

Project Management Essentials

Student Manual

Project Management Essentials

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Project Management Essentials

Introduction

After reading this introduction, you will know how to:

- A** Use ILT Series training manuals in general.
- B** Use prerequisites, a target student description, course objectives, and a skills inventory to properly set your expectations for the course.

Topic A: About the manual

ILT Series philosophy

ILT Series training manuals facilitate your learning by providing structured interaction with the subject. While we provide text to explain difficult concepts, the activities are the focus of our courses. By paying close attention as your instructor leads you through these activities, you will learn the concepts effectively.

We believe strongly in the instructor-led classroom. During class, focus on your instructor. Our manuals are designed and written to facilitate your interaction with your instructor, and not to call attention to manuals themselves.

We believe in the basic approach of setting expectations, delivering instruction, and providing summary and review afterwards. For this reason, lessons begin with objectives and end with summaries. We also provide overall course objectives and a course summary to provide both introduction and closure to the entire course.

Manual components

The manuals contain these major components:

- Table of contents
- Introduction
- Units
- Course summary
- Glossary
- Index

Each element is described below.

Table of contents

The table of contents acts as a learning roadmap.

Introduction

The introduction contains information about our training philosophy and our manual components, features, and conventions. It contains descriptions of the target student, objectives, and setup for the course.

Units

Units are the largest structural component of the course content. A unit begins with a title page that lists objectives for each major subdivision, or topic, within the unit. Within each topic, conceptual and explanatory information alternates with hands-on activities. Units conclude with a summary comprising one paragraph for each topic, and an independent practice activity that gives you an opportunity to practice the skills you've learned.

The conceptual information takes the form of text paragraphs, exhibits, lists, and tables. The activities are structured in two columns, one telling you what to do, the other providing explanations, descriptions, and graphics.

Course summary

This section provides a text summary of the entire course. It is useful for providing closure at the end of the course. The course summary also indicates the next course in this series, if there is one, and lists additional resources you might find useful as you continue to learn about the subject.

Glossary

The glossary provides definitions for all of the key terms used in this course.

Index

The index enables you to quickly find information about a particular topic or concept of the course.

Manual conventions

We've tried to keep the number of elements and the types of formatting to a minimum in the manuals. This aids in clarity and makes the manuals more elegant looking. But there are some conventions and icons you should know about.

Convention/Icon	Description
<i>Italic text</i>	In conceptual text, indicates a new term or feature.
Bold text	In unit summaries, indicates a key term or concept.

Activities

The activities are the most important parts of our manuals. They are usually divided into two columns, with a questions or concepts on the left and answers and explanations on the right. Here's a sample:

Do it!

A-1: Steps for brainstorming**Exercises**

1 Sequence the steps for brainstorming.

Begin generating ideas.

Select the purpose.

Organize for the session.

Ask questions and clarify ideas.

Review the rules.

Topic B: Setting your expectations

Properly setting your expectations is essential to your success. This topic will help you do that by providing:

- A description of the target student at whom the course is aimed
- A list of the objectives for the course
- A skills assessment for the course

Target student

The typical students of this course will be managers, supervisors, or team leaders who need to learn about essential project management concepts.

Course objectives

These overall course objectives will give you an idea about what to expect from the course. It is also possible that they will help you see that this course is not the right one for you. If you think you either lack the prerequisite knowledge or already know most of the subject matter to be covered, you should let your instructor know that you think you are misplaced in the class.

After completing this course, you will know how to:

- Identify the participants in the project, the influence of stakeholders on a project, the objectives of the project, benefits of planning for a project, and project constraints.
- Identify project activities, create a work breakdown structure (WBS), recognize types of project activities, create a Program Evaluation and Review Technique (PERT) chart, analyze activities by creating an activity analysis form, estimate the time duration and cost of project activities, and identify the categories of dependencies and dependency relationships.
- Develop the project schedule by using CPM, PERT, project network diagrams, arrow charting, and Gantt charts, identify the benefits of CPM and PERT, the critical path, and the methods of duration compression.
- Define project change control and identify the steps in accommodating the changes in a project.
- Identify the importance of historical information, the pitfalls to avoid when completing project cost estimates, the importance of organization's financial policy, the different types of cost, and the best use of available funds.
- Measure project performance by using various analysis methods, control project cost, identify performance, status, progress, close-out, and final project reports.

Skills inventory

Use the following form to gauge your skill level entering the class. For each skill listed, rate your familiarity from 1 to 5, with five being the most familiar. *This is not a test.* Rather, it is intended to provide you with an idea of where you're starting from at the beginning of class. If you're wholly unfamiliar with all the skills, you might not be ready for the class. If you think you already understand all of the skills, you might need to move on to the next course in the series. In either case, you should let your instructor know as soon as possible.

Skill	1	2	3	4	5
Identify project participants					
Understand influence of stakeholders on a project					
Understand project objectives					
Understand project planning benefits					
Identify constraints in a project					
Understand project activities					
Create and use Work Breakdown Structure (WBS)					
Sequence activities in a project					
Create and use a PERT chart					
Use an activity analysis form					
Understand duration and cost estimating					
Understand dependency					
Identify dependency relationships					
Understand Critical Path Method (CPM)					
Understand project network diagrams					
Create and use Gantt charts					

Skill	1	2	3	4	5
Understand methods of duration compression					
Understand project change control					
Know steps in accommodating change					
Identify types of cost					
Identify pitfalls in estimating costs					
Understand methods of measuring project performance					
Understand classifications and characteristics of project reports					

Topic C: Reviewing the course

No special preparation is needed for you to review this course on your own.

Unit 1

Defining the project

Unit time: 45 minutes

Complete this unit, and you'll know how to:

- A** Identify the participants and the influence of stakeholders on a project.
- B** Identify project objectives, benefits, and constraints.

Topic A: Project participants

Explanation

In a given project, the participants will include at least the project manager and the project originator. In rare instances, these roles might be filled by one individual, but usually the project manager is someone who manages the project for the originator. The project originator might be the manager's boss or a customer. Other individuals or groups that can be considered as project participants include people assigned to work on the project; the public, if they are affected by the outcome of the project; the parent organization, who staffs the project; and customers, if they use a product created by the project. Any individual, group, or organization involved in a project or whose interests might be influenced as a result of project achievement can be considered project *stakeholders*. As a project manager, it is important for you to identify all the stakeholders for your project and determine their expectations for it. Managing stakeholders' expectations reduces conflict and leads to project success.

Stakeholders' influence

Stakeholders have various levels of influence on a project:

- Some stakeholders simply need to feel appreciated throughout the project process.
- Some stakeholders outline specific requirements that they want the project to meet. You should advise the stakeholders if their requirements for a project are not going to be completely fulfilled.
- Some stakeholders have specific requirements that they want the project to meet, and their stake in the project is large enough that you should strive to meet their needs under most circumstances.

Do it!

A-1: Determining influence of stakeholders

Exercises

- 1 Read the following scene. In the scene, Mr. Sullivan (project manager) and Ms. Harris (project manager) are sitting across each other in the conference room.

Mr. Sullivan: I understand that Mr. Elliot called this morning for an update on the telecommunications satellite project.

Ms. Harris: Yes, and I assured him that everything is proceeding as scheduled.

Mr. Sullivan: Good. If we finish the project on schedule, Mr. Elliot will be more likely to collaborate with us on the next project.

Who is the stakeholder in the scene?

What is the level of influence of a stakeholder on a project?

- 2 Share your experiences of a project in which the public was a key stakeholder.

Topic B: Project objectives and planning

Explanation

A project's *objective* is a written statement that details what goals the project should accomplish. Clearly defining the project's objective enables you to know exactly what you need to accomplish. Regardless of how hard you work at project management, if the project does not accomplish the correct goal, the project fails. Therefore, you must have a clear objective you can work toward to ensure that you accomplish all that is expected of the project.

Project planning benefits

Project planning is often considered as the most important step of the project management process. During project planning, the project manager and stakeholders define the project's goals, and then determine how to meet those goals. Planning helps you avoid costly changes during the process of completing the project by ensuring that the work is done correctly the first time.

Do it!

B-1: Identifying benefits of project planning

Exercises

- 1 Defining the objective of a project enables a project manager to know what needs to be accomplished. Explain with an example.
- 2 Project planning is often considered the most important step of the project management process. Give two reasons why.

Constraints affecting a project

Explanation

There are three constraints that affect a project:

- Performance standards
- Time
- Budget

Performance standards

Performance standards are the goals set forth for a project. Since a project cannot be successful if it does not accomplish the goals the stakeholders set for it, performance standards are vital to a project. Performance standards are constraints because they can dictate how project work must be completed. When considering the performance standards of a project, you should always look deeper than the initial goals the project originator or other stakeholders set.

Frequently, stakeholders do not explicitly state every goal they want a project to achieve. Nevertheless, you should understand that stakeholders will judge the success of the project based on their expectations, even if those expectations were not clearly defined. Therefore, while planning a project, you should obtain as much information as you can about stakeholders' expectations.

Time

The amount of time you are given to complete a project will affect every aspect of it. Time can greatly affect the amount of resources needed to complete a project, as well as the order in which you complete tasks and activities. As you plan your project, you should keep in mind any organizational or political issues that could arise and affect your ability to complete the project on time.

Budget

Budget allocations will influence your ability to accomplish a project by determining what resources you can use to achieve your project's objective. Your project budget will also influence whether you can achieve the specified performance standards within the allotted time.

Often, before taking responsibility for a project, project managers act as consultants for project originators. The consultation is a valuable opportunity that can increase your chances for success as a project manager. If you are given an opportunity to work as a consultant before a project begins, be sure to research the project thoroughly before making a budget proposal. You should examine any organizational or political influences that could affect the project completion.

Prioritizing project constraints

Before you can effectively plan a project, you must prioritize the performance standard, budget, and time constraints. Prioritizing constraints is essential. You'll make strategic decisions based on the constraints so that you can make the best use of the project resources.

As a project manager, you'll have to make trade-offs based on one or more of the constraints. How well you compromise and make those trade-offs affects the success of the project.

Therefore, you should determine the most important constraint, or the *driver*, since it will drive the activities needed to complete the project. If you, as the project manager, fail to adjust for this constraint, the project will fail even if you adjust to the other constraints. The least important constraint, or the *weak constraint*, is not as important to the success of your project. The remaining constraint is the *middle constraint*.

As you prioritize project constraints, remember that you do not decide which constraint is most important; rather, you identify the relative importance of each constraint based upon the expectations the project originator has for the project. You must determine these expectations and how they influence the constraints, so you can manage the project appropriately.

Once you have identified the driver, middle, and weak constraints for your project, you'll be prepared to begin planning your project. Understanding the level of importance of each constraint will provide you with a strategic tool for managing your project. For example, since the weak constraint is not as critical for project success as the driver and middle constraints, it often provides a source of flexibility for the project.

For example, you are working on a project in which time is the driver constraint and performance standards are the middle constraint. If your project falls behind schedule, you could make use of the flexibility in the weak constraint by using your budget to add resources that can move the project back on schedule.

Do it!

B-2: Prioritizing project constraints

Exercises

- 1 Read the following scene. In the scene, Patricia (project manager), Benjamin (project team member), and Marisa (project team member) are sitting across from each other in the conference room.

Patricia: As you know, the research group at the head office works on ideas for new products. They have no particular deadlines, but we get their suggestions every now and then. Last Monday they presented an idea to upper management and the reaction was very positive.

Benjamin: What is it, and how will it affect us?

Patricia: It's a new addition to the mid-range line. We'll be working out the development details, and that'll be a good experience for all of us. That's the good news. The not-so-good news is that upper management wants this product in the market by the end of the third quarter.

Marisa: How can we possibly do that? There's not enough time.

Patricia: We have no choice. So, what we need now is some intense brainstorming to come up with ways to accelerate the development process. We'll meet back here at one o'clock today to get started.

List two constraints that you or your project team might have encountered while developing a project. What steps would you take to overcome them?

- 2 Read the following scene. In the scene, Marcus (project team member) is sitting at his workstation when Elliot (project team member) approaches him.

Elliot: Hey, Marcus, did you hear that Mr. Kramer called a last-minute meeting to discuss the Pearson Project?

Marcus: No, I hadn't heard. Is there a problem?

Elliot: Well, upper management told him the deadline for the project has been moved up two weeks.

Marcus: What do you think this means for us?

Elliot: I'm not sure, but the meeting is scheduled for tomorrow at 8:00. My guess is that they'll assign more people to help us. It'll cost more money, but that's the only way we'll get done on time.

List a trade-off that Mr. Kramer can make to prioritize project constraints.

Unit summary: Defining the project

Topic A

In this topic, you learned that the **participants** in a project include at least the **project manager** and the **project originator**. You also learned about the **influence** of stakeholders on a project.

Topic B

Finally, you learned that the **objective** of a project is a written statement that details the goals to be accomplished in the project. You also learned that during **project planning**, the project manager and stakeholders define the project's goals and then determine how to meet those goals. Project managers then determine which of the three project constraints—**performance standards**, **time**, or **budget**—drives the project and then adjust their plan accordingly. By prioritizing **project constraints**, project managers are better able to meet project goals.

Independent practice activity

- 1 The project participants in a project team include at least the _____ and the _____.
 - A Project originator
 - B Project executive
 - C Project administrator
 - D Project manager
- 2 Choose the group of people that should be included as project participants when a project involves the creation of a consumer project.
 - A Customers
 - B Sales staff
 - C Consultants
 - D Suppliers
- 3 Which of the following statements are true regarding stakeholders' influence on a project?
 - A Stakeholders might have requirements that should be met because the stakeholders can influence the success of the project.
 - B Stakeholders must always help you plan the project schedule.
 - C Stakeholders will identify the time, budget, and performance constraints for the project.
 - D Stakeholders might simply need to feel appreciated.

- 4 Choose the project constraints.
 - A Project requirements
 - B Stakeholders' expectations
 - C Performance standards
 - D Group specifications
 - E Budget
- 5 Choose how project activities are affected by the time constraint.
 - A Affects the classification of project activities
 - B Affects the verification of project activities
 - C Affects the order of project activities
 - D Affects the regulation of project activities
- 6 Complete the following sentence to determine how the project budget affects the performance standards and time constraints. The project budget influences whether _____.
 - A Time becomes more important than performance standards
 - B Performance standards become more important than time
 - C Performance standards will be completed ahead of schedule
 - D You can achieve the performance standards in the allotted time
- 7 Choose the driver for the project after considering that the project has a flexible budget, the design specifications can be modified, and the product must be released within a month of the project start.
 - A Time
 - B Budget
 - C Performance standards
- 8 What does a weak constraint provide to the project?
 - A Efficiency
 - B Flexibility
 - C Productivity
 - D Profitability

- 9 Select the option that describes the driver constraint.
- A The constraint the provides flexibility
 - B The constraint about which you do not have to be concerned
 - C The most important constraint
 - D The remaining constraint
- 10 Which constraint should be identified first?
- A Central
 - B Driver
 - C Middle
 - D Weak

Unit 2

Activities and dependencies

Unit time: 90 minutes

Complete this unit, and you'll know how to:

- A** Identify project activities and recognize the types of project activities.
- B** Analyze activities by creating an activity analysis form.
- C** Estimate the time duration and cost of project activities.
- D** Identify the categories of dependencies and dependency relationships.

Topic A: Project activities

Explanation

It is essential for the success of your project to identify all the activities, or elements of work, that must occur in order to complete the project. As you plan a project, it is important to identify every activity, so you can budget the time and resources needed to complete them. Failing to identify all of the activities can cause unexpected problems. One way to ensure that you identify all the project's activities is to use a work breakdown structure, or WBS.

