks, work in progress, and the pace at which the team is completing work. They are crucial for managing flow in Kanban and other Agile methodologies.



VELOCITY TRACKING

- **Definition:** Velocity is a measure of the amount of work a team can tackle during a single Sprint and is the key metric in Scrum.

- **Usage:** Helps in forecasting how quickly a team can work through the backlog, enabling more accurate planning.



AGILE METRICS

- **Lead Time:** The time taken from the moment a work item is requested to the moment it is delivered.
- **Cycle Time:** The time it takes to complete a work item once it has started.
- **Throughput:** The number of work items completed in a given period.

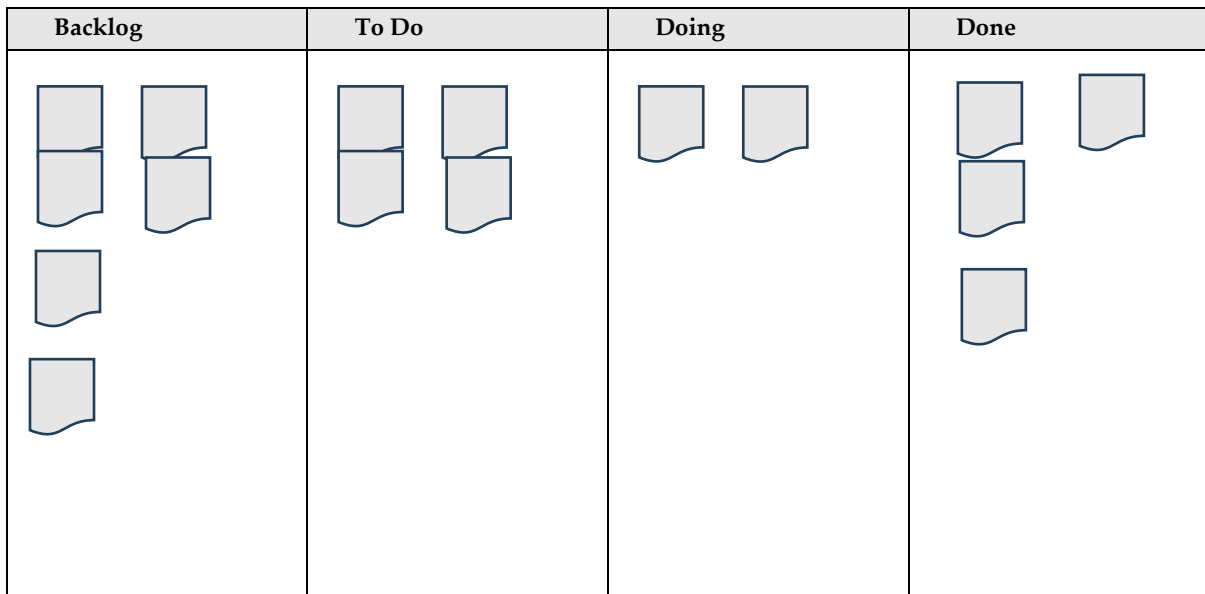
Effective monitoring and controlling in Agile projects involve a blend of visual representations and key metrics. Understanding these tools is critical for the PMP® credential exam, as they provide insights into project progress, team efficiency, and help in forecasting future performance. Agile metrics and charts are not just about tracking; they're about facilitating a more responsive and adaptive project management approach.

12.5 AGILE TOOLS AND TECHNOLOGIES

In addition to specific graphs, tools and techniques for monitoring and controlling progress of work and agile projects there are also a range of other common tools used. The following section provides a description of the most common of these.

TASK BOARDS AND KANBAN BOARDS

- **Task Boards:** Visual tools used primarily in Scrum to track the progress of work during a Sprint. They typically have columns such as 'To Do', 'In Progress', and 'Done'.
- **Kanban Boards:** Used in Kanban methodology, these boards visualize the entire workflow. They help in managing work in progress and identifying bottlenecks. Unlike task boards, they often include more stages of the workflow to reflect the Kanban process. The following is an example of a generic Kanban Board.



AGILE PROJECT MANAGEMENT SOFTWARE

- **Overview:** There are various software tools designed to support Agile methodologies. They provide features for backlog management, sprint planning, task tracking, and reporting.
- **Examples:**
 - **JIRA:** Widely used for its robust Agile management features, including scrum and Kanban boards, customizable workflows, and detailed reporting.
 - **Trello:** A simpler, more intuitive tool based on Kanban principles, suitable for smaller teams or less complex projects.
 - **Asana:** Known for its user-friendly interface, task assignments, and timeline views, ideal for managing Agile workflows.

AUTOMATED TESTING TOOLS

- **Purpose:** In Agile, frequent, and iterative releases necessitate rapid testing. Automated testing tools help in executing repetitive tasks and managing testing processes.
- **Common Tools:** Selenium for web applications, JUnit for unit testing in Java, and TestComplete for end-to-end automated testing across various platforms.

CONTINUOUS INTEGRATION AND CONTINUOUS DEPLOYMENT TOOLS

- **Continuous Integration (CI):** Involves automatically testing and integrating code changes into a shared repository to detect problems early.
- **Continuous Deployment (CD):** Automates the delivery of applications to selected infrastructure environments.
- **Tools:** Jenkins, widely used for CI/CD processes; CircleCI, known for its ease of setup and maintenance; and Travis CI, popular in open-source projects.

Familiarity with Agile tools and technologies is essential for PMP® credential candidates. These tools facilitate Agile practices by automating routine tasks, enhancing collaboration, and improving visibility into project progress. Understanding the capabilities and appropriate application of these tools will be a valuable asset in your PMP credential exam preparation and future project management endeavors.

12.6 AGILE LEADERSHIP AND SOFT SKILLS

It is often said that Agile does not feature the role of project manager and instead features the role of the scrum master or agile coach. Of critical importance to the role of either the scrum master or agile coach is the ability to facilitate and bring out the best in the team members. Central to this is the concept of the servant leader. This is different from the somewhat generic and stereotypical image of a project manager who may use more directive styles of leadership. Please keep in mind that for the exam servant leadership is the expected no matter if you are leading an agile team or a predictive team. Here are brief descriptions of the most important competencies for Agile leadership.

SERVANT LEADERSHIP

- **Definition:** In Agile, the concept of servant leadership is crucial. It's a leadership philosophy where the main goal of the leader is to serve the team.
- **Characteristics:** Includes listening, empathy, healing, awareness, persuasion, conceptualization, foresight, stewardship, commitment to the growth of people, and building community.
- **Application:** Agile leaders focus on empowering and enabling teams, rather than directing them. This involves removing impediments, facilitating processes, and supporting team decisions.

EMOTIONAL INTELLIGENCE

- **Importance:** Emotional intelligence (EI) is critical in Agile environments, where collaboration and communication are key.
- **Components:** Self-awareness, self-regulation, motivation, empathy, and social skills.
- **Role in Agile:** Helps in building stronger team bonds, resolving conflicts effectively, and creating a positive working environment.

CONFLICT RESOLUTION AND NEGOTIATION

- **Conflict Resolution:** Agile leaders must be adept at identifying and resolving conflicts constructively. This involves understanding the root causes of conflicts and facilitating discussions to find mutually acceptable solutions.
- **Negotiation:** In Agile, negotiation skills are often needed when discussing requirements, scope changes, or resource allocations. The focus is on achieving win-win outcomes that align with customer needs and project goals.

EFFECTIVE COMMUNICATION IN AGILE TEAMS

- **Criticality:** Clear and open communication is the backbone of Agile methodology.
- **Techniques:** Includes active listening, clear and concise messaging, regular and transparent updates, and ensuring a common understanding among team members.
- **Tools:** Daily stand-ups, sprint reviews, and retrospectives are key Agile events that rely heavily on effective communication.

FACILITATION TECHNIQUES FOR AGILE CEREMONIES

- **Role of the Facilitator:** In Agile, facilitators guide Agile ceremonies to ensure they are productive and meet their objectives.
- **Techniques:** Includes setting clear agendas, encouraging participation from all team members, managing time effectively, and ensuring action items and decisions are clearly documented and followed up on.

Leadership and soft skills are essential in Agile project management. They enable effective team collaboration, ensure smooth process facilitation, and lead to successful project outcomes. For PMP® credential candidates,

understanding these skills is crucial not only for exam success but also for real-world application in leading and managing Agile projects.

12.7 RISK MANAGEMENT IN AGILE

Managing risks in agile is an important part of any approach due to the highly iterative and somewhat uncertain nature of agile projects. In addition to the risk management processes, tools and techniques discussed in an earlier chapter in this book there are some specific Agile risk management approaches as follows.

RISK-ADJUSTED BACKLOGS

- **Concept:** In Agile, the product backlog is often adjusted to account for risk. High-risk items may be prioritized to be addressed earlier in the project, reducing uncertainty and allowing for more informed decision-making as the project progresses.
- **Application:** This involves identifying the risk level of each backlog item and adjusting its priority accordingly. It's a dynamic process, with the backlog being continuously reviewed and re-prioritized as new information is uncovered.

AGILE RISK MANAGEMENT STRATEGIES

- **Frequent Reassessment:** Agile methodologies encourage frequent reassessment of risks at the end of each iteration or sprint. This approach allows for timely identification and mitigation of risks.
- **Collaborative Risk Identification:** In Agile, risk identification is a team effort. Regular meetings, like retrospectives and daily stand-ups, are opportunities to identify potential risks.
- **Embracing Change:** Agile frameworks are designed to adapt to change, making them inherently more responsive to risk. The flexibility of Agile allows teams to pivot or adjust their approach in response to emerging risks.

RISK BURNDOWN CHARTS

- **Purpose:** Risk burndown charts are used to track and display the reduction of risk over time. They show the total risk score at the start of the project and how it changes after each iteration.
- **Usage:** These charts provide a clear visual representation of risk mitigation progress, helping teams understand if their risk mitigation strategies are effective.

Risk management in Agile differs from traditional or predictive approaches, focusing on flexibility, team collaboration, and continuous reassessment. Understanding Agile risk management techniques is crucial for PMP® credential candidates, as it highlights the proactive, adaptive nature of Agile in dealing with uncertainties and challenges in project environments.

12.8 AGILE AND ORGANIZATIONAL CHANGE

One important key parts of any agile initiative is to understand changes that may be required in users of software for example and how these changes in behavior will be implemented in fully embedded. It is not enough to just deliver new software without taking into account the user experience and any changes in the behavior of the user. Therefore it is common with agile approaches for either the scrum master or the product owner to take into account any impacts on user or organizational change.

AGILE TRANSFORMATION STRATEGIES

- **Understanding the Need for Change:** The first step in Agile transformation is recognizing the need for change and aligning it with business goals.
- **Creating a Vision for Change:** Define a clear vision of what Agile will achieve for the organization, including improved responsiveness, higher quality products, and better customer satisfaction.

