

Chapter 6: Project Time Management

**Information Technology
Project Management**

Learning Objectives

- Understand the importance of project schedules and good project time management
- Define activities as the basis for developing project schedules
- Describe how project managers use network diagrams and dependencies to assist in activity sequencing
- Understand the relationship between estimating resources and project schedules
- Explain how various tools and techniques help project managers perform activity duration estimating

Learning Objectives (continued)

- Use a Gantt chart for planning and tracking schedule information, find the critical path for a project, and describe how critical chain scheduling and the Program Evaluation and Review Technique (PERT) affect schedule development
- Discuss how reality checks and people issues are involved in controlling and managing changes to the project schedule
- Describe how project management software can assist in project time management and review words of caution before using this software

Importance of Project Schedules

- Managers often cite delivering projects on time as one of their biggest challenges
- Time has the least amount of flexibility; it passes no matter what happens on a project
- Schedule issues are the main reason for conflicts on projects, especially during the second half of projects

Individual Work Styles and Cultural Differences Cause Schedule Conflicts

- One dimension of the Meyers-Briggs Type Indicator focuses on peoples' attitudes toward structure and deadline
- Some people prefer to follow schedules and meet deadlines, while others do not (J vs. P)
- Different cultures and even entire countries have different attitudes about schedules

Media Snapshot

- In contrast to the 2002 Salt Lake City Winter Olympic Games (see Chapter 4's Media Snapshot), planning and scheduling was very different for the 2004 Summer Olympic Games held in Athens, Greece
- Many articles were written before the opening ceremonies predicting that the facilities would not be ready in time
- Many people were pleasantly surprised by the amazing opening ceremonies, beautiful new buildings, and state-of-the-art security and transportation systems in Athens
- The Greeks even made fun of critics by having construction workers pretend to still be working as the ceremonies began

Project Time Management Processes

- **Activity definition:** identifying the specific activities that the project team members and stakeholders must perform to produce the project deliverables
- **Activity sequencing:** identifying and documenting the relationships between project activities
- **Activity resource estimating:** estimating how many **resources** a project team should use to perform project activities
- **Activity duration estimating:** estimating the number of work periods that are needed to complete individual activities
- **Schedule development:** analyzing activity sequences, activity resource estimates, and activity duration estimates to create the project schedule
- **Schedule control:** controlling and managing changes to the project schedule

Figure 6-1: Project Time Management Summary

Planning

Process: **Activity definition**

Outputs: Activity list, activity attributes, milestone list, requested changes

Process: **Activity sequencing**

Outputs: Project schedule network diagram, requested changes, updates to the activity list and attributes

Process: **Activity resource estimating**

Outputs: Activity resource requirements, resource breakdown structure, requested changes, and updates to activity attributes, resource calendars

Process: **Activity duration estimating**

Outputs: Activity duration estimates, updates to activity attributes

Process: **Schedule development**

Outputs: Project schedule, schedule model data, schedule baseline, requested changes, and updates to resource requirements, activity attributes, the project calendar, project management plan



Monitoring and Controlling

Process: **Schedule control**

Outputs: Performance measurements, requested changes, recommended corrective actions, and updates to the schedule model data, schedule baseline, organizational process assets, activity list and attributes, the project management plan



Project Start

Project Finish



Activity Definition

- Project schedules grow out of the basic documents that initiate a project
 - Project charter includes start and end dates and budget information
 - Scope statement and WBS help define what will be done
- Activity definition involves developing a more detailed WBS and supporting explanations to understand all the work to be done so you can develop realistic cost and duration estimates

Activity Lists and Attributes

- An **activity list** is a tabulation of activities to be included on a project schedule that includes:
 - The activity name
 - An activity identifier or number
 - A brief description of the activity
- **Activity attributes** provide more information such as predecessors, successors, logical relationships, leads and lags, resource requirements, constraints, imposed dates, and assumptions related to the activity

Milestones

- A **milestone** is a significant event that normally has no duration
- It often takes several activities and a lot of work to complete a milestone
- They're useful tools for setting schedule goals and monitoring progress
- Examples include obtaining customer sign-off on key documents or completion of specific products

What Went Wrong?

- At the U.S. Federal Bureau of Investigation (FBI), poor time management was one of the reasons behind the failure of Trilogy, a “disastrous, unbelievably expensive piece of vaporware, which was more than four years in the (un)making. The system was supposed to enable FBI agents to integrate intelligence from isolated information silos within the Bureau.”*
- In May 2006, the Government Accounting Agency said that the Trilogy project failed at its core mission of improving the FBI’s investigative abilities and was plagued with missed milestones and escalating costs

*Roberts, Paul, “Frustrated contractor sentenced for hacking FBI to speed deployment,” *InfoWorld Tech Watch*, (July 6, 2006).

Activity Sequencing

- Involves reviewing activities and determining dependencies
- A **dependency** or **relationship** is the sequencing of project activities or tasks
- You *must* determine dependencies in order to use critical path analysis

