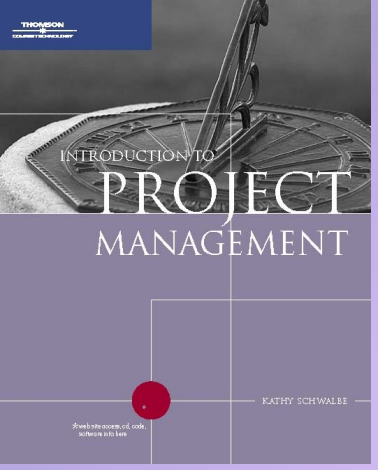


Chapter 4: Planning Projects, Part I (Integration, Scope, Time, and Cost Management)

Introduction to Project Management

Learning Objectives

- Describe the importance of creating plans to guide project execution, and list several planning tasks and outputs for project integration, scope, time, and cost management.
- Discuss project integration management planning tasks, and explain the purpose and contents of a team contract and a project management plan.
- Explain the project scope management planning tasks, and create a scope management plan, scope statement, work breakdown structure (WBS), and WBS dictionary.

Learning Objectives (continued)

- Describe the project time management planning tasks, and prepare a project schedule based on activity and milestone lists, activity sequencing, durations, and resources.
- Discuss the project cost management planning tasks, and create a cost estimate and cost baseline.

Introduction

- Many people have heard the following sayings:
  - If you fail to plan, you plan to fail.
  - If you don’t know where you’re going, any road will take you there.
  - What gets measured gets managed.
- Successful project managers know how important it is to develop, refine, and follow plans to meet project goals.
- People are more likely to perform well if they know what they are supposed to do and when.

Project Planning Should Guide Project Execution

- Planning is often the most difficult and unappreciated process in project management.
- Often, people do not want to take the time to plan well, but theory and practice show that good planning is crucial to good execution.
- *The main purpose of project planning is to guide project execution,* so project plans must be realistic and useful.

What Went Wrong?

- Top managers often require a plan, but then no one tracks whether the plan was followed.
- One project manager said he would meet with each project team leader within two months to review their project plans. Two months later, the project manager had still not met with over half of the project team leaders.
- Why should project team members feel obligated to follow their own plans when the project manager obviously does not follow his?

Table 4-1. Planning Outputs for Project Integration, Scope, Time, and Cost Management

Knowledge area	Outputs
Project integration management	Team contract Project management plan
Project scope management	Scope management plan Scope statement Work breakdown structure (WBS) WBS dictionary
Project time management	Activity list and attributes Milestone list Network diagram (showing activity dependencies) Activity resource requirements Activity duration estimates Project schedule (in Gantt chart format)
Project cost management	Cost estimate Cost baseline

Project Integration Management Planning Tasks

- **Project integration management** involves coordinating all the project management knowledge areas throughout a project's life span.
- The main planning tasks include:
  - Creating a team contract
  - Developing the project management plan

Team Contracts

- **Team contracts** help promote teamwork and clarify team communications.
- The process normally includes the core project team members reviewing a template and then working in small groups to prepare inputs for their team contract.
- The project manager should act as a coach or facilitator, observing the different personalities of team members and seeing how well they work together.
- Everyone involved in creating the team contract should sign it, and as new project team members are added, the project manager should review ground rules with them and have them read and sign the contract as well.

Topics Covered in a Team Contract

- Code of conduct
- Participation
- Communication
- Problem solving
- Meeting guidelines

Table 4-2. Sample Team Contract

Team Contract
July 9, 2007

Project Name: Just-In-Time Training Project

Project Team Members' Names and Sign-Off:

Name	Date
Kristin Maur	**July 9, 2007**
Etc.	

Code of Conduct: As a project team, we will:

- Work proactively, anticipating potential problems and preventing their occurrence.
- Keep other team members informed of information related to the project.
- Focus on what is best for the entire project team.

Participation: We will:

- Be honest and open during all project activities.
- Provide the opportunity for equal participation.
- Be open to new approaches and consider new ideas.
- Let the project manager know well in advance if a team member has to miss a meeting or may have trouble meeting a deadline for a given task.

Communication: We will:

- Keep discussions on track and have one discussion at a time.
- Use the telephone, e-mail, a project Web site, instant messaging, and other technology to assist in communicating.
- Have the project manager or designated person facilitate all meetings and arrange for phone and videoconferences, as needed.
- Work together to create the project schedule and related information and enter actuals, issues, risks, and other information into our enterprise project management system by 4 p.m. every Friday.

Problem Solving: We will:

- Only use constructive criticism and focus on solving problems, not blaming people.
- Strive to build on each other's ideas.
- Bring in outside experts when necessary.

Meeting Guidelines: We will:

- Plan to have a face-to-face meeting of the entire project team every Tuesday morning.
- Arrange for telephone or videoconferencing for participants as needed.
- Hold other meetings as needed.
- Develop and follow an agenda for all meetings.
- Record meeting minutes and send them out via e-mail within 24 hours of all project meetings, focusing on decisions made and action items and issues from each meeting.

Project Management Plans

- A **project management plan** is a document used to coordinate all project planning documents and to help guide a project's execution and control.
- Plans created in the other knowledge areas are subsidiary parts of the overall project management plan and provide more detailed information about that knowledge area.
- Project management plans facilitate communication among stakeholders and provide a baseline for progress measurement and project control.
  - A **baseline** is a starting point, a measurement, or an observation that is documented so that it can be used for future comparison; also defined as the original project plan plus approved changes.

Attributes of Project Management Plans

- Project management plans should be dynamic, flexible, and receptive to change when the environment or project changes.
- Just as projects are unique, so are project plans.
  - For a small project involving a few people over a couple of months, a project charter, team contract, scope statement, and Gantt chart might be the only project planning documents needed; *there would not be a need for a separate project management plan.*
  - A large project involving 100 people over three years would benefit from having a detailed project management plan and separate plans for each knowledge area.
- It is important to tailor *all* planning documentation to fit the needs of specific projects.

Common Elements in Project Management Plans

- Introduction/overview of the project
- Project organization
- Management and technical processes
- Work to be performed
- Schedule information
- Budget information
- References to other project planning documents

Table 4-3. Sample Project Management Plan

Project Management Plan Version 1.0
September 17, 2007

Project Name: Just-in-Time Training Project

Introduction/Overview of the Project

Global Construction employs 10,000 full-time employees in ten different counties and fifteen U.S. states. The company spends, on average, $1,000 per employee for training (not including tuition reimbursement), which is higher than the industry average. By redesigning training, Global Construction can reduce training costs and improve productivity. The main goal of this project is to develop a new training program that provides just-in-time training to employees on key topics, including supplier management, negotiating skills, project management, and software applications.

Project Organization

The basic organization of the project is provided in Figure 4-1. The project sponsor, Lucy Camarena, will have the final say on major decisions, with consultation from the project steering committee and the project champion, Mike Sundby. The project sponsor should have time to thoroughly review important project information and provide timely feedback to the project manager. The project manager in this case reports to the project sponsor, and the team leaders and supplier project managers report to the project manager.

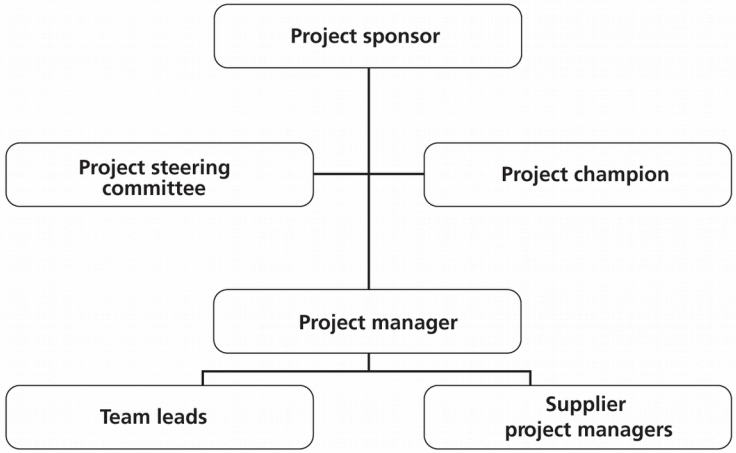


FIGURE 4-1 Project organizational chart

Management and Technical Processes

Management Processes:

1. Management Review Process: The project steering committee will meet at least monthly to provide inputs and review progress on this project.
2. Progress Measurement Process: The project steering committee will review project progress during project review meetings, and they can also review information as needed by viewing reports on the enterprise project

Table 4-3. Sample Project Management Plan (continued)

management software system. Earned value data will be provided for this project and available on a weekly basis in the system. Post-project progress will also be measured to see if the project met its goals. These goals include reducing the training cost per employee by $100/person/year and receiving positive results from survey participants on the effectiveness of the training.