WBS

A WBS is the foundation for project planning and is vital to project management. A WBS helps you identify complex project activities and divide those activities into smaller activities. Focusing on smaller activities simplifies estimating the duration, cost, and resource consumption for the project.

Creating a WBS

- 1 *Brainstorm.* To create a WBS, the first step you should take is to brainstorm the different project activities. If other people will be working on the project with you, include them in the brainstorming process. Write down every possible activity that will need to be completed to achieve the project's goals. A helpful way to record the activities is to write individual activities on sticky notes. This method will facilitate grouping and arranging the activities later.
- 2 *Refine activities.* The second step you should take to create a WBS is to refine your activity list. It is possible that you'll create multiple strategies for accomplishing a project's goals. Each strategy might consist of a different set of activities. If this is true for your project, you should choose the best approach for achieving the goals and make any necessary adjustments to the set of activities. In addition, you might discover that some activities need to be broken down into smaller ones, while others might need to be combined. Use your best judgment to determine a final set of activities.
- 3 *Group activities into categories.* After you have identified and recorded the project activities, group the sticky notes into logical categories, such as "Purchasing," "Installing," or "Testing". As you do so, look for any places where you might have forgotten activities. Once you have completely organized the categories, review the entire set again to ensure that you have not forgotten any activities.

*Do it!***A-1: Creating a WBS****Exercises**

- 1 Sequence the steps for creating a WBS.

Refine activities.

Group activities into categories.

Brainstorm for activities.

- 2 Read the following scene. In the scene, Mr. Kramer (project manager), Chala (project team member), and Marcus (project team member) are seated across from each other in the conference room.

Mr. Kramer: A shipment of PCs is coming on next Monday. Today, we need to discuss every detail of the delivery to make sure we're prepared.

Chala: I'll call you when the first delivery truck arrives, then I'll meet the driver at the dock to collect the paperwork. If the truck's on time, it should be about ten o'clock when I call you.

Marcus: After you call, I'll gather my crew together and meet you at the dock. We can have all 450 PCs off the dock and into the warehouse by one o'clock. They'll be out of the way by the time the second truck arrives at two o'clock.

Chala: Now, wait a minute—where are we going to stack all the shipping pallets? There won't be room for them in the docking bay.

Mr. Kramer: That's a good point. I'll have a flatbed truck parked next to the dock. Once the PCs are off the pallets, your guys can put the pallets on the flatbed. What other details have we missed?

Create a work breakdown structure for the tasks described in the scene.

Sequencing activities

Explanation

The purpose of sequencing project activities is to arrange them in a logical order for completion. Activity sequencing is important, because it enables you to determine the order of activity completion that best manages the time and resources available for completing the project.

Types of activities

Part of activity sequencing is recognizing that there are different kinds of activities and understanding the relationships among them. There are several types of activities that might be part of your project:

- Predecessor and successor activities
- Concurrent activities
- Dummy activities
- Lag activities
- Milestones

Predecessor and successor activities

Predecessor activities must be finished before other activities can begin. The activities that follow predecessor activities are known as successor, or dependent, activities. *Successor activities* are “links” in the chain of activity flow from a project’s start through its completion. Once a successor activity is completed, it can either be a predecessor for other activities, or it can be the final activity of a project. Some successor activities can be completed concurrently.

Since a dependency exists between predecessor and successor activities, they are said to produce sequence constraints. Since sequence constraints dictate a specific order in which some activities must be completed, they limit the flexibility you have in scheduling.

Concurrent activities

Concurrent activities, or parallel activities, are another type of activity that might be part of your project. Concurrent activities can be completed simultaneously, thus shorten the duration of a project. When scheduling concurrent activities, be sure there are enough resources available to execute them at the same time.

Dummy activities

Another type of activity you might include in your project schedule is a dummy activity. *Dummy activities* are used to demonstrate how concurrent activities relate to one another, and they can be used to improve the layout of your project schedule. Dummy activities neither expend resources nor require time to complete.

Lag activities

Another type of activity you might encounter in your project is a lag activity. *Lag* activities do not require the use of any resources since they occur when there is a waiting period, or “lag” time, between the time that one activity is completed and the next one begins. Although there is no work associated with lag activities, it is helpful to include them in your project schedule so that you do not forget that the lag time exists.

Milestones

Milestones are another type of activity commonly used in project scheduling. *Milestones* do not require work, use time, or expend resources. They are used in project scheduling to indicate that a series of activities is complete, to represent progress points, or to denote when a meeting should be held. Although milestones appear along the project schedule, it is important to note that they do not affect workflow.

Do it!

A-2: Identifying types of project activities

Exercises

- 1 List any three activities that you perform while developing a project. Then, identify their predecessor, successor, and concurrent activities.
- 2 Read the following scene. In the scene, Mr. Kramer (project manager), Monica (project team member), and Marcus (project team member) are seated across from each other in the conference room.

Monica: Mr. Kramer, I don't think this timeline is going to work.

Mr. Kramer: What's the problem?

Monica: Well, you have Marcus working on the research statistics at the same time I'm supposed to prepare the competitor reports. I can't compile those reports without the stats from Marcus.

Mr. Kramer: You know, you're right.

Marcus: If that's the case, how are we going to finish the project on time?

Mr. Kramer: Hold on a second. We can make this timeline work. Let's just find the activities that can be done at the same time.

List two benefits of planning for the activities that can be completed simultaneously.

- 3 Match the following activity descriptions with the respective activity: lag; dummy; and milestones.

A project activity that can be used to denote when a meeting should be held

A project activity that demonstrates how concurrent activities relate to each other and can be used to improve the layout of the project schedule

A project activity that does not require the use of any resources because it occurs during a waiting period

PERT chart

Explanation

You can begin sequencing your project's activities by creating a Program Evaluation and Review Technique (PERT) chart, as shown in Exhibit 2-1. A PERT chart will help you determine the best sequence for your project's activities. You can create a PERT chart by using the set of activities identified in the WBS. The sticky notes you used for the WBS will facilitate the process of developing a PERT chart.

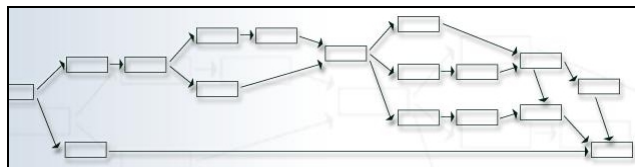


Exhibit 2-1: PERT chart

Begin by determining which of the activities have or do not have successors or predecessors. Activities that have successors but no predecessors are starting points for your PERT chart. Activities that have successors and predecessors comprise the pathways from the start points to the end points of your chart. Activities that have predecessors but no successors are ending points for your PERT chart.

A good way to convert your WBS sticky notes into a PERT chart is to arrange them on a wall in the sequence in which the activities must occur. Using sticky notes allows you to arrange the activities in various ways to determine the best order of completion for a project.

When you schedule the activities in a project, you can make strategic choices about how to sequence the dependencies among activities. Therefore, you should try as many combinations as possible and analyze the benefits and drawbacks of each combination. Doing so will enable you to develop the best sequence for the activities in your project.

Do it!

A-3: Creating PERT charts

Exercises

- 1 Select the first step in creating a PERT chart.
 - A Determine the project activities
 - B Analyze the sequence of activities
 - C Analyze the advantages and disadvantages of each activity
 - D Determine which activities have successors and predecessors

- 2 Your project is to arrange a birthday party for a colleague.

Identify 6 to 10 different activities that you need to perform. There must be at least two activities that are performed in parallel.

Create a WBS based on the activities.

Create a PERT chart based on the activities.

Topic B: Activity analysis

Explanation

Activity analysis is the process of studying activities in your project so that you fully understand all aspects of the project. Activity analysis will help you gather data, write specifications, and develop estimates for activities. In addition, analysis will help you assign tasks appropriately and identify potential problems that could disrupt progress. Collecting extensive information about each activity will not only help you understand all the elements of your project but also help you manage the project and control its performance.

Appropriate level of detail

The appropriate level of detail needed in your activity analysis is often determined by the complexity and expense of your project. Complex and expensive projects usually require more in-depth analysis than smaller, less sophisticated projects. A mistake in a costly project could have more serious consequences than a mistake in an inexpensive project.

There are two issues you should consider when determining the level of analysis to complete for your project. The first issue is how closely involved you'll be with the project as it is completed. If you have a high level of involvement in the project work as it is completed, your activity analysis will not need to be as detailed as it would need to be if you have little involvement as the work is performed.

The second issue in determining the level of activity analysis needed is the capability of the people working on the project. If your project team is talented and motivated, they will need less activity detail listed on the activity analysis forms in order to perform the work correctly.

Do it!

B-1: Determining appropriate level of detail

Exercises

- 1 Select the factors that indicate a need for a high level of detail in activity analysis.
 - A The project is simple
 - B The project team is inexperienced
 - C You'll have a high level of involvement as work is performed
 - D The project is expensive
- 2 Collecting extensive information about each activity will not only help you understand all the elements of your project but also help you manage the project and control its performance. True or false?

Effect of activity analysis on activity sequencing

Explanation

As you analyze the activities in your project, you might discover information that influences how you should schedule them. Therefore, as you perform activity analysis, you might need to return to your PERT chart and make changes to the dependency sequences. As a result, activity analysis helps you finalize the project schedule.

Activity analysis form

The best way to analyze project activities is to create an activity analysis form and complete one for every activity, as shown in Exhibit 2-2. How you design an activity analysis form depends on the level of analysis you plan to do.

ACTIVITY ANALYSIS FORM	
Project Name:	Activity Number:
Activity Name:	Predecessors:
Dates:	
Must Start By:	
Must Finish By:	
Milestones:	Successor:
red:	
	Equipment:

Exhibit 2-2: Activity analysis form

Since the level of detail you need in your activity analysis will vary by project, there are many items you should consider adding to an activity analysis form:

- *An activity name.* It is helpful to assign specific names to each activity. The activity name is usually the name it was given in the WBS. Examples of activity names might be “Train employees” or “Install software.”
- *An activity number.* Numbering each activity can help you organize the work for a project. Base your activity numbers on the WBS for the project. Start by numbering each of the categories into which you divided the WBS activities. Then, number the activities under each category. For example, imagine category two on your WBS is “Purchasing” and under this category the third activity is “Purchase printer.” The number for this activity would be 2-3.

- *Predecessor and successor activities.* Including an activity's predecessor and successor on the activity analysis form can be helpful since these activities are dependent on each other. You can simply list the predecessor and successor activities' names and numbers, which will help you locate them on the WBS.
- *Equipment and supplies.* In order for each activity to be completed smoothly, it is helpful to list all the equipment and supplies needed. Forgetting equipment and supplies can cause problems or delays in the project. In addition, you might want to note on your activity analysis form where the equipment and supplies can be obtained.
- *"Must start" or "must finish" dates.* Occasionally, activities must be started or finished by specific dates. These dates often depend on the scheduling of the surrounding activities. For example, if you want to train employees on a new task, and you intend to give them a handbook, you might assign a "must finish" date for printing the handbooks. A late activity completion time could disrupt the project schedule. Since you can only estimate how long most projects will take to complete, only use "must finish" and "must start" dates when necessary.
- *Milestones.* Since a project manager must determine whether work is being completed on time, on budget, and within the performance standards, you should assign checkpoints, or milestones, at which progress can be monitored. The number of milestones required will vary among activities based on activity duration and complexity.

Items required in an activity analysis form

Regardless of the level of analysis you intend to complete, the activity analysis form should include four specific details:

- The person(s) responsible for completing the activity
- An estimate of activity duration
- An estimate of activity cost
- The results the activity will produce

*Do it!***B-2: Creating activity analysis forms****Multiple-choice questions**

- 1 Select the items that must be included in an activity analysis form.
 - A “Must finish” and “must start” dates
 - B Person responsible for completing the activity
 - C Activity number
 - D Results the activity will produce
 - E Estimate of activity cost and duration
 - F Milestones
- 2 Identify what the number 2 represents in an activity that is numbered 2-3.
 - A The activity category
 - B The activity order
 - C The activity dependency
 - D The activity cost

Work assignments*Explanation*

Assigning who will complete each activity is a critical planning step. The person responsible for an activity has a great deal of influence on the outcome of the activity. As you assign work, you should ask yourself several questions to determine whether an individual is the right person to complete an activity:

- Does the person have the skills needed to complete the activity within the specifications?
- Does the person have time to work on the activity at the time specified in your schedule?
- What factors, such as other responsibilities and commitments, will affect the person’s ability to complete the activity?

If you do not have enough information about an activity to assign it, or if you cannot find the right individual, you should record as much information as possible about the skills an individual would need to complete the activity. Doing so will help you assign the activity at a later time.

*Do it!***B-3: Assigning work****Group discussion**

- 1 Do you agree that the person responsible for an activity has a lot of influence on the outcome of the activity? Give a relevant example.

Topic C: Activity estimation

Explanation

Estimating the time duration and cost of activities is an important step for successfully planning a project. The purpose of assessing activity duration is to determine how long a project will take to complete, as well as the number of work shifts needed for a project. Since they will be able to make the most reasonable estimates based on their experience, project team members should be involved in assessing activity duration. Estimating cost involves identifying the cost of the resources needed to complete a project. When completing a cost estimate, you'll always have a degree of uncertainty. The level of uncertainty depends on your experience, as well as the type of project. Generally, throughout the life of a project, more details become available and the cost estimate can be refined.

Estimating duration and cost

There are several types of estimating that you can use to determine the time duration and cost of project activities:

- Top-down estimating
- Bottom-up estimating
- Parametric estimating
- Phased estimating

Top-down estimating

Top-down estimating, as shown in Exhibit 2-3, utilizes a previous project's work breakdown structure (WBS) to compute the duration of a similar new project. When using top-down estimating, you assume that estimates for the past project accurately apply to the new one. It is important that the degree of similarity between the projects is very close, or estimates for the new project will be inaccurate.

Top-down estimating is generally useful when you do not have a finely detailed WBS for a new project. Another name for top-down estimating is "analogous estimating."

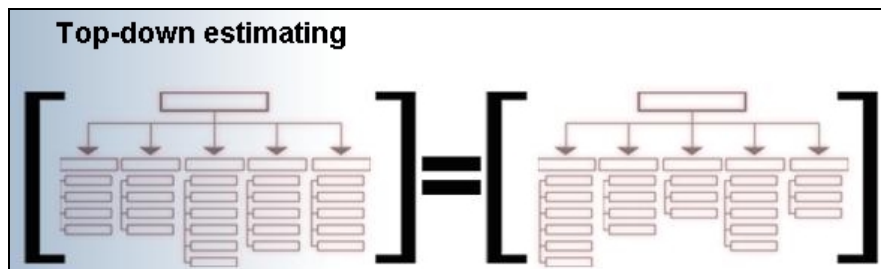


Exhibit 2-3: Top-down estimating

Bottom-up estimating

Bottom-up estimating involves both duration and cost estimates. For bottom-up estimating, duration and cost estimates start at the lowest level of activity on the WBS, then work up toward the highest level of activity. Once duration and cost estimates are completed for each activity, they are combined into a single time and cost forecast for the entire project.

The benefit of this technique is that it yields accurate total time and cost estimates for a project. Accurate estimates allow for realistic project scheduling and budget planning.

Parametric estimating

The *parametric estimating* technique uses historical data and other variables to calculate statistical relationships, resulting in a cost estimate. This technique takes a basic variable and uses it as a multiplier to figure the cost for an entire project. For example, if homes in a specific subdivision generally cost \$85 per square foot, and the home you are building is 1200 square feet, the total project cost estimate can be found by multiplying the two. The cost estimate for your home is \$102,000.