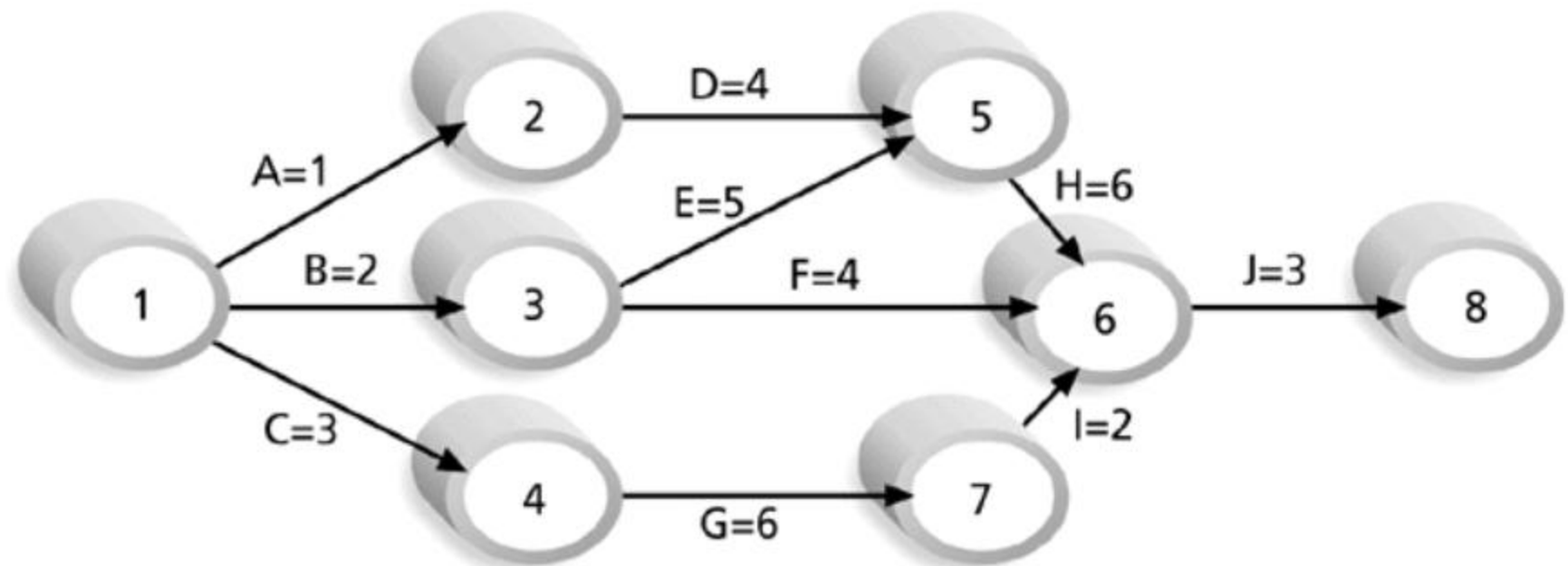
Three Types of Dependencies

- **Mandatory dependencies:** inherent in the nature of the work being performed on a project, sometimes referred to as hard logic
- **Discretionary dependencies:** defined by the project team; sometimes referred to as soft logic and should be used with care since they may limit later scheduling options
- **External dependencies:** involve relationships between project and nonproject activities

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
- Two main formats are the arrow and precedence diagramming methods

Figure 6-2: Sample Activity-on-Arrow (AOA) Network Diagram for Project X



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

Arrow Diagramming Method (ADM)

- Also called activity-on-arrow (AOA) network diagrams
- Activities are represented by arrows
- Nodes or circles are the starting and ending points of activities
- Can only show finish-to-start dependencies

Process for Creating AOA Diagrams

1. Find all of the activities that start at node 1: Draw their finish nodes and draw arrows between node 1 and those finish nodes; put the activity letter or name and duration estimate on the associated arrow
2. Continue drawing the network diagram, working from left to right: Look for bursts and merges
 - **Bursts** occur when a single node is followed by two or more activities
 - A **merge** occurs when two or more nodes precede a single node
3. Continue drawing the project network diagram until all activities are included on the diagram that have dependencies
4. As a rule of thumb, all arrowheads should face toward the right, and no arrows should cross on an AOA network diagram

Precedence Diagramming Method (PDM)

- Activities are represented by boxes
- Arrows show relationships between activities
- More popular than ADM method and used by project management software
- Better at showing different types of dependencies

Figure 6-3: Task Dependency Types

Task dependencies

The nature of the dependencies between 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:

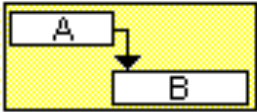
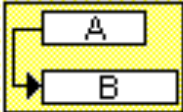
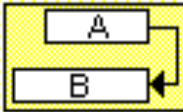
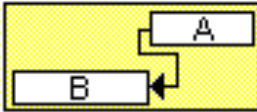
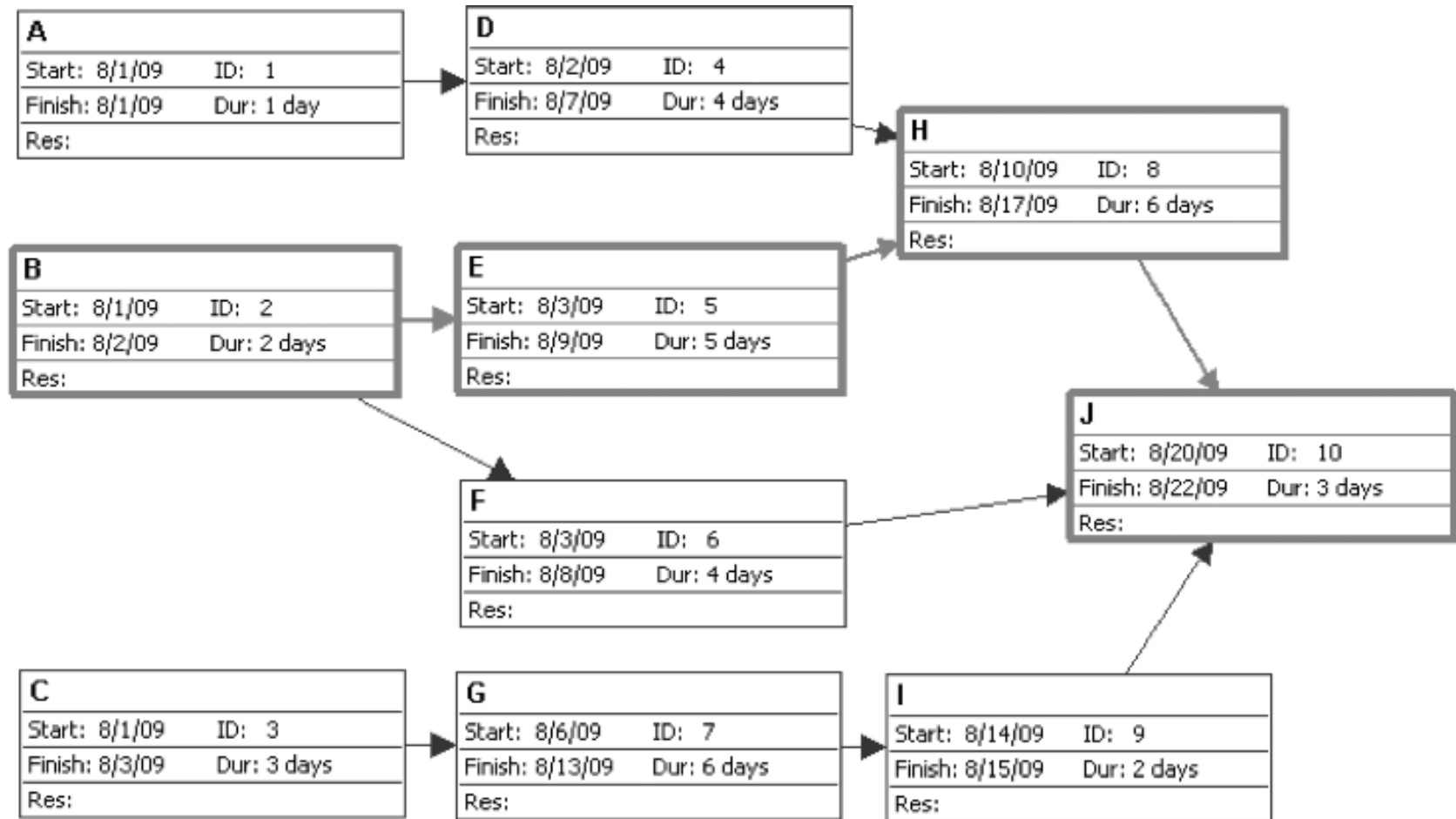
Task dependency	Example	Description
Finish-to-start (FS)		Task (B) cannot start until task (A) finishes.
Start-to-start (SS)		Task (B) cannot start until task (A) starts.
Finish-to-finish (FF)		Task (B) cannot finish until task (A) finishes.
Start-to-finish (SF)		Task (B) cannot finish until task (A)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