3. Change Approval Process: See Attachment 1 based on corporate standards.
4. Supplier Management Process: See Attachment 2 based on corporate standards.

Technical Processes:

1. Enterprise Project Management Software: All tasks, costs, resources, issues, and risks will be tracked for this project using our enterprise project management software. Data must be entered on at least a weekly basis to provide timely information.
2. Supplier Evaluation: The project team will coordinate with the purchasing department to follow our standard procedures for selecting and working with suppliers. See Attachment 2 for corporate standards.
3. Productivity Improvement: The project team will work with the finance and quality assurance departments to develop and implement a system to measure improvements in employee productivity that result from this new training program. The finance department will report on this information annually, beginning one year after the first new training course is offered.

Work to Be Performed

Summary: Research, develop or purchase, and implement a new just-in-time training program covering the topics of supplier management, negotiating skills, project management, and software applications, and determine a way to measure the effectiveness of the training and its impact on productivity on an annual basis. See the scope statement, WBS, and other scope documents for further details.

Schedule Information

The entire project will be completed in one year, with a projected completion date of June 30, 2008. See the project schedule and other time management documents for further details.

Budget Information

The total budget for this project is $1,000,000. Approximately half of these costs will be for internal labor, whereas the other half will be for outsourced labor and training programs. See the cost estimate and cost baseline for further details.

References to Other Project Planning Documents

All current project plans created for this project are provided in Appendix A. Initial documents and revisions are available on the project Web site.

Project Scope Management Planning Tasks

- **Project scope management** involves defining and controlling what work is or is not included in a project.
- The main planning tasks include scope planning, scope definition, and creating the WBS.
- The main documents produced are a scope management plan, scope statement, WBS, and WBS dictionary.

Scope Planning and the Scope Management Plan

- A project's size, complexity, importance, as well as other factors affect how much effort is spent on scope planning.
- The main output of scope planning is a **scope management plan**, which is a document that includes descriptions of how the team will prepare the scope statement, create the WBS, verify completion of the project deliverables, and control requests for changes to the project scope.

Table 4-4. Sample Scope Management Plan

Scope Management Plan
July 17, 2007

Project Name: Just-In-Time Training Project

Introduction

The purpose of this document is to provide suggestions and guidance for preparing several important scope management documents related to the Just-In-Time Training project at Global Construction.

Preparing the Scope Statement

The preliminary scope statement will provide the basis for preparing more detailed scope statements. It is also important to review the scope statement with key stakeholders, especially the project sponsor, potential suppliers, and users of the project deliverables. The scope statement will become longer and more detailed as the project progresses. To limit the length and complexity of the scope statement, it is best to reference and include several attachments, such as product descriptions, specifications, and corporate standards. Each version of the scope statement should be clearly labeled and dated to ensure that everyone uses the most recent version. Changes and additions will be highlighted and communicated to affected personnel. The scope statement will be available on the password-protected project Web site.

Creating the Work Breakdown Structure (WBS)

The project team should work together to create the WBS. The project sponsor and project steering committee should review the WBS to ensure that it includes all of the work required to complete the project. The project team should review WBSs of similar projects, review corporate guidelines for creating WBSs, and focus on determining all of the deliverables required for the project. The tasks required to complete each deliverable should also be determined. These tasks should include product- and process-related tasks. A general guideline to follow for determining the level of detail is that the lowest level of the WBS should normally take no longer than two weeks to complete. The WBS can be revised as needed, and the sponsor and steering committee must approve these revisions.

Verifying Completion of Project Deliverables

The project manager will work with the sponsor and steering committee to develop a process for verifying successful completion of project deliverables. In general, the project sponsor will be responsible for verifying the completion of major deliverables. The contract administrator will also be involved in verifying successful completion of deliverables received from outside sources. Contracts will include clauses describing the scope verification process.

Managing Requests for Changes to Project Scope

All requests for changes to project scope that may have significant effects on meeting project requirements must follow the formal change-control procedures specified in Attachment 1. A change request form will be completed and reviewed by the appropriate group. It is crucial to follow these procedures to prevent scope creep.

Scope Definition and the Scope Statement

- Good scope definition is crucial to project success. It helps:
  - Improve the accuracy of time, cost, and resource estimates.
  - Define a baseline for performance measurement and project control.
  - Aid in communicating clear work responsibilities.
- Work that is not included in the scope statement should not be done.
- The main output of scope definition is the scope statement.
- The preliminary project scope statement should provide basic scope information, and subsequent scope statements should clarify and provide more specific information.

Table 4-5. Sample Scope Statement

Scope Statement, Version 1.0
August 1, 2007

Project Title: Just In-Time Training Project

Project Justification
Strategic planning initiatives identified the opportunity to improve productivity and reduce costs by changing Global Construction's approach to internal training. The project team will develop a new training program that provides just-in-time training to employees on key topics, including supplier management, negotiating skills, project management, and software applications.

Product Characteristics and Requirements
1. Supplier management training: The supplier management director estimates the need to train at least 100 employees each year in supplier management. There should be three levels of courses: an executive course, an introductory course, and an advanced course. Course materials should be developed as a joint effort among internal experts, outside training experts, if needed, and key suppliers. This training must be tailored to our business needs. A partnership might be developed to maximize the effectiveness of the training and minimize development costs. Different delivery methods should be explored, including instructor-led, CD-ROM, and Web-based. About half of employees would prefer an instructor-led approach, and about half would prefer a self-paced course they could take at their convenience.
2. Negotiating skills training: Employees from supplier management and other departments would benefit from this training. There should be several courses offered, including a basic course, a course tailored to negotiating contracts, and a course tailored to international negotiations. Different delivery methods should be explored, including instructor-led, CD-ROM, and Web-based.
Etc.

Table 4-5. Sample Scope Statement (continued)

Deliverables

Project Management-Related Deliverables: Team contract, project management plan, scope management plan, scope statement, WBS, etc.

Product-Related Deliverables:

1. Supplier management training:

    1.1. Needs assessment: A survey will be conducted to determine the learning objectives for the executive, introductory, and advanced courses.

    1.2 Research of existing training: A study will be done to identify current training courses and materials available.

    1.3. Partnerships: Partnership agreements will be explored to get outside training organizations and suppliers to work on developing and providing training.

    1.4. Course development: Appropriate materials will be developed for each course. Materials could take various formats, including written, video, CD-ROM, and Web-based. Materials should include interactivity to keep learners engaged.

    1.5. Pilot course: A pilot course will be provided for the introductory supplier management course. Feedback from the pilot course will be incorporated into future courses.

2. Negotiating skills training:

    2.1. Needs assessment: A survey will be conducted to determine the learning objectives for the basic negotiations, contract negotiations, and international negotiations courses.

    2.2 Research of existing training: A study will be done to identify current training courses and materials available.

Etc.

Project Success Criteria

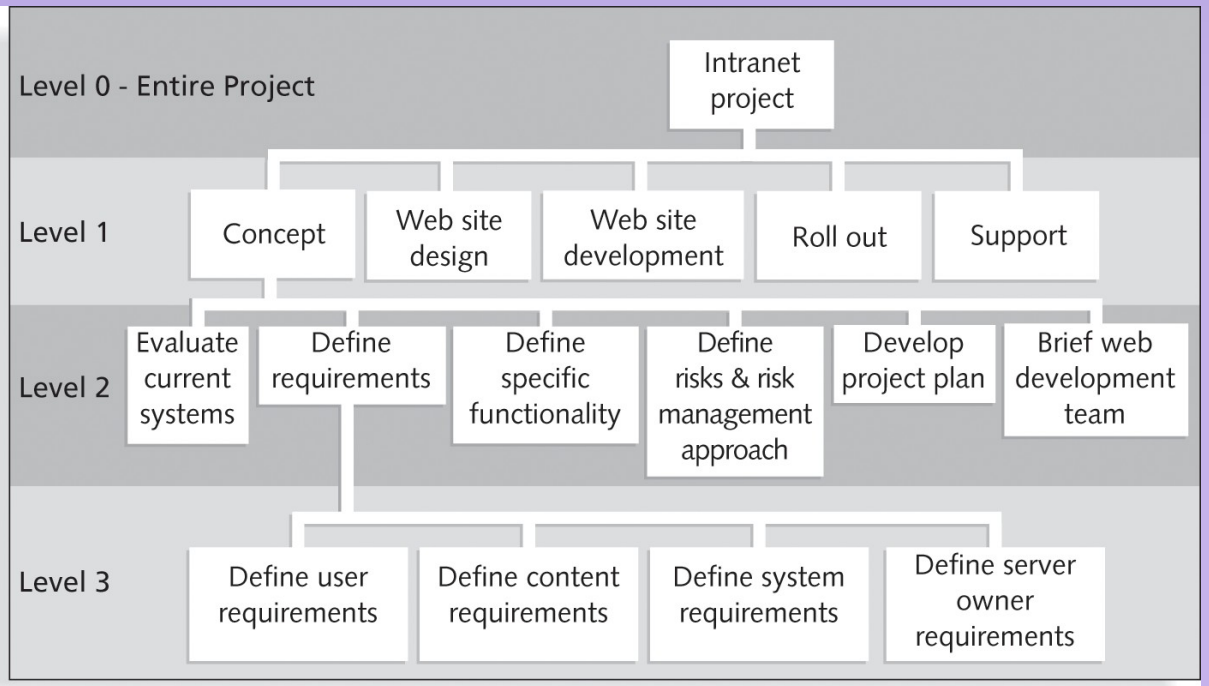
Our sponsor has stated that the project will be a success if the new training courses are all available within one year, if the average course evaluations are at least 3.0 on a 1-5 scale, and if the company recoups the cost of the project in reduced training costs within two years after project completion.