When using parametric estimating, it is important to understand that the cost estimates are not always accurate. The estimates can range from less than 25 percent accurate to better than 75 percent accurate, depending on the statistical data used to make the calculations. Project stakeholders must understand that parametric estimates are susceptible to change; otherwise, they run the risk of finalizing project goals based on unrealistic estimates.

Phased estimating

Project managers might have difficulty estimating a project's entire cost at the outset of the project if there is not enough information available to understand all of the project details. The *phased estimating* technique allows a project to be broken into phases, with separate cost estimates for each phase, rather than completing an estimate for an entire project.

As each phase of a project is finished, estimates for the next phase are completed. This estimating method is generally easier to use than other methods and results in a more accurate cost estimate. In addition, phased estimating protects you from the risks involved with committing to cost estimates for the entire project before you have enough information to estimate the overall costs accurately.

*Do it!***C-1: Estimating project activities****Multiple-choice questions**

- 1 _____ estimating type works best when you don't have important project details.
 - A Parametric
 - B Phased
 - C Bottom-up
 - D Top-down
- 2 Choose the estimating type that works best when you have information from a similar project.
 - A Bottom-up estimating
 - B Parametric estimating
 - C Phased estimating
 - D Top-down estimating

Assumptions while estimating*Explanation*

Estimating activity duration might involve three assumptions that are combined to determine the expected duration of an activity:

- *Optimistic completion time.* Assumes that an activity will proceed from start to finish without interruptions or obstacles.
- *Pessimistic completion time.* Assumes that every possible activity-related problem will occur prior to activity completion.
- *Most likely completion time.* Assumes that some difficulties will arise during the course of an activity.

Identifying results

Two types of results an activity might produce include specifications and deliverables. *Specifications* are detailed performance standards that must be achieved when an activity is completed. *Deliverables* are end products that are produced by an activity. On the activity analysis form, you should identify the most important specifications or the ones that will have the greatest influence on how the activity must be completed.

Problems and opportunities

Within every activity exists the potential for problems and opportunities. Since potential problems can endanger the success of your project and potential opportunities can increase the chance of success, you must plan for both of these situations.

Potential problems and opportunities

The more action you take during the planning phase to manage potential problems, the more likely problems can be resolved effectively or avoided completely. Similarly, you need to plan for opportunities in order to take advantage of them when they arise. Some project managers create a document called a Control Point Identification Chart, which helps them manage potential problems and opportunities for each activity.

The Control Point Identification Chart helps you identify what could go wrong or right, when something might go wrong or right, and how to overcome the problem or take advantage of the opportunity. To create a Control Point Identification Chart, brainstorm what problems or opportunities could occur while an activity is performed. Then, identify warning signals that can alert you if the problem or opportunity occurs during the activity. Finally, list strategies for managing the problem or opportunity.

Do it!

C-2: Identifying problems and opportunities**Exercises**

- 1 Read the following scene. In the scene, Marisa (project team member), Benjamin (project team member), and Patricia (project team member) are seated across from each other in the conference room.

Marisa: Okay, I found out that the shipments should take four to six weeks.

Benjamin: So, I guess we should just wait and see how we should proceed once the shipment is in.

Patricia: Actually, it would be worth our while to establish a course of action that assumes the shipment will come in four weeks and a course of action that assumes the shipment will take six weeks or longer.

Marisa: Yeah, you're right. If the shipment comes in four weeks, we want to make sure we take advantage of those extra two weeks.

Patricia: Exactly. Let's determine how we can schedule activities around both scenarios.

Why is it important to identify potential problems and opportunities in a project?

- 2 A Control Point Identification Chart helps project managers in managing potential problems and opportunities for each activity. True or False?

Topic D: Dependencies

Explanation

Dependencies dictate when an activity can be performed, which affects activity sequencing. There are three categories of dependencies you should understand:

- Mandatory dependencies
- Discretionary dependencies
- External dependencies

Mandatory dependencies

Mandatory dependencies, or hard logic, are restrictions specific to an activity. They require that one activity be completed before another can begin. For example, when building a house, the foundation must be finished before raising the walls. Mandatory dependencies are static, which means that they never change.

Discretionary dependencies

Discretionary dependencies, or soft logic, are restrictions outlined by the project manager based on two factors. First, if there are multiple methods of doing an activity, the project manager should choose the best method. For example, if you have the option to use one of two software programs, you can use the program you think best suits your needs for activity completion. Secondly, if there are many activity sequences, you can pick the one most desirable for achieving the project's objective.

As a project manager, you should use discretionary dependencies only after careful consideration since they can affect the activity sequence throughout an entire project.

External dependencies

External dependencies are restrictions that result from activities outside the project itself. This type of dependency creates restrictions that are beyond your control. External dependencies include such things as unfavorable weather conditions at a construction site or an important package delayed in the mail.

Dependency relationships

There are specific relationships between certain project activities. These relationships create dependencies between the activities and affect how you schedule activities. There are four dependency relationships that affect activity sequencing, and they might fall under the categories of mandatory or discretionary dependencies:

- Finish-to-start dependency
- Finish-to-finish dependency
- Start-to-start dependency
- Start-to-finish dependency

Finish-to-start dependency

The *finish-to-start dependency* is the most common activity relationship you'll encounter when creating a project schedule. In the finish-to-start dependency, Activity X must finish before Activity Y can start. For example, if you were installing a LAN at your office, you would need to purchase cables before you could install them.

Finish-to-finish dependency

Another dependency you'll encounter while creating a project schedule is the *finish-to-finish dependency*. In the finish-to-finish dependency, Activity X must finish before Activity Y can finish. This dependency can increase the efficiency of a project. For example, for a LAN installation project, you could begin connecting computers to the network before all of the offices are wired. By making the office wiring finish-to-finish dependent on connecting computers to the network, you allow work to begin sooner than if the activities were finish-to-start dependent.

Start-to-start dependency

The *start-to-start dependency* is another activity relationship that will affect how you schedule activities. In the start-to-start dependency, Activity X must start before Activity Y can start. In the LAN project, you could make developing training sessions start-to-start dependent on creating manuals since you could begin setting times for training sessions before all the training materials have been produced.

Start-to-finish dependency

A *start-to-finish dependency* can also occur between activities in a project. However, this relationship is usually less common than the other dependencies. In the start-to-finish dependency, Activity X must start before Activity Y can finish.

Do it!

D-1: Identifying dependencies**Multiple-choice questions**

- 1 Which dependency relationship increases the efficiency of a project?
 - A Finish-to-start
 - B Finish-to-finish
 - C Start-to-start
 - D Start-to-finish

- 2 Study the following scenario and select the dependency relationship it depicts.

Your project is to plan the company picnic. You cannot order the food until you know how many people will attend. Which type of dependency relationship do the activities of "ordering food" and "collecting RSVP cards" have?

 - A Start-to-finish dependency
 - B Finish-to-start dependency
 - C Finish-to-finish dependency
 - D Start-to-start dependency

- 3 Choose the dependency relationship that is least common.
- A Start-to-start
 - B Finish-to-start
 - C Finish-to-finish
 - D Start-to-finish

*Explanation***Leads affecting activity sequencing**

When two activities are controlled by a finish-to-start dependency, a *lead* represents an accelerated time-span between the completion of a predecessor activity and the start of its successor. For example, if Activity A is a predecessor to Activity B, and there is a five-day lead, then Activity B can start five days before Activity A is finished.

Lags affecting activity sequencing

In a finish-to-start dependency, a *lag* is the time between the finish of a predecessor activity and the start of its successor. Suppose that Activity C is a predecessor for Activity D, and once Activity C has been completed, Activity D cannot begin until two days later. The two days between the completion of Activity C and the start of Activity D is a lag.

Managing resources

As you schedule the activities in your project and establish dependencies, you must keep in mind the amount of resources needed and available for each activity. For example, if you want to make two tasks concurrent to shorten the amount of time needed to complete them, you must first determine whether you have the necessary resources at your disposal to complete the activities at the same time.

Resource availability can also affect the time needed to perform an individual activity. If the ideal resource for an activity is unavailable, you might need to consider an alternate resource. The alternate resource might or might not affect the activity's duration.

Risks affected by dependencies

Activity dependencies can increase or decrease a project's risk of failure since they can influence whether a project remains on schedule, on budget, and within the performance standards. Therefore, as you sequence the activities, you need to determine how the activity dependencies will affect the outcome of the project.

Slack

Slack is the difference in time required to complete concurrent activities. Frequently, you might not need the same amount of time to complete two concurrent activities. As a general rule, you should remember that slack decreases risk since the extra time can often be used to enhance the quality of work being completed or to reduce costs by completing an activity more slowly and using fewer resources.

*Do it!***D-2: Identifying lags and slack****Exercises**

- 1 In a finish-to-start dependency, a lag is the time between the finish of a predecessor activity and the start of its successor. True or false?
- 2 Select the items that are characteristics of slack.
 - A Increases the amount of resources needed
 - B Reduces risk
 - C Enhances the quality of project work
 - D Reduces the overall time needed for a project

Unit summary: Activities and dependencies

- Topic A** In this topic, you learned that you can use the **WBS** to identify complex project activities and divide them into smaller activities. Next, you learned that **sequencing** project activities arranges them in a logical order for completion. Part of activity sequencing is recognizing that there are different kinds of activities and understanding the relationships among them. A **PERT chart** will help you determine the best sequence for the activities in your project.
- Topic B** Next, you learned that **activity analysis** is the process of studying activities in a project to understand all the aspects of the project. The best way to analyze project activities is by creating an **activity analysis form**.
- Topic C** Then, you learned that **estimating the time duration** and **cost** of activities is an important step in successfully planning a project. Estimating the activity duration helps determine how long a project will take to complete. Estimating the cost helps determine the cost of the resources required in completing a project. You can use several types of **estimating techniques** to determine the time duration and cost of project activities.
- Topic D** Finally, you learned that different **categories of dependencies** determine when an activity can be performed. You also learned that specific relationships between certain project activities create **dependency relationships** between the activities that affect how activities are scheduled.

Independent practice activity

- 1 _____ activities must be finished before another activity can begin.
 - A Dummy
 - B Predecessor
 - C Successor
 - D Lag
- 2 Choose the project activity that is scheduled during a waiting period.
 - A Milestones
 - B Dummy
 - C Lag
 - D Concurrent

- 3 Choose the three types of dependencies.
 - A Mandatory
 - B Primary
 - C Secondary
 - D Discretionary
 - E External
 - F Lead
- 4 Which dependency requires that one activity be finished before a second activity can begin?
 - A External
 - B Discretionary
 - C Mandatory
 - D Internal
- 5 Your key supplier has declared bankruptcy and you are now waiting to purchase manufacturing equipment from another company. What is this type of project dependency called?
 - A Discretionary
 - B Internal
 - C External
 - D Mandatory
- 6 Choose the dependency relationship between buying land and constructing a new warehouse.
 - A Finish-to-finish dependency
 - B Finish-to-start-dependency
 - C Start-to-finish dependency
 - D Start-to-start dependency
- 7 Which document provides the activity name for the activity analysis form?
 - A Project objective statement
 - B Program evaluation and review technique
 - C Work breakdown structure
 - D Project constraint schedule

- 8 Choose the activity analysis item that can be used to monitor the progress of the project.
- A Predecessor and successor activities
 - B Equipment and supplies
 - C Milestones
 - D “Must finish” and “must start” dates
- 9 Your project involves implementing a new e-mail system. One of the activities in the activity analysis form that needs to be completed is training employees. The head engineer will be in charge of the training sessions, which should take two weeks. The training should enable all employees to effectively use the new system. Which detail is missing from this activity analysis?
- A The results of the activity
 - B The estimated duration of the activity
 - C The estimated cost of the activity
 - D Person responsible for completing the activity
- 10 Choose the estimating technique that assumes a basic variable and uses it as a multiplier to figure the cost of a project.
- A Parametric estimating
 - B Phased estimating
 - C Top-down estimating
 - D Bottom-up estimating

Unit 3

Project scheduling

Unit time: 60 minutes

Complete this unit, and you'll know how to:

- A** Develop a project schedule by using CPM, PERT, project network diagrams, arrow charting, and Gantt charts.
- B** Identify the benefits of CPM and PERT, the critical path, and the methods of duration compression.

Topic A: Schedule development

Explanation

Schedule development is the process by which a project manager arranges a project's main activities into a schedule. The purpose of project scheduling is to ensure effective time management during the project and to ensure that a project is completed within a reasonable time frame. During schedule development, you should assign a start and end date to each activity. When doing so, it is critical to consider activity relationships, activity duration, and resource availability.

Benefits of schedule development

Schedule development provides several benefits for a project:

- *A schedule establishes activity and project commencement and completion dates.* A project's life cycle begins with the first activity on the schedule. A project's life cycle ends with the final activity on the schedule, and its completion date should reflect the completion date for the entire project. Since the project completion date is based on the time estimates for each activity, it should represent a practical goal for the project manager and team.
- *A schedule facilitates monitoring activity completion.* A schedule can be used to monitor activity completion, which ensures that the project will be completed within a practical amount of time. Using the schedule as a monitoring tool is beneficial since incomplete activities can disrupt the timing of the rest of the project.
- *A schedule illustrates activity interdependence.* Related activities are grouped together on a schedule enabling you to discover potential conflicts between activities. Recognizing conflicts before the project begins helps identify and avoid problems during the project life cycle.
- *A schedule dictates when project team members work.* Since all project team members do not need to be present for each project activity, a schedule is beneficial because it dictates the dates and times when team members need to complete work.

Constraints in schedule development

When developing a project schedule, you should consider two major constraints. First, a project completion date might be imposed by an outside entity. For example, if your company wants to redesign one of its products, the management staff might dictate a date by which the new design must be complete.

A second constraint to consider during schedule development is the time frame expectations of project stakeholders. Since stakeholders expect to see progress, you should include milestones on project schedules. The milestones enable stakeholders to verify what progress has been made.

*Do it!***A-1: Identifying benefits and constraints****Exercises**

- 1 Select the benefits that schedule development provides for a project.
 - A Determines individuals' activity cost
 - B Illustrates activity interdependence
 - C Establishes start and end dates
 - D Helps monitor activity completion
 - E Ensures project performance stays on budget
 - F Dictates when team members work
- 2 Share your experiences of a project that could not be completed on time because of an ineffective project schedule.
- 3 Which of the following is a constraint that needs to be considered when developing a project schedule?
 - A The time frame expectations of project stakeholders
 - B The current stock price of the company
 - C The self-imposed deadlines for the project
 - D The expectations of team members

Mathematical analysis techniques*Explanation*

The following are the two most widely known mathematical analysis techniques for schedule development:

- Critical Path Method
- Program Evaluation and Review Technique

The CPM and the PERT are both techniques for network planning. Each shows a project as a sequence of activities, and each facilitates a project manager's ability to analyze an entire project or individual activities. In addition, the CPM and PERT charts allow a project manager to analyze the relationships and dependencies among activities. In the strictest sense, CPM is charted using activity-on-node diagrams, and PERT is charted using activity-on-arrow diagrams. However, in general use, most project managers use a combination of features from PERT and CPM. Most project management software programs combine the systems as well.

Critical Path Method

The *Critical Path Method* (CPM) is a schedule development technique used to identify the least flexible activities in a project based on float calculations. *Float* is the length of time that the start of an activity can be deferred without affecting the completion date for the entire project.

Float calculations are used to determine the longest sequence of activities that cannot be completed concurrently, which yields the earliest time of project completion. This long sequence of activities is the critical path. Any delays in activities on the critical path affect the duration of the whole project.