- **Engaging Stakeholders:** Involve all stakeholders, including leadership, employees, and customers, in the Agile transformation process. Their buy-in is crucial for success.

OVERCOMING RESISTANCE TO CHANGE

- **Communication:** Clearly and continuously communicate the benefits of Agile, the reasons for the change, and the impact on various roles.
- **Training and Support:** Provide comprehensive training and ongoing support to help individuals adapt to Agile methods and tools.
- **Small Wins:** Start with small, manageable projects to demonstrate the benefits of Agile, building confidence and reducing resistance.

AGILE IN DISTRIBUTED TEAMS

- **Challenges:** Distributed teams can face challenges in communication, coordination, and maintaining a shared understanding of project goals and progress.
- **Best Practices:**
 - Use of collaborative tools (e.g., video conferencing, real-time document editing, Agile project management software) to facilitate communication and collaboration.
 - Regular and frequent communication, including daily stand-ups, even if done virtually.
 - Clear documentation of work and processes to ensure alignment and understanding across the team.

Agile transformation and managing Agile in distributed teams are complex but vital topics for PMP® credential candidates. Understanding these aspects is critical, as they reflect the realities of modern project management environments. Successfully navigating organizational change and managing distributed teams are key skills in the Agile project manager's toolkit.

KEY AGILE CONCEPTS RECAP

- **Agile Fundamentals:** Review the Agile Manifesto and its 12 principles. Understand the differences between Agile and traditional project management approaches.
- **Agile Frameworks:** Revisit the core concepts of Scrum, Kanban, Lean, and Extreme Programming (XP), focusing on their specific practices, roles, and artifacts.
- **Planning and Estimation:** Ensure a clear understanding of iterative planning, user stories, story points, and relative estimation techniques.
- **Monitoring and Controlling:** Be familiar with Agile metrics and tools like burndown/burnup charts, cumulative flow diagrams, and velocity tracking.
- **Tools and Technologies:** Recall the purpose and application of Agile project management software, automated testing tools, and CI/CD tools.
- **Leadership and Soft Skills:** Emphasize the importance of servant leadership, emotional intelligence, and effective communication in Agile environments.
- **Risk Management:** Understand Agile-specific risk management approaches, including risk-adjusted backlogs and risk burndown charts.

12.9 CHAPTER SUMMARY

- This chapter outlines that Agile methodologies have revolutionized project management by introducing flexibility, adaptability, and a customer-centric approach.
- Agile's greatest strength is its ability to adapt to changing project requirements, market conditions, and customer needs, making it highly effective in today's dynamic business environment.
- Agile fosters a collaborative work culture and focuses on continuous improvement, leading to higher-quality outputs and more efficient processes.

- Agile is not just a set of practices but a mindset. Continual learning and adaptation are crucial to staying effective in applying Agile methodologies.

12.10 EXERCISE

The answers for this exercise are located in the “Answers” section at the end of this chapter.

Instructions: Match each term in Column A with its correct description in Column B. Write the letter corresponding to the correct description next to each term.

Column A	Column B
1. Scrum Master	a) A leadership style focused on serving the team, facilitating their work, and removing impediments.
2. User Story	b) A visualization tool used in Kanban to show work items in various stages of a process.
3. Kanban Board	c) A large body of work in Agile that is broken down into smaller tasks or user stories.
4. Velocity	d) An Agile estimation technique where team members use T-shirts sizes to estimate the size or complexity of a task.
5. Epic	e) A metric used in Scrum to measure the amount of work a team can complete in a single sprint.
6. Burnup Chart	f) A short, simple description of a feature from the perspective of the user or customer.
7. Planning Poker	g) A role in Scrum responsible for facilitating the team and ensuring adherence to Agile practices.
8. Servant Leadership	h) An estimation technique where team members use numbered cards to vote on the effort required for a task.
9. T-shirt Sizing	i) A practice in software development where code changes are frequently integrated into a shared repository.
10. Continuous Integration	j) A chart that shows the amount of work completed over time against the total work scope.

12.11 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 12 by answering these questions. The answers to these questions, and the explanations of each answer choice is correct, are in the “Answers” section at the end of this chapter.

1. What does the Agile Manifesto prioritize over processes and tools?
 - A. Detailed documentation
 - B. Customer satisfaction
 - C. Individuals and interactions
 - D. Budget constraints
2. Which of the following is a core role in the Scrum framework?
 - A. Project Manager
 - B. Scrum Master
 - C. Quality Analyst
 - D. Technical Lead

3. In Kanban, what is used to represent individual work items?
 - A. User stories
 - B. Kanban cards
 - C. Burnup charts
 - D. Sprints

4. Which Agile methodology focuses on 'sustainable pace' and 'pair programming'?
 - A. Lean
 - B. Scrum
 - C. Extreme Programming (XP)
 - D. Kanban

5. What estimation technique uses T-shirt sizes like XS, S, M, L, XL?
 - A. Fibonacci sequence
 - B. Planning Poker
 - C. T-shirt sizing
 - D. Relative mass valuation

6. Which of the following is a key metric in Scrum for velocity tracking?
 - A. The number of sprints completed
 - B. The amount of work completed in a sprint
 - C. The duration of daily stand-ups
 - D. The total number of user stories

7. What Agile tool is primarily used for tracking risk over time?
 - A. Risk-adjusted backlog
 - B. Risk burndown chart
 - C. Cumulative flow diagram
 - D. Lead time chart

8. In Agile leadership, what is the focus of a 'servant leader'?
 - A. Commanding the team
 - B. Serving the team
 - C. Delegating tasks
 - D. Making all decisions

9. What is the purpose of a 'Feature' in Agile methodology?
 - A. To represent a single functionality
 - B. To group related User Stories
 - C. To define project scope
 - D. To outline project budget

10. Which Agile framework uses Sprints as its basic unit of development?
 - A. Kanban
 - B. Scrum
 - C. Lean
 - D. Extreme Programming

12.12 ANSWERS

This section contains the answers for the Exercise and Review Questions in this chapter.

EXERCISE

Column A	Column B
1. Scrum Master	g) A role in Scrum responsible for facilitating the team and ensuring adherence to Agile practices.
2. User Story	f) A short, simple description of a feature from the perspective of the user or customer.
3. Kanban Board	b) A visualization tool used in Kanban to show work items in various stages of a process.
4. Velocity	e) A metric used in Scrum to measure the amount of work a team can complete in a single sprint.
5. Epic	c) A large body of work in Agile that is broken down into smaller tasks or user stories.
6. Burnup Chart	j) A chart that shows the amount of work completed over time against the total work scope.
7. Planning Poker	h) An estimation technique where team members use numbered cards to vote on the effort required for a task.
8. Servant Leadership	a) A leadership style focused on serving the team, facilitating their work, and removing impediments.
9. T-shirt Sizing	d) An Agile estimation technique where team members use T-shirts sizes to estimate the size or complexity of a task.
10. Continuous Integration	i) A practice in software development where code changes are frequently integrated into a shared repository.

REVIEW QUESTIONS

1. **Correct answer: C**

Individuals and interactions: The Agile Manifesto values individuals and interactions over processes and tools, emphasizing the importance of human communication and collaboration.

2. **Correct answer: B**

Scrum Master: Scrum Master is a core role in the Scrum framework, responsible for facilitating the process and ensuring adherence to Scrum practices.

3. **Correct answer: B**

Kanban cards: In Kanban, individual work items are represented by Kanban cards, which move through various stages of the workflow on a Kanban board.

4. **Correct answer: C**

Extreme Programming (XP): Extreme Programming (XP) emphasizes a sustainable pace of work and practices like pair programming.

5. **Correct answer: C**

T-shirt sizing: T-shirt sizing is an estimation technique that uses T-shirt sizes to represent the scale of work.

6. **Correct answer: B**

The amount of work completed in a sprint: Velocity tracking in Scrum involves measuring the amount of work

completed in a sprint, which helps in forecasting future performance.

7. **Correct answer: B**

Risk burndown chart: Risk burndown charts are used in Agile to track the reduction of risk over time.

8. **Correct answer: B**

Serving the team: In Agile, a 'servant leader' focuses on serving the team, ensuring that their needs are met and helping to remove obstacles.

9. **Correct answer: B**

To group related User Stories: In Agile, a 'Feature' is used to group related User Stories that together deliver a significant piece of functionality.

10. **Correct answer: B**

Scrum: Scrum uses Sprints, which are fixed-length iterations, as its basic unit of development for delivering increments of the product.

13. Ethics and Professional Conduct

This chapter focuses on the topic of ethics and professional conduct, which describes the way that a professional project manager is expected to act in many different situations.

EXAM TIP

The expected and accepted behaviors described in this section may differ from your own experience. It is important to remember that, for the exam, the behaviors described here are considered the correct way to act in any situation.

There are no explicit domain tasks that are reflected in this section. Several years ago there were distinct questions about ethics and professional situations in the PMP® exam. However, these questions have now been incorporated into the main body of questions and may lie hidden within a question that appears to be about estimating, or risk, or quality, or customer relations, or any other topic. Thus it is very important that you read the question carefully to determine if it is presenting you with a situation that requires you to specify how you would act ethically and professionally.

Although there are no domain tasks for this topic, there is the Code of Ethics and Professional Conduct from the Project Management Institute (PMI). Both mandatory and aspirational standards are captured in the Code of Ethics and Professional Conduct. The Code of Ethics and Professional Conduct, and the behavior of professional project management practitioners, reflects the values of responsibility, respect, fairness, and honesty.

The PMI Code of Ethics and Professional Conduct applies to all members of the Project Management Institute. Additionally, it applies to nonmembers who hold a PMI certification, those who apply to commence a PMI certification process, and nonmembers who serve PMI in a volunteer capacity. Beyond these people, whom it directly applies to, it also serves as a guideline for all professional project management practitioners.

A breach of this code can result in an ethics complaint to the Project Management Institute, which has the ability to consider the complaint and take action against anyone found to have breached the code.

Real World

I have always found that the Code of Ethics and Professional Conduct serves as a very valuable reference to guide my own decisions and behaviors in real-world situations where perhaps I might be tempted to act differently. It has also served as a guide to the behaviors I expect of other professional project managers. Keep in mind that sometimes the right course of action isn't the easiest course of action. When considering what is best to do in an ethical situation, one approach is to look at what the impact of a bad decision will do to your professional and personal reputation and credibility. Always select an answer that will enhance your credibility and reputation.

13.1 RESPONSIBILITY, RESPECT, FAIRNESS, AND HONESTY

The four key foundational values for any project manager are responsibility, respect, fairness, and honesty. Though these may all seem to be fairly straightforward concepts that you think you both understand and apply consistently, you may not fully understand the implications and expected behaviors. Individually they describe specific behaviors, and collectively they present a unified code by which any professional project manager can guide and assess his or her own actions and the actions of others. Therefore, it is worth taking the time to investigate each one and review the specific actions and behaviors that each demands of a professional project manager.