Figure 6-4: Sample PDM Network Diagram



Activity Resource Estimating

- Before estimating activity durations, you must have a good idea of the quantity and type of resources that will be assigned to each activity
- Consider important issues in estimating resources
 - How difficult will it be to do specific activities on this project?
 - What is the organization's history in doing similar activities?
 - Are the required resources available?
- A **resource breakdown structure** is a hierarchical structure that identifies the project's resources by category and type

Activity Duration Estimating

- **Duration** includes the actual amount of time worked on an activity *plus* elapsed time
- **Effort** is the number of workdays or work hours required to complete a task
- Effort does not normally equal duration
- People doing the work should help create estimates, and an expert should review them

Three-Point Estimates

- Instead of providing activity estimates as a discrete number, such as four weeks, it's often helpful to create a **three-point estimate**
 - An estimate that includes an optimistic, most likely, and pessimistic estimate, such as three weeks for the optimistic, four weeks for the most likely, and five weeks for the pessimistic estimate
- Three-point estimates are needed for PERT and Monte Carlo simulations

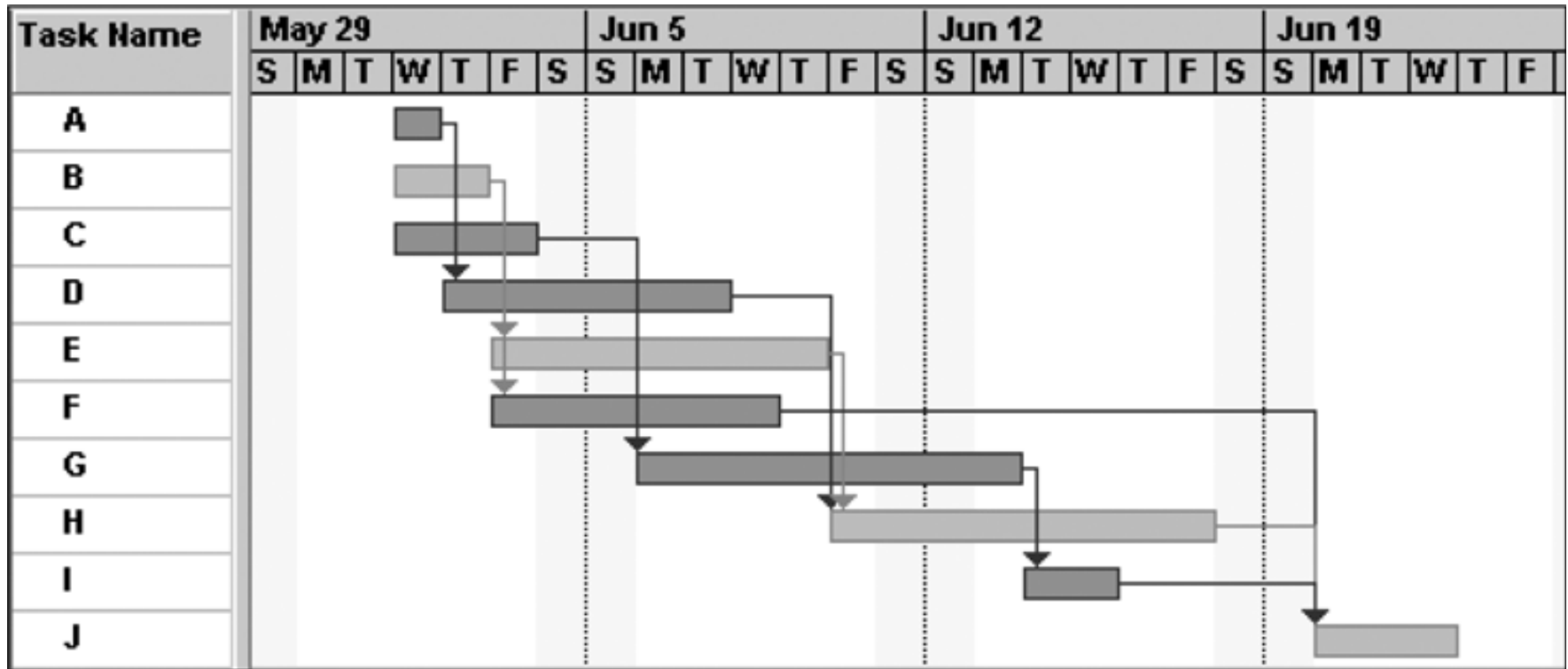
Schedule Development

- Uses results of the other time management processes to determine the start and end date of the project
- Ultimate goal is to create a realistic project schedule that provides a basis for monitoring project progress for the time dimension of the project
- Important tools and techniques include Gantt charts, critical path analysis, critical chain scheduling, and PERT analysis