Project managers use CPM to find a logical flow for project activities, identify where the critical path can be shortened, and determine where resources can be added to improve the project. In addition, CPM can be used to develop a crash plan for a schedule. Crash refers to the process of accelerating activity completion by adding resources. A crash plan illustrates the effects of crashing on individual activity duration and overall project cost.

Program Evaluation and Review Technique

The *Program Evaluation and Review Technique* (PERT) for schedule development is used to determine project duration based on three time estimates: optimistic, pessimistic, and most likely. PERT is used mainly for large-scale projects, since it can display large amounts of complex data in an orderly form. Project managers use PERT charts to determine which areas of a project require the most effort to stay on schedule.

Do it!

A-2: Identifying mathematical techniques for analysis

Multiple-choice questions

- 1 Select the characteristics of CPM.
 - A Identifies where critical path can be shortened
 - B Uses three time estimates to find duration
 - C Identifies least flexible activities
 - D Determines where to add resources for improvement
 - E Helps determine logical flow for activities
- 2 Select the choice that best describes the effects of delays in activities on the critical path.
 - A Delays affect concurrent activities
 - B Delays affect the duration of the entire project
 - C Delays affect the duration of the next activity
 - D Delays affect predecessor activities

- 3 Select the characteristics of a PERT chart.
- A Develops a crash plan for a schedule
 - B Identifies the least flexible activities in a project
 - C Determines project duration based on time estimates
 - D Determines the longest sequence of activities that cannot be completed simultaneously
 - E Determines which areas of a project require the most effort to stay on schedule

Project network diagram

Explanation

Nodes and arrows on a project network diagram illustrate the activity relationships and completion sequences from the beginning of a project to the end. A project network diagram, as shown in Exhibit 3-1, starts with an activity that does not have any predecessors and ends with an activity that does not have any successors. Network diagrams are generally constructed so that workflow starts on the left and proceeds to the right.

Why use networks?

Networks are used when planning a project's schedule for a variety of reasons:

- Networks highlight dependencies among project activities.
- Networks identify the critical path.
- Networks indicate amounts of time needed for each activity.
- Networks illustrate float and free float.

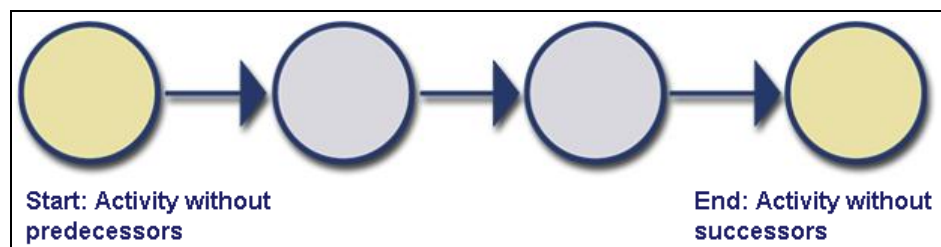


Exhibit 3-1: Project network diagram

Do it!

A-3: Understanding network diagrams

Exercises

- 1 Read the following scene. In the scene, Mr. Kramer (project manager) and Elliot (project team member) are seated across each other in the conference room.

Mr. Kramer: Thanks for stopping by, Elliott. I wanted to see how you're coming along with the Franklin account.

Elliott: Just fine. Last week's meeting marked my first milestone, and I'll pass the second one sometime next week, when I complete the purchase orders.

Mr. Kramer: That's great! Keep me updated on your progress, so I can mark it on the diagram. The stakeholder meeting is scheduled for the end of the month, so they'll want to see copies of the diagram, along with the usual progress report.

Elliott: Sure, no problem.

Identify two benefits that you can derive from plotting project milestones on a project network diagram.

- 2 Why should a project manager use network diagrams when planning a project's schedule?
 - A To give broad overview of the project
 - B To indicate the time needed for each activity
 - C To indicate the number of activities the project will require
 - D To identify the goal for the project

Methods of arrow charting

Explanation

There are two methods of arrow charting used to create project network diagrams:

- Activity-on-node method
- Activity-on-arrow method

Activity-on-node method

One way to create a project network diagram is to use the activity-on-node method. In an *activity-on-node diagram*, as shown in Exhibit 3-2, nodes represent activities, while arrows drawn between the nodes represent activity relationships.

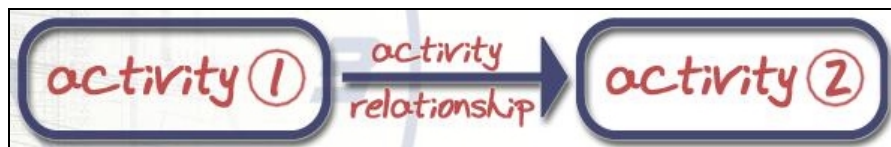


Exhibit 3-2: Activity-on-node method

Activity-on-arrow method

An *activity-on-arrow diagram* uses arrows to represent activities, while the nodes represent events and demonstrate how activities relate to one another, as shown in Exhibit 3-3.



Exhibit 3-3: Activity-on-arrow method

Most common arrow charting method

Activity-on-node is more commonly used than activity-on-arrow since many project management software programs use activity-on-node diagrams. In addition, activity-on-node diagrams can be created easily from a work breakdown structure created with sticky notes since the sticky notes can become the nodes. However, neither method is better than the other, because they both allow you to schedule project activities and analyze dependencies among activities.

Do it!

A-4: Identifying arrow charting methods

Exercises

- 1 Which of the following are types of arrow charting methods used to create a project network diagram?
 - A Activity-on-lag
 - B Activity-on-event
 - C Activity-on-node
 - D Activity-on-sticky-notes
 - E Activity-on-arrow
- 2 Match the following descriptions with the appropriate arrow-charting methods: activity-on-node and activity-on-arrow.

The arrow-charting method in which nodes represent activities and arrows represent activity relationships

The arrow-charting method that uses arrows to represent activities, while the nodes represent events and demonstrates how activities relate to one another

Gantt charts

Explanation

A *Gantt chart* is a bar chart that displays activity duration. The horizontal axis of a Gantt chart indicates the project schedule, while the vertical axis indicates the activities from the work breakdown structure. Symbols on Gantt charts denote such things as milestones or project concerns.

Advantages and disadvantages

Using Gantt charts can be advantageous since they

- Incorporate the work breakdown structure to illustrate a project's activity sequence from start to finish.
- Show individual activity start and finish dates.
- Summarize activity descriptions, which makes the charts easy to understand.
- Can be updated simply by adding or deleting lines and columns from the chart.
- Can be read easily by team members.

Using Gantt charts also has some disadvantages, which include the inability to

- Illustrate activity dependencies.
- Exhibit the effects of early or late activity start times.
- Show variations in activity duration.

Creating a Gantt chart

The information you need to create a Gantt chart is readily available in your activity analysis forms, which you should have created while planning the project. Use the following process to create a Gantt chart:

- 1 On the horizontal axis, create the headings Activity Name, Number, and Duration.
- 2 Add a fourth heading that includes time increments for the project schedule.
- 3 On the vertical axis, list all of the project activities.
- 4 Then, create bars that reflect the duration for each activity by matching the activities' start and finish times to the time increments on the horizontal axis.

You might find it helpful to differentiate the bars for critical activities from the bars for non-critical activities, which can be done by coloring or shading the bars. In addition, if an activity's duration is not as long as the time available for completing it, you can note the extra time, or float, with a line extending from the duration bar. A sample Gantt chart is shown in Exhibit 3-4.



Exhibit 3-4: Gantt chart

Resource leveling

After creating your Gantt chart, you might discover that there are certain periods of time in which you might not have enough resources, such as project team members, available to complete all the activities. This situation is not uncommon and can be remedied in one of two ways.

One way you can match your resources and schedule is to increase the number of resources. For example, if you do not have enough team members for certain times during the project schedule, you might be able to use additional staff for a limited amount of time in order to accomplish all the activities as scheduled.

A second way you can match your resources and schedule is to move the schedule so that it accommodates the resources. For periods of time in which you do not have enough resources to complete the scheduled activities, you might be able to shift some of the work ahead or behind so that it can be completed when there are sufficient resources available. This practice is called *resource leveling*.

Do it!

A-5: Creating Gantt charts

Exercises

- 1 Select the advantages provided by a Gantt chart.
 - A Can be updated by adding or deleting lines and columns
 - B Illustrates the project activity sequence
 - C Shows activity start and end dates
 - D Exhibits the effects of early and late starts
 - E Summarizes activity descriptions
 - F Can be read easily by team members
 - G Illustrates activity dependencies
- 2 Select the two ways in which you can match your resources and the project schedule.
 - A Adding resources to accommodate the schedule
 - B Negotiating with other departments for more resources
 - C Requesting more funding from the project stakeholders
 - D Moving the schedule to accommodate available resources

- 3 Your project is to arrange a birthday party for a colleague.

Now, do the following in groups of four:

Identify 6-10 different activities that you need to perform. There must be at least two activities that are performed in parallel.

Choose reasonable durations for each activity.

Create WBS based on the activities.

Create a PERT chart based on the activities.

Create a Gantt chart based on the activities.

Topic B: CPM and PERT

Explanation

Using CPM, PERT, or a combination of the two provides several benefits. One benefit is that both systems allow you to determine whether a project can be completed by a designated time. Another benefit is that CPM and PERT can show when individual activities need to be completed to achieve the overall project deadline. In addition, both systems can show which activities have leeway for when they need to start or end, and both systems can help you determine the critical path for a project.

Resource availability considerations

You should keep in mind that resources are not shown on the CPM and PERT charts. Therefore, you might create a CPM or PERT schedule that looks good on paper but is unrealistic. As you create a CPM or PERT chart, you should assume that the necessary resources are available so that you can develop the schedule without continuously checking on resource availability. However, once you have completed the project schedule, you must take resource availability into consideration since the amount and type of resources you use will affect whether activities can be completed within the specified durations.

Critical path

The *critical path* on a CPM or PERT chart is the longest chain of activities that cannot be completed concurrently. This path determines the minimum duration of the entire project. The activities on the critical path are called critical activities since missing the deadline on one of these activities affects successor activities and the project deadline. Identifying the critical path and critical activities in a project schedule can help you determine how priority changes affect a project and which activities are most affected by the changes. In addition, identifying the critical path and critical activities can help you determine where you can adjust the schedule to make up for lost time.

Do it!

B-1: Understanding critical path

Exercises

- 1 Critical path helps determine _____ and _____.
 - A Where the schedule can be adjusted
 - B The latest completion date of the project
 - C How changes affect the project
 - D The shortest path for activity completion
- 2 The critical path determines the minimum duration of the entire project. True or False?
- 3 Create a project with at least 6-10 different activities. Create a PERT chart based on the activities and identify the critical path. Complete this activity in groups of four or five.

Steps for CPM scheduling

Explanation

There are nine steps for CPM scheduling:

- 1 Develop an activity list that includes all main project activities.
- 2 Use the activity list to construct an arrow diagram.
- 3 Compute activity duration estimates for each activity on the network diagram.
- 4 Examine the activity sequence represented on the network diagram to ensure that it is realistic.
- 5 List the respective duration times and costs next to each activity.
- 6 Determine the critical path of the project.
- 7 Assign calendar dates to each activity on the diagram.
- 8 Compare the critical path of the CPM chart to the mandatory project dates to make sure you'll complete the project on time according to stakeholder expectations.
- 9 When necessary, apply methods to reduce activity duration so that the project can be completed on time.

CPM calculations

When discussing CPM, it is imperative that you understand four terms and their respective calculations:

- Earliest start time
- Earliest finish time
- Latest finish time
- Latest start time

Earliest start time

The *earliest start time* (EST) of an activity is the least amount of time that must pass from a project start date before that activity can begin. Finding EST involves making a forward pass through a network diagram along the longest path toward the activity for which you are estimating EST. Making a *forward pass* means starting at the beginning of the diagram and calculating the duration of each activity preceding the activity for which you are estimating EST. The EST of an activity is equal to the sum of all duration times for its predecessor activities.

Suppose Activity A is the first activity of a project, so it does not have predecessor activities. Since Activity A must begin on Day One of the project, it has an EST of zero. Suppose Activity C is the third activity of a project, and its predecessors are Activities A and B. If Activity A has a two-day duration and Activity B has a one-day duration, then the EST for Activity C is three days. Therefore, three days must pass after the project start date before Activity C can begin.

Earliest finish time

The *earliest finish time* (EFT) of an activity is the least amount of time that must pass from the project start date before an activity can finish. Like EST, finding EFT involves making a forward pass through a network diagram. The EFT of an activity is equal to the sum of its EST and its own duration:

$$\text{EFT} = \text{EST} + \text{activity duration}$$

Suppose the EST Activity D is four days into the project and that Activity D has a six-day duration. Therefore, the EFT for Activity D is 10 days from the first day of the project.

Latest finish time

The *latest finish time* (LFT) of an activity is the greatest amount of time that can pass between the project start date and the activity finish date without affecting the end date of the entire project. The latest finish time is calculated by making a backward pass through the network. In other words, LFT calculation starts at the end of a project and works backward to the beginning.

Suppose a project must be completed by the end of Day 50. The final two project activities are Activities Y and Z. The latest that Activity Z can finish without disrupting timely project completion is Day 50. If Activity Z cannot begin until Activity Y ends, and if Activity Z takes exactly 10 days to complete, then the LFT for Activity Y is no later than the end of Day 40.

Latest start time

The *Latest start time* (LST) is the latest time that an activity can start without affecting the end date of the entire project. The latest start time of an activity is equal to the difference between its latest finish time and its duration:

$$\text{LST} = \text{LFT} - \text{activity duration}$$

Suppose Activity Y has an eight-day duration and an LFT of Day 40 of the project. The LST for Activity Y is Day 32. If Activity Y does not begin on or before Day 32, then the project will not finish on time.

Do it!

B-2: Understanding CPM scheduling and calculations**Exercises**

- 1 Sequence the first four steps of CPM scheduling.
 - Compute duration estimates
 - Develop an activity list
 - Construct an arrow diagram
 - Examine activity sequences
- 2 Sequence the last five steps of CPM scheduling.
 - Assign calendar dates
 - Determine critical path
 - Compare critical path to mandatory project dates
 - List duration and cost estimates
 - Apply methods to reduce duration
- 3 As a project manager for an upcoming telecommunications project at Icon International, you are creating a CPM schedule for the project. You have identified the activities and constructed an arrow diagram. You have also computed the activity duration estimates for each activity on the project network diagram. What would be your next step?
 - A Determine the critical path of the project
 - B Compare the critical path of the CPM chart to the mandatory project dates to ensure that you'll complete the project on time according to stakeholder expectations
 - C Apply methods to reduce activity duration
 - D Examine the activity sequence represented on the network diagram to ensure that it is realistic

- 4 Activity C has Day Four EST and duration of five days. Select the EFT for Activity C.
 - A Five days from the project start
 - B Nine days from the project start
 - C Four days from the project start
 - D One day from the project start
- 5 Activity C has a Day 18 LFT and duration of eight days. Select the LST for Activity C.
 - A 26 days from the project start
 - B 8 days from the project start
 - C 10 days from the project start
 - D 18 days from the project start
- 6 Select the correct equation for calculating the EFT for an activity.
 - A $EFT = EFT - LST$
 - B $EFT = LFT + \text{activity duration}$
 - C $EFT = EST + \text{activity duration}$
 - D $EFT = LFT - EST$
- 7 Select the correct equation for calculating the LST for an activity.
 - A $LST = LFT - \text{activity duration}$
 - B $LST = \text{Activity duration} - EFT$
 - C $LST = \text{Activity duration} - LFT$
 - D $LST = EFT - \text{activity duration}$

Calculating project duration

Explanation

To calculate project duration from an activity-on-node diagram, begin by adding the duration for each activity, represented by a node, from start to finish through the network. If there is more than one possible path to follow, determine the duration times for each possible path. The path that takes the longest amount of time to complete is the critical path and represents the earliest possible completion date of the project.