Creating the Work Breakdown Structure

- A **work breakdown structure (WBS)** is a deliverable-oriented grouping of the work involved in a project that defines the total scope of the project.
- The WBS is a document that breaks all the work required for the project into discrete tasks, and groups those tasks into a logical hierarchy.
- Often shown in two different forms:
  - Chart form
  - Tabular form

Figure 4-2. WBS in Chart and Tabular Form

Chart form →



Tabular form →

1.0 Concept
- 1.1 Evaluate current systems
- 1.2 Define requirements
  - 1.2.1 Define user requirements
  - 1.2.2 Define content requirements
  - 1.2.3 Define system requirements
  - 1.2.4 Define server owner requirements
- 1.3 Define specific functionality
- 1.4 Define risks and risk management approach
- 1.5 Develop project plan
- 1.6 Brief Web developement team

2.0 Web site design
3.0 Web site development
4.0 Roll out
5.0 Support

Work Packages

- A **work package** is a task at the lowest level of the WBS.
- It represents the level of work that the project manager monitors and controls.
- You can think of work packages in terms of accountability and reporting.
  - If a project has a relatively short time frame and requires weekly progress reports, a work package might represent work completed in one week or less.
  - If a project has a very long time frame and requires quarterly progress reports, a work package might represent work completed in one month or more.
  - A work package might also be the procurement of a specific product or products, such as an item purchased from an outside source.

Creating a Good WBS

- It is difficult to create a good WBS.
- The project manager and the project team must decide as a group how to organize the work and how many levels to include in the WBS.
- It is often better to focus on getting the top levels of the WBS done well to avoid being distracted by too much detail.
- Many people confuse tasks on a WBS with specifications or think it must reflect a sequential list of steps.

Media Snapshot

- The 2002 Olympic Winter Games and Paralympics took five years to plan and cost more than $1.9 billion. PMI awarded the Salt Lake Organizing Committee (SLOC) the Project of the Year award for delivering world-class games that, according to the International Olympic Committee, "made a profound impact upon the people of the world."
- Four years before the Games began, the SLOC used a Primavera software-based system with a cascading color-coded WBS to integrate planning. A year before the Games, they added a Venue Integrated Planning Schedule to help the team integrate resource needs, budgets, and plans. This software helped the team coordinate different areas involved in controlling access into and around a venue, such as roads, pedestrian pathways, seating and safety provisions, and hospitality areas, saving nearly $10 million.*

*Ross Foti, "The Best Winter Olympics, Period," *PM Network* (January 2004) p. 23.

Table 4-6. Sample WBS

Work Breakdown Structure (WBS) for the Just-In-Time Training Project
August 1, 2007

1. Initiating
   - 1.1. Prepare stakeholder analysis
   - 1.2. Prepare business case
   - 1.3. Create project charter
   - 1.4. Hold project kick-off meeting
   - 1.5. Develop preliminary scope statement
2. Planning
   - 2.1. Project integration management
     - 2.1.1. Create team contract
     - 2.1.2. Develop project management plan
   - 2.2. Project scope management
     - 2.2.1. Develop scope statement
     - 2.2.2. Create WBS and WBS dictionary
   - 2.3. Project time management
   - 2.4. Project cost management
   - 2.5. Project quality management
   - 2.6. Project human resources management
   - 2.7. Project communications management
   - 2.8. Project risk management
   - 2.9. Project procurement management

Table 4-6. Sample WBS (continued)

3. Executing
    3.1. Course design and development
        3.1.1. Supplier management training
            3.1.1.1. Needs assessment
                3.1.1.1.1. Develop survey
                3.1.1.1.2. Administer survey
                3.1.1.1.3. Analyze survey results
            3.1.1.2. Research of existing training
            3.1.1.3. Partnerships
                3.1.1.3.1. Research potential partners for providing training
                3.1.1.3.2. Meet with potential partners
                3.1.1.3.3. Develop partnership agreements
            3.1.1.4. Course development
                3.1.1.4.1. Develop executive course
                3.1.1.4.2. Develop introductory course
                3.1.1.4.3. Develop advanced course
            3.1.1.5. Pilot course
                3.1.1.5.1. Plan pilot course
                3.1.1.5.2. Hold pilot course
                3.1.1.5.3. Prepare report on pilot course
                3.1.1.5.4. Review results of pilot course
        3.1.2. Negotiating skills training
        3.1.3. Project management training
        3.1.4. Software applications training
    3.2. Course administration
    3.3. Course evaluation

    3.4. Stakeholder communications
        3.4.1. Communications regarding project and changes to training
            3.4.1.1. Prepare e-mails, posters, memos, and other information
            3.4.1.2. Plan and hold meetings
            3.4.1.3. Prepare information for the corporate intranet
        3.4.2. Communications regarding productivity improvements
4. Monitoring and controlling
5. Closing

Creating the WBS Dictionary

- A **WBS dictionary** is a document that describes each WBS task in detail.
- The format can vary based on project needs.
  - It might be appropriate to have just a short paragraph describing each work package.
  - For a more complex project, an entire page or more might be needed for the work-package descriptions.
  - It might require describing the responsible person or organization, resource requirements, estimated costs, and other information.

Table 4-7. Sample WBS Dictionary Entry

WBS Dictionary Entry
August 1, 2007

Project Title: Just-In-Time Training Project
WBS Item Number: 3.1.1.1.2
WBS Item Name: Administer survey
Description: The purpose of the survey for the supplier management training is to determine the learning objectives for the executive, introductory, and advanced supplier management courses (see WBS item 3.1.1.1.1 for additional information on the survey itself). The survey will be administered online using the standard corporate survey software. After the project steering committee approves the survey, the IT department will send it to all employees of grade level 52 or higher in the purchasing, accounting, engineering, IT, sales, marketing, manufacturing, and HR departments. The project champion—Mike Sundby, VP of Human Resources—will write an introductory paragraph for the survey. Department heads will mention the importance of responding to this survey in their department meetings and will send an e-mail to all affected employees to encourage their inputs. If the response rate is less than 25 percent one week after the survey is sent out, additional work may be required.

Scope Baseline

- The approved project scope statement and its associated WBS and WBS dictionary form the **scope baseline**.
- Performance in meeting project scope goals is based on the scope baseline.

Project Time Management Planning Tasks

- **Project time management** involves the processes required to ensure timely completion of a project.
- The main planning tasks performed include activity definition, activity sequencing, activity resource estimating, activity duration estimating, and schedule development.
- The main documents produced are an activity list and attributes, a milestone list, a network diagram, the activity resource requirements, the activity duration estimates, and a project schedule.

Activity Definition

- The goal of the activity definition process is to ensure that project team members have a complete understanding of all the work they must do as part of the project scope so that they can start scheduling the work.
- For example, how can you estimate how long it will take or what resources you need to prepare a report if you don't have more detailed information on the report?

Creating the Activity List and Attributes

- The **activity list** is a tabulation of activities to be included on a project schedule.
- It should include the activity name, an activity identifier or number, and a brief description of the activity.
- The **activity attributes** provide schedule-related information about each activity, such as predecessors, successors, logical relationships, leads and lags, resource requirements, constraints, imposed dates, and assumptions related to the activity.
- Both should be in agreement with the WBS and WBS dictionary <u>and</u> be reviewed by key project stakeholders.