EXAM TIP

Take time when reading a question in the exam to determine if it is presenting you with a technical situation or an ethical situation. If it is an ethical situation, then answer according to the Code of Ethics and Professional Conduct.

13.2 RESPONSIBILITY

MORE INFO Responsibility

You can read more about responsibility in the Project Management Institute Code of Ethics and Professional Conduct.

Responsibility means being personally and professionally accountable for your own actions, being accountable for acting ethically and professionally at all times, and ensuring that others do the same. *Responsibility* also means that you as the project manager are responsible for the actions of those in your team.

The mandatory standard of responsibility requires you to first make sure that you know and uphold all the relevant policies, rules, regulations, and laws that govern your work, professional, and volunteer activities. If you disagree with any of these rules, you can seek to change them, but until they are changed you must abide by them.

Furthermore, you must always report unethical or illegal conduct to the appropriate people or body. This means that whenever you discover or observe unethical or illegal behavior you must report it to the appropriate authorities. If you discover someone on your project not dealing fairly or honestly with a stakeholder, you must report this to your project team or sponsor. Although your natural inclination maybe to ignore the behavior if you regard it as minor, you must report it no matter how small it is. If the behavior is an ethical breach, you must report it to the Project Management Institute in accordance with the process on their website. Make sure that any complaints you file are substantiated by fact and documented appropriately.

You must also encourage people to do the same and neither retaliate yourself nor let others retaliate against any person who does bring a breach of rules to the attention of the right person or body, or who files an ethical complaint. This is to encourage and support the role of the *whistleblower*.

Real World

There will always be a temptation to avoid responsibility, but I have found that as well as enhancing your professional reputation and credibility, the simple act of taking responsibility also contributes to your ongoing leadership development. Great leadership enhances the chances of project success, and being a great leader requires you to take responsibility and lead by example.

The aspirational standards of responsibility require you to make your decisions and subsequent actions based on the best interests of society, public safety, and the environment and not in your own best interests. The greater good of society, public safety, and the environment must always take precedence over self-interest. This means that if a project you are working on conflicts with or adversely affects society, public safety, or the environment, you should reconsider whether the project is worth doing.

Taking responsibility also means accepting only that project work that is consistent with your background, experience, technical and interpersonal skills, and qualifications. Don't be tempted to exaggerate you own ability; only take on work that you know you are competent to do. After the work is taken on, you must make sure that you fulfill these commitments and see them through to completion.

If you make mistakes, errors, or omissions, you must take responsibility, take ownership, and make corrections as soon as possible. If you discover errors or omissions made by others, you must communicate them to the appropriate body as soon they are discovered. Knowingly acting in error or with information you know is false is considered a breach of this standard.

Finally, taking responsibility means protecting the intellectual property rights, copyright, and confidential information of any person or body. This means that if you are in a situation where you have the opportunity to use intellectual property of a previous client, you should always seek their approval first. Additionally, you should not allow anyone to break any copyright rules, laws, or regulations.

EXAM TIP

If you do discover anyone breaching these standards, you must report them to the relevant authority. So if you find someone breaking a company standard, you must report them within your organization. If you find someone breaking a PMI standard, you must report them to PMI, and if you find someone breaking the law, you must report them to the appropriate legal authorities.

Quick Check

1. What role do you as project manager have in upholding the value of responsibility?
2. What must you do if you disagree with a particular policy that your organization has?
3. What must you do if you discover that a member of your team has made an error?

Quick Check Answers

1. The project manager must lead by example and take personal and professional responsibility themselves and demand it from others.
2. If you disagree with a policy that your organization has, you must still follow it. You can seek to change it, but until it is changed, you must follow it.
3. Any errors, either by yourself or by another, must be recognized, reported, and acted on immediately.

13.3 RESPECT

MORE INFO Respect

You can read more about respect in the Project Management Institute Code of Ethics and Professional Conduct.

The value of *respect* means having appropriate regard for yourself and also regard for others personally and professionally. It requires you to negotiate agreements and contracts in good faith and not exercise the power of your expertise or position to influence the decisions or actions of others in order to benefit personally at their expense. This doesn't mean you can't influence people, because that is a key skill in stakeholder management and communications activities. It means that you can't seek to benefit personally by taking advantage of others using your position of power.

Respect also means not acting in an abusive manner toward any other person. Keep in mind that abuse can take many forms, from outright verbal and physical abuse to the more insidious forms of gossip, slander, libel, and passive-aggressive behavior. Complying with this standard means observing the golden rule of treating others as you would like to be treated.

Respect also means that you respect the property rights of others, which ties in nicely with the value of responsibility, in which you must protect the intellectual property rights, copyright, and confidential information of any person or body. This means that you must acknowledge the ownership and copyright that others hold on their work.

Demonstrating respect also means being aware of the norms and customs of others and avoiding engaging in behaviors they might consider disrespectful. This is increasingly important in an ever-more globalized economy, where projects are often done internationally. Also, many stakeholders may have different customs from you own, and effective communication and management of stakeholders requires you to understand their customs and treat them with respect. A key element in effective communications with, and expectation management of, stakeholders is the ability to listen to others' points of view and seek to understand them.

When it comes to resolving conflicts or disagreements, respect means dealing directly and in an open manner with those people with whom you have a conflict or disagreement. Seek to deal with the issue and not let personalities get in the way.

Whatever happens around you and whatever the actions of others, respect also means that you always conduct yourself in a professional manner, even when it is not reciprocated.

Real World

I have always found that having respect for myself and for others is a great personal asset. It improves my ability to build genuine relationships with others and understand their point of view. Keep in mind that people will know, either consciously or subconsciously, if you are faking respect, so make sure that it is always genuine.

Quick Check

1. If you are given the opportunity to negotiate a contract that would place an undue burden on the other party, what should you do?
2. If you are working in another country and it is a commonly accepted practice to pay bribes to get project work done, what should you do?

Quick Check Answers

1. In any negotiations, you should seek to get an agreement that both parties can live with. You should not negotiate contracts if you have no intention of honoring them.
2. This is a tricky question. You know that you should always respect the culture and customs of others, but taking precedence over this is the requirement that you should always obey the laws of the country in which you are working. If bribery is illegal, it doesn't matter what the custom is—you simply do not participate in it.

13.4 FAIRNESS

MORE INFO Fairness

You can read more about fairness in the Project Management Institute Code of Ethics and Professional Conduct.

The value of *fairness* deals with conflict of interest, favoritism, and discrimination.

A *conflict of interest* situation arises when your own personal interest may conflict with the interest of your employer, or you may derive personal benefit from an action undertaken on behalf of another person. Conflict of interest can be both real and perceived. Whether it is real or perceived, it should always be fully and openly disclosed as early as possible so that it can be dealt with in an appropriate manner. You should not participate in any process or project until the disclosure has been made and a decision has been made about the best way to move forward.

Conflict of interest situations can also arise as a result of the business dealings of family members or friends, when they have professional or business connections to your project. In this case, your relationship should always be fully disclosed.

Real World

Many organizations keep a documented conflict of interest register where all employees must disclose and record any real or potential conflict of interest. Often the level of conflict of interest is so small that it can be managed via simple disclosure; at other times it may require those affected to be removed from that particular process or project. Always disclose any real or perceived conflict of interest quickly.

The value of fairness also extends to favoritism and discrimination. To display fairness, you must avoid both favoritism and discrimination, which means that you neither hire nor fire, neither reward nor punish, and neither award nor deny contracts based on your own personal considerations, bias, or benefit. This means that you should treat everyone equally and fairly, regardless of any preconceived notions you may have. It also means that you must not discriminate against anyone based on gender, race, age, religion, disability, nationality, or sexual orientation.

In order to show and prove fairness you must be able to demonstrate transparency and impartiality in your decision-making process and provide equal access to information to those who are authorized to have that information. This is particularly important in legal or contractual matters, because a lack of fairness could be grounds for a legal challenge to your decisions.

Quick Check

1. What should you do if a family member works for a firm submitting a bid for contract work on your project?
2. What should you do if you are given the opportunity to provide extra information to a contractor that you really want to award a contract to?

Quick Check Answers

1. If you, a friend, or family member could benefit, or is perceived to benefit, from a commercial transaction in which you are involved, there is a real or potential conflict of interest. It must first be fully disclosed, and you should not take part in any process until it is resolved.
2. You should treat everyone involved in procurement negotiations fairly and equally. Everyone should receive exactly the same information at the same time.

13.5 HONESTY

MORE INFO Honesty

You can read more about honesty in the Project Management Institute Code of Ethics and Professional Conduct.

Honesty seems like one of those self-evident terms. We all know when we are being honest, and if we aren't being honest, then surely we are being dishonest. Or is there some grey area between honesty and dishonesty?

If you want to act in accordance with the value of honesty, there is no grey area; you are either being honest or dishonest. Telling half-truths or omitting key information is dishonest. In order to meet the standards required by this value, you must be 100 percent honest at all times. This means that you, as a professional project manager, will not engage in or condone behavior in others that is designed to deceive anyone. This includes making misleading or false statements, telling half-truths, providing information out of context, or omitting information that, if known, would make your statements misleading or incomplete.

The value of honesty also ties in with other values of responsibility, respect, and fairness, and demands of us that we do not engage, condone, or participate in dishonest behavior with the intention of personal gain or at the expense of another.

EXAM TIP

If you are ever presented with a question that asks you what is best to do in a situation where you suspect dishonesty, the answer is always to disclose this, then investigate and rectify the situation with honesty.

Displaying honesty means being prepared to ensure that the information you are basing your decisions upon or providing to others is accurate, reliable, and timely. Being honest also means being prepared to share bad news even when it may be poorly received.

Real World

Being honest will sometimes have repercussions that will test your skill as a relationship builder and influencer. You may even lose some credibility in the short term. But over the long term, you will develop a reputation based on honesty, and this will serve you better than a reputation of someone who isn't always honest.

Displaying the value of honesty also means you only make promises you can keep, and you keep the promises you make. By leading the way and acting honestly at all times, you will create a culture of honesty that encourages and expects it all times. Ultimately it will be your reputation and credibility that is enhanced by sticking to this value at all times.

Quick Check

1. If giving the truth about the status of your project to your project sponsor and client would result in the project being terminated when you are sure that the problem is short-lived and can be fixed, what should you do?
2. If you are halfway through a complex set of contractual negotiations with a potential vendor and your sponsor tells you that the project is likely to be cancelled, what should you do in relation to the contractual negotiations?

Quick Check Answers

1. In order to be honest, you must openly share all information that you have. Communicating half-truths and omissions about the status of your project to buy time to fix the problems is dishonest.
2. This question relates not only to the value of honesty, but also to responsibility, fairness, and respect. You have a duty to not continue the negotiations until the future of the project is decided, and to inform the vendor of the reasons.