Methods of duration compression

Once a schedule has been created, you might need to reduce activity duration to ensure that the project can be completed on time. *Duration compression* is the process by which a project's completion time is reduced without altering the project scope or what the project is expected to accomplish. While the project scope should not change, duration compression often affects quality and cost and leads to additional risk. There are several methods of duration compression that project managers can consider during scheduling:

- Crashing
- Fast tracking
- Assigning limited overtime
- Implementing shortcuts

Crashing

One method is *crashing*, which accelerates activity completion by using more resources to complete activities on the critical path. Crashing alters the duration of activities on the original critical path and can lead to the creation of a new critical path. Since crashing uses more resources, it often results in a higher cost for activity completion. For that reason, crash plans should illustrate crash cost versus original cost, as well as changes in activity duration. Project managers can use a crash plan to determine whether crashing is compatible with the project's budget and goals.

It is important to understand that critical path activities are the only activities eligible for crashing, since crashing other activities will not affect the project completion date. Before crashing a project, always make sure that it is a feasible option for schedule compression.

Fast tracking

Another method of compressing activity duration is *fast tracking*. Activities that are put on a fast track are rearranged based on precedence relationships so that those activities are performed at the same time rather than in sequence. Performing activities simultaneously reduces project duration.

It is important to understand that fast tracking involves a high level of risk. Therefore, a project's major stakeholders must be aware of the risks before agreeing to fast tracking. Due to the risk involved, it should be used only when other schedule compression methods are inadequate for project completion purposes.

Assigning limited overtime

Assigning limited overtime to project team members for certain activities can also shorten overall project duration. It is important to carefully consider which project team members to include when assigning overtime. Too many hours of overtime leads to burnout. In addition, overtime should be carefully considered since it can increase overall project cost.

Implementing shortcuts

Shortcuts might include using a specialized computer program to design a construction model, acquiring resources based on availability rather than specification, or reducing the amount of time allotted for product testing. It is important to note that there is risk involved when using shortcuts. You must be careful when implementing shortcuts, so they do not adversely affect the final project results.

Do it!

B-3: Understanding duration compression**Exercises**

- 1 An option for reducing activity duration is to rearrange activities based on precedence relationships so that they're formed at the same time rather than in a sequence. What is this method of duration compression called?
 - A Implementing shortcuts
 - B Fast tracking
 - C Reorganizing
 - D Tabling
- 2 Assume that in order to complete a project on time, you decide that there should be less time allotted for product testing. Which method of duration compression are you using?
 - A Fast tracking
 - B Assigning limited overtime
 - C Implementing shortcuts
 - D Re-evaluating

- 3 Read the following scene. In the scene, Marcus (project team member) is sitting at his workstation when Elliot (project team member) approaches him.

Elliot: Hey, Marcus, did you hear that Mr. Kramer called a last-minute meeting to discuss the Pearson Project?

Marcus: No, I hadn't heard. Is there a problem?

Elliot: Well, upper management told him the deadline for the project has been moved up two weeks.

Marcus: What do you think this means for us?

Elliot: I'm not sure, but the meeting is scheduled for tomorrow at 8:00. My guess is that they'll assign more people to help us. It'll cost more money, but that's the only way we'll get done on time.

Suggest a duration compression method that will help Mr. Kramer complete the project activities on time. Provide reasons for your answer.

Float and free float

Explanation

The term *float* refers to the length of time that the start of an activity can be deferred without affecting the completion date for the entire project. *Free float*, or slack, differs from float in that it refers to the length of time that an activity can be deferred without affecting the earliest possible start time of any immediate successor activities. An activity that cannot be deferred without affecting the project completion date or another activity's start date is said to have zero float. Calculations of float and free float are completed for each activity in a network. These calculations are useful in the event that a project manager must change the project schedule.

It is important to understand that on a project network diagram, the critical path is the longest path with the least amount of float. Therefore, most of the activities along the critical path have little float time, but they do not necessarily have zero float.

Calculating float

To calculate float for an activity, subtract the earliest finish time from the latest finish time:

$$\text{Float} = \text{LFT} - \text{EFT}$$

Suppose Activity D has an LFT of 25 days and an EFT of 11 days. Using the equation, the float for Activity D is 14 days. There are 14 days of float in scheduling the start for Activity D.

Do it!

B-4: Calculating float

Multiple-choice questions

- 1 Activity C has a Day 26 LFT and a Day 18 EFT. Select the float for Activity C.
 - A 26 days
 - B 18 days
 - C 44 days
 - D 8 days
- 2 What is float?
 - A The latest time an activity can be started without affecting the next activity's earliest start
 - B The length of time an activity can be deferred without affecting the project duration
 - C The length of time an activity can be deferred without affecting the next activity's earliest start
 - D The latest time an activity can be started without affecting the project duration

- 3 Select the correct equation for calculating float for an activity.
- A $\text{Float} = \text{LFT} - \text{EST}$
 - B $\text{Float} = \text{LST} - \text{EST}$
 - C $\text{Float} = \text{LFT} - \text{EFT}$
 - D $\text{Float} = \text{LST} - \text{EFT}$
- 4 The length of time an activity can be deferred without affecting the earliest start time of any immediate successor activity is called _____.
- A non-float
 - B free float
 - C zero float
 - D intermediate float
- 5 What is the term for an activity that cannot be deferred without affecting the project completion date or another activity's start date?
- A Standard float
 - B Intermediate float
 - C Free float
 - D Zero float

Unit summary: Project scheduling

Topic A

In this topic, you learned that **schedule development** is the process by which a project manager arranges the main activities of a project into a schedule. You can create a project schedule by using various techniques, such as **CPM**, **PERT**, **project network diagrams**, **arrow charting**, and **Gantt charts**.

Topic B

In this topic, you discovered that using **CPM**, **PERT**, or a combination of the two, provides several benefits. You also learned that the **critical path** on a CPM or PERT chart is the longest chain of activities that cannot be completed concurrently. After developing the schedule, to ensure that the project can be completed on time, you can use the process of **duration compression** to reduce activity duration.

Independent practice activity

- 1 What is the primary benefit of developing a schedule?
 - A It outlines the chain of command on the project team.
 - B It determines the goals for the project.
 - C It facilitates the monitoring of activity completion.
 - D It guarantees that the project will be completed on time.
- 2 What can be accomplished by recognizing the interdependence between activities?
 - A It helps you establish the time frame required for each activity.
 - B It enables you to discover potential conflicts between activities.
 - C It helps you determine the start and end dates of the project.
 - D It enables you to determine the persons who will work on various aspects of the project.
- 3 In Critical Path Method, what is meant by float?
 - A The approximate length of time that must pass before a subsequent activity can begin.
 - B The average length of time it takes to complete each activity during the course of the project.
 - C The length of time that the start of an activity can be delayed without influencing the completion date for the entire project.
 - D The cumulative length of time from the beginning of the project until its completion.

- 4 Select the two time estimates that are used to determine project duration by using PERT.
 - A Optimistic and least likely
 - B Optimistic and most likely
 - C Ideal and pessimistic
 - D Most likely and least likely
- 5 On an activity-on-node diagram, what do the arrows represent?
 - A The duration of the activities
 - B The resources required to complete the activity
 - C The relationships between the activities
 - D The float time calculation
- 6 Identify an advantage of using Gantt charts.
 - A They explain each activity in detail.
 - B They can be easily updated.
 - C They show the effects of late activity start times.
 - D They illustrate activity dependencies.
- 7 Identify the benefit of using CPM and PERT to schedule projects.
 - A They illustrate the cost of each activity relative to the project as a whole.
 - B They allow you to determine whether or not a project can be completed by the designated time.
 - C They help make you aware of the expectations of the management for the project.
 - D They allow you to ascertain whether or not the project will be completed using the limited budget.
- 8 What is a critical path?
 - A The chain of activities that can be completed in the shortest period of time
 - B The shortest chain of activities that cannot be completed consequently
 - C The longest chain of activities that cannot be completed concurrently
 - D The longest chain of activities that can be completed simultaneously

- 9 How is the earliest start time (EST) of an activity calculated?
- A By estimating the total duration for the project and subtracting the estimated start time for the activity for which you are estimating EST
 - B By calculating the earliest finish time (EFT) of each activity preceding the activity for which you are estimating EST
 - C By calculating the duration of each activity following the activity for which you are estimating EST
 - D By calculating the duration of each activity preceding the activity for which you are estimating EST
- 10 Consider an EST of five days and duration of four days. Now, calculate the EFT of the activity.
- A 1 day
 - B 9 days
 - C 10 days
 - D 20 days
- 11 Which of the following is an effect of duration compression on a project?
- A It can negatively affect project quality.
 - B It allows for less risk.
 - C It can lower the cost of the project.
 - D It can lengthen the project duration.
- 12 What is crashing?
- A Using more time to complete activities not on the critical path
 - B Using more resources to complete activities on the critical path
 - C Using fewer activities to shorten the overall project duration
 - D Using fewer resources to complete activities on the critical path

Unit 4

Project change control

Unit time: 45 minutes

Complete this unit, and you'll know how to:

- A** Define project change control.
- B** Identify the steps in accommodating the changes in a project.

Topic A: Project change control system

Explanation

Control involves measuring, monitoring, and adjusting aspects of a project to produce a desired outcome and achieve the project's goals. Since control requires knowledge of the project status, the project manager and team must continually monitor the project. Comparing the project's progress to the original plan enables a project manager to identify deviations from the plan and take corrective actions to put the project back on the plan. Project managers control projects by using change control systems, measuring performance, and analyzing reports.

Project change control

Project change control involves managing changes so they benefit the project and verifying that performance standards for the project are met. If tools are used to measure the performance of the project, change control verifies that the tools are properly configured to ensure accurate measurements.

In addition, project change control requires recording all changes to the scope of a project or the work that is required to complete a project. Since changes can have an impact on more than one area of a project, the project manager must ensure that all affected individuals are aware of the changes and how the changes affect them.

The processes used to control a project are defined and compiled by the project manager and team into an overall change control system. During project execution, the control processes are used to track progress and make changes when problems arise. A change control system should have specific guidelines for processing and executing changes to a project or project-related documents. This system should designate what forms should be filled out to request or make changes and to whom the forms should be given for approval and implementation.

A change control system should also indicate how and where changes should be documented. In addition, a change control system should provide a method for evaluating the benefits and drawbacks of potential changes, how to communicate changes to the necessary people, and how to monitor the implementation of changes.

Objectives of project change control system

Change control systems have three basic objectives:

- Screen project change requests
- Document the accepted changes
- Update the project plan and other documents affected by changes

Characteristics of project change control system

Good change control systems have several characteristics in common:

- Emphasizes project success
- Focuses on what is important
- Establishes a system for taking corrective action
- Emphasizes timely response

Emphasizes project success

A change control system should emphasize the overall success of a project, so it does not inhibit progress. A project change control system should be flexible so the project manager can incorporate specific measurement techniques needed during each phase of the project. Therefore, a change control system should include provisions for changing performance measurement techniques as necessary. In addition, the performance measurement techniques, such as measuring cost and schedule variance, should be reasonably accurate and appropriate for the type of performance measured.

A change control system should also operate ethically and efficiently. It should not conceal actual performance results, and it should not waste resources or strain the project budget while measuring performance.

Focuses on what is important

Since the goal of any project is to accomplish the project objectives, a change control system should focus on the elements that can affect whether the objectives are met. Keep in mind that the elements you control in a project frequently become the most important elements to the team because more emphasis has been put on them. Be sure that the elements you control are the most important ones. Otherwise, you might unintentionally de-emphasize important project elements. For example, if you control cost and schedule, team members might accomplish the schedule and budget goals at the expense of quality.

Several questions can help you determine what elements should be controlled:

- What is the project supposed to accomplish?
- What elements are important to the organization?
- Which activities are critical for project success?
- Where should controls be placed in the process to ensure success?

Establishes a system for taking corrective action

Perhaps the most important function of a change control system is to give the project manager and team members rules for taking corrective action. A change control system that identifies problems without providing guidance to correct the problems will not ensure the success of the project. When data shows that the project is deviating from plan, the project manager needs to help put it back on plan. This does not mean that the project manager has to actually make the corrective actions, only that he or she needs to ensure that team members are taking steps to correct the problems.

Emphasizes timely response

Corrective action must be made in a timely manner. If corrections are made too late, they might be ineffective or even make the problems worse. For these reasons, project managers always need to know the current status of the project, and they need to collect control data on a regular basis. For many projects, weekly status reports might be sufficient, but a control system should be based on the needs of each particular project.

*Do it!***A-1: Understanding project change control system****Exercises**

- 1 A change control system that identifies problems without providing guidance to correct the problems will not ensure the success of the project. Do you agree or disagree?

Identify the most important reason for your opinion.

- 2 Select the characteristics of a good change control system.
 - A Focuses on accurate performance reporting
 - B Emphasizes timely response
 - C Focuses on what is important
 - D Emphasizes micromanagement
 - E Emphasizes project success
 - F Establishes a system for taking corrective action

Topic B: Controlling change

Explanation

You need the following items to control changes to a project:

- The project plan and scope statement
- A list of project factors which are necessary to control, such as performance, cost, and time constraints
- Current and accurate performance reports
- Documentation of changes or potential changes
- Equipment to measure such things as performance and cost

Role of status meetings

Status meetings are used during project implementation to discuss status and find solutions to any problems. For example, if the project is behind schedule, a status meeting should be held to determine what can be done to put the project back on track. Or, if the project is going over budget, a status meeting can help identify ways to lower operating costs.

Steps in accommodating change

Use the steps in the AMEND acronym to accommodate changes in a project.

- 1 Assess the potential change
- 2 Modify the project plan
- 3 Examine alternatives
- 4 Navigate project procedures
- 5 Deliver sufficient information

Assess the potential change

Before making any changes to a project, you should assess exactly what they should accomplish. Changes should be implemented only when necessary to ensure project success, so you need to determine the desired results they should produce. In addition, you should determine how to measure whether or not the changes create the desired results.

Modify the project plan

After you have determined the expected results of a change, modify the project schedule and budget to see how the change will affect them. In addition, determine whether the change will affect the project performance standards. If a change is imposed by an outside source, you should determine the effects before agreeing to make the change. Since project team members might be able to identify effects that you have overlooked, reviewing potential changes with them can be beneficial.

Examine alternatives

Before choosing a solution, you should examine alternatives. Usually, there is more than one way to achieve a goal. Re-examine your budget and schedule and decide whether the potential change is the best possible choice considering the available resources.

Navigate project procedures

When you have determined the best course of action, you should thoroughly document the change by adding it to the original project plan, and if necessary, submit the change for approval. For significant changes, you should provide all stakeholders with written notification of the change.

Deliver sufficient information

When you implement a change, you must notify everyone affected by it. Project team members need to understand how the change will affect the project and how expectations might have changed. You should also tell team members how the results of the change will be measured. Doing so will help them communicate with you as the change is implemented.

Do it!

B-1: Accommodating change**Exercises**

- 1 What are the first two steps in the process for accommodating change?
 - A Assess the potential change
 - B Modify the project plan
 - C Address plan deviations
 - D Manage the team's reaction to change
- 2 Select the last three steps in the process for accommodating change.
 - A Negotiate for more resources
 - B Determine the effects of the change on the budget
 - C Examine alternatives
 - D Navigate project procedures
 - E Estimate efforts to the project schedule and budget
 - F Deliver sufficient information
- 3 From your experience, share a do or a don't tip on accommodating changes in a project.