Table 4-8. Sample Activity List and Attributes

Activity List and Attributes
August 1, 2007

Project Name: Just-In-Time Training Project
WBS Item Number: 3.1.1.1.2
WBS Item Name: Administer survey
Predecessors: 3.1.1.1.1 Develop survey
Successors: 3.1.1.1.3 Analyze survey results
Logical Relationships: Finish-to-start
Leads and Lags: None
Resource Requirements: IT personnel, corporate survey software, corporate Intranet
Constraints: None
Imposed dates: None
Assumptions: The survey for the supplier management training will be administered online using the standard corporate survey software. It should include questions measured on a Likert scale. For example, a question might be as follows: "I learned a lot from this course." Respondents would enter 1 for Strongly Agree, 2 for Agree, 3 for Undecided, 4 for Disagree, or 5 for Strongly Disagree. There should also be several open-ended questions, such as "What did you like most about the pilot course? What did you like least about the pilot course?" After the project steering committee approves the survey, the IT department will send it to all employees of grade level 52 or higher in the purchasing, accounting, engineering, IT, sales, marketing, manufacturing, and HR departments. The project champion—Mike Sundby, VP of Human Resources—will write an introductory paragraph for the survey. Department heads will mention the importance of responding to this survey in their department meetings and will send an e-mail to all affected employees to encourage their inputs. If the response rate is less than 25 percent one week after the survey is sent out, additional work may be required, such as a reminder e-mail to follow-up with people who have not responded to the survey.

Creating a Milestone List

- A **milestone** is a significant event in a project.
- It often takes several activities and a lot of work to complete a milestone, but the milestone itself is like a marker to help identify necessary activities.
- There is usually no cost or duration for a milestone.
- Project sponsors and senior managers often focus on major milestones when reviewing projects.
- Sample milestones for many projects include:
  - Sign-off of key documents
  - Completion of specific products
  - Completion of important process-related work, such as awarding a contract to a supplier

Table 4-9. Sample Milestone List

Milestone List
August 1, 2007

Project Name: Just-In-Time Training Project

Milestone	**Estimated Completion Date***
Draft survey completed	8/3/07
Survey comments submitted	8/8/07
Survey sent out by IT	8/10/07
Percentage of survey respondents reviewed	8/17/07
Survey report completed	8/22/07
Survey results reported to steering committee	8/24/07

*Note: Dates are in U.S. format. 8/3/07 means August 3, 2007.

Activity Sequencing

- Activity sequencing involves reviewing the activity list and attributes, project scope statement, and milestone list to determine the relationships or dependencies between activities.
- A **dependency** or **relationship** relates to the sequencing of project activities or tasks.
  - For example, does a certain activity have to be finished before another one can start?
  - Can the project team do several activities in parallel?
  - Can some overlap?
- Activity sequencing has a significant impact on developing and managing a project schedule.

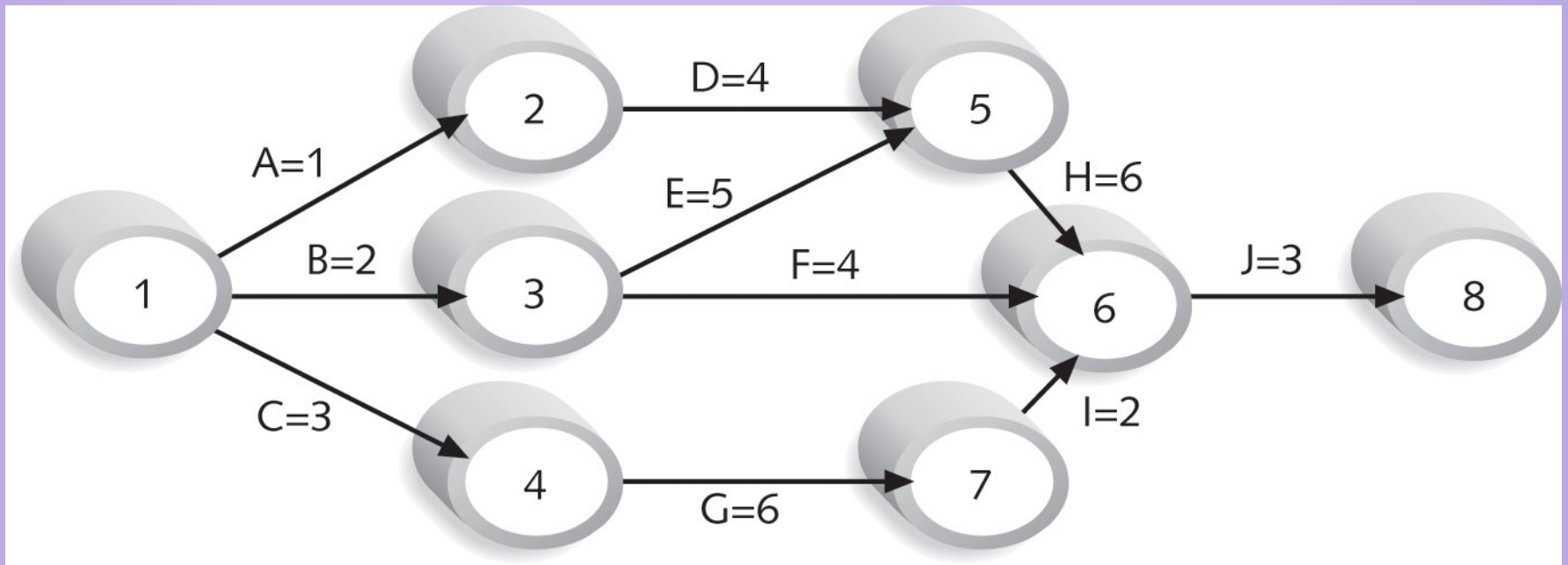
Reasons for Creating Dependencies

- **Mandatory dependencies** are inherent in the nature of the work being performed on a project.
  - You cannot hold training classes until the training materials are ready.
- **Discretionary dependencies** are defined by the project team.
  - A project team might follow good practice and not start detailed design work until key stakeholders sign off on all of the analysis work.
- **External dependencies** involve relationships between project and non-project activities.
  - The installation of new software might depend on delivery of new hardware from an external supplier. Even though the delivery of the new hardware might not be in the scope of the project, it should have an external dependency added to it because late delivery will affect the project schedule.

Network Diagrams

- Network diagrams are the preferred technique for showing activity sequencing.
- A **network diagram** is a schematic display of the logical relationships among, or sequencing of, project activities.
  - In the **activity-on-arrow (AOA)** approach, or the **arrow diagramming method (ADM),** activities are represented by arrows and connected at points called **nodes** (starting and ending point of an activity) to illustrate the sequence of activities; only show finish-to-start dependencies (most common type of dependency).
  - The **precedence diagramming method (PDM)** is a network diagramming technique in which boxes represent activities. These are more widely used as they can show all dependency types.

Figure 4-3. Activity-on-Arrow (AOD) Network Diagram for Project X



Note: Assume all durations are in days; A=1 means Activity A has a duration of 1 day.

More on Network Diagrams

- Keep in mind that the network diagram represents activities that must be done to complete the project; it is not a race to get from the first node to the last.
- *Every* activity on the network diagram must be completed for the project to finish.
- Not every item on the WBS needs to be on the network diagram; only activities with dependencies need to be shown on the network diagram.

Steps for Creating an AOA Network Diagram

1. Find all of the activities that start at Node 1. Draw their finish nodes, and draw arrows between Node 1 and each of those finish nodes. Put the activity letter or name on the associated arrow. If you have a duration estimate, write that next to the activity letter or name.
2. Continue drawing the network diagram, working from left to right. Look for bursts and merges.
   - **Bursts** occur when two or more activities follow a single node.
   - A **merge** occurs when two or more nodes precede a single node.
3. Continue drawing the AOA network diagram until all activities with dependencies are included on the diagram.
4. As a rule of thumb, all arrowheads should face toward the right, and no arrows should cross on an AOA network diagram. You might need to redraw the diagram to make it look presentable.

