



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

## Slide 2

### Introduction to Project Management

## 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 and be reviewed by key project stakeholders.

## Table 4-8. Sample Activity List and Attributes

Activity List and Attributes August 1, 2007
<b>Project Name:</b> Just-In-Time Training Project
<b>WBS Item Number:</b> 3.1.1.1.2
<b>WBS Item Name:</b> Administer survey
<b>Predecessors:</b> 3.1.1.1.1 Develop survey
<b>Successors:</b> 3.1.1.1.3 Analyze survey results
<b>Logical Relationships:</b> Finish-to-start
<b>Leads and Lags:</b> None
<b>Resource Requirements:</b> IT personnel, corporate survey software, corporate Intranet
<b>Constraints:</b> None
<b>Imposed dates:</b> None
<b>Assumptions:</b> 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.

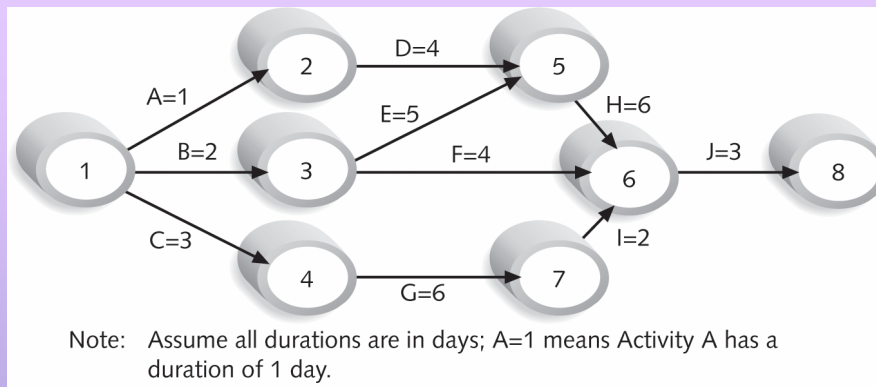
## Reasons for Creating Dependencies

- **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



## 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.

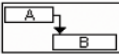



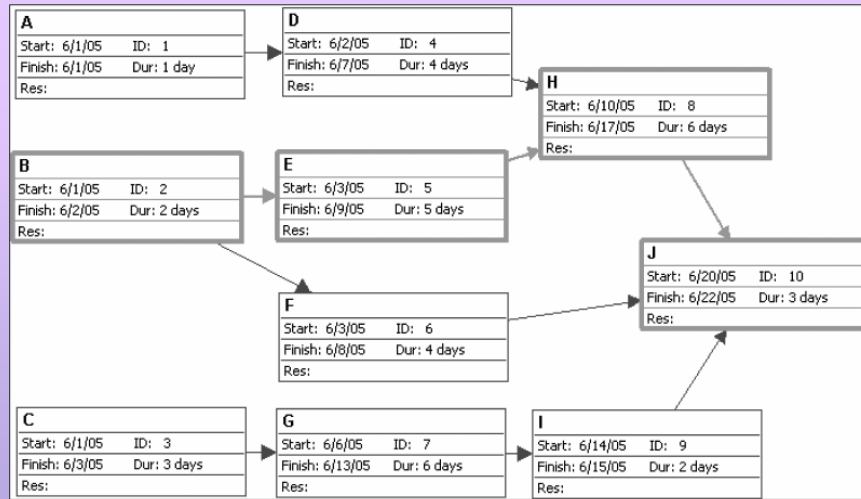
Task dependency	Example	Description
Finish-to-start (FS)		Task (B) cannot start until task (A) finishes.
Start-to-start (SS)		Task (B) cannot start until task (A) starts.
Finish-to-finish (FF)		Task (B) cannot finish until task (A) finishes.
Start-to-finish (SF)		Task (B) cannot finish until task (A) 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** =  
$$(1 \text{ workday} + 4 \times 2 \text{ workdays} + 9 \text{ workdays}) / 6 = 3 \text{ workdays}$$
- 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