Project change control board

Explanation

In addition to the process for accommodating change, you might need to seek approval for changes with a project change control board. Some projects have a group of people, approved by major project stakeholders, who have the authority to approve or deny change requests. It is important that the members' roles are clearly defined, so they know the extent of their authority.

Generally, changes can be made on an emergency basis without prior approval from the change control board. Emergencies should be specified somewhere in a project's change control system. It is important to understand that changes made in response to emergencies require the same documentation and follow-up as other changes.

Results of project change control

Results of project change control include updates to the project's plan, scope statement, and budget. Another result of change control is that all corrective actions taken during the project should be documented, as well as any lessons learned while implementing changes.

Do it!

B-2: Understanding a project change control board

Exercises

- 1 Read the following scene. In the scene, Mr. Harding (project manager), Nathan (project team member), and Elliot (project team member) are seated in the conference room.

Mr. Harding: Are you all aware of the procedure for making changes to the project?

Nathan: Changes have to go through the change control board, right?

Mr. Harding: Yes, that's right.

Elliot: Who's on the board?

Mr. Harding: Derek and Marcus are on it, but I'm not sure who else is.

Nathan: Is there a deadline for how long they can take to grant or deny a change request? If a change needs to be made quickly, the approval process could really slow us down.

Mr. Harding: That's why we're allowed to make certain changes without going through the usual channels. If there's an emergency situation, you can do what's necessary to get things under control. You just have to make sure you keep everyone informed and carefully document the circumstances.

Elliot: That sounds reasonable.

Nathan: Yeah, that's okay.

Consider the dialog above and list two reasons why it is necessary for approval from the change control board to accommodate change. Give reasons for your answers.

- 2 Results of project change control include only updates to the project's plan and the budget. True or False?

Unit summary: Project change control

Topic A

In this topic, you learned that **project change control** involves managing changes to benefit the project and verifying that performance standards for the project are met. Good change control systems have several characteristics in common, such as emphasizing project success, focusing on what is important, establishing a system for taking corrective action, and emphasizing timely responses to change.

Topic B

In this topic, you discovered that you use the steps in the AMEND acronym to **accommodate the changes** in a project. AMEND stands for **assess** the potential change, **modify** the project plan, **examine** alternatives, **navigate** project procedures, and **deliver** sufficient information.

Independent practice activity

- 1 Select the options that describe a project manager's role in controlling change.
 - A Modify the team's goals to reflect the recent changes
 - B Verify that the project's performance standards are met
 - C Reconfigure each tool to be used in the project
 - D Delegate all responsibilities to the team members
 - E Ensure that all affected individuals are aware of the changes
- 2 Choose the characteristics of a good change control system.
 - A A focus on personal advancement, a system for taking evasive action, a focus on career advancement, and an emphasis on timely response
 - B A strong, opinionated project manager, a focus on career advancement, a system for taking decisive actions, and an emphasis on accuracy
 - C An emphasis on project success, a focus on what is important, a system for taking corrective actions, and an emphasis on timely response
 - D An emphasis on project timelines, a focus on what is important to management, a system for taking disciplinary action, and an emphasis on communication
- 3 Select the primary functions of a change control system in most project teams.
 - A Make a permanent record to document the problem for upper management
 - B Keep all team members focused on the completion of the project
 - C Notify all team members when the project encounters a problem
 - D Track the progress and make changes when things go wrong during project execution
 - E Indicate how and where changes should be documented

- 4 Select the action that you, as a project manager, should take when you encounter a problem while accommodating change.
 - A Ensure that team members are taking steps to correct the problem
 - B Ensure that you are available to handle every problem for the team
 - C Allow team members to take steps to solve problems on their own
 - D Tell team members the steps to take to solve the problem
- 5 Select two items that are necessary for controlling change.
 - A Accurate performance reports
 - B Plan and scope statements
 - C Accurate financial reports
 - D Documentation of changes
 - E Documentation of changes that occurred in similar projects
- 6 What is the primary purpose of status meetings?
 - A Discuss the project's status and find solutions to problems
 - B Discuss the project's focus and determine if the project is still relevant
 - C Discuss the project's status and determine who is to blame for the problems
 - D Discuss the project's status and decide if the project should be cancelled
- 7 Select the primary concern of the first step in the AMEND process.
 - A Determine who will be affected by the change
 - B Determine the results required from the change
 - C Determine who will benefit from the change
 - D Determine if the damage caused by the change can be minimized
- 8 Select the concerns when modifying a project plan.
 - A Expected budget increase
 - B Project budget
 - C Project schedule
 - D Project performance standards
 - E Project limitations
 - F Affected outside resources
 - G Project purpose

- 9 Who should be notified when making a project change?
- A Members of your project team
 - B The entire division in which you work
 - C Notify people solely on a need-to-know basis
 - D Everyone who is affected by the change
- 10 What is the primary purpose of a change control board?
- A Determine who is responsible for developing new project changes
 - B Determine the changes to be made
 - C Determine which members of the team have lost their right to implement change
 - D Determine who is responsible for dealing with the effects of a change
- 11 Select the choice that represents the letter M in the AMEND acronym.
- A Maximize the project budget
 - B Modify the project plan
 - C Manage the change
 - D Minimize the effect on team members

Unit 5

Financial issues

Unit time: 45 minutes

Complete this unit, and you'll know how to:

- A** Identify the fundamental considerations involved in completing project cost estimates.
- B** Identify the importance of your organization's financial policy and the different types of cost.

Topic A: Fundamentals of cost estimating

Explanation

Effective cost estimations require knowing what resources are needed and what rates are charged for each resource. For example, if it takes 12 team members 10 days to complete an activity, their wage-rate must be known in order to estimate the cost of that activity. Or, if the project goal is to produce a new software program and have 10,000 CD-ROM copies on the market, the cost per CD-ROM must be known in order to estimate the cost of reaching that goal.

Historical information

Previous cost approximations are frequently available for the resources you plan to use in your current project. However, if you use historical information to estimate costs, remember to adjust for inflation. In addition, when using historical data, be sure that a previous project and your current project are similar enough that a realistic comparison can be made.

Use the following sources when looking for historical information on which to base cost estimates:

- The knowledge of experts or team members with similar experience
- A project database with your company's records from previous projects
- Industry-wide cost estimate databases

Do it!

A-1: Analyzing historical information

Exercises

- 1 Read the following scene and answer the questions that follow. In the scene, Nicholas Richter (project team member) is standing in the break room when Caroline (project manager) approaches him and begins talking.

Caroline: Nicholas, I just finished reading through the McGregor Project file, and it didn't sound like a success.

Nicholas: Believe me, it wasn't. The McGregor project was a disaster from day one. We never had the resources to make that project a success.

Caroline: Why's that?

Nicholas: Our project manager didn't budget the resources correctly. Although he based his estimates on a past project, he underestimated labor costs, material costs, and he didn't consider inflation at all. The project was scheduled to take five years, and by the fourth year, we were broke.

Caroline: If that's the case, I think my project team needs to meet immediately. The Pearson Project, which is what I'm planning right now, is similar to the McGregor Project, and I don't want us to run into those same problems.

Do you think reviewing the McGregor project file will help Caroline develop a better plan for her project? List three reasons.

What is the impact of historical information on project initiation?

- 2 Select the actions that you should take when analyzing historical data.
 - A Ignore previous project duration
 - B Use information from only successful projects
 - C Ensure the previous and current projects are similar
 - D Adjust for inflation

Activity duration and cost estimates

Explanation

It is important to understand that when you assign resources to a project, the activity duration can affect the cost estimates. For example, suppose you have leased a resource, such as several extra desktop computers, for three weeks. The computers are actually needed only during the first and third weeks, so the activity duration for this example is two weeks. However, since you'll have the computers for three weeks, you must base your cost estimate on three weeks, which increases project costs.

Do it!

A-2: Understanding activity duration and cost estimates

Exercises

- 1 Read the following scene and answer the question that follows. In the scene, Mr. Kramer (project manager) and Monica (project team member) are seated in the conference room. Both have papers spread out in front of them, and Mr. Kramer is staring at a piece of paper.

Mr. Kramer: (*Looking at the budget, then at Monica*) Monica, your budget estimates don't work. There's no way construction costs can be that much.

Monica: I spoke with the contractor yesterday, and that was her quote.

Mr. Kramer: It's that expensive to rent the machinery for five days?

Monica: (*Reminding him*) Mr. Kramer, we're only using the machinery for five days, but we have to rent it for an entire three weeks since we need it on several nonconsecutive days.

Mr. Kramer: Well that significantly increases the project's budget. Let's see if there's any way to make the time period shorter to cut costs.

Monica: I already spoke to Robin, and she said that was impossible. We need the machinery for three weeks.

Should Mr. Kramer base the cost estimates of renting machinery for the project on three weeks or five days? Provide reasons for your answer.

- 2 When assigning resources to a project, the activity duration can affect the cost estimates. True or False?

Types of supporting details

Explanation

When you submit cost estimates for a project, they should be accompanied by supporting details. Supporting details for cost estimates will give the estimates credibility, as well as enable the project stakeholders to better understand them.

Some types of supporting details include the following:

- A description of the scope of work for which cost estimates were completed
- A description of how estimates were made for each activity
- A reference to any historical data used to make estimates
- A list of assumptions made when estimating

Project estimating pitfalls

The following are several pitfalls you should avoid when completing project cost estimates:

- Poorly defined project scope
- Inadequately defined schedule
- Incorrect work breakdown structure
- Failure to account for inflation
- Failure to account for overhead costs

Problems while estimating costs

A common response to the possibility of errors when estimating project costs is to simply increase all cost estimates by 5 to 10 percent. Although this is a fairly common practice, you might be able to avoid problems if you are aware of some cost estimating problems that occur on a regular basis.

One cost estimating problem is that the price of resources can change over the course of a project. Make sure you are aware of this possibility and, if at all possible, account for it in your estimate. In addition, project resources can spoil or be wasted, so you should include a cost allowance for problems and have more resources available than necessary.

Another cost estimating problem is that costs are frequently understated in order to make the project seem more attractive to stakeholders. Never understate project costs since doing so will have a negative affect on the project's end goal and your credibility with the stakeholders.

And finally, sometimes problems occur without any obvious explanation. Always make sure the project has an allowance for contingencies.

Do it!

A-3: Identifying problems while estimating costs

Exercises

- 1 Share your experiences of problems encountered while estimating the cost of a project.
- 2 You are a project manager at Icon International. Your current project is to upgrade the telecommunications department at Icon. You have been asked to estimate the cost of the project and present it to upper management. What are some of the cost estimating problems that you should keep in mind?
 - A Change in the price of resources
 - B Allowing for contingencies
 - C Understating the project cost
 - D Lack of credibility with stakeholders

Topic B: Organizational financial systems

Explanation

A number of organizational financial issues can affect a project. Overhead expenses, general and administrative expenses, and profit goals can be passed on to a project. Overhead expenses include items such as employee benefits. General and administrative expenses include items such as rent and utilities. Profit goals are built in to project costs to ensure that the company earns the desired amount on the project. It is important to know whether these expenses must be included in your project's budget since they will affect how you manage the project. In addition, you should know whether your project budget will be charged for all labor costs.

Company financial cycles

You need to be aware of your company's financial cycles because it can affect how you manage a project budget. The amount of operating cash in most organizations is seasonal to some degree, so the amount of available funds might fluctuate throughout the year. You should understand these financial cycles, so you can determine whether funds will be available for your project when you need them.

Do it!

B-1: Understanding organizational financial issues

Multiple-choice exercise

- 1 You need to be aware of your company's financial cycles because
 - A It can affect how you manage a project budget
 - B It will help in negotiating for a larger budget
 - C It can ensure that the company will make more profit on the project
 - D It will help arrange labor costs for the project

Types of cost

Explanation

Projects can incur a variety of costs. First, a project might have fixed or variable costs. Fixed costs do not change and include rent of a building where the project team members work. Variable costs can change based on external factors. Variable costs include labor expenses, which can change depending on the duration of activities. Therefore, you should always estimate duration before cost.

Use of labor estimates

When completing a cost estimate for a project, it is important to consider labor estimates. To develop reasonable cost estimates for labor, identify the necessary man-hours for each activity on the work breakdown structure (WBS). Next, multiply the man-hours by the appropriate labor rates. You can determine the appropriate labor rates by basing them on historical costs for the most recent month or quarter.

You should be aware that labor rates can be difficult to predict for projects that will take longer than one year to complete since the labor rates can fluctuate over time.

Estimating costs for R&D oriented projects

Occasionally, you might manage a project that relies heavily on research and development. In this case, you might have difficulty estimating the project cost because many unknown variables could affect the cost of the project. You can choose from three methods to help you estimate cost for an R&D oriented project.

One method is to examine previous projects that are similar to the current project. After examining a previous project, you can estimate how much more difficult the current project is than the previous project. For example, the current project seems to be three times more difficult than the previous project. Multiply the number you estimated by the budget for the previous project. Keep in mind that the more similar the previous and current projects the more accurate your cost estimate.

A second method you can use to estimate the cost for an R&D oriented project is to make your best guess. The accuracy of this estimate depends solely on your experience and judgment.

A third method is to estimate the cost for each activity in the project and add the estimates to find the cost of the entire project. Although time consuming, this method yields the most accurate cost estimate.

Factors while negotiating

If your project budget has been set by someone else, you might be able to negotiate for more funds. If you want to negotiate for a larger budget, you should begin as soon as possible. When you negotiate early in the project or before the project begins, there are usually more options available for adjusting the budget.

You should also keep in mind that if the final decision comes down to your estimate versus your manager's estimate, you'll need data to make your case. If you do not have this information, you'll have to settle for your manager's estimate. Therefore, it is essential for you to prepare thoroughly any time you want to negotiate for more funds.

Available funds

If your project budget is tight, you can use the following actions to make the most of the available funds:

- Eliminate activities that are nonessential for project completion.
- Shorten activity duration.
- Use lower-priced resources when possible.
- Spend from other budgets when acceptable.
- Use project slack.
- Reduce the scope of the project as a last resort.

Do it!

B-2: Budgeting factors

Exercises

- 1 Read the following scene. In the scene, Kate (negotiator-supplier) and Roger (negotiator-Icon International) are seated at the table in the conference room.

Roger: (*slightly frustrated*) Kate, I need to get a lower price on the electrical components.

Kate: (*firm*) Roger, I don't know how many times I have to tell you: my price is final. I simply cannot lower it.

Roger: (*annoyed*) Won't you even consider \$2.20?

Kate: (*unyielding*) I'm sorry, Roger. My final offer is \$2.50.

How and when should you negotiate for a larger budget with the upper management? Give reasons for your answer.

- 2 You are a project manager at Icon International. Your current project is to upgrade the telecommunications department at Icon. You feel that the budget allotted for the project is not sufficient to perform all the activities. What steps can you take to best utilize your project budget?
- A Shorten the activity duration
 - B Use activity slack
 - C Eliminate nonessential activities
 - D Add project team members
 - E Use lower-priced resources
 - F Spend from other budgets
 - G Conserve activity float
 - H Reduce the scope

Unit summary: Financial issues

Topic A

In this topic, you learned that it is important to analyze **historical information** to create an accurate project cost estimate. You also learned that there are several **pitfalls** that you should avoid when completing project cost estimates. These pitfalls include a poorly defined project scope, an inadequately defined schedule, an incorrect work breakdown structure, a failure to account for inflation, and a failure to account for overhead costs.