Gantt Charts

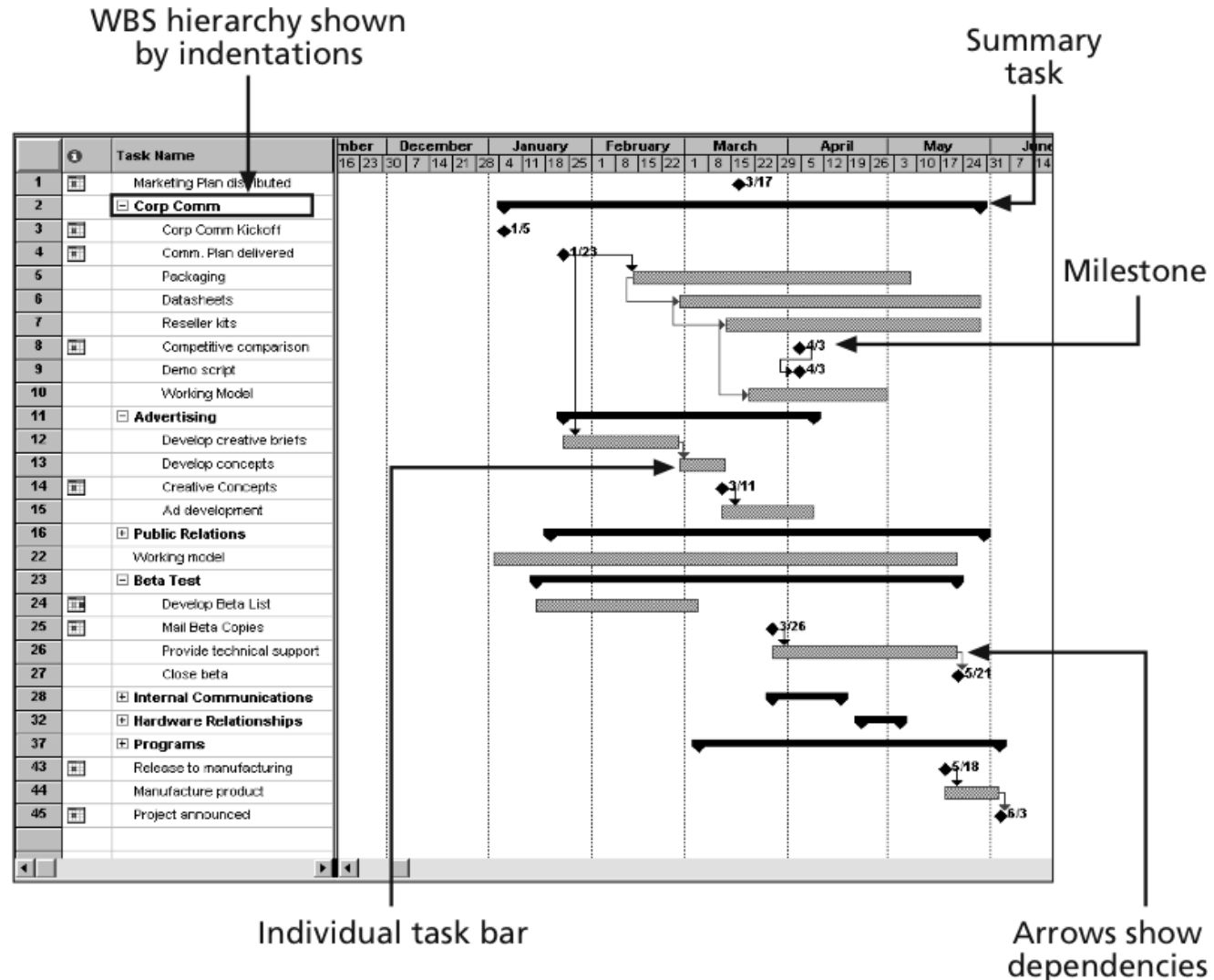
- **Gantt charts** provide a standard format for displaying project schedule information by listing project activities and their corresponding start and finish dates in a calendar format
- Symbols include:
 - Black diamonds: milestones
 - Thick black bars: summary tasks
 - Lighter horizontal bars: durations of tasks
 - Arrows: dependencies between tasks

Figure 6-5: Gantt Chart for Project X



Note: Darker bars would be red in Project 2007 to represent critical tasks

Figure 6-6: Gantt Chart for Software Launch Project



Adding Milestones to Gantt Charts

- Many people like to focus on meeting milestones, especially for large projects
- Milestones emphasize important events or accomplishments on projects
- Normally create milestone by entering tasks with a zero duration, or you can mark any task as a milestone

SMART Criteria

- Milestones should be:
 - **S**pecific
 - **M**easurable
 - **A**ssignable
 - **R**ealistic
 - **T**ime-framed