13.6 CHAPTER SUMMARY

- This chapter outlines the expected and accepted behaviors of a professional project manager. It outlines the four key values of responsibility, respect, fairness, and honesty, which define the behavior of a project manager and their behavior towards others.
- The key value of responsibility requires a project manager to take personal and professional responsibility for his or her own actions, acting ethically and professionally at all times, and ensuring that others do the same.
- The key value of respect requires professional project managers to display respect for themselves and others. It requires that they refrain from abusive behaviors and understand different customs and cultures.
- The key value of fairness seeks to avoid either real or potential conflict of interest situations and avoid favoritism and discrimination by treating everyone equally and openly.
- The key value of honesty requires a project manager to be completely truthful at all times and not engage in half-truths or omission of information.

13.7 EXERCISE

The answers for this exercise are located in the “Answers” section at the end of this chapter.

1. Categorize each statement from the PMI Code of Ethics and Professional Conduct in the following list as a value associated with either responsibility, respect, fairness, or honesty.
 - i. We report unethical or illegal conduct to appropriate management and, if necessary, to those affected by the conduct.
 - ii. We negotiate in good faith.
 - iii. We provide accurate information in a timely manner.
 - iv. We do not act in an abusive manner toward others.
 - v. We proactively and fully disclose any real or potential conflicts of interest to the appropriate stakeholders.
 - vi. We protect proprietary or confidential information that has been entrusted to us.
 - vii. We provide equal access to information to those who are authorized to have that information.
 - viii. We make opportunities equally available to qualified candidates.
 - ix. We do not exercise the power of our expertise or position to influence the decisions or actions of others in order to benefit personally at their expense.
 - x. We do not engage in or condone behavior that is designed to deceive others.
 - xi. We inform ourselves and uphold the policies, rules, regulations, and laws that govern our work, professional, and volunteer activities.
 - xii. We do not engage in dishonest behavior with the intention of personal gain or at the expense of another.

13.8 REVIEW QUESTIONS

Test your knowledge of the information in Chapter 13 by answering these questions. The answers to these questions, and the explanations of why each answer choice is correct or incorrect, are located in the “Answers” section at the end of this chapter.

1. What are the four foundational values upon which the PMI Code of Ethics and Professional Conduct is built?
 - A. Trust, honesty, respect, fairness
 - B. Honesty, respect, responsibility, fairness
 - C. Integrity, trust, respect, honesty
 - D. Respect, truthfulness, responsibility, transparency
2. You are the project manager on a project that is behind schedule and over budget. You have gathered your team together to think of ways that you can make up time and save money. A team member who has recently joined your organization says that he has access to design drawings from his previous employer that are very similar to your current project, and using them would save both time and cost. What should you do?
 - A. Use the drawings and acknowledge where they came from in your project reports
 - B. Refuse to use the drawings
 - C. Use the drawings without acknowledging where they came from
 - D. Refuse to use the drawings during the team meeting, then during a one-on-one conversation with your team member, encourage him to use them

3. Your spouse is working for a company that is submitting a bid for a contract you are managing on your project. Your spouse's role within the company has nothing to do with the bid process. What should you do?
 - A. You don't need to do anything because your spouse can have no impact nor can they derive any benefit from the process.
 - B. Refuse to allow your spouse's organization to participate in the bid process.
 - C. Resign from the project.
 - D. Disclose the potential conflict of interest to your project sponsor.

4. You are working on a project in a country where bribery is the norm, and the only way to get a permit you need processed is to pay a bribe to a local official. Your project cannot continue without this permit, and the amount of the bribe is relatively small. What should you do?
 - A. Pay the bribe but lodge a complaint with local officials
 - B. Pay the bribe
 - C. Do not pay the bribe
 - D. Do not pay the bribe and continue your project without obtaining the permit

5. You are about to walk into a meeting with your project sponsor and client to report progress on your project, and you notice that the financial figures you are about to present to them do not look correct and present an overly optimistic view of your project. What should you do?
 - A. Go ahead with the meeting and point out the mistakes
 - B. Tell your project sponsor and client that you can't proceed with the meeting until you are sure you have the correct information
 - C. Go ahead with the meeting and hope they don't notice the error
 - D. Cancel the meeting without explanation

6. You and several of your colleagues are studying to sit the Project Management Professional (PMP®) examination when one of your colleagues admits that she has downloaded a copy of a copyrighted study book by using a peer-to-peer file sharing network, without paying for it. She offers a copy to you and recommends the text as a great way to help you pass the exam. What should you do?
 - A. Gratefully accept the study aid
 - B. Offer to pay her for it
 - C. Refuse the offer and report her to the author of the work
 - D. Use the book for your study and delete it once finished

7. Your project sponsor has asked you to lead a project and has given you a deadline of six months to deliver the product. After completing the time estimating processes with your team, you discover that the fastest you can deliver the project is nine months. Your project sponsor asks you to start the project anyway and still try to deliver the project within six months. What should you do?
 - A. Start working on the project, looking for ways to save three months
 - B. Start working on the project, knowing that it will take nine months regardless of what you do
 - C. Refuse to work on the project
 - D. Explain to your project sponsor that you cannot make a promise you can't keep, and that the project should not start without accurate and agreed timeframes

8. You discover that a colleague of yours whom you have worked alongside for 12 years lied on his CV to get the job and does not have the engineering degree he claims to have. However, he has proven himself as more than competent to design and manage engineering projects over the 12 years you have worked with him. What should you do?
 - A. Talk with your colleague and encourage him to disclose this information to management
 - B. Report this information immediately to your employer
 - C. Do nothing because he has proven himself as competent
 - D. Refuse to work on projects with this person

9. You are managing a project to build a new motorway next to land that your parents have owned for 50 years. As a result of the new motorway, the value of your parents' land will increase significantly. What should you do?
 - A. Go ahead with the project because the land was there before the planned motorway
 - B. Keep your parents informed on project progress so they know the best time to sell
 - C. Disclose this to your project sponsor and ask him or her what the best course of action is
 - D. Do nothing because you will not personally benefit from this

10. You are acting as a volunteer for the Project Management Institute and, during a meeting in your capacity as a volunteer, the people that you are meeting with discover that you are a skilled project management trainer and ask you to provide training services to them. What should you do?
 - A. After you have spoken to them about PMI business, start discussing ways you can help them as a trainer
 - B. Explain to them that you are there on PMI business and it is not appropriate to discuss commercial possibilities at this time
 - C. Explain to them that you are there on PMI business, then explain the situation to PMI and seek guidance on the best way forward
 - D. Try to get a contract for your training services signed before you leave

11. You are the project manager on a project and, during the business feasibility phase, you discover that your project will have large and irreversible effects upon a natural wetlands area. Your project sponsor asks you to keep quiet about this because it will mean that the project will not proceed. What should you do?
 - A. Report the effects of the project to the local government agency responsible for the environment
 - B. Resign from the project
 - C. Keep managing the project because that is what you promised you would do
 - D. Manage the project and try to minimize the impact upon the environment

12. You are preparing to give a talk to your team about how to improve your risk management planning and identification processes, and you plan to use an article you have downloaded for free from the Project Management Institute website. The article is freely available to members for download and for their professional development. During the presentation, what should you do?
 - A. Deliver a great presentation without making reference to the article
 - B. Acknowledge the article and attribute the authors' ideas during your presentation
 - C. Hand out a copy of the original article to all team members
 - D. Decide not to use the article because it would be a breach of copyright

13. You have successfully managed a large, complex project for a client and they are very happy with the results and your leadership. As a thank-you gift, they send you a brand new car with a note expressing their gratitude. What should you do?
 - A. Make sure the ownership papers have been transferred into your name correctly
 - B. Refuse the gift because it does not align with your company's policy on receiving gifts
 - C. Sell the car and split the proceeds among all project team members
 - D. Have the car delivered to your home without telling anyone

14. You are managing a large team whose members come from many different countries. Among your team members there are several who observe a particular religious holiday at a time when your team is scheduled to be delivering part of the final deliverable. The team members have asked for time off to observe the holiday. What should you do?
- A. Allow the team members the time off and use factors such as this as constraints in the resource calendar
 - B. Give all team members the time off so that everyone is treated equally
 - C. Do not approve the time off because it will adversely affect your project
 - D. Do not approve the time off because you are working in a country that does not recognize that particular holiday as a public holiday

13.9 ANSWERS

This section contains the answers for the Exercise and Review Questions in this chapter.

EXERCISE

1. Categorize each statement from the PMI Code of Ethics and Professional Conduct in the following list as a value associated with either responsibility, respect, fairness, or honesty.
 - A. We report unethical or illegal conduct to appropriate management and, if necessary, to those affected by the conduct.
RESPONSIBILITY
 - B. We negotiate in good faith.
RESPECT
 - C. We provide accurate information in a timely manner.
HONESTY
 - D. We do not act in an abusive manner toward others.
RESPECT
 - E. We proactively and fully disclose any real or potential conflicts of interest to the appropriate stakeholders.
FAIRNESS
 - F. We protect proprietary or confidential information that has been entrusted to us.
RESPONSIBILITY
 - G. We provide equal access to information to those who are authorized to have that information.
FAIRNESS
 - H. We make opportunities equally available to qualified candidates.
FAIRNESS
 - I. We do not exercise the power of our expertise or position to influence the decisions or actions of others in order to benefit personally at their expense.
RESPECT
 - J. We do not engage in or condone behavior that is designed to deceive others.
HONESTY
 - K. We inform ourselves and uphold the policies, rules, regulations, and laws that govern our work, professional, and volunteer activities.
RESPONSIBILITY
 - L. We do not engage in dishonest behavior with the intention of personal gain or at the expense of another.
HONESTY

REVIEW QUESTIONS

11. **Correct Answer: B**
 - A. **Incorrect:** Trust is not one of the four foundational values of the Code of Ethics and Professional Conduct.
 - B. **Correct:** Honesty, respect, responsibility, and fairness are the four foundational values of the Code of Ethics and Professional Conduct.
 - C. **Incorrect:** Integrity is not one of the four foundational values of the Code of Ethics and Professional Conduct. Having integrity is an important value, though, because it means having a set of values and sticking to them.
 - D. **Incorrect:** Transparency and truthfulness are not part of the four foundational values of the Code of Ethics and Professional Conduct.
12. **Correct Answer: B**