Figure 4-4. Dependency Types

Task dependencies

The nature of the relationship between two linked tasks. You link tasks by defining a dependency between their finish and start dates. For example, the "Contact caterers" task must finish before the start of the "Determine menus" task. There are four kinds of task dependencies in Microsoft Project:

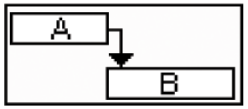
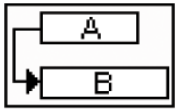
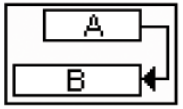
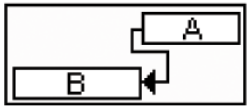
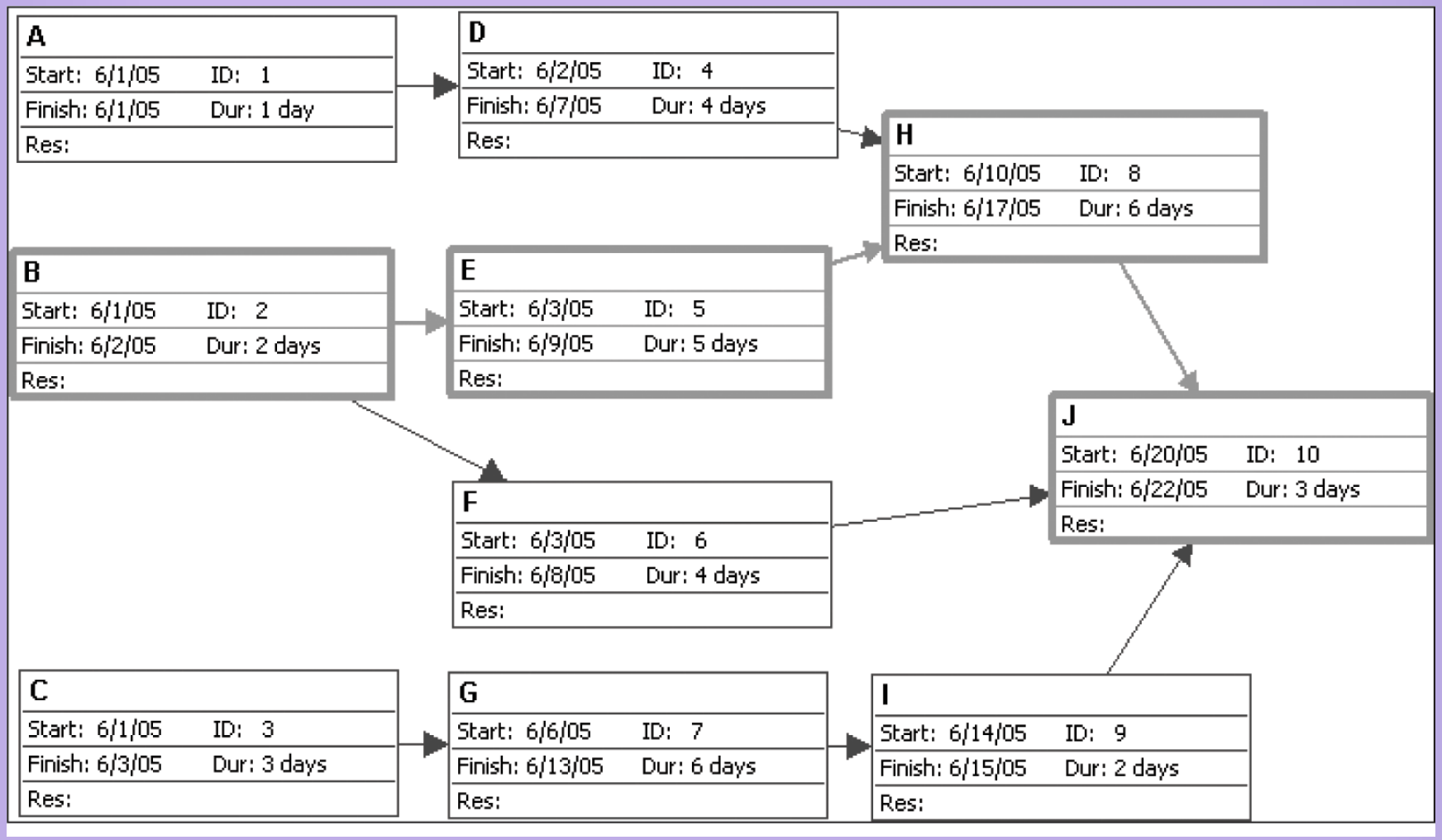
Task dependency	Example	Description
Finish-to-start (FS)		Task (B) cannot start until task (A) finishes.
Start-to-start (SS)		Task (B) cannot start until task (A) starts.
Finish-to-finish (FF)		Task (B) cannot finish until task (A) finishes.
Start-to-finish (SF)		Task (B) cannot finish until task (A) starts.

Figure 4-5. Precedence Diagramming Method (PDM) Network Diagram for Project X



Activity Resource Estimating

- Questions to consider:
  - How difficult will it be to do specific activities on this project?
  - Is there anything unique in the project's scope statement that will affect resources?
  - What is the organization's history in doing similar activities? Has the organization done similar tasks before? What level of personnel did the work?
  - Does the organization have appropriate people, equipment, and materials available for performing the work? Are there any organizational policies that might affect the availability of resources?
  - Does the organization need to acquire more resources to accomplish the work? Would it make sense to outsource some of the work? Will outsourcing increase or decrease the amount of resources needed and when they will be available?

Table 4-10. Sample Activity Resource Requirements Information

Activity Resource Requirements
August 1, 2007

Project Name: Just-In-Time Training Project
WBS Item Number: 3.1.1.1.2
WBS Item Name: Administer survey
Description: Internal members of our IT department will perform this task. The individuals must be knowledgeable in using our online survey software so that they can enter the actual survey into this software. They must also know how to run a query to find the e-mail addresses of employees of grade level 52 or higher in the purchasing, accounting, engineering, IT, sales, marketing, manufacturing, and HR departments.

Activity Duration Estimating

- **Duration** includes the actual amount of time spent working on an activity *plus* elapsed time.
  - For example, even though it might take one workweek or five workdays to do the actual work, the duration estimate might be two weeks to allow extra time needed to obtain outside information or to allow for resource availability.
- **Effort** is the number of workdays or work hours required to complete a task.
  - A duration estimate of one day could be based on eight hours of work or eighty hours of work.
- Duration relates to the time estimate, not the effort estimate; the two are related, so project team members must document their assumptions when creating duration estimates and update the estimates as the project progresses.

Discrete, Range, and Three-Point Estimates

- **Duration estimates** are often provided as discrete estimates, such as four weeks.
- A **range estimate** might be between three and five weeks.
- A **three-point estimate** is an estimate that includes an optimistic, most likely, and pessimistic estimate, such as three, four, and five weeks.

Program Evaluation and Review Technique (PERT)

- **Program Evaluation and Review Technique (PERT)** is a network analysis technique used to estimate project duration when there is a high degree of uncertainty about the individual activity duration estimates.
- **PERT weighted average** =

$$\frac{\text{optimistic time} + 4 \times \text{most likely time} + \text{pessimistic time}}{6}$$

- **Example: PERT weighted average** =

(1 workday+4×2 workdays+9 workdays)/6 = 3 workdays

- Instead of using the most likely time of two workdays for this task, you'd use three workdays with a PERT estimate.

Monte Carlo Simulations and Probabilities

- Some people prefer using a Monte Carlo simulation over PERT because it accounts for various probabilities.
- To perform a Monte Carlo simulation, in addition to the three-point estimate, you also collect probabilistic information for each activity duration estimate.
  - For example, estimators must provide a probability of each activity being completed between the optimistic and most likely times.
  - You then run a computer simulation to find probability distributions for the entire schedule being completed by certain times.

Sample Activity Duration Estimates

- Kristin and her team decided to enter realistic discrete estimates for each activity instead of using PERT or a Monte Carlo simulation.
- She stressed that people who would do the work should provide the estimate, and they should have 50 percent confidence in meeting each estimate.
- If some tasks took longer, some took less time, and some were exactly on target, they should still meet their overall schedule.