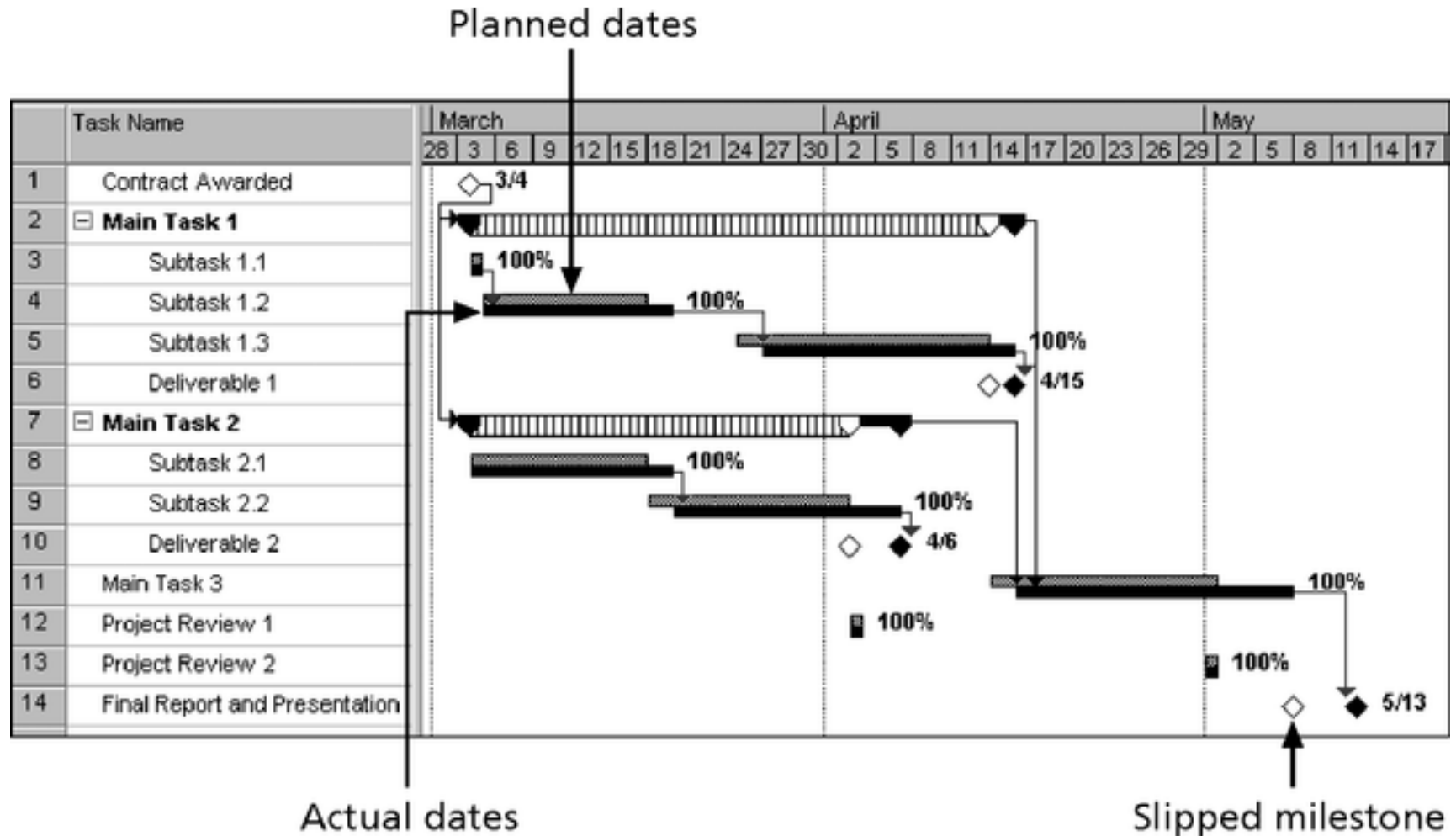
Best Practice

- Schedule risk is inherent in the development of complex systems
- L u c R i c h a r d , t h e f o u n d e r o f www.projectmangler.com, suggests that project managers can reduce schedule risk through project milestones, a best practice that involves identifying and tracking significant points or achievements in the project

Best Practice (continued)

- The five key points of using project milestones include the following:
 1. Define milestones early in the project and include them in the Gantt chart to provide a visual guide
 2. Keep milestones small and frequent
 3. The set of milestones must be all-encompassing
 4. Each milestone must be binary, meaning it is either complete or incomplete
 5. Carefully monitor the critical path

Figure 6-7: Sample Tracking Gantt Chart



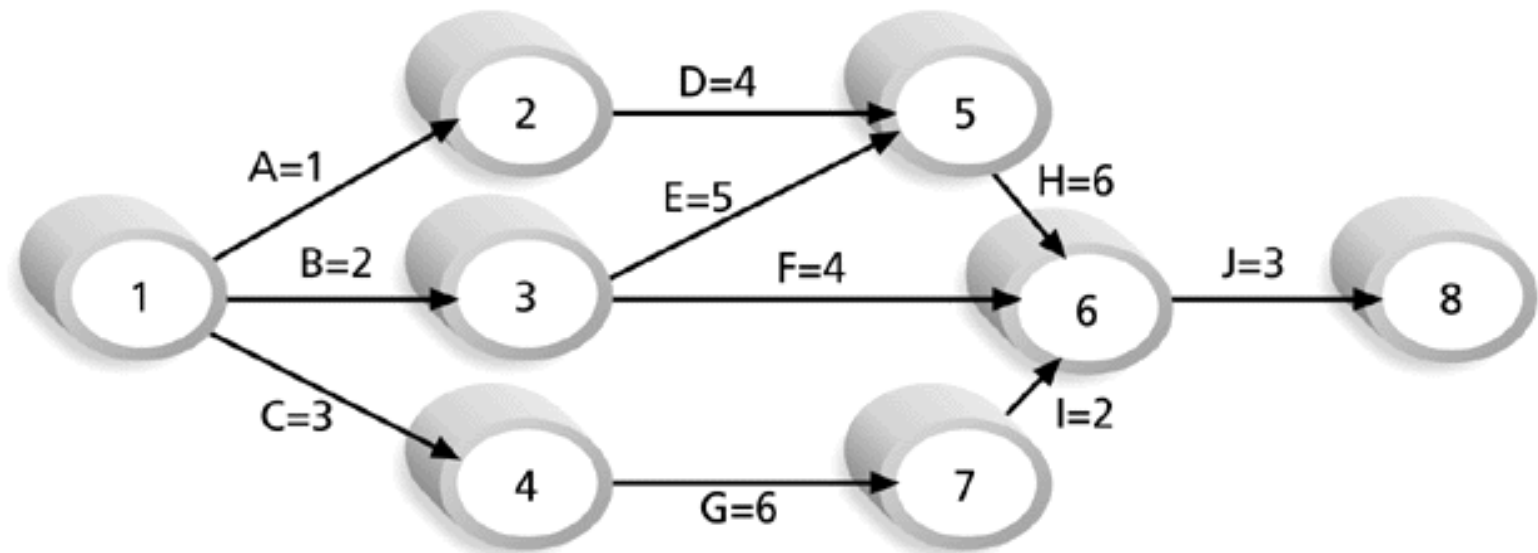
Critical Path Method (CPM)