- A. **Incorrect:** It would be unethical to use drawings that belong to someone else, even if you acknowledge where they came from. You should always seek permission and negotiate terms of use of someone else's intellectual property.
- B. **Correct:** The best option in this instance is to refuse to use the drawings. You may also want to educate your new employee about expected ethical standards.
- C. **Incorrect:** It would be unethical to use drawings that belong to someone else.
- D. **Incorrect:** This answer displays a level of dishonesty and is not correct.
- 13. Correct Answer: D**
- A. **Incorrect:** It doesn't matter whether there is an impact or not. What matters is whether there is a perceived or potential impact. So in this case, you do need to disclose your relationship.
- B. **Incorrect:** This answer does not address the issue of potential conflict and puts your husband's organization at a disadvantage.
- C. **Incorrect:** Resigning from the project will not address the issue.
- D. **Correct:** The first step is to disclose the potential conflict of interest and seek advice on how best to manage it.
- 14. Correct Answer: C**
- A. **Incorrect:** You cannot pay the bribe because it is illegal, and lodging a complaint with officials will not make it okay to pay the bribe.
- B. **Incorrect:** Paying the bribe is illegal and thus you cannot do it.
- C. **Correct:** Your only choice here is to not pay the bribe, because it is an illegal payment.
- D. **Incorrect:** Not paying the bribe is correct, but proceeding without a legally required permit would be illegal and, as such, is not an option.
- 15. Correct Answer: B**
- A. **Incorrect:** You have an obligation to be honest at all times, and if you know or suspect that information is incorrect, you must address this, so you cannot go ahead with the meeting.
- B. **Correct:** This answer presents the most honest approach to dealing with the situation.
- C. **Incorrect:** This would be dishonest.
- D. **Incorrect:** Cancelling the meeting without explanation is not the best option because you should be honest about the reason for the cancellation.
- 16. Correct Answer: C**
- A. **Incorrect:** She has downloaded a copy of a book without paying for it, and this is both illegal and dishonest, so this is not the correct answer.
- B. **Incorrect:** Paying her for it does not change the fact that it is an illegal copy.
- C. **Correct:** Your only option here is to refuse her offer and then report her illegal activity.
- D. **Incorrect:** You cannot use the book because it is an illegal copy.
- 17. Correct Answer: D**
- A. **Incorrect:** Starting to work on a project that you know can't be delivered is unethical.
- B. **Incorrect:** This option begins the project with dishonesty.
- C. **Incorrect:** Refusing to work on the project may be a last option, but it is not the best answer in resolving this dilemma.
- D. **Correct:** Being very honest about the situation is the best option.
- 18. Correct Answer: B**
- A. **Incorrect:** When you are aware of an unethical or illegal act, you must report it. You should not wait for him to disclose this.

- B. **Correct:** When you are aware of an unethical or illegal act, you must report it.
- C. **Incorrect:** When you are aware of an unethical or illegal act, you must report it. Doing nothing is no longer an option.
- D. **Incorrect:** Refusing to work with this person does not address the issue of fake credentials.

19. **Correct Answer: C**

- A. **Incorrect:** This situation is an example of a real or potential conflict of interest and, as such, it must first be disclosed before the project can proceed.
- B. **Incorrect:** When the conflict of interest has been disclosed, you would not be able to give your parents any special information.
- C. **Correct:** Because this is either a real or potential conflict of interest, you must disclose it first.
- D. **Incorrect:** It doesn't matter whether you benefit from it directly; your actions could benefit a member of your family, and thus there is a conflict of interest.

20. **Correct Answer: C**

- A. **Incorrect:** This situation requires you to be clear about the role you have. You would have to clearly separate your PMI activities from your commercial interests and explain that you are there on PMI business, not your own business.
- B. **Incorrect:** This may be a good answer in the absence of answer C.
- C. **Correct:** This is the best answer because it directs you to seek guidance on how to deal with this situation.
- D. **Incorrect:** Mixing PMI interests and your commercial interest is not permissible because it is a clear conflict of interest.

21. **Correct Answer: A**

- A. **Correct:** You have a responsibility to protect the natural environment, and thus this is the best answer.
- B. **Incorrect:** Resigning from the project does not address the damage to the environment that the project will do. It may be a last-resort option, though.
- C. **Incorrect:** You cannot be silent about this after you know about it.
- D. **Incorrect:** This option requires you to be dishonest and, as such, is not a good choice.

22. **Correct Answer: B**

- A. **Incorrect:** You must acknowledge the authorship and ownership of the article during your presentation.
- B. **Correct:** You must acknowledge the authorship and ownership of the article, and you should also check with PMI as to whether it is OK to use it in this way.
- C. **Incorrect:** Handing out a copy to your team members does not address the issues of ownership and authorship.
- D. **Incorrect:** You can use the article as long as you follow the standard use of copyright articles such as acknowledging authorship and ownership.

23. **Correct Answer: B**

- A. **Incorrect:** You should first check your company's policy on receiving gifts. Many organizations have clear guidelines forbidding the acceptance of gifts, to ensure a lack of conflict of interest and promote fairness.
- B. **Correct:** If the gift does not align with your organization's policy, then you must refuse it.
- C. **Incorrect:** This does not address issues of honesty and fairness.
- D. **Incorrect:** This does not address issues of honesty and fairness.

24. **Correct Answer: A**

- A. **Correct:** This is a common situation, and you should be prepared to allow for different customs in your team members.
- B. **Incorrect:** This is not about treating everyone equally but about respecting the customs of everyone. Other

team members may observe different holidays.

- C. **Incorrect:** Not approving the time off shows disrespect for other people's customs.
- D. **Incorrect:** Not approving the time off shows disrespect for other people's customs.

14. Eligibility, Study and Exam Taking Tips

Here are some eligibility, study and exam taking tips you may find useful.

ELIGIBILITY

Before studying for and sitting the PMP® examination you will need to first check you are eligible to sit it. Full eligibility criteria can be found at the PMI® website www.pmi.org and you should check this website to ensure the following information is up to date.

Before being allowed to sit the PMP® exam you must meet the eligibility criteria set by PMI as follows:

If you have a Four-Year College / University Degree, you must have:

36 months of experience leading projects within the past eight years

35 hours of project management education/training (which our course provides) or CAPM® certification

– or –

If you do not have a Four-Year College/University Degree but do have a High School or Secondary School Diploma

60 months of experience leading projects within the past eight years

35 hours of project management education/training (which our course provides) or CAPM® certification

STUDY TIPS

- Set aside time each week to study.
- Plan your study so you know which sections you are studying.
- Complete all the Quick Check questions, chapter exercises and review questions in this book.
- Figure out the areas you are weakest in and focus extra attention on these areas.
- Ask someone to listen to you explain difficult concepts in your own words. If you can't explain it you probably don't understand it.
- Form study groups with other candidates and learn from each other.
- Ask for patience from workmates, family and friends as you focus on your study. It does require a bit of effort and you may strain some of the relationships.
- Use a commercial training provider that has courses specifically designed to help you pass the exam. We strongly recommend you look for a PMI Authorized Training Provider® (ATP) to ensure you are getting a quality trainer.
- Lock in your examination date – nothing focusses your mind like having a deadline to meet.

EXAM TAKING TIPS

- Visit the testing center before the day you have booked the exam so you know where it is and where you will park.
- If you are doing the test from you home or workplace, check that your computer will allow you to sit it. Common problems are quality of video and audio for the proctor to be able to check on you, and also things like company firewalls which will restrict full access the exam needs.
- Be early – allow enough time to relax.
- Take the required forms of identification as per the confirmation email PMI® sent you. If you don't do this you will not be allowed into the examination testing center.
- Don't panic! It's normal to feel some stress but don't let it negatively affect your performance.
- Answer all the questions – there are no points deducted for wrong answers.
- Use any remaining time to recheck answers – there are no points for leaving early.
- Check your progress throughout the exam – at the 1 hour mark you should have answered about 40 questions. At the 2 hour mark you should have answered about 90 questions. At the 3 hour mark you should have answered about 150 questions.

QUESTION ANSWERING TIPS

- Read the question fully.
- Reread the question! Seriously, a lot of mistakes are made because people don't read the questions fully.
- Read all the answers before deciding on which one is correct. Sometimes the first one looks really good and you may be tempted to mark this one as correct when a better one was further along.
- Eliminate any obviously wrong answers.
- Place the answers on a spectrum of most right to most wrong and choose the most right one.
- Organize the answers in order of which would be done first to the one which would be done last, choose the one you would do first.
- Guess! Leave no question unanswered.

15. Formulae to Remember

Communications	How many people in a communications network; n=number of people	$= n(n-1)/2$
PERT	Weighted average of three estimates (Optimistic, Realistic & Pessimistic)	$= (O+(4 \times R)+P)/6$
Standard Deviation (SD)	A PMBOK® Guide heuristic for calculating standard deviation from the mean 1SD either side of the mean \approx 68% 2SD either side of the mean \approx 95% 3SD either side of the mean \approx 99.7%	$=(P-O)/6$
Variance	The standard deviation squared	$=(P-O)/6)^2$
Planned Value (PV)	How much you planned to spend on what you planned to have achieved. The total PV for the project is the Budget at Completion (BAC)	Time % complete X BAC
Earned Value (EV)	The value of the work performed expressed in dollars	$=PV \times \% \text{ complete}$
Actual Cost (AC)	How much you actually spent on what you actually achieved	
Budget at Completion (BAC)	How much you originally planned for the project to cost and the total Planned Value (PV) for the project	
Cost Variance (CV)	The difference between what you have earned and what it cost at a certain point in time. Positive is good; negative is bad	$= EV - AC$
Cost Performance Index (CPI)	Cost Variance expressed as an index; above 1 is good, below 1 is bad	$= EV/AC$
Schedule Variance (SV)	The difference between what you have earned and what you planned to have achieved at a certain point in time. Positive is good; negative is bad	$= EV - PV$
Schedule Performance Index (SPI)	Schedule Variance expressed as an index; above 1 is good, below 1 is bad	$= EV/PV$

Estimate at Completion (EAC)	How much the project is forecast to cost at completion.	$=AC + ETC$ $=AC + (BAC - EV)$ $=BAC/CPI^c$ $=AC+[(BAC-EV)/(CPI^c \times SPI^c)]$
Estimate To Complete (ETC)	How much more money will it cost to finish the project	$= EAC - AC$
Variance at Completion (VAC)	Difference between what you thought the project would cost and what it actually ends up costing. Positive is good; negative is bad	$= BAC - EAC$
To Complete Performance Index (TCPI)	The rate at which you have to go to achieve the desired outcome of either BAC or EAC ; above 1 is bad, below 1 is good	$=(BAC-EV)/(BAC-AC)$ $=(BAC-EV)/(EAC-AC)$
Point of Total Assumption (PTA)	The point in a form of a fixed price contract that the seller assumes total responsibility for all cost increases	$= Target\ cost + ((Ceiling\ price - Target\ price)/buyers\ \% \ share\ of\ cost\ overrun)$