Topic B

Next, you learned that it is important to be aware of your **organization's financial policy** when creating a cost estimate. You also learned about the different **types of cost**, namely **fixed** and **variable costs**. Finally, you learned how to **make the best use of available funds**. Strategies include eliminating activities that are nonessential for project completion, shortening activity duration, and using lower-priced resources when possible.

Independent practice activity

- 1 Which of the following is an example of an effective supporting detail?
 - A A list of estimates made for each activity
 - B A brief outline of the goals of the project
 - C A reference to any historical data used to make estimates
 - D Your personal assessment of the cost estimate
- 2 What are the pitfalls to avoid when completing project cost estimates?
 - A Including historical information as references
 - B Using an incorrect work breakdown structure
 - C Having an intricately defined schedule
 - D Including overhead costs in the estimate
 - E Failing to account for inflation
- 3 Which of the following factors can result in errors when completing cost estimates?
 - A Accounting for too much inflation
 - B Not allowing for price changes over time
 - C Overstating project costs
 - D Wasting project resources
 - E Allowing for contingencies
 - F Understating costs

- 4 What is the most accurate method for estimating the cost for an R&D project?
 - A Collecting information from other industry sources
 - B Using past R&D projects as a guideline
 - C Estimating the cost for each activity in the project and adding them up
 - D Guessing based on experience and judgment
- 5 Which type of cost is labor expense?
 - A Hidden
 - B Extraneous
 - C Variable
 - D Fixed
- 6 What types of organizational financial issues can affect a project?
 - A Profit goals and resource costs
 - B Resource costs and administrative expenses
 - C Overhead expenses and profit goals
 - D General and administrative expenses
- 7 Why is it important to understand an organization's financial cycles?
 - A To adjust your budget accordingly
 - B To know whether the scope of the project should be expanded or reduced
 - C To determine if funds for your project come from other departments' budgets
 - D To determine whether or not funds will be available for your project when they are needed
- 8 When is the ideal time for negotiating for a larger budget?
 - A After the second month of the project
 - B At the point in the organization's financial cycle when funds are most likely to be available
 - C Either early in the project or before the project begins
 - D At the end of the project

- 9 In the condition of a tight budget, what actions should be taken?
- A Conserve activity float
 - B Decrease the scope of the project
 - C Add project team members
 - D Spend from other budgets
- 10 Select the historical data sources you can use to estimate the cost.
- A Your company's project database
 - B Knowledge of experts
 - C Industry-wide cost estimate database
 - D Your project's critical path duration
 - E Knowledge of team members with similar experience

Unit 6

Project performance

Unit time: 45 minutes

Complete this unit, and you'll know how to:

- A** Measure project performance by using various analysis methods, use calculations in earned value analysis, and control project cost.
- B** Identify performance, status, progress, close-out, and final project reports.

Topic A: Measuring project performance

Explanation

Measuring the performance of a project is critical for its successful execution. You should gauge project performance based on the answers to the following questions:

- Is the project meeting the quality standards?
- Is the team's morale satisfactory?
- Are activities completed as scheduled?
- Is the project operating within its budget?

Determining quality standards

You can determine whether a project is meeting its quality standards by comparing performance reports to the objectives set for the project. If the performance reports indicate that the project is not accomplishing its objectives, you should try to determine when, where, and why actual results do not conform to the quality standards. When you identify the answers to these questions, you can take action to improve quality.

Morale of the project team

You can determine the level of morale of the project team by talking to its members. Pay attention to whether they put quality effort into fulfilling their responsibilities and take notice of any conflicts that arise.

Measuring project performance

There are several methods you can use to measure project performance:

- Variance analysis
- Trend analysis
- Earned value analysis

Variance analysis

Variance analysis is used to gauge how closely a project adheres to its schedule, resource use, and budget provisions. Variance analysis can also be used to determine whether or not a project's quality standards are met.

Trend analysis

Trend analysis is used to evaluate the progress of a project over time. For example, trend analysis can be used to establish whether a solution to a problem is effective by determining if the problem still exists once a solution has been implemented. Trend analysis can also be used to show patterns of project resource consumption.

Earned value analysis

Earned value analysis measures overall project performance by calculating a dollar amount for every project activity. These dollar amounts are calculated using the following values:

- *Budgeted Cost of Work Scheduled* (BCWS) is a portion of the project budget expected to be spent during a specific time period. For example, \$6,000 is assigned to Activity A, which takes six days to complete.
- *Budgeted Cost of Work Performed* (BCWP) is the total budgeted cost of all work completed to date on a project. For example, imagine that Activity B is allotted \$1,000. Activity B is only 40 percent complete at the time that BCWP is calculated. As a result, of the \$1,000 allotted for Activity B, only \$400 is included in the BCWP.
- *Actual Cost of Work Performed* (ACWP) is the amount of money actually spent completing a specific activity within a given time period. For example, if the six days worth of work completed on Activity A actually cost \$5,000 instead of \$6,000, then \$5,000 is your ACWP.

Earned value analysis is important to performance reporting because it can give the project manager and team members the most accurate measure of whether or not a project's activities are being completed as planned.

Do it!

A-1: Determining project performance

Exercises

- 1 Select the function of trend analysis.
 - A Measure overall project performance
 - B Evaluate the progress of a project over time
 - C Gauge how closely a project adheres to its schedule
 - D Determine whether quality standards are being met
- 2 You are a project manager at Icon International. Your current project is to install new equipment in the telecommunications department of Icon in a period of seven days. Your budget allows \$20,000 to be spent on installing the latest equipment; however, you overspent by \$2,500. Determine the ACWP for the project.
 - A \$20,000
 - B \$22,500
 - C \$2,500
 - D \$17,500

3 You are a project manager at Icon International. Your project is to develop a prototype of an e-commerce solution. Your first milestone meeting is scheduled one week from now. Before the meeting, you need to determine whether or not your project is progressing in accordance with the schedule and meeting the required quality standards. Which analysis method will you use to measure project performance?

- A Earned value analysis
- B Variance analysis
- C Trend analysis

Calculations used during earned value analysis

Explanation

The following calculations are used during earned value analysis:

- Cost variance
- Schedule variance
- Cost performance index
- Schedule performance index

Cost variance

Cost variance (CV) occurs when the actual cost of an activity differs from the estimated cost. You can calculate cost variance by subtracting the Actual Cost of Work Performed from the Budgeted Cost of Work Performed, which is represented by the following equation:

$$CV = BCWP - ACWP$$

If the cost variance is a negative number, the activity is using more money than planned. If it is a positive number, the activity is using less money than planned. If the cost variance is zero, the activity is on track.

Schedule variance

Schedule variance (SV) occurs when the actual completion time of an activity differs from the scheduled completion time. You can calculate schedule variance by subtracting the Budgeted Cost of Work Scheduled from the Budgeted Cost of Work Performed, which is represented by the following equation:

$$SV = BCWP - BCWS$$

If the schedule variance is a positive number, then more work than originally planned has been completed up to that point. If it is a negative number, then less work than originally planned has been completed up to that point.

Cost performance index

The *cost performance index* (CPI) of a project is the ratio of the budgeted cost of a project to the actual cost, or the Budgeted Cost of Work Performed divided by the Actual Cost of Work Performed, which is represented by the following equation:

$$\text{CPI} = \text{BCWP}/\text{ACWP}$$

If the CPI is greater than one, then the cost performance of the project is efficient. If the CPI is less than one, then the cost performance is inefficient.

Schedule performance index

The *schedule performance index* (SPI) of a project is the ratio of the actual work performed to the scheduled work, or the Budgeted Cost of Work Performed divided by the Budgeted Cost of Work Scheduled, which is represented by the following equation:

$$\text{SPI} = \text{BCWP}/\text{BCWS}$$

If the SPI is greater than one, then the schedule performance of the project is efficient. If the SPI is less than one, then the schedule performance is inefficient.

Do it!

A-2: Using calculations in earned value analysis**Exercises**

- 1 Icon's office construction team had estimated that the budget for laying the building's carpet should be \$ 35,000. But, after the work was completed, it actually cost \$ 40,000. Calculate the cost variance.
 - A \$5,000
 - B \$75,000
 - C -\$75,000
 - D -\$5,000
- 2 For landscaping, the budgeted cost of work performed is \$25,000, and the budgeted cost of work scheduled is \$ 65,000. Calculate the schedule variance.
 - A \$90,000
 - B -\$90,000
 - C \$40,000
 - D -\$40,000

- 3 During the one-year update of Icon's office construction project, the analysis showed that the BCWS was \$1,000,000, the ACWP was \$500,000, and the BCWP was \$750,000. Determine the project's status.
- A The project was under budget and also behind schedule
 - B The project was over its budget and also behind schedule
 - C The project was both on schedule and on its budget
 - D The project is under its budget but ahead of its schedule

Explanation

Project control involves measuring, monitoring, and adjusting aspects of a project to achieve specific goals. Comparing the project's progress to the original plan enables a project manager to identify deviations from the plan and take corrective action. Project managers control projects by using project change control systems, measuring project performance, and analyzing project reports.

Items used to control project performance

Some items used to control a project include change requests, test results, quality assurance measures, and rework. Additional items include resource consumption reports and maintenance reports.

Importance of controlling project schedule

Through schedule control, project managers can ensure that schedule changes are in line with project objectives and are favorable to project completion. To control a project schedule, project managers should identify variances from the original project schedule. Then they should determine where, when, and why the project has fallen behind and take corrective action. The project schedule should be updated since corrective action can affect the execution of remaining project activities.

Items used to control project schedule

When controlling a project's schedule, it is important to always refer to the project's master schedule. To show schedule variances, it might be helpful to display additional schedules on Gantt charts or use graphs and process control charts. Project status reports can also be useful when controlling a project's schedule.

Importance of controlling project cost

To control project costs, you should identify variances from the project's budget. You can follow these steps to control project costs:

- 1 Monitor spending by examining status reports.
- 2 Identify variances from the original project plan.
- 3 Determine when and why each cost variance occurred.
- 4 Obtain authorization from stakeholders before making any budgetary changes.
- 5 Record any budgetary changes you make.
- 6 Inform project stakeholders that the approved changes have been made.

Items used to control project's budget

Some of the items used to control the budget of a project include receipts from contractors or vendors, income and account statements, and cost reports. In addition, records of wages paid, overtime hours worked, and absences from work are also helpful when controlling a project's budget.

Do it!

A-3: Controlling project cost

Exercises

- 1 Sequence the steps for controlling cost.

Identify variances.

Obtain authorization.

Monitor spending.

Inform stakeholders when changes are made.

Record changes.

Determine when and why cost variance occurred.

- 2 Items, such as receipts from contractors or vendors can be used to control the budget of a project. Yes or No?

Topic B: Reporting project performance

Explanation

Part of a project's communication system includes performance reporting. The purpose of performance reporting is to collect and distribute information to project stakeholders about how effectively resources are being used. In addition, when combined with change control systems and project performance measurements, performance reporting helps a project manager control a project.

Facilitating project control

Project control involves measuring, monitoring, and adjusting aspects of a project to accomplish specific objectives. A project manager cannot adequately control a project unless he or she knows the project's status at any given point, so project performance must be continually measured and reported.

Performance reports should record any variation between actual project results and expected project results. If variations exist, the project manager can take corrective action to return the project to its original plan.

Reporting period

The time between one performance report and the next is called a reporting period. Frequently, a reporting period coincides with the beginning and end of a project phase.

When reporting periods do not coincide with project phases, it might help to include reporting period dates on the project schedule. Doing so helps team members know when they need to write performance reports.

Timing of performance reports

The intervals at which performance reports are produced depend on the project. Lengthy projects might need formal status reports only once per month. Shorter projects might need a status report once every week or even more frequently.

Consider how often a report should be produced to provide stakeholders with information when they need it. A project manager's ability to control a project depends on timely information.

Classifying performance reports

Performance reports can be classified by frequency, purpose, or both. The following are common classifications of performance reports:

- Routine
- Exception
- Special analysis

Routine

Routine reports are not necessarily scheduled, but might be distributed at intervals that coincide with project phases or milestones. The frequency of performance reports depends on how smoothly a project functions.

Exception

Exception reports provide information project team members need to make decisions or they notify team members of changes that affect their work. Exception performance reports are also distributed to stakeholders to inform them that a decision has been made about some aspect of a project.

Special analysis

Special analysis reports contain information about the results of a study. Special studies might be conducted as part of a project or to determine a solution to a problem encountered during a project. Special analysis reports are useful to a current project and provide valuable documentation of lessons learned that can be applied to future projects.

Determining the appropriate performance report

When trying to determine whether a report is necessary for a project, consider whether the report serves a purpose by answering the following questions:

- What information will the report contain?
- What is the reason for producing the report?
- Who will write the report?
- Who is the audience for the report?
- How often will the report need to be produced?
- Is the information in the report necessary for project control?
- Is the information in the report valuable to you or other stakeholders?

When you determine which reports are necessary for a project, keep in mind that none of them will be beneficial if the information in them is inaccurate. You should stress the importance of accurate information to team members who will complete the reports.

Effect of performance reporting on project costs

Performance reporting can affect project costs when time for writing the reports is not allocated in a project's schedule. If the time is not recorded, then the project's total cost will be inaccurate. Be sure to include the time spent for writing reports in the project budget.

*Do it!***B-1: Understanding performance reports****Multiple-choice questions**

- 1 Select the classifications of performance reports.
 - A Special analysis
 - B Phased
 - C Limited analysis
 - D Exception
 - E Routine
- 2 Which factor determines the frequency of routine performance reports?
 - A How many milestones are listed on the plan
 - B How long the project phases are
 - C How many weeks are covered by the project plan
 - D How smoothly the project is functioning
- 3 Select the choice that best completes the sentence.

If the time spent writing reports is not recorded in the project budget, the project's total cost will be _____.

 - A overestimated
 - B under budget
 - C unchanged
 - D inaccurate

Importance of status reports*Explanation*

Another type of performance report is the status report. It covers a wider range of information than a progress report and provides a detailed account of a project's status up to a given point. The status report should include items such as activity completion for the current reporting period, resource consumption, budget expenditure, forecasted completion dates for activities in progress, problems encountered, and suggestions for improvement.

Status reports must include the current status of all activities completed during a given reporting period, so the project manager can determine whether problems exist and what corrective action to take.

*Do it!***B-2: Understanding status reports****Exercises**

- 1 Read the following scene. In the scene, Mr. Kramer (project manager) and Amanda (project team member) are seated in Mr. Kramer's office.

Amanda: I ordered the computers this morning, and the rep I talked to said that the earliest they can get them to us is a week from Friday.

Mr. Kramer: That's cutting us pretty close to our Phase II start date. How long will it take to set them up once they arrive?

Amanda: As long as Jeff and Dwayne are around to help me, it shouldn't take more than four or five hours to take them out, set them up, and load all the development software.

Mr. Kramer: Talk to Jeff and Dwayne. I'm sure they'll be able to help you. But, if it looks like we're not going to get things set up on time, I'll need a status report.

Amanda: Okay, I'll be sure to keep you updated.

Do you agree that it is important to maintain updated status reports of the project?

- 2 Based on your experience, identify three benefits of updated status reports of a project.

Importance of progress reports*Explanation*

One specific type of performance report is a progress report, which provides a detailed summary of what project team members have accomplished up to a given point and how they did it. Progress reports should also include the number of people who actually worked on an activity compared to the number of people who were scheduled to work on it.

Problems with progress reporting

Some frequent problems with progress reporting include the following:

- Too much information
- The wrong kinds of information
- Not enough information
- Out of date information

To avoid these problems when reporting progress, you can take the following actions:

- Keep progress reports concise and accurate.
- Make sure information is current and relevant.
- Create reminders for yourself as to when progress reports are due.

Do it!