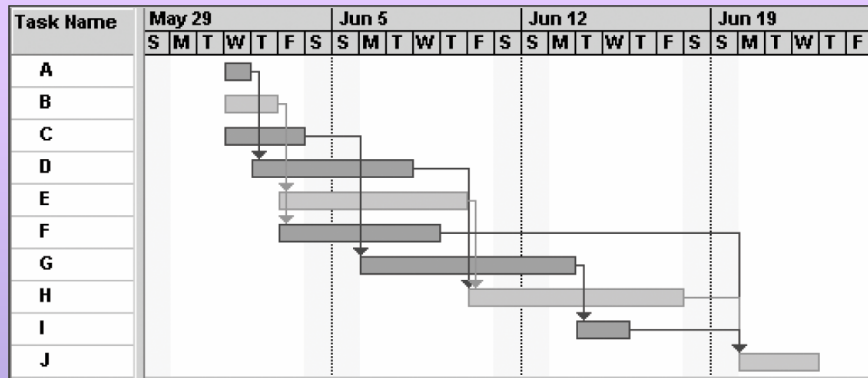
- Schedule development uses the results of all the preceding project time management processes to determine the start and end dates of project activities and of the entire project.
- The resulting project schedule is often shown on a **Gantt chart**, a standard format for displaying project schedule 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).

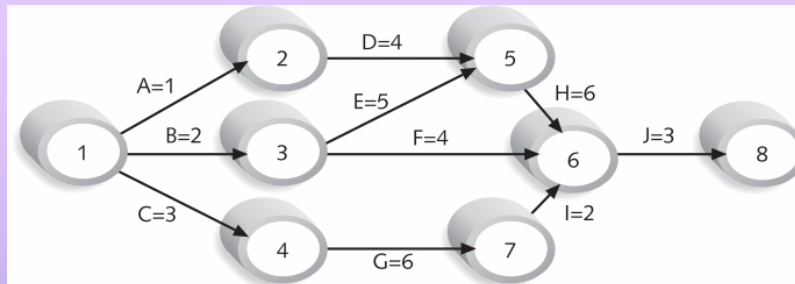
Figure 4-6. Gantt Chart for Project X



## 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

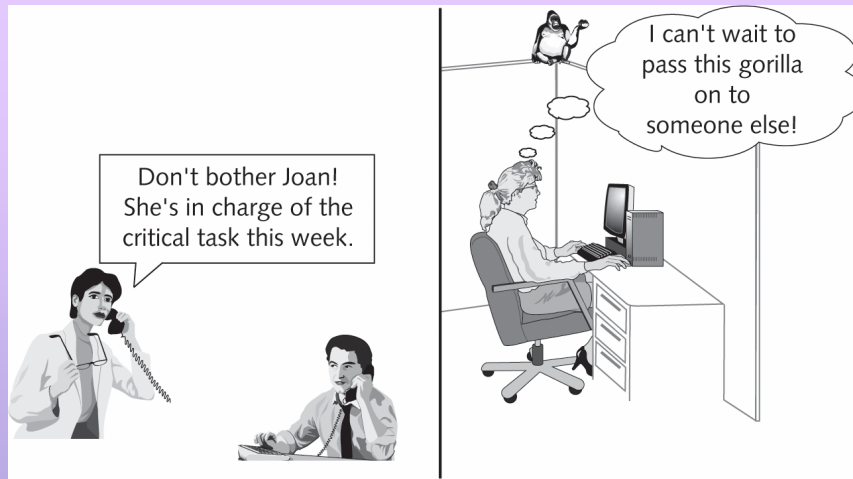
Path 4: C-G-I-J Length =  $3+6+2+3 = 14$  days