16. Glossary of Key Terms

- accept** A risk response strategy for either positive or negative risks that involves simply accepting the consequences of risk occurring.
- accepted deliverable** A project deliverable that has been through both validation and quality control to ensure that it meets the requirements and specifications.
- accuracy** How close the measured value is to the actual value; compare with *precision*, which refers to how uniform measurements are.
- acquisition** The tool of advertising externally for project team members.
- active listening** A communications technique in which the listener takes active steps to ensure that the message was understood correctly.
- activity attributes** Detail provided about activities on the activity list.
- activity cost estimates** The cost estimates developed for each identified activity.
- activity durations estimate** The estimate of the duration of a defined activity
- activity list** The list of identified activities developed as part of the schedule management processes.
- activity network diagram** A tool used in quality planning to show relationships between interdependent activities and calculate the paths of activities and their durations. The generic term for all network diagrams, including those used in scheduling management.
- activity resource requirements** The resources required to complete the work of identified activities.
- activity-on-arrow** An arrow diagramming method that represents activities on arrows and uses dummy activities to represent multiple predecessor and successor relationships between activities.
- activity-on-node** A precedence diagramming method that represents activity information on nodes and uses arrows to indicate the relationship between activities.
- actual cost** The actual incurred cost of completing project work.
- additional quality planning tool** In quality management, a generic referral to those quality tools not captured in the seven basic quality tools; includes the seven new quality tools.
- advertising** A tool for promoting a project's procurement requirements to a particular audience.
- affinity diagram** A graphical representation of ideas and similar concepts grouped by their relationship to each other. One of the seven new quality tools.
- agreements** Any and all formal contracts that initiate a project.
- alternative analysis** A consideration of all the possible different ways that a potential outcome may be achieved and making a decision about which method is best.
- alternatives generation** A process tool that considers many potential alternatives in order to determine whether you have selected the most efficient and appropriate one.
- analogous estimating** An estimating process that takes a similar activity and compares it to a planned activity to generate the estimate.
- analytical techniques** A group of mainly mathematical techniques used to forecast potential outcomes based upon known data.
- approved change request** A change request that has been through the documented change control process and received approval.
- approved change requests review** A tool to determine whether approved change requests have been implemented as planned.
- artifact** Any, and all, project management processes, inputs, tools, techniques, outputs, Enterprise Environmental Factors (EEF), and Organizational Process Assets (OPA) that are used on a project.
- assumptions analysis** An analysis of the assumptions made when calculating estimates.
- audit** A tool for carrying out an assessment of whether or not a defined process has been followed.
- avoid** A risk response strategy for negative risk that involves putting in place measures to avoid the risk occurring.
- backward pass** The process of calculating the late finishes and late starts in a network diagram. After calculating the backward pass, the amount of total float for each activity and the critical path can be identified.

balanced matrix A type of matrix organizational structure in which power is equally shared between the functional manager and the project manager.

basis of estimates Supporting documentation for activity cost estimates that provides additional information about assumptions, constraints, uncertainty, and estimating techniques used.

benchmarking Comparing a project, or parts of a project, against other projects to judge how they compare.

bidder conference A forum or meeting where all potential bidders on a procurement request can ask questions of the buyer for clarification.

bottom-up estimating The process of aggregating individual activity estimates upward to arrive at a total cost.

brainstorming A technique for gathering information that encourages creative and thorough thinking.

budget at completion The original approved project budget to complete all the work.

business case A document that examines the objectives, cost, benefits, strategic goals, constraints, and assumptions and provides justification for an organization to approve a project.

business value The sum of all tangible and intangible value in an organization.

buyer The person or organization procuring external goods or services.

cause-and-effect diagram Also called a Fishbone or Ishikawa diagram; a graphical representation of a known and identified effect and the potential causes of the effect. One of the seven basic quality tools.

change control board A panel of people with experience to consider and make decisions upon any requested changes as part of the change control process.

change control meeting A meeting that is defined and scheduled by the documented change control process. Change control meetings typically occur at regular intervals, and attendees at the meetings have the necessary skills and authority to make decisions about change requests.

change control tool Any tool defined by the change control process that can help define and manage the change requests received.

change log A log used to document change requests received and manage their status.

change request A request made in response to new or amended requirements, or as a result of variances discovered.

checklist analysis A technique of having a predefined checklist of steps, or activities, that must be completed and ensuring that they are.

checksheet A standardized list of activities, process, and steps that need to be completed during quality management activities. One of the seven basic quality tools.

claims administration A tool for recording and assessing any claims made by either party to a contract.

closed procurement A documented output that provides a formal record that a contract has been completed and closed.

co-location Putting project team members within the same physical location so that they can see each other and work together more effectively.

communications management plan The management plan that guides project communications.

communications method A tool that recognizes that communications can be interactive, push, or pull.

communications model A tool that describes how communications move from sender to receiver through a particular medium.

communications requirements analysis A tool for gathering and documenting the communication requirements of project stakeholders.

communications technology A tool that decides the particular form of technology to be used to disseminate information.

conflict management The process of resolving conflict.

conflict of interest A situation in which an individual may benefit personally from decisions or actions they undertake while acting in the best interests of another party.

context diagram A method of graphically representing how users interact with a process.

contingency plan A documented plan of contingent responses to a unplanned risk occurring.

contingency reserves The reserve developed, usually as a result of quantitative risk analysis, for known unknowns for time or cost.

contingent response strategy A risk response strategy for unplanned risk.

continuous improvement An iterative process of always seeking to improve your overall approach to quality management and the specific results obtained from quality management processes.

contract A formal agreement, usually in writing, between two or more parties with obligations, roles, and responsibilities clearly defined.

contract change control system A technique for defining how the procurement process can be changed.

control chart A graphical representation of data points mapped over time against an expected mean or average; upper and lower control limits are set three standard deviations either side of the mean, and beyond the control limits there are upper and lower specification limits. One of the seven basic quality tools.

control limit A limit used on a control chart, set three standard deviations either side of the expected mean to get the upper and lower control limit.

conversation A tool used to communicate with team members about their performance.

corrective action An action that seeks to realign the project performance with the project management plan.

cost aggregation The technique of adding up lower-level cost estimates to arrive at a total cost estimate for higher-level deliverables.

cost baseline The approved project cost over time.

cost forecast A forecast that contains the project costs for a project or part of a project based on the available information.

cost management plan The management plan outlining how you will plan, monitor, and control changes to your project costs.

cost of quality A consideration of the impacts of manufacturing high quality or low quality over the life of the product.

cost performance index A relative measure of cost performance calculated by dividing earned value by actual cost.

cost variance A measure of variance between what was planned and what is occurring in relation to project cost performance, calculated by subtracting actual cost from earned value.

cost-benefit analysis A tool for analyzing the expected costs to be incurred against the expected benefits to be gained. Benefits should outweigh costs.

crashing A schedule compression technique that involves allocating more resources to an activity to speed its completion. It usually involves additional cost.

data gathering and representation techniques Techniques and methods of collecting and presenting data in graphical form for further analysis.

decision tree A tool for making decisions about which option to select based on known probabilities and outcomes, to calculate the expected monetary value of each.

decomposition The technique of breaking down high-level descriptions into their component parts. When used in the creation of a WBS, decomposition is used down to the work package level.

defect repair A required activity to repair a discovered defect.

deliverable A unique and verifiable product, service, or result produced by the project.

Delphi technique An estimating technique that involves soliciting information from experts anonymously to avoid peer pressure.

dependency determination The consideration given to whether activities represent mandatory, discretionary, external, or internal dependencies.

design of experiments A tool for determining quality by using a known set of variables, designing an experiment, and being able to control different variables to determine the variable responsible, or most responsible, for quality issues.

diagramming techniques A variety of techniques of using diagrams to show relationships between related activities, events, causes, and effects.

document analysis A technique of analyzing existing documents to gather information.

documentation reviews A technique of thoroughly examining documents that serve as inputs into processes to fully understand and review them.

dummy activity A relationship, represented by a dotted line, between multiple activities in an activity-on-arrow (AOA) diagram.

early finish The earliest an identified activity can finish. Calculated by adding the duration of the activity to the early start.

early start The earliest an activity can start.

earned value The value of the work completed.

earned value management A technique for analyzing past performance and utilizing formulas to forecast future performance based on planned value, earned value, and actual cost.

effective listening Similar to active listening, a communications technique that also includes the listener or receiver monitoring nonverbal and physical communication.

enhance A risk response strategy for positive risks that seeks to enhance the probability or impact of a risk occurring.

enterprise environmental factor A factor that is external to a project that can influence the success of a project.

enterprise environmental factors update An update to the enterprise environmental factors as a result of completing processes.

estimate at completion The formula for calculating what the forecast cost estimate at the completion of the project will be.

estimate to complete The calculation to estimate how much more money there is to be spent on the project to reach the estimate at completion.

expected monetary value analysis A mathematical technique, often using decision trees, of calculating the probability and impact of a particular decision in order to calculate expected monetary value.

expert judgment The advice and decisions from people with specialist knowledge in a particular area.

exploit A risk response strategy for positive risks that seeks to put in place strategies to ensure that if a positive risk occurs you are ready to exploit it.

exploratory study An initial assessment and review of an issue to gain a preliminary understanding of potential ways to address it

facilitated workshop A workshop with a focus on a particular issue, directed by an independent facilitator.

facilitation techniques A broad range of techniques designed to solicit information from groups of people with the objective of accomplishing project activities.

fairness One of four key values underpinning the ethical and professional conduct expected of a project manager. It seeks to avoid conflict of interest, favoritism, and discrimination. See also responsibility, respect, and honesty.

fallback plan another name for a contingency plan developed to manage risks

fast tracking A schedule compression technique that involves performing activities in parallel that were originally scheduled in sequence.

feedback Cues from the receiver to the sender that indicate whether or not the message has been understood.

Fielder's Contingency Theory A theory that states that leadership effectiveness is contingent on whether the situation is stressful or calm and whether the leader is task-oriented or relationship-oriented.

final product, service, or result The deliverable, product, or service produced by the project and handed over to operations.

fishbone diagram Also called a cause-and-effect diagram or Ishikawa diagram; a graphical representation of a known and identified effect and the potential causes of the effect. One of the seven basic quality tools.

flowchart A tool for showing in graphical form the steps in a process. One of the seven basic quality tools.

focus group A gathering of a group of stakeholders or participants to address a particular issue or provide specific feedback.

forecasting The technique of extrapolating from past performance what likely future performance will be.

forward pass The calculation of early starts and early finishes in a network diagram that results in the project duration.

free slack or free float The amount of time an activity can be delayed before it affects the next activity on the path.

functional manager A general manager or team leader in charge of a functional area in an organization.

functional organization An organization that is structured into its separate functional areas, each having its own technical specialty and manager or leader.

funding limit reconciliation A technique for reconciling forecast funding requirements against actual funding limits.

grade A measure of the amount of features a product has. Low grade means the product has few features, whereas high grade means it has lots of features.

ground rules Rules established by the project manager and project team members for accepted and expected behaviors for being part of the team.

group creativity techniques A range of techniques used to get a group of people to generate and consider a wide range of possible options.

group decision-making techniques A range of techniques to enable a group of people to reach a decision.

grouping method A particular method of deciding how results will be categorized for easy assessment and prioritization

Herzberg's Motivation-Hygiene Theory A theory that states that hygiene factors will not motivate, but their absence will make staff unsatisfied, and that motivation will motivate, but only if hygiene factors are in place.

histogram Also called a bar chart; a tool for showing amount or frequency of a variable. One of the seven basic quality tools.

historical relationships Any past information about interactions between variables used in an estimating process.

honesty One of four key values underpinning the ethical and professional conduct expected of a project manager. See also responsibility, respect, and fairness.