- **CPM** is a network diagramming technique used to predict total project duration
- A **critical path** for a project is the series of activities that determines the *earliest time* by which the project can be completed
- The critical path 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

Calculating the Critical Path

- First develop a good network diagram
- Add the duration estimates for all activities on each path through the network diagram
- The longest path is the critical path
- 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

Figure 6-8: Determining the Critical Path 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

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

More on the Critical Path

- A project team at Apple computer put a stuffed gorilla on the top of the cubicle of the person currently managing a critical task
- The critical path is *not* the one with all the critical activities; it only accounts for time
 - Remember the example of **growing grass** being on the critical path for Disney's Animal Kingdom
- There can be more than one critical path if the lengths of two or more paths are the same
- The critical path can change as the project progresses

Using Critical Path Analysis to Make Schedule Trade-offs

- **Free slack** or **free float** is the amount of time an activity can be delayed without delaying the early start of any immediately following activities
- **Total slack** or **total float** is the amount of time an activity may be delayed from its early start without delaying the planned project finish date
- A **forward pass** through the network diagram determines the early start and finish dates
- A **backward pass** determines the late start and finish dates

Figure 6-9: Calculating Early and Late Start and Finish Dates

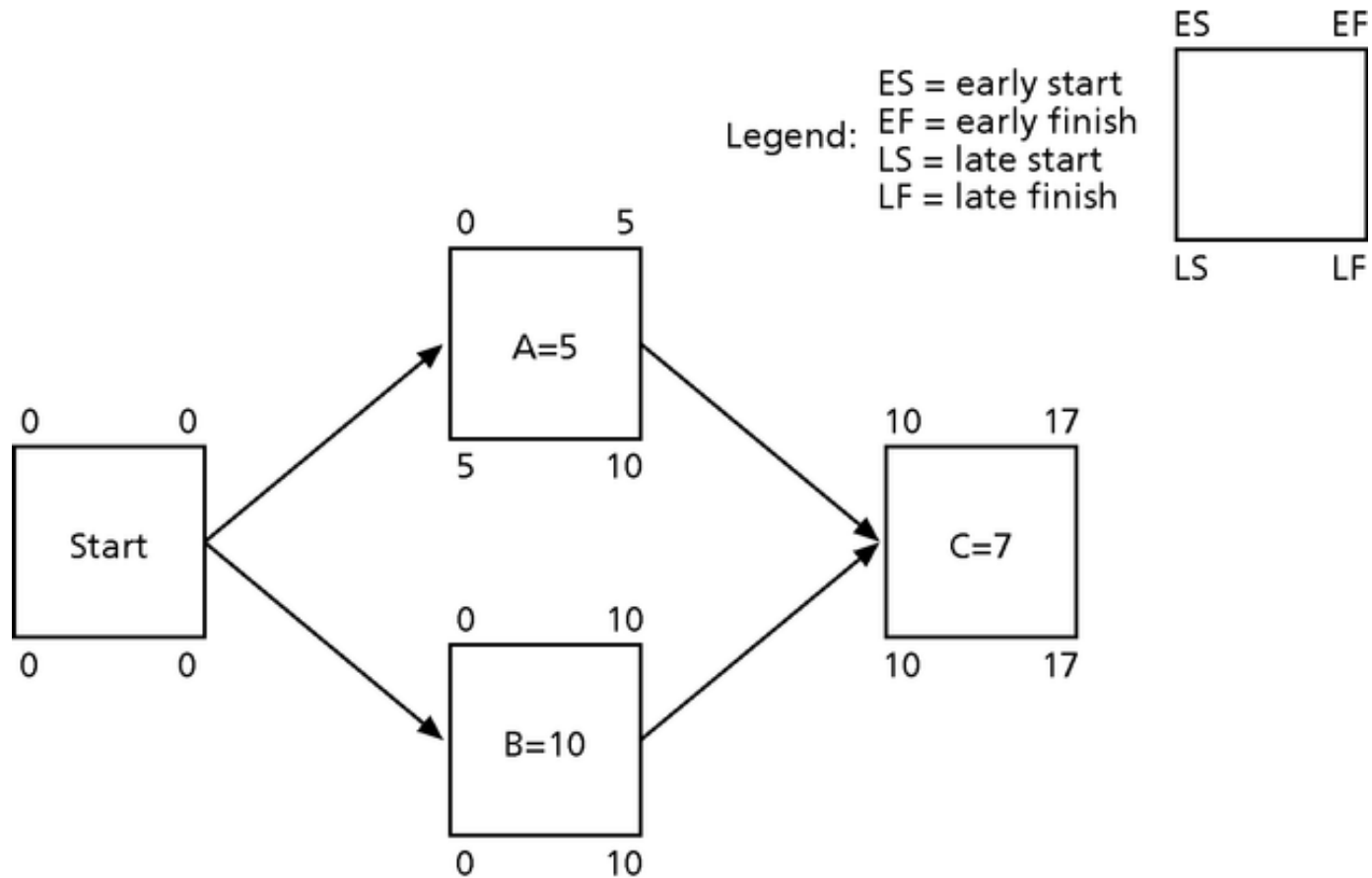


Table 6-1: Free and Total Float or Slack for Project X

TASK NAME	START	FINISH	LATE START	LATE FINISH	FREE SLACK	TOTAL SLACK
A	8/1/09	8/1/09	8/3/09	8/3/09	0d	2d
B	8/1/09	8/2/09	8/1/09	8/2/09	0d	0d
C	8/1/09	8/3/09	8/3/09	8/7/09	0d	2d
D	8/2/09	8/7/09	8/8/09	8/9/09	2d	2d
E	8/3/09	8/9/09	8/3/09	8/9/09	0d	0d
F	8/3/09	8/8/09	8/14/09	8/17/09	7d	7d
G	8/8/09	8/13/09	8/8/09	8/15/09	0d	2d
H	8/10/09	8/17/09	8/10/09	8/17/09	0d	0d
I	8/14/09	8/15/09	8/18/09	8/17/09	2d	2d
J	8/20/09	8/22/09	8/20/09	8/22/09	0d	0d