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

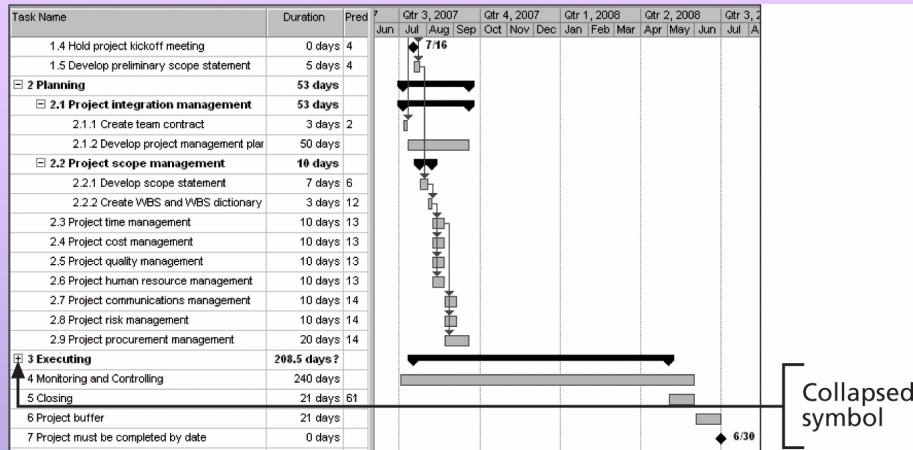
- It is important to know what the critical path is throughout the life of a project so that the project manager can make trade-offs.
- If one of the tasks on the critical path is behind schedule, should the schedule be renegotiated with stakeholders, or should more resources be allocated to other items 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\*

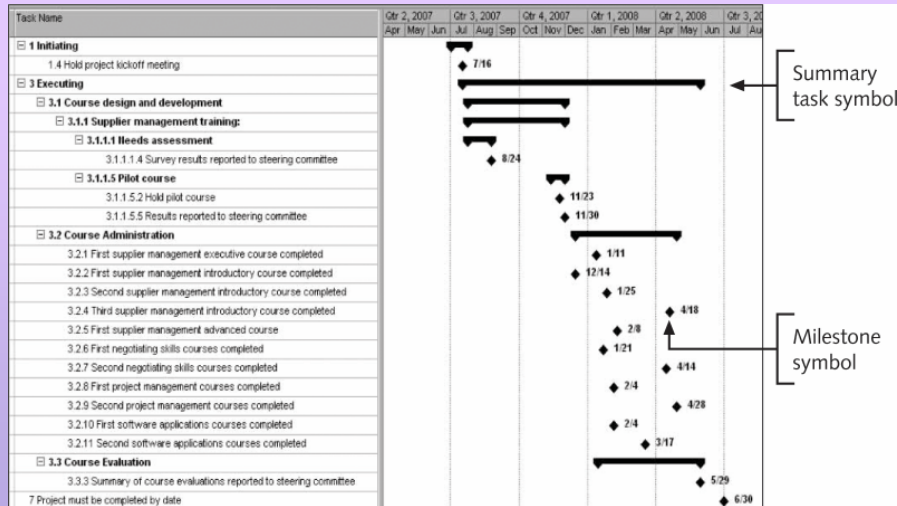


\*You can find this Project 2003 file on the companion Web site.

## 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

WBS Categories	Internal	\$/hour	Internal	External	\$/hour	External	Total	Non-labor \$	Total Cost
	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
<b>Total</b>	<b>4,200</b>		<b>243,000</b>	<b>2,000</b>	<b>850</b>	<b>330,000</b>	<b>573,000</b>	<b>330,000</b>	<b>\$ 993,300</b>

### 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

WBS Categories	Month												Total Cost	
	1	2	3	4	5	6	7	8	9	10	11	12		
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	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	1,000	\$ 27,500
5. Closing											8,000	3,000		\$ 11,000
Subtotal														\$ 903,000
Reserves*													90,300	\$ 90,300
<b>Total</b>	<b>20,000</b>	<b>19,500</b>	<b>31,500</b>	<b>199,667</b>	<b>200,667</b>	<b>218,167</b>	<b>61,833</b>	<b>61,833</b>	<b>60,833</b>	<b>12,000</b>	<b>11,500</b>	<b>95,800</b>		<b>993,300</b>

\*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.