Schedule Development

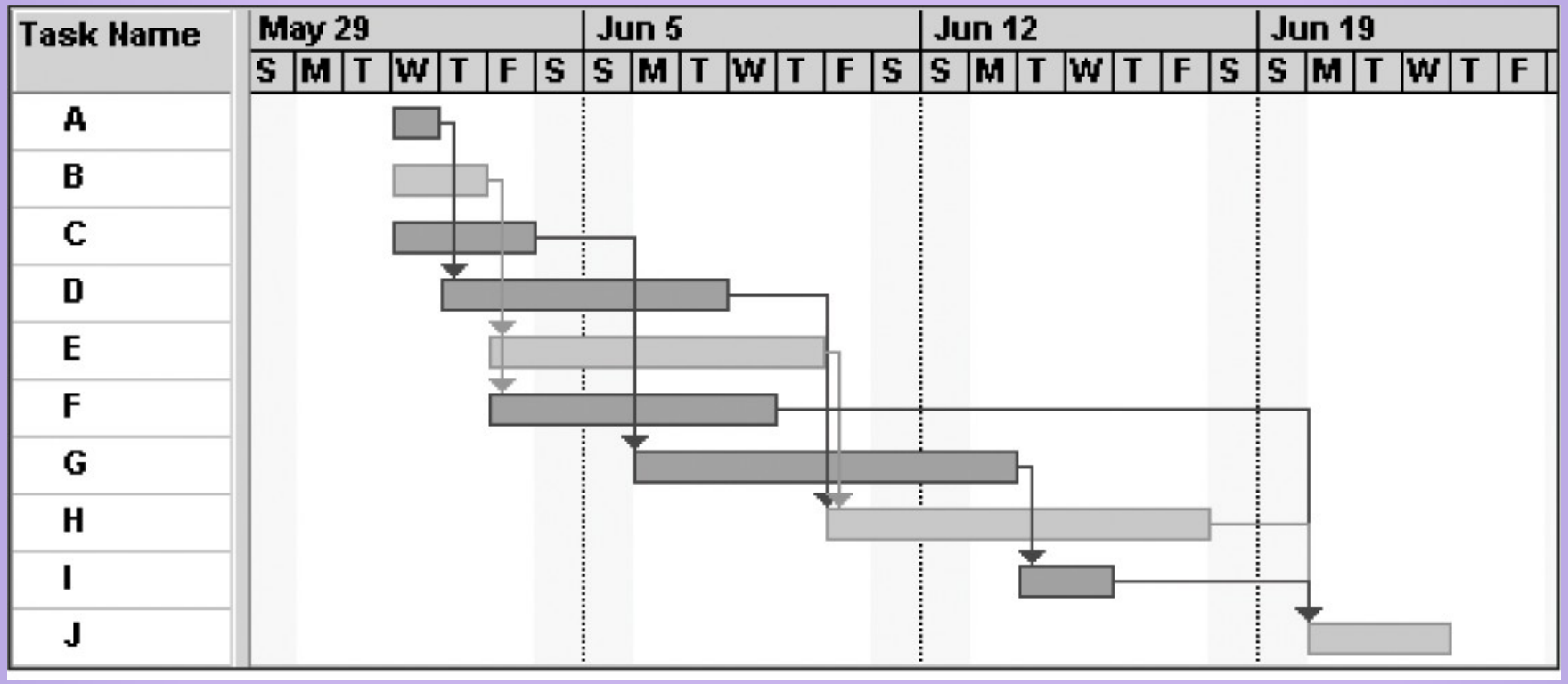
- Schedule development uses the results of all the preceding project time management processes to determine the start and end dates of project activities and of the entire project.
- The resulting project schedule is often shown on a **Gantt chart**, a standard format for displaying project schedule information by listing project activities and their corresponding start and finish dates in a calendar format.
- The ultimate goal of schedule development is to create a realistic project schedule that provides a basis for monitoring project progress for the time dimension of the project.

What Went Right?

- Chris Higgins used the discipline he learned in the Army to transform project management into a cultural force at Bank of America. His project team was pushing to get to the coding phase of the project quickly, but Higgins held them back.
- He made the team members develop a realistic project schedule that included adequate time to analyze, plan, and document requirements for the system in detail.
- It turned out that they needed six months just to complete that work. However, the discipline up front enabled the software developers on the team to do all of the coding in only three months, as planned, and the project was completed on time.*

*Kathleen Melymuke, "Spit and Polish," *ComputerWorld* (February 16, 1998).

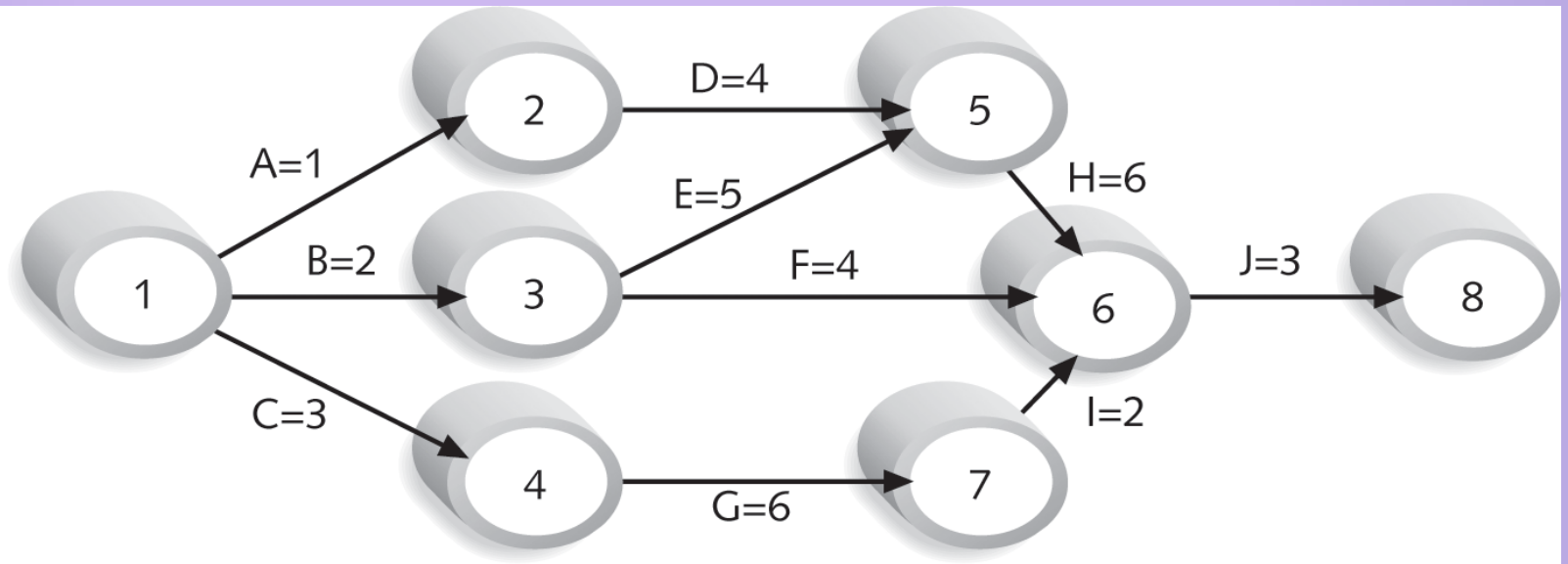
Figure 4-6. Gantt Chart for Project X



Critical Path Analysis

- **Critical path method (CPM)**—also called **critical path analysis**—is a network diagramming technique used to predict total project duration.
- A **critical path** for a project is the series of activities that determine the *earliest* time by which the project can be completed. It is the *longest* path through the network diagram and has the least amount of slack or float.
  - **Slack** or **float** is the amount of time an activity may be delayed without delaying a succeeding activity or the project finish date.
- The longest path or the path containing the critical tasks is what is driving the completion date for the project.

Figure 4-7. Critical Path Calculation for Project X



Note: Assume all durations are in days.

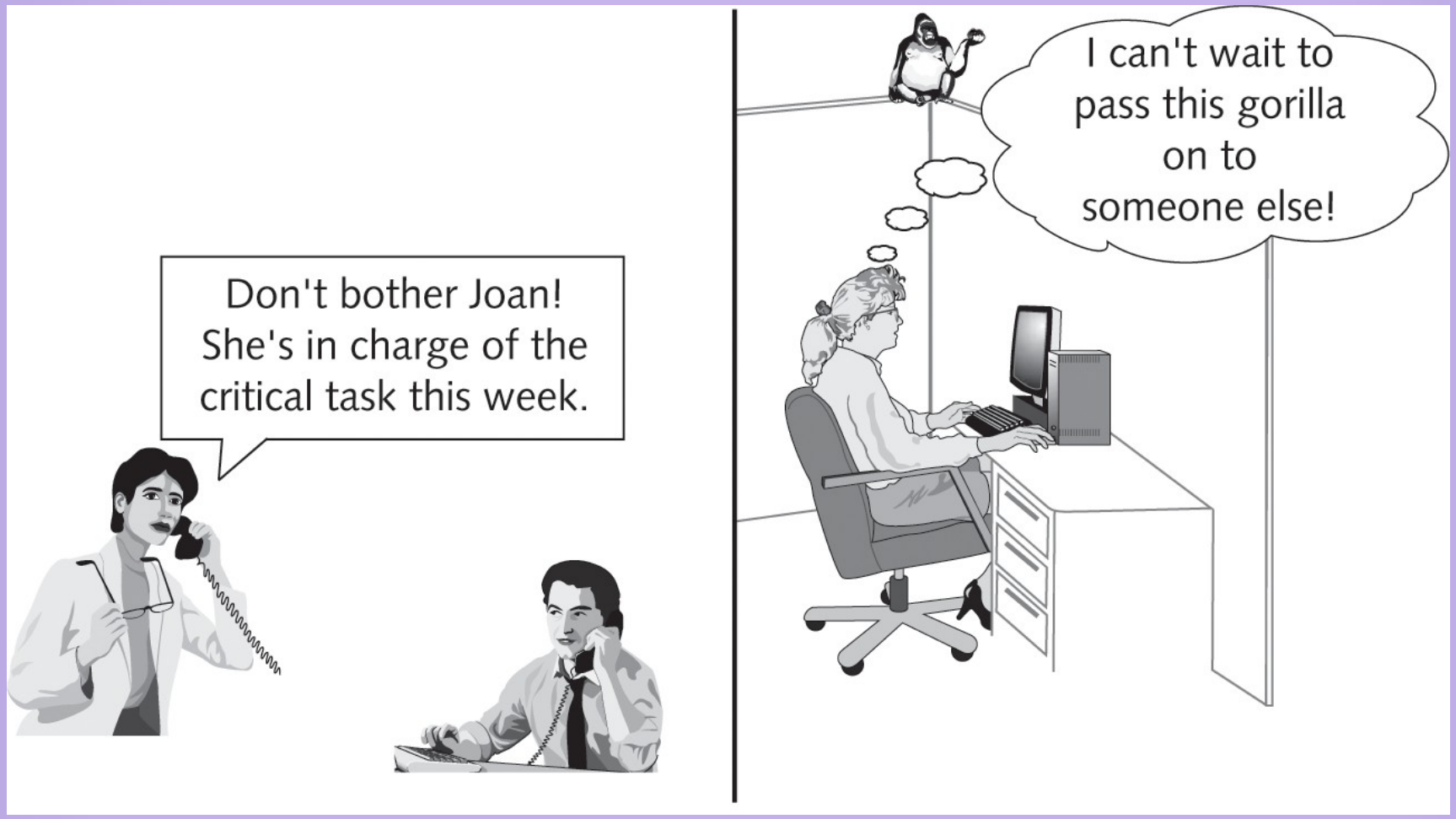
Path 1:	A-D-H-J	Length = 1+4+6+3 = 14 days
Path 2:	**B-E-H-J**	**Length = 2+5+6+3 = 16 days**
Path 3:	B-F-J	Length = 2+4+3 = 9 days
Path 4:	C-G-I-J	Length = 3+6+2+3 = 14 days