B-3: Understanding progress reports

Exercises

- 1 Select the actions that can help you avoid common progress reporting problems.
 - A Create reminders for yourself as to when progress reports are due
 - B Produce biweekly progress reports
 - C Make sure information is current and relevant
 - D Limit report information to critical path
 - E Keep progress reports concise and accurate
- 2 Progress reports should include the number of people who actually worked on an activity. True or False?

Steps to close a project

Explanation

There are four steps you should follow to close a project:

- 1 Create a task list.
- 2 Communicate about the close.
- 3 Celebrate accomplishments.
- 4 Release the resources.

Create a task list

As a project nears completion, you should create a list of all the tasks that must be done to end the project. In addition to wrapping up the final project activities, there are a number of other tasks that need to be completed to close a project, such as writing the final report. Creating a task list can help you manage all the extra tasks.

In addition, task lists tailored specifically for your team members can help them focus on completing their activities. This is important, especially for any team members who might be apprehensive about the end of the project. These team members will frequently work on insignificant tasks in an attempt to prolong the project.

Communicate about the close

Communication is essential to the successful close of a project. As a project manager, you need to communicate several messages at the end of a project. First, you need to communicate to all stakeholders when the project will officially end. Second, you need to close out all contracts and communicate the project end date to suppliers and vendors to ensure that all bills will be sent as soon as possible. Third, if project team members have been borrowed from other teams or departments, you should notify the respective managers that the end of the project is near. The fourth and final message you need to communicate is to the finance department to ensure that the project books are closed.

Celebrate accomplishments

When a project has been successfully completed, it is important to take time to appreciate all that has been accomplished and thank team members for their work. A celebration is a fun way to wrap up a project, and it marks the official end of the project for all involved. Consider giving awards to team members whose contributions to the project were exceptional. In addition, acknowledge all team members' hard work to help them feel good about what they have accomplished and ease their transition back to their previous work or to their next project.

Release the resources

After a project is completed, any number of resources might be left over. Leased equipment should be returned, unused supplies should be returned for credit, if possible, and supplies that have been used might need to be sold or incorporated into the organization.

Do it!

B-4: Closing projects

Exercises
1 Sequence the steps for closing a project.
Celebrate accomplishments.
Create a task list.
Release the resources.
Communicate about the close.

- 2 Identify the people with whom you should communicate the following messages during the close of a project.

Message

Person

Communicate when the project officially ends.

Communicate when team members will be finished with the project.

Communicate when bills should be sent.

Communicate when the books should be closed.

- 3 Select the actions that can be completed during the “Celebrate accomplishment” step of closing a project.

- A Thank team members
- B Release the resources
- C Appreciate accomplishments
- D Mark the official end
- E Ease team members’ transitions
- F Create a list of remaining tasks

Close-out reports

Explanation

During the close of a project, a project manager and team members should write detailed reports, or close-out reports, about the processes used for phase and overall project completion, including any lessons learned. Writing these reports helps the team and the project manager evaluate how successfully they met the project’s objectives. The reports are then archived for use as references for future projects.

Importance of close-out reports

Close-out reporting is often neglected because concluding a project is not as exciting or interesting as beginning a project. The project manager or team members might not recognize the value of writing close-out reports, and they might become preoccupied with other tasks. Also, team members are frequently eager to start a new project, so they start looking ahead instead of focusing on the present.

It is important to complete close-out reports for every project since they assure stakeholders that the project is actually complete. As part of close-out reporting, a project manager should obtain signed confirmation from key stakeholders to ensure their awareness of the project status.

Information contained in the final project report

A project's final report, or "project history," consists of the information recorded in performance, status, and close-out reports, as well as other project documents. A project's final report should include the following:

- Which organizational structure was used for the project
- Which project management techniques were used
- Who was involved in the project and in what capacity
- What went right and wrong during the project and why
- What corrective action was taken to bring problems back in line with project goals
- What activity completion processes were used

The information in the project's final report supplements a project's historical database, so the information can be used to help plan future projects.

Do it!

B-5: Understanding a final project report

Exercises

- 1 Select the items that should be included in a project's final report.
 - A Who was involved and in what capacity
 - B Organizational structure used
 - C Corrective action taken
 - D Project management techniques used
 - E How stakeholders assessed final results
 - F What went wrong and right and why
 - G Activity completion processes used
 - H Team performance evaluation methods used
- 2 Information in the project's final report supplements a project's historical database. True or False?

Unit summary: Project performance

Topic A In this topic, you learned how to measure project performance by using various analysis methods, such as a **variance analysis**, a **trend analysis**, or an **earned value analysis**. Measuring the performance of a project is critical for its successful execution. You also learned how to use **calculations in earned value analysis** and **control project cost**.

Topic B Next, you learned about the various reports used during the course of a project. These reports include **performance**, **status**, **progress**, **close-out**, and **final project reports**. You also learned about the **steps to close a project**. These include creating a task list, communicating about the close, celebrating accomplishments, and releasing the resources.

Independent practice activity

- 1 Select the questions that you need to ask when measuring project performance.
 - A Will the project be successful?
 - B Are activities being completed as scheduled?
 - C Is the project meeting the needs of the organization?
 - D Is the morale of the team satisfactory?
 - E Is upper management happy with the team's progress?
- 2 Select the three types of performance reports.
 - A Routine
 - B Normal
 - C Exception
 - D Special analysis
 - E Special circumstances
 - F Detailed analysis
- 3 Select the first two steps to take when reporting a project close.
 - A Celebrate accomplishments
 - B Disperse the resources
 - C Create a task list
 - D Communicate about the close

- 4 Select the three variables that are necessary to determine earned value analysis.
- A Budgeted Cost of Project Expense
 - B Budgeted Cost of Anticipated Work
 - C Budgeted Cost of Work Scheduled
 - D Budgeted Cost of Work Performed
 - E Actual Cost of Work Performed
- 5 Select the two steps to take when communicating a project close.
- A Let the managers of your team members know that the project is coming to an end
 - B Communicate to the stakeholders exactly when the project will end
 - C Close out all contracts and ensure that the bills will be sent immediately
 - D Inform your team members that they can have a few days off if they've earned it
 - E Ensure that the Finance department closes the books for the project
- 6 Determine the schedule variance for a project after considering the budgeted amount of \$5,000 and actual expenses of \$3,000.
- A (\$2,000)
 - B (\$200)
 - C \$200
 - D \$2000
- 7 Determine the cost performance index for a project after considering the budget of \$8,000 and actual expenses of \$10,000. In addition, determine whether or not the project was efficient.
- A 0.80, efficient
 - B 1.25, inefficient
 - C 0.80, inefficient
 - D 1.25, inefficient
- 8 Determine the efficiency of the project and its schedule performance index if the BCWS is \$5,000 and BCWP is \$10,000.
- A 0.5, inefficient
 - B 0.5, efficient
 - C 2.0, inefficient
 - D 2.0, efficient

- 9 Identify the methods that help a project manager control a project.
 - A Measure market performance
 - B Use project change control systems
 - C Measure project performance
 - D Study project statistics
 - E Use project manipulation methods
 - F Analyze project reports
- 10 Select the reason for controlling the project schedule.
 - A Ensuring the project will be accepted by people outside the company
 - B Ensuring the support of the entire project team
 - C Ensuring that the project will be approved by the management
 - D Ensuring that changes are favorable to the project
- 11 Select the two steps for controlling project costs.
 - A Hold an emergency meeting
 - B Examine status reports
 - C Consult your supervisor
 - D Determine when and why the variance occurred
 - E Determine how to avoid the problem in the future
- 12 Select the three common items that can help control the budget of a project.
 - A Receipts
 - B Market position of the company
 - C Historical data
 - D Income and account statements
 - E Cost reports
 - F Timeframe of the project

Project Management Essentials

Course summary

This summary contains information to help you bring the course to a successful conclusion. Using this information, you will be able to:

- A** Use the summary text to reinforce what you've learned in class.
- B** Determine the next courses in this series (if any), as well as any other resources that might help you continue to learn about Project Management Essentials.

Topic A: Course summary

Use the following summary text to reinforce what you've learned in class. It is not intended as a script, but rather as a starting point.

Project Management Essentials

Unit 1

In this unit, you learned about **project participants** and the **influence extended on a project by its stakeholders**. Next, you learned about the **project objective** and benefits of **project planning**. Finally, you learned how to prioritize **project constraints**.

Unit 2

In this unit, you learned how to create a **WBS, sequence project activities**, and recognize **different kinds of activities**. Next, you learned how to create a **PERT chart** to determine the best sequence of the activities in a project. Then, you learned that the best way to analyze project activities is by creating an **activity analysis form**. Next, you learned about the several **types of estimating techniques** to determine the time duration and cost of project activities. Finally, you learned about the different **categories of dependencies** and **dependency relationships**.

Unit 3

In this unit, you learned about **schedule development** and how to create a project schedule by using various techniques, such as **CPM, PERT, network diagrams, arrow charting**, and **Gantt charts**. Next, you learned about the benefits of **CPM** and **PERT** and that the **critical path** is the longest chain of activities that cannot be completed concurrently. Finally, you learned that **duration compression** ensures that the project can be completed on time by reducing activity duration.

Unit 4

In this unit, you learned that **project change control** involves managing changes to benefit the project and verifying that performance standards for the project are met. Finally, you learned that project managers use the steps in the AMEND acronym to **accommodate the changes** in a project.

Unit 5

In this unit, you learned that it is important to analyze **historical information** and be aware of the **organization's financial policy**. Next, you learned about the different **types of cost**, namely **fixed** and **variable costs**. Finally, you learned how to **make the best use of available funds** and that there are several **pitfalls** to avoid when completing project cost estimates.

Unit 6

In this unit, you learned how to **measure project performance** by using various **analysis methods**, to use **calculations in earned value analysis**, and to **control project cost**. Next, you learned about performance, status, progress, close-out, and final project reports

Topic B: Continued learning after class

It is impossible to learn to use any subject effectively in a single day. To get the most out of this class, it is important that you begin identifying how to plan, schedule, budget, control, and close a project as soon as possible.

We also offer resources for continued learning.

Next courses in this series

This is the only course in this series.

Other resources

For more information, visit www.axzopress.com.

Glossary

Activity-on-arrow diagram

An arrow charting method in which arrows represent activities, while nodes represent events. This method demonstrates how activities relate to one another.

Activity-on-node diagram

An arrow charting method in which nodes represent activities, while arrows drawn between the nodes represent activity relationships.

Actual Cost of Work Performed (ACWP)

The amount of money actually spent in completing a specific activity within a given time period.

Bottom-up estimating

Involves both duration and cost estimates. The duration and cost estimates start at the lowest level of the activity on the WBS then work up toward the highest level of the activity.

Budgeted Cost of Work Performed (BCWP)

Total budgeted cost of all work completed to date on a project.

Budgeted Cost of Work Scheduled (BCWS)

A portion of the project budget expected to be spent during a specific time period.

Concurrent activities

Activities that can be completed simultaneously and can shorten the duration of a project.

Control

Involves measuring, monitoring, and adjusting aspects of a project to produce a desired outcome and achieve the project's goals.

Cost performance index

The ratio of the budgeted cost of a project to the actual cost, or the Budgeted Cost of Work Performed divided by the Actual Cost of Work Performed.

Cost variance

Occurs when the actual cost of an activity differs from the estimated cost.

Crashing

Accelerates activity completion by using more resources to complete activities on the critical path.

Critical path

The longest chain of activities that cannot be completed concurrently.

Critical Path Method

A schedule development technique used to identify the least flexible activities in a project based on float calculations.

Discretionary dependencies

Dependencies that are a restriction outlined by the project manager based on two factors. First, if there are multiple methods of doing an activity, the project manager should choose the best method. Second, if there are many activity sequences, the project manager can pick the one most desirable for achieving the project's objective.

Dummy activities

Activities that are used to demonstrate how concurrent activities relate to one another, and they can be used to improve the layout of your project schedule.

Earliest finish time

The least amount of time that must pass from the project start date before an activity can finish.

Earliest start time

The least amount of time that must pass from a project start date before that activity can begin.

Earned value analysis

Measures overall project performance by calculating a dollar amount for every project activity.

Exception reports

A type of performance report that provides information on which project team members need to make decisions. They also notify team members of changes that affect their work.

External dependencies

Dependencies that are restrictions that result from activities outside the project itself.

Fast tracking

Activities on fast track are rearranged based on precedence relationships so that those activities are performed at the same time rather than in sequence.

Finish-to-finish dependency

Dependency in which Activity X must finish before Activity Y can finish. This dependency can increase the efficiency of a project.

Finish-to-start dependency

Depicts most common activity relationship in a project schedule. In this dependency, Activity X must finish before Activity Y can start.

Float

Length of time that the start of an activity can be deferred without affecting the completion date for the entire project.

Gantt chart

A bar chart that displays activity duration.

Lag activities

Activities that do not require the use of any resources since they occur when there is a waiting period, or “lag” time, between the time that one activity is completed and the next one begins.

Latest finish time

The greatest amount of time that can pass between the project start date and the activity finish date without affecting the end date of the entire project.

Latest start time

The latest time that an activity can start without affecting the end date of the entire project.

Mandatory dependencies

Dependencies that specify restrictions specific to an activity. They require that one activity be completed before another can begin.

Milestones

Activities that do not require work, use time, or expend resources. They are used in project scheduling to indicate that a series of activities is complete, to represent progress points, or to denote when a meeting should be held.

Parametric estimating

Uses historical data and other variables to calculate statistical relationships resulting in a cost estimate.

Phased estimating

Allows a project to be broken into phases with separate cost estimates for each phase rather than completing an estimate for an entire project.

Predecessor activities

Activities that must be finished before other activities can begin.

Program Evaluation and Review Technique (PERT)

Helps determine the best sequence for a project’s activities.

Progress report

Provides a detailed summary of what project team members have accomplished up to a given point and how they did it.

Project change control

Involves managing changes so they benefit the project and verifying that performance standards for the project are met.

Project objective

A written statement that details what goals the project should accomplish.

Routine reports

A type of performance report that is not necessarily scheduled, but may be distributed at intervals coinciding with project phases or milestones.

Schedule development

Process by which a project manager arranges a project’s main activities into a schedule.

Schedule performance index

The ratio of the actual work performed to the scheduled work, or the Budgeted Cost of Work Performed divided by the Budgeted Cost of Work Scheduled.

Schedule variance

Occurs when the actual completion time of an activity differs from the scheduled completion time.

Shortcuts

A duration compression method that includes using a specialized computer program to design a construction model, acquiring resources based on availability rather than specification, or reducing the amount of time allotted for product testing.

Slack

Difference in time required in completing concurrent activities.

Special analysis reports

A type of performance report that contains the results of a study.

Stakeholders

Any individual, group, or organization involved in a project or whose interests may be influenced as a result of project achievement.

Start-to-finish dependency

Occurs between activities in a project. In this dependency, Activity X must start before Activity Y can finish.

Start-to-start dependency

Affects how a project manager schedules activities. In this dependency, Activity X must start before Activity Y can start.

Status meetings

Used during project implementation to discuss status and find solutions to any problems.

Status report

Covers a wider range of information than a progress report and provides a detailed account of a project’s status up to a given point.

Successor

Activities that are “links” in the chain of activity flow from a project’s start through its completion. Once a successor activity is completed, it can either be a predecessor for other activities, or it can be the final activity of a project.

Top-down estimating

Utilizes a previous project’s work breakdown structure (WBS) to compute the duration of a similar new project.

Trend analysis

Used to evaluate the progress of a project over time.

Variance analysis

Used to gauge how closely a project adheres to its schedule, resource use, and budget provisions.

WBS

Helps identify complex project activities and divide them into smaller activities.

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