Resource Management Plan The management plan for planning, acquiring, developing, and controlling human resources on the project.

independent estimate A technique that uses an independent professional to provide advice on what seller responses in relation to cost should reasonably be.

influencing The technique of understanding, modifying, and changing the expectations and engagement of stakeholders to ensure that they support your project or do not oppose it.

information gathering techniques A variety of techniques for gathering information from project team members, subject matter experts, and other stakeholders, and other sources of information.

information management system A tool for the management, storage, and distribution of project information in either hard copy or electronic form.

inspection The tool of physically checking work that has been done.

interactive communication A form of communication where multiple parties communicate concurrently.

interpersonal skills A range of technical, personal, and conceptual skills that a project manager should have and be able to display at appropriate times in order to increase his or her effectiveness.

interrelationship digraph A tool for graphically showing the many relationships that exist between different variables or steps in a process. One of the seven new quality tools.

interview A formal and structured meeting between small groups of people to solicit specialist information.

Ishikawa diagram Also called a cause-and-effect diagram or a Fishbone diagram; a graphical representation of a known and identified effect and the potential causes of the effect. One of the seven basic quality tools.

issue log A document that lists and describes issues that have been identified and the status of those issues.

just in time A tool for controlling inventory in which inventory is delivered just as it is needed. Can be used as a quality management tool, because lack of inventory in stock exposes mistakes very fast and provides a reason to improve quality.

kaizen The loose Japanese translation of *continuous improvement*, which means always seeking to improve your quality processes and products.

kick-off meeting A meeting held before project execution activities start.

lag The amount of time an activity must wait after its predecessor finishes before it can start.

late finish The latest an activity can finish.

late start The latest an activity can start.

lead The amount of time before the finish of its predecessor that an activity can start.

make or buy analysis A tool for assessing whether work should be done by the project team or procured from an external source.

make or buy decision The output from the make or buy analysis that decides whether an organization will make the required goods or services or buy them from an external provider.

management reserves A reserve of cost or time for unknown unknowns; under the control of management.

management skills A set of skills a project manager should have that include presentation, negotiation, time management, and public speaking skills.

market research As tool for examining and assessing current marketplace conditions in order to assess the impact upon procurement decisions.

Maslow's hierarchy of needs A theory that states that a person will always be motivated by lower needs before being motivated by higher-order needs.

matrix diagram A tool for graphically showing how one set of variables on a vertical axis interacts with other variables on a horizontal axis. One of the seven new quality tools.

matrix organization A type of organizational structure in which projects are completed across functional lines and a project manager draws on different technical specialties from different functional areas.

McClelland's Human Motivation, Achievement, or Three Needs Theory A theory that states that people will work not for more money, but instead for achievement, power, and affiliation.

McGregor's theory X and theory Y A set of theories that states that managers either view employees as trustworthy and self-motivated (theory Y) or untrustworthy and needing constant motivation (theory X).

meeting A gathering of a group of people for a defined purpose and agenda.

methodology A defined set of processes, tools, techniques, and templates for managing projects in a particular way.

milestone list A high-level graphical representation of the milestones to be achieved on the project.

mitigate A risk response strategy for negative risks that seeks to minimize the probability and impact of a particular risk.

modeling techniques A variety of mathematical and computer-based techniques to forecast possible outcomes based on several different inputs.

Monte Carlo Analysis A statistical and complex mathematical method of extrapolating from observed data what a likely future scenario or scenarios will be.

multicriteria decision analysis A tool used to assess the different attributes of prospective team members, and give each attribute a particular weight so that the overall ranking of the preferred team member can be assessed.

negotiated settlement A technique for arriving at an agreed means of terminating and closing a contract between parties to the contract.

negotiation A tool for interacting with another party and attempting to come to a mutually beneficial agreement.

networking A tool used to build relationships between individuals and groups based on mutual benefit.

nominal group technique A method of using group members to vote on which ideas generated from a brainstorming session are most worthy of investigating or using further.

nonverbal Communication in the form of body language, posture, and similar.

observation A tool used to observe team members' performance so that performance appraisals can be completed and also. the technique of physically observing how people act in the environment and how they might use a particular product, service, or result.

organizational chart A hierarchical and graphical representation of the way that an organization is structured, identifying specific roles and their reporting lines.

organizational process asset Any formal or informal process that the performing organization has in place to assist in delivery of the project.

organizational process assets update Any update that will be made to existing organizational process assets as a result of information gathered or observations made during the execution of the project.

organizational project management maturity A method of assessing the level of organizational maturity in relation to the use of portfolio, program, and project management processes, tools, templates, and methodologies.

organizational theory A range of theories describing the way people and organizations interact.

Ouchi Theory Z A theory that states that employee loyalty and productivity can be increased by offering a job for life and providing full care.

padding The unjustifiable increase in estimates of time or cost.

paralingual Communication that is vocal but not verbal, and includes tone of voice, inflection, and volume.

parametric estimating An estimating technique that multiplies a known quantity by a known metric.

Pareto diagram A tool for showing the frequency of events individually, and also cumulatively, so that the 20 percent of events responsible for 80 percent of the effects can be identified. One of the seven basic quality tools.

payment system A tool for ensuring that payments due under the terms of a contract are properly paid and recorded.

performance reporting A tool for collecting and disseminating appropriate reporting on project progress to stakeholders.

performance reviews The process of measuring, comparing, and analyzing actual project performance.

personnel assessment tools A range of tools and techniques that enable project managers and team members to assess individual and team performance, strengths, and weaknesses.

phase A defined part of a project marked by a milestone, stage gate, phase gate, or major decision point.

plan-do-check-act (PDCA) cycle An iterative cycle developed by Shewhart and Deming to describe continuous planning and checking processes.

planned value The value of work that should have been completed at a certain point in time.; calculated by multiplying the budget at completion by percentage of time elapsed.

PMBOK® guide A collection of what is considered good practice in the profession of project management, providing a framework from which to draw appropriate processes, tools, and techniques for managing projects.

point of total assumption The price point in a contract where the seller assumes total responsibility for all cost increases.

portfolio manager The person responsible for managing a portfolio of projects; the portfolio manager typically operates at strategic level.

portfolio The range of projects being undertaken by an organization.

position description A document that sets out the required responsibilities, skills, and experience for a particular role on the project team.

preassignment A tool that allocates project team members to a project based on their specific experience or contractual agreements.

precedence diagramming method A graphical representation of activities in the project with arrows indicating the relationship between them. The most common type of precedence diagram is the activity-on-arrow (AOA) diagram.

precision The degree to which measurements are clustered together rather than scattered. Compare to *accuracy*.

predecessor An activity that comes immediately before another activity.

preventive action An action to stop work that will cause the project to deviate from the project management plan.

prioritization matrix A tool for prioritizing and weighting issues and events and displaying the results graphically. One of the seven new quality tools.

probability and impact matrix A graphical means of displaying the combined probability and impact of risks in a standardized manner.

process analysis A tool that follows steps in a process to determine whether they are appropriate and can be improved upon.

process decision program chart A tool that links ideas together and graphically represents them as a means to achieve a particular goal. One of the seven new quality tools.

process improvement plan A plan that identifies the way in which project processes will be defined, analyzed, and improved. A subset of the project management plan.

procurement audit A tool for auditing whether or not procurement processes and contracts are being carried out as per the approved documentation.

procurement documents A range of documents produced by the procurement processes that provide additional advice or record decisions made about the procurement process.

procurement management plan A management plan that provides guidance on how the procurement management processes will be carried out.

procurement negotiation A technique of entering into negotiations with prospective sellers that results in an agreed contract.

procurement performance review A technique for carrying out a structured review of a seller's performance and progress against an agreed contract.

procurement statement of work A defined and documented description of the scope of work to be completed as part of the procurement process.

product analysis The technique of breaking a defined product down into its component parts to fully understand it.

program A number of projects that are interrelated in some way.

Program Evaluation and Review Technique (PERT) A graphical technique developed to evaluate the time and cost elements of a project and the relationship and interdependencies between them.

program manager The person responsible for managing a program of projects.

progressive elaboration A process of iteratively defining and planning work to be done on a project.

project A temporary activity to deliver a unique product, service, or result.

project calendars The times that activities on the project can and cannot be carried out in completing project deliverables.

project charter The foundational document for the project; it provides political and financial support for the project.

project communications The output from the Manage Communications process that includes all information created, stored, and disseminated by the project.

project coordinator A person given a leadership role in managing a project with less power and authority than a project manager.

project documents update An update to any project documents as a result of information gathered, or observations made during the execution of the project.

project expeditor A person given a leadership role in managing a project with very little power and authority.

project funding requirements The documented timing of when project funding will be required.

project life cycle The defined stages of initiating, planning, executing, monitoring and controlling, and closing a project.

project management The proactive application of professional project management practices to deliver a project.

project management information system Any system the project utilizes to gather, store, record, and disseminate information about the project.

project management office The center of excellence for project management within an organization.

project management plan The collection of all planning documents used to guide project execution.

project management plan update Any update to any part of the project management plan or its subsidiary plans.

project management software Any software that provides monitoring and reporting capability for managing a project.

project manager The person ultimately responsible for all aspects of the project.

project performance appraisal A tool used to assess individual and team performance against expected performance, provide feedback to team members, identify individual training needs, and use this information to plan future team and individual performance.

project schedule The expected timeframe the project will take.

project schedule network diagram A graphical representation of all the activities to be completed on a project and the relationships between them.

project scope statement The description of all the work to be done, and the work not to be done, as part of the project.

project staff assignments A document outlining which project staff members are allocated to the project, their roles, and contact details.

project steering committee An oversight group made up of senior managers providing high-level advice, support, and governance to the project.

projectized organization An organizational structure that reflects an organization that is divided and structured along project lines.

proposal evaluation technique A technique for assessing and scoring all proposals received as part of a procurement process.

prototype A technique of producing an example of the finished product, service, or result to seek feedback from stakeholders.

published estimating data A database of known quantities or costs relating to completion of activities in the project. Such databases are usually available commercially.

pull communication A form of communication where information is downloaded and accessed by the receivers when they want it.

push communication A form of communication where information is sent to the receiver.

quality The degree to which a set of inherent characteristics fulfills requirements.

quality audit A tool for checking conformity to defined process to ensure that they are being followed.

quality checklist An input/output that provides a standardized list of steps to be taken. Compare with *checksheets*, which are used as a quality tool.

quality control measurement An input/output that describes the result of Control Quality activities.

quality management plan A subset of the project management plan that describes how quality management will be defined, document, measured, and improved in a project.

quality metric An input/output that describes a particular product or project attribute in detail and how the Quality Control process will measure it.

quantitative risk analysis and modeling techniques A variety of tools and techniques for performing quantitative risk analysis.

questionnaires and surveys Formal documented methods of asking for information and feedback from stakeholders.