Because the critical path is the longest path through the network diagram, Path 2, B-E-H-J, is the critical path for Project X.

What Does the Critical Path Really Mean?

- *The critical path shows the shortest time in which a project can be completed*.
- If one or more of the activities on the critical path takes longer than planned, the whole project schedule will slip *unless* the project manager takes corrective action.
- For example: Apple Computer team members put a stuffed gorilla on top of the cubicle of whoever was in charge of a critical task, so they would not distract him or her.

Figure 4-8. Who's Stuck With the Gorilla This Week?



Growing Grass Can Be on the Critical Path

- The fact that its name includes the word “critical” does *not* mean that the critical path includes all critical activities.
- Frank Addeman, executive project director at Walt Disney Imagineering, explained in a keynote address at the May 2000 PMI-ISSIG Professional Development Seminar that growing grass was on the critical path for building Disney’s Animal Kingdom theme park.
- This 500-acre park required special grass for its animal inhabitants, and some of the grass took years to grow.
- So, growing grass was driving the completion date of the theme park; not what most people would think of as a critical activity.

Using Critical Path Analysis to Make Schedule Trade-offs

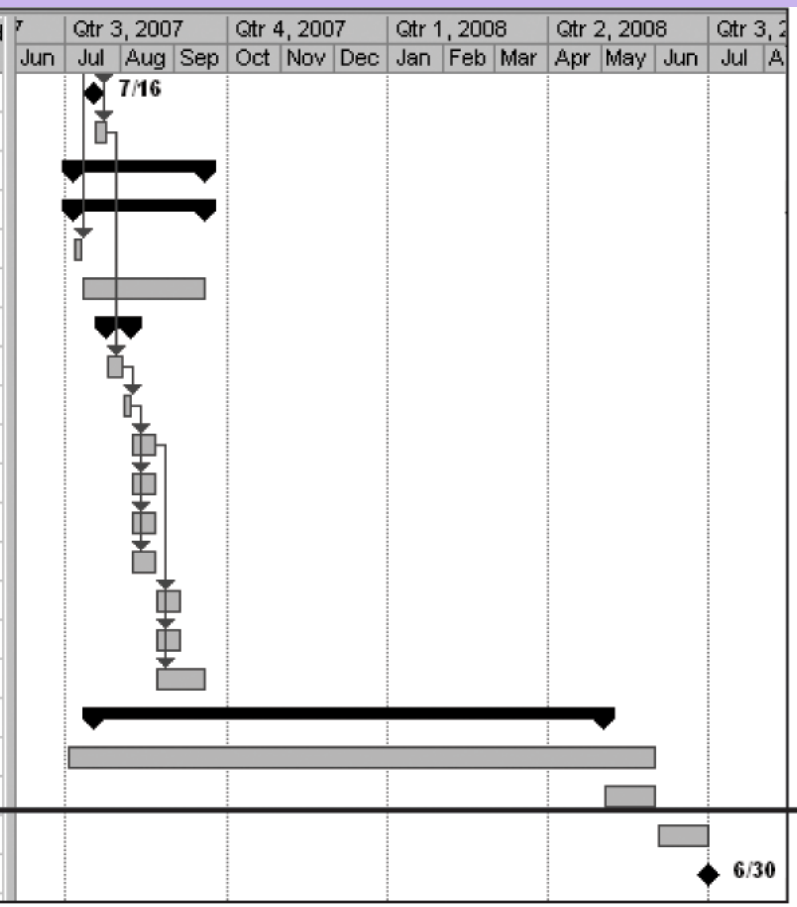
- It is important to know what the critical path is throughout the life of a project so that the project manager can make trade-offs.
- If one of the tasks on the critical path is behind schedule, should the schedule be renegotiated with stakeholders, or should more resources be allocated to other items on the critical path to make up for that time?
- It is also common for project stakeholders to want to shorten project schedule estimates, so you need to know what tasks are on the critical path.

Schedule Compression Techniques

- **Crashing** is a technique for making cost and schedule trade-offs to obtain the greatest amount of schedule compression for the least incremental cost.
  - If two critical tasks each take two weeks, and it will take $100 to shorten Task 1 by a week and $1,000 to shorten Task 2 by a week, shorten Task 1.
- **Fast tracking** involves doing activities in parallel that you would normally do in sequence.
  - Instead of waiting for Task 1 to be totally finished before starting Task 2, start Task 2 when Task 1 is halfway done.
- Schedule compression often backfires by causing cost, human resource, and quality problems, which lead to even longer schedules.

Figure 4-9. Sample Project Schedule*

Task Name	Duration	Pred
1.4 Hold project kickoff meeting	0 days	4
1.5 Develop preliminary scope statement	5 days	4
2 Planning	**53 days**	
2.1 Project integration management	**53 days**	
2.1.1 Create team contract	3 days	2
2.1.2 Develop project management plar	50 days	
2.2 Project scope management	**10 days**	
2.2.1 Develop scope statement	7 days	6
2.2.2 Create WBS and WBS dictionary	3 days	12
2.3 Project time management	10 days	13
2.4 Project cost management	10 days	13
2.5 Project quality management	10 days	13
2.6 Project human resource management	10 days	13
2.7 Project communications management	10 days	14
2.8 Project risk management	10 days	14
2.9 Project procurement management	20 days	14
3 Executing	**208.5 days?**	
4 Monitoring and Controlling	240 days	
5 Closing	21 days	61
6 Project buffer	21 days	
7 Project must be completed by date	0 days	