Using the Critical Path to Shorten a Project Schedule

- Three main techniques for shortening schedules
 - Shortening durations of critical activities/tasks by adding more resources or changing their scope
 - **Crashing** activities by obtaining the greatest amount of schedule compression for the least incremental cost
 - **Fast tracking** activities by doing them in parallel or overlapping them

Importance of Updating Critical Path Data

- It is important to update project schedule information to meet time goals for a project
- The critical path may change as you enter actual start and finish dates
- If you know the project completion date will slip, negotiate with the project sponsor

Critical Chain Scheduling

- **Critical chain scheduling**
 - A method of scheduling that considers limited resources when creating a project schedule and includes buffers to protect the project completion date
- Uses the **Theory of Constraints (TOC)**
 - A management philosophy developed by Eliyahu M. Goldratt and introduced in his book *The Goal*
- Attempts to minimize **multitasking**
 - When a resource works on more than one task at a time

Figure 6-10: Multitasking Example

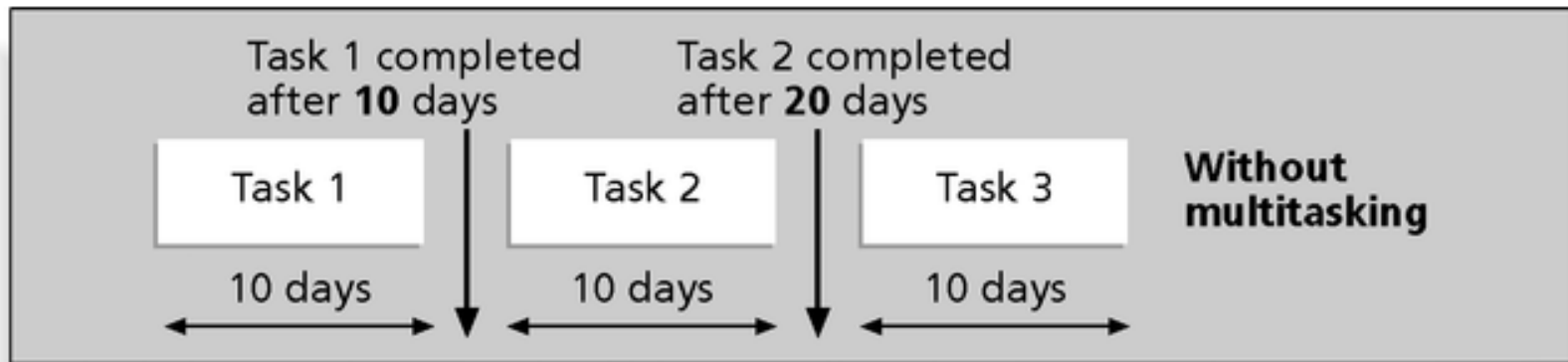


Figure 6-10a. Three Tasks Without Multitasking

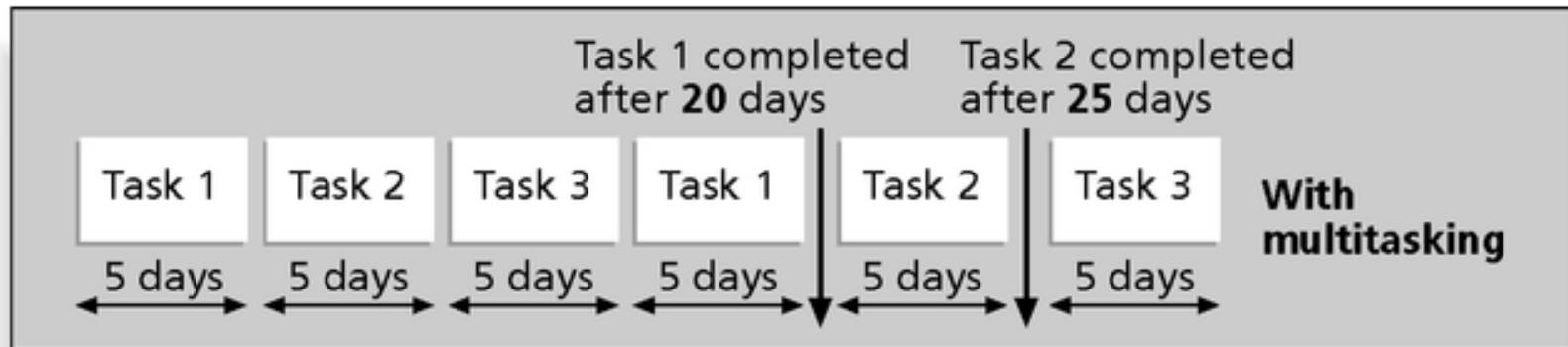
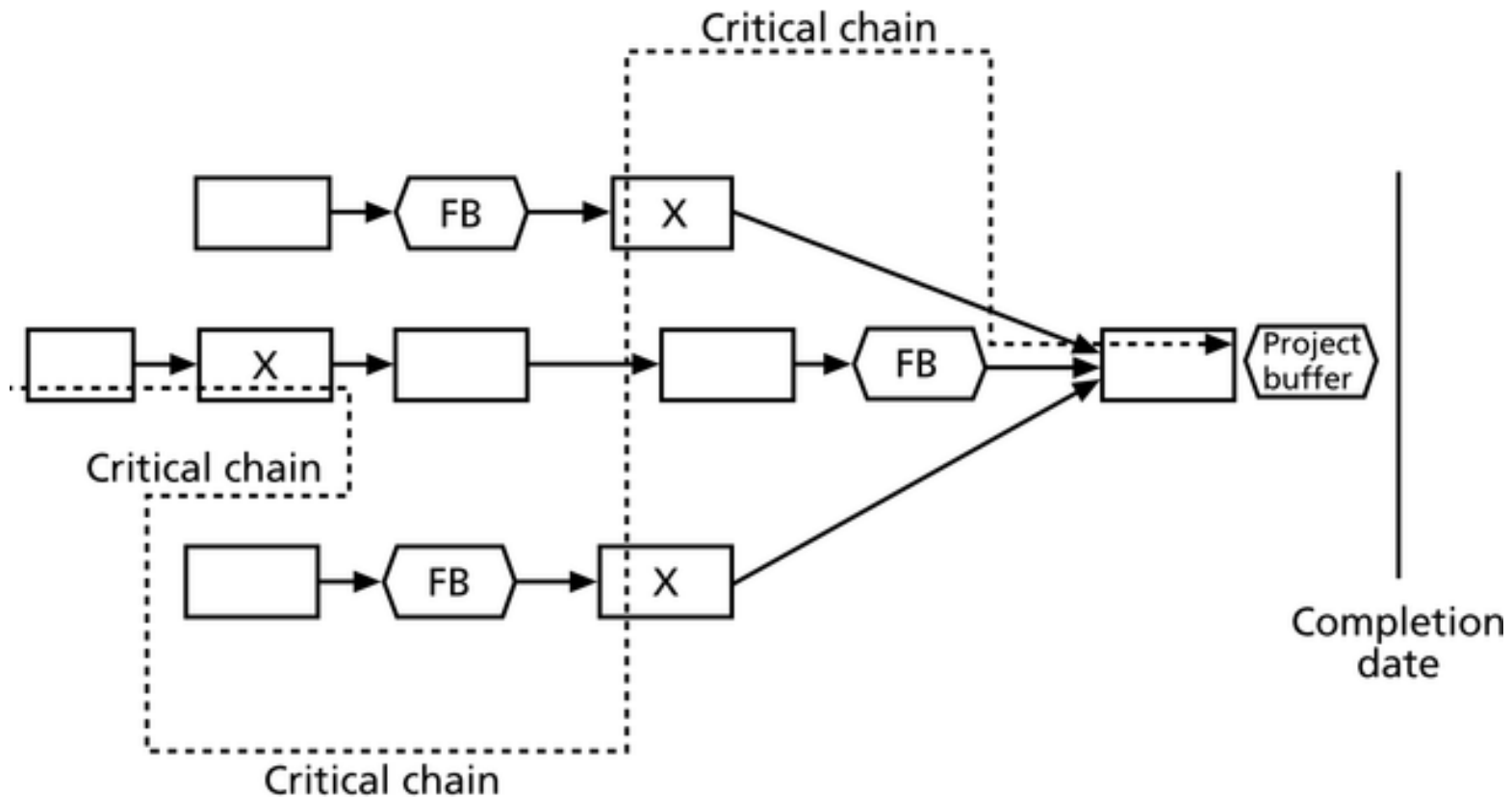