RACI chart A type of responsibility assignment matrix (RAM) that identifies particular team members and activities to be completed, and defines whether the team members are responsible, accountable, consulted, or informed.

recognition A tool for acknowledging the performance of team members.

records management system A tool used to record, store, and distribute information relating to procurement processes and decisions.

reporting system A tool for gathering, storing, and distributing project information.

requirements The attributes, condition or capability that a stakeholder requires from a product, service or result produced as part of the project

requirements documentation A document that describes individual requirements and their priority; developed in consultation with stakeholders.

requirements management plan The document that sets out how you will define, document, and manage your project requirements.

requirements traceability matrix A document that maps individual project requirements to specific business objectives and stakeholders.

reserve analysis An analysis, usually using quantitative risk analysis, that results in the provision of either a contingency or management reserve for time and cost.

resource breakdown structure A breakdown, using the process of decomposition, of the categories and types of resources required to complete the project.

resource calendars The specific time periods that a particular resource is available to be used on the project.

resource leveling The process of optimizing and making most efficient use of resources over a given period of time.

resource optimization techniques Any of the techniques that enable a more efficient use of resources on the project.

resource smoothing A resource optimization technique that seeks to optimize the use of resources without extending the total float of any activity.

respect One of four key values underpinning the ethical and professional conduct expected of a project manager. It seeks to ensure that respect is provided for. See also responsibility, fairness, and honesty.

responsibility One of four key values underpinning the ethical and professional conduct expected of a project manager. It seeks to ensure that a project manager takes full personal and professional responsibility for all actions and decisions. See also respect, fairness, and honesty.

responsibility assignment matrix A tool for displaying particular roles in a project and the responsibilities each role has.

rewards A tool for compensating high performance.

risk audit A technique for determining if the processes outlined in the risk management plan for conducting risk management activities are being followed.

risk breakdown structure (RBS) A graphical representation of different risk categories and subcategories.

risk categorization A technique for assigning similar and interrelated risks into identified categories.

risk data quality assessment A technique for examining the quality and certainty of data being used in risk analysis.

risk management plan The particular management plan that outlines how you will approach the planning, monitoring, and controlling of risk management activities on your project. It is a subsidiary of the project management plan.

risk probability and impact assessment A tool for assigning likely probability and impact to individual identified risks on the project.

risk reassessment A technique for continually reassessing the information used to identify individual risks, their probability and impact, the prepared risk responses, and any new risks that may have arisen.

risk register The documented list, analysis, and planned responses to identified risks on the project.

risk tolerance The maximum level of risk that an organization is prepared to tolerate on a project.

risk urgency assessment A technique for assessing those risks that are likely to occur in the short term, and prioritizing those over risks that will occur at a further point in time.

rolling wave planning A form of progressive elaboration that focuses on planning the immediate future in more detail than timeframes further off.

rule of seven A guide for determining when a process may be out of control in a control chart. If seven consecutive data points appear above or below the mean and within the control limits, this may indicate that the process is out of control or is about to go out of control.

scatter diagram A tool for graphically representing the results of two variables. One of the seven basic quality tools.

schedule baseline The developed and approved project timeframe.

schedule compression Any technique that reduces individual activity or the total project duration.

schedule data The collection of information describing and controlling the schedule, including the schedule milestones, schedule activities, activity attributes, and any schedule contingency reserves.

schedule forecast The estimated time the project, or parts of the project, will take based on available information.

schedule management plan The plan developed to guide the development, monitoring, and control of the project schedule. It forms part of the overall project management plan.

schedule network templates Any templates that an organization has for assisting with developing a schedule network.

schedule performance index A calculation measuring the time performance on the project. Calculated by dividing earned value by planned value.

schedule variance The difference between what was planned and what is actually occurring in relation to the project schedule.

scheduling tool Any manual or automated tool that focuses on the project schedule.

scope baseline The scope statement, work breakdown structure (WBS), and WBS dictionary.

scope management plan The document that sets out how you will define, document, and manage changes to your project scope statement.

selected sellers The group of sellers chosen to participate in the procurement process either by being prequalified or by completing a stage in the procurement process.

seller The individual or organization responsible for delivery of externally contracted goods or services.

seller proposal A formal response to a procurement request from a prospective seller.

sensitivity analysis A mathematical technique for determining which parts of the project are most sensitive to risk.

seven basic quality tools Initially developed by Ishikawa, graphical ways of showing complex text based or numerical information. They are the cause-and-effect diagrams, flowcharts, checksheets, Pareto diagrams, histograms, control charts, and scatter diagrams.

seven new quality tools A further seven ways to show information in graphical form. They are affinity diagrams, process decision program charts, interrelationship digraphs, tree diagrams, prioritization matrices, activity network diagrams, and matrix diagrams.

share A risk response strategy for positive risks that seeks to increase the probability or impact of a risk occurring by sharing experience and capabilities with another organization.

simple average A mathematical average obtained by adding a set of numbers and dividing the total by the amount of numbers.

Six Sigma A proprietary approach to quality management which seeks to reduce defects and errors to as close to zero as possible. Named after six standard deviations, which includes 99.999 percent of a population.

source selection criteria A tool for developing a range of approved criteria for assessing seller responses to procurement requests.

specification limit A limit used on a control chart outside the control limits set by the customer. Any product manufactured outside either the upper or lower specification limit will not be accepted by the customer.

sponsor The person who provides financial and political support for the project, appoints the project manager, and authorizes the project charter.

staffing management plan An important component of the Resource Management Plan that specifically addresses the skills required, the time people are able to work on the project, and how and when project team members will be obtained to work on the project.

stakeholder Any person or group that can affect or be affected by your project.

stakeholder analysis A technique for identifying and documenting stakeholders' interests, expectations, power, influence, and level of engagement in the project.

stakeholder engagement plan The document that sets out how you will define, document, and manage stakeholders and their expectations.

stakeholder register A register of all project stakeholders and information about their interest in the project, the power they have to influence the project, their expectations, and how their expectations will be managed.

stakeholder risk profile analysis An assessment of individually identified stakeholders' attitudes toward risk on the project.

standard deviation A measurement about how widespread a particular set of data is from the mean.

statement of work A high-level narrative description of the work to be done on the project.

statistical sampling A tool for sampling a small subset of a large population and extrapolating the result to the entire population. Used when testing the entire population is not possible or when destructive testing is involved.

status meetings Regularly scheduled meetings that focus upon a particular project status metric.

strategies for negative risks or threats A range of suitable options for dealing with negative risks, including transfer, mitigate, avoid, and accept.

strategies for positive risks or opportunities A range of suitable options for dealing with positive risks, including enhance, exploit, share, and accept.

strong matrix A type of matrix organization in which the project manager has most of the power and authority, and the functional manager has little power and authority.

successor An activity that comes immediately after another activity.

SWOT analysis A technique that analyzes strengths, weaknesses, opportunities, and threats.

tailoring The process of taking and using only those processes, tools, and techniques that provide benefit to managing your project.

team performance assessment A tool used to develop a formal or informal assessment of a project team's effectiveness.

team-building activities A wide range of activities designed to enhance team performance via the creation of team morale, culture, and ground rules.

technical performance measurement A technique for checking whether predetermined parameters for initiating particular risk strategies have been met.

template Any blank preformed document that can be used to complete processes, documents, or forms on a project.

three-point estimating A formula taken from the Program Evaluation and Review Technique (PERT) that calculates a weighted average of the optimistic, most likely, and pessimistic estimates. The formula is $(O + (4 \times M) + P) / 6$

to-complete performance index The rate at which you must perform to achieve either the budget at completion or the estimate at completion.

tornado diagram A tool for graphically representing the results of sensitivity analysis in hierarchical form to identify those parts of the project to be affected by risk, from most likely down to least likely.

total quality management (TQM) A management-led philosophy and approach to quality that involves everyone in the organization and seeks to continuously improve all aspects of quality within an organization and a project.

total slack or total float The amount of time an activity can be delayed before it affects the total project duration.

training A tool used to increase the level of skills a team member has through formal learning.

transfer A risk response strategy for negative risks, which involves making the probability and impact of the risk someone else's responsibility.

tree diagram A tool for showing the systemic breakdown of concepts or issues. Used as a quality management tool and also is the generic term for breakdown structures such as the work breakdown structure and organizational breakdown structure.

trend analysis A technique for identifying any trends and observed data and extrapolating from this a likely future outcome.

Tuckman's five-stage model of team development A theory that describes the five stages of forming, storming, norming, performing, and adjourning that a team goes through.

validated change An approved change that has been acted upon and checked for accuracy.

validated deliverable A deliverable that has previously been verified and has been checked with stakeholders to ensure it meets stakeholder requirements and expectations.

variance The difference between what was planned and what is actually occurring.

variance analysis The technique of checking what you planned to do against what you are actually doing and spotting any difference between the two.

variance and trend analysis The technique of checking what you planned to do against what you are actually doing and using this information to forecast likely future trends.

variance at completion The difference between the budget at completion and the estimate at completion.

variance formula The formula used to determine the mathematical variance; calculated by multiplying the standard deviation by itself.

vendor bid analysis The technique of getting an independent assessment of prices submitted by vendors to check for accuracy.

verified deliverable A deliverable that has previously been verified and has been checked with stakeholders to ensure it meets stakeholder requirements and expectations.

virtual team A tool that recognizes that project team members may come from different geographic locations but can still work together by using technology.

Vroom's Expectancy Theory A theory that states that the expectation of receiving a reward for a certain accomplishment will motivate people to work harder, but that this only works if the accomplishment is perceived to be achievable.

war room A specific form of co-location activity that places team members in the same room.

weak matrix A type of matrix organization in which the functional manager has much more power and authority than a project manager.

weighted average A mathematical average calculated by adding a set of numbers and prescribing different weights to each of the numbers, then dividing by the sum of the weights given; used to calculate three-point estimates.

what-if scenario analysis A complex mathematical model which examines the probability of different scenarios.

whistleblower Someone who reports illegal or unethical behavior within an organization.

work breakdown structure (WBS) A hierarchical graphical representation of the work to be done on the project, broken down to work package level.

work breakdown structure (WBS) dictionary A document providing additional information about each node in a WBS.

work package An amount of work that can have time and cost accurately estimated; the lowest level of the WBS.

work performance data The raw data gathered as part of observations and inspections.

work performance information The refined work performance data presented in a relevant form

work performance reports The presentation of work performance information to stakeholders.

workaround An acceptable response to unplanned risk, which involves creating a makeshift solution to allow work to continue.