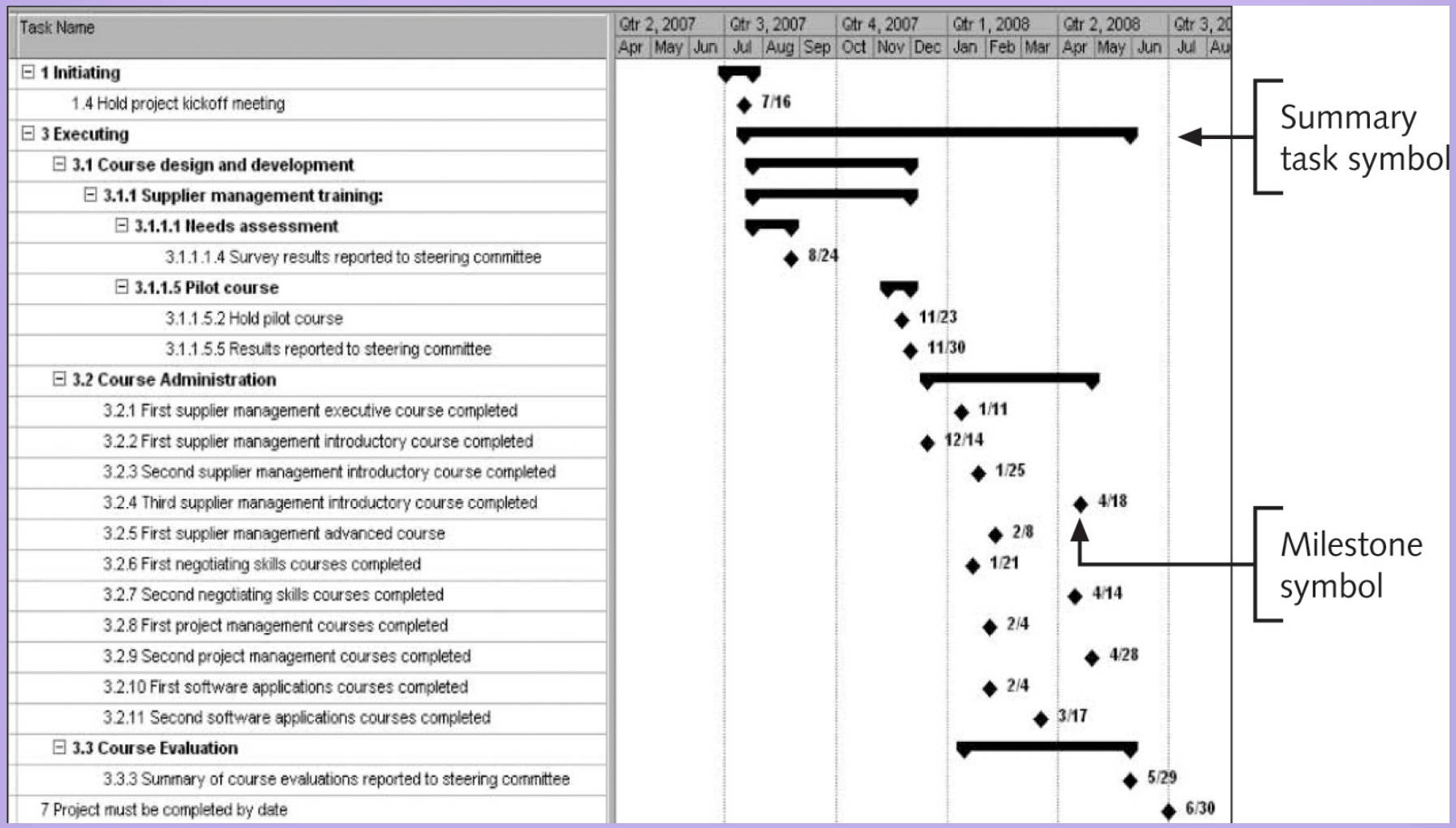
Collapsed symbol

*You can find this Project 2003 file on the companion Web site.

Project Buffers

- A **project buffer** is additional time added before the project's due date to account for unexpected factors.
- Kristin learned from past projects that no matter how well you try to schedule everything, it can still be a challenge to finish on time without a mad rush at the end, so she included a buffer in their project schedule.

Figure 4-10. Sample Gantt Chart Showing Summary Tasks and Milestones



Project Cost Management Planning Tasks

- **Project cost management** includes the processes required to ensure that a project team completes a project within an approved budget.
- The main planning tasks are cost estimating and cost budgeting.
- The main documents produced include a cost estimate and a cost baseline.

Cost Estimating

- Project teams normally prepare cost estimates at various stages of a project, and these estimates should be fine-tuned as time progresses.
- It is also important to provide supporting details for the estimates, including ground rules and assumptions.
- A large percentage of total project costs are often labor costs, so it is important to do a good job estimating labor hours and costs.

Cost Estimating Techniques

- **Analogous estimates**, also called **top-down estimates**, use the actual cost of a previous, similar project as the basis for estimating the cost of the current project. This technique requires a good deal of expert judgment and is generally less costly than others are, but it can also be less accurate.
- **Bottom-up estimates** involve estimating individual activities and summing them to get a project total. This approach can increase the accuracy of the cost estimate, but it can also be time intensive and, therefore, expensive to develop.
- **Parametric modeling** uses project characteristics (parameters) in a mathematical model to estimate project costs.
- It is good practice to use more than one technique for creating a cost estimate.

Cost Estimating Process

- See the detailed steps, ground rules, and assumptions that Kristin's team used for developing their cost estimate.
- Summary information was documented in a cost model.
- Just as projects are unique, so are cost estimates.
- Consult with internal and external experts and organizations for assistance.

Figure 4-11. Sample Cost Estimate

	Internal	$/hour	Internal	External	$/hour	External	Total	Non-labor $	Total Cost
WBS Categories	**Labor**		**$ Total**	**Labor**		**$ Total**	**Labor**		
1. Initiating	200	$ 65	$ 13,000			$ -	$ 13,000		$ 13,000
2. Planning	600	$ 60	$ 36,000			$ -	$ 36,000		$ 36,000
3. Executing			$ -			$ -	$ -		$ -
3.1 Course design and development			$ -			$ -	$ -		$ -
3.1.1 Supplier management training	600	$ 60	$ 36,000	600	$ 150	$ 90,000	$ 126,000	$ 100,000	$ 226,000
3.1.2 Negotiating skills training	300	$ 55	$ 16,500	300	$ 150	$ 45,000	$ 61,500	$ 50,000	$ 111,500
3.1.3 Project management training	400	$ 60	$ 24,000	400	$ 150	$ 60,000	$ 84,000	$ 50,000	$ 134,000
3.1.4 Software applications training	400	$ 60	$ 24,000	400	$ 150	$ 60,000	$ 84,000	$ 50,000	$ 134,000
3.2 Course administration	400	$ 55	$ 22,000	300	$ 250	$ 75,000	$ 97,000	$ 80,000	$ 177,000
3.3.Course evaluation	300	$ 55	$ 16,500			$ -	$ 16,500		$ 16,500
3.4 Stakeholder communications	300	$ 55	$ 16,500			$ -	$ 16,500		$ 16,500
4. Monitoring and Controlling	500	$ 55	$ 27,500			$ -	$ 27,500		$ 27,500
5. Closing	200	$ 55	$ 11,000			$ -	$ 11,000		$ 11,000
Subtotal									$ 903,000
Reserves			$ -			$ -	$ -		90,300.0
Total	4,200		243,000	2,000	850	330,000	573,000	330,000	**$ 993,300**

Assumptions

Internal labor rates include benefits and overhead. Average hourly rates are based on skill levels and departments of stakeholders.

External labor rates are based on historical averages; may change as contracts are awarded.

Non-labor costs include purchasing licenses for using training materials, books, CD/ROMs, travel expenses, etc.

Non-labor costs may change as contracts are awarded.

Reserves are calculated by taking 10% of the total estimate.

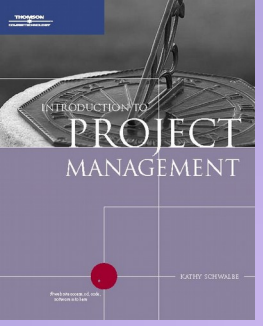
Cost Budgeting

- Project cost budgeting involves allocating the project cost estimate to tasks over time.
- The tasks are based on the work breakdown structure for the project.
- The main goal of the cost budgeting process is to produce a **cost baseline**, or time-phased budget, that project managers use to measure and monitor cost performance.

Figure 4-12. Sample Cost Baseline

	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	Total
WBS Categories													Cost
1. Initiating	13,000												$ 13,000
2. Planning	6,000	16,000	8,000	1,000	1,000	1,000	1,000	1,000	1,000				$ 36,000
3. Executing			-			-	-						$ -
3.1 Course design and development			-			-	-						$ -
3.1.1 Supplier management training			5,000	73,667	73,667	73,667							$ 226,000
3.1.2 Negotiating skills training			5,000	35,500	35,500	35,500							$ 111,500
3.1.3 Project management training			5,000	43,000	43,000	43,000							$ 134,000
3.1.4 Software applications training			5,000	43,000	43,000	43,000							$ 134,000
3.2 Course administration						17,000	53,333	53,333	53,333				$ 177,000
3.3.Course evaluation							3,000	3,000	3,000	7,500			$ 16,500
3.4 Stakeholder communications		1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	$ 16,500
4. Monitoring and Controlling	1,000	2,000	2,000	2,000	3,000	3,500	3,000	3,000	2,000	3,000	2,000	1,000	$ 27,500
5. Closing											8,000	3,000	$ 11,000
Subtotal													$ 903,000
Reserves*			-			-	-					90,300	$ 90,300
Total	20,000	19,500	31,500	199,667	200,667	218,167	61,833	61,833	60,833	12,000	11,500	95,800	993,300

*Reserves are all entered in month 12



Chapter Summary

- It is important to remember that the main purpose of project plans is to guide project execution.
- Planning tasks for integration management include developing a team contract and a project management plan.
- Planning tasks for scope management include creating a scope management plan, a scope statement, a WBS, and a WBS dictionary.
- Planning tasks for time management include developing a project schedule by creating an activity list, a milestone list, network diagrams, activity resource requirements, and activity duration estimates. It is also important to understand critical path analysis to make schedule trade-off decisions.
- Planning tasks for cost management include developing a project cost estimate and a cost baseline.