Figure 6-10b. Three Tasks With Multitasking

Buffers and Critical Chain

- A **buffer** is additional time to complete a task
- **Murphy's Law** states that if something can go wrong, it will
- **Parkinson's Law** states that work expands to fill the time allowed
- In traditional estimates, people often add a buffer to each task and use it if it's needed or not
- Critical chain scheduling removes buffers from individual tasks and instead creates:
 - A **project buffer** or additional time added before the project's due date
 - **Feeding buffers** or additional time added before tasks on the critical path

Figure 6-11: Example of Critical Chain Scheduling



X = Tasks done by limited resource
FB = Feeding buffer

Program Evaluation and Review Technique (PERT)

- **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 uses **probabilistic time estimates**
 - Duration estimates based on using optimistic, most likely, and pessimistic estimates of activity durations, or a three-point estimate

PERT Formula and Example

- PERT weighted average =
$$\frac{\text{optimistic time} + 4 \times \text{most likely time} + \text{pessimistic time}}{6}$$

- Example:

$$\text{PERT weighted average} = \frac{8 \text{ workdays} + 4 \times 10 \text{ workdays} + 24 \text{ workdays}}{6} = \mathbf{12 \text{ days}}$$

where optimistic time = 8 days,
most likely time = **10 days**, and
pessimistic time = 24 days

Therefore, you'd use **12 days** on the network diagram instead of 10 when using PERT for the above example

Guidelines For Schedule Control

- Perform reality checks on schedules
- Allow for contingencies
- Don't plan for everyone to work at 100% capacity all the time
- Hold progress meetings with stakeholders and be clear and honest in communicating schedule issues

Schedule Control (continued)

- Goals are to know the status of the schedule, influence factors that cause schedule changes, determine that the schedule has changed, and manage changes when they occur
- Tools and techniques include:
 - Progress reports
 - A schedule change control system
 - Project management software, including schedule comparison charts like the tracking Gantt chart
 - Variance analysis, such as analyzing float or slack
 - Performance management, such as earned value (chapter 7)

Reality Checks on Scheduling

- First review the draft schedule or estimated completion date in the project charter
- Prepare a more detailed schedule with the project team
- Make sure the schedule is realistic and followed
- Alert top management well in advance if there are schedule problems

Working with People Issues

- Strong leadership helps projects succeed more than good PERT charts
- Project managers should use:
 - Empowerment
 - Incentives
 - Discipline
 - Negotiation

What Went Right?

- Chris Higgins used the discipline he learned in the U.S. Army to transform project management into a cultural force at Bank of America; he used the same approach he did for packing tents when he led an interstate banking initiative
- He made the team members analyze, plan, and document requirements for the system in such detail that it took six months just to complete that phase
- However, because of his discipline with time management and planning, the software developers on the team finished all of the coding in only three months, and the project was completed on time*

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

Using Software to Assist in Time Management

- Software for facilitating communications helps people exchange schedule-related information
- Decision support models help analyze trade-offs that can be made
- Project management software can help in various time management areas

Words of Caution on Using Project Management Software

- Many people misuse project management software because they don't understand important concepts and have not had training
- You must enter dependencies to have dates adjust automatically and to determine the critical path
- You must enter actual schedule information to compare planned and actual progress

Chapter Summary

- Project time management is often cited as the main source of conflict on projects, and most IT projects exceed time estimates
- Main processes include:
 - Activity definition
 - Activity sequencing
 - Activity resource estimating
 - Activity duration estimating
 - Schedule development
 - Schedule control