

6 : Project Schedule Management

IT4306– IT Project Management

Level II - Semester 4

Intended Learning Outcomes

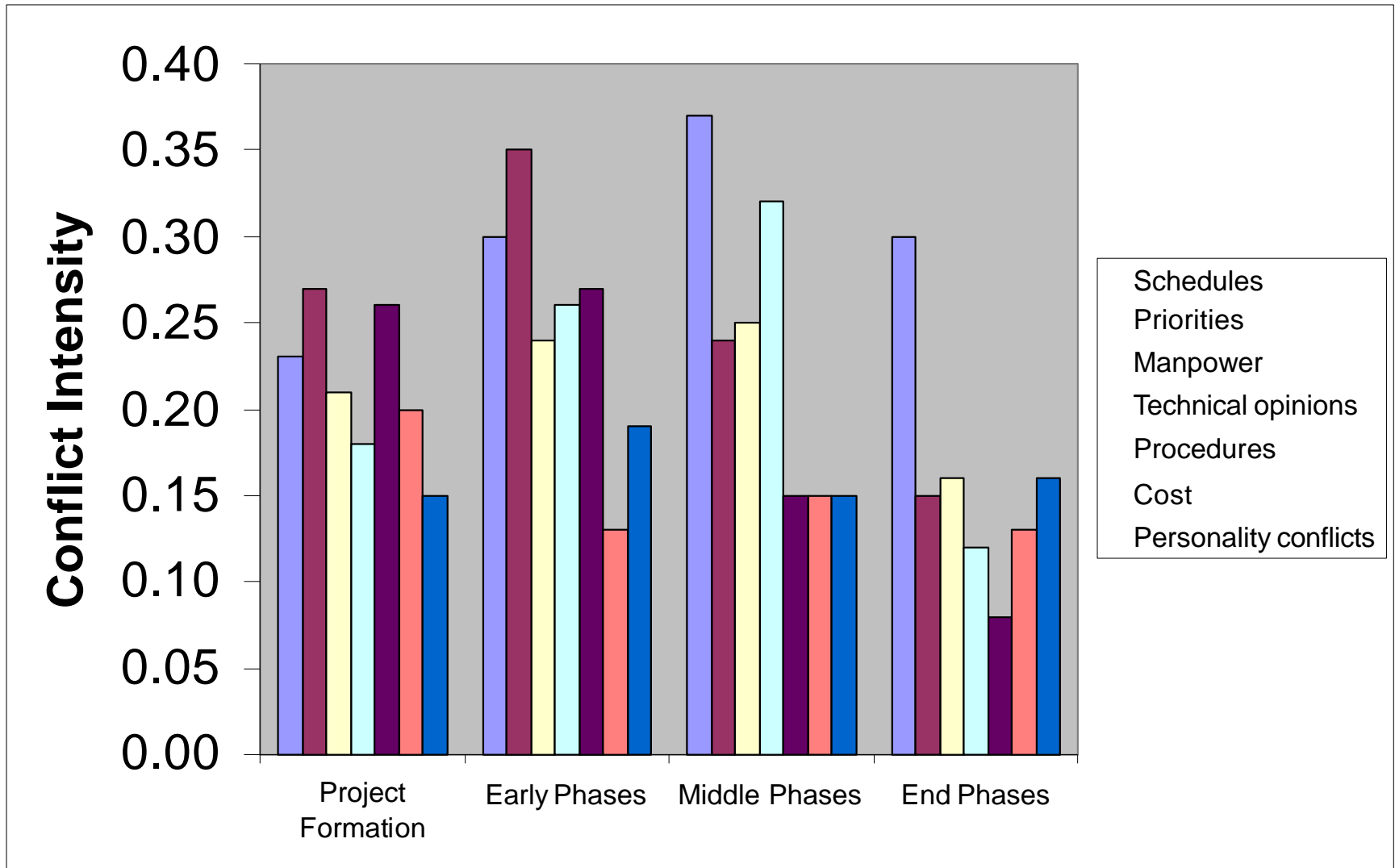
- At the end of this lesson, you will be able to;
 - State the importance of project schedules and good project time management
 - Define activities as the basis for developing project schedules
 - Use network diagrams and dependencies to assist in activity sequencing
 - Identify the relationship between estimating resources and project schedules
 - Explain how various tools and techniques help project managers to perform activity duration estimating
 - Use a Gantt chart for planning and tracking schedule information, find the critical path for a project, and use of the Program Evaluation and Review
 - Technique (PERT) as project time management techniques.

6.1. The Importance of Project Schedules

- Managers often cite delivering projects on time as one of their biggest challenges.
- Fifty percent of IT projects were challenged in the 2003 CHAOS study, and their average time overrun increased to 82 percent from a low of 63 percent in 2000.*
- Schedule issues are the main reason for conflicts on projects, especially during the second half of projects.
- Time has the least amount of flexibility; it passes no matter what happens on a project.

*The Standish Group, "Latest Standish Group CHAOS Report Shows Project Success Rates Have Improved by 50%," (www.standishgroup.com) (March 25, 2003).

Conflict Intensity Over the Life of a Project



Individual Work Styles and Cultural Differences Cause Schedule Conflicts

- One dimension of the Myers-Briggs Type Indicator focuses on people's attitudes toward structure and deadline.
- Some people prefer to follow schedules and meet deadlines while others do not.
- Different cultures and even entire countries have different attitudes about schedules.

6.3. Defining Activities

- An activity or task is an element of work normally found on the WBS that has an expected duration, a cost, and resource requirements.
- Project schedules grow out of the basic documents that initiate a project.
 - The project charter includes start and end dates and budget information.
 - The 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. The list should include:
 - The activity name
 - An activity identifier or number
 - A brief description of the activity
- **Activity attributes** provide more information about each activity, 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.
- Milestones are useful tools for setting schedule goals and monitoring progress.
- Examples include completion and customer sign-off on key documents and completion of specific products.

6.4. Sequencing Activities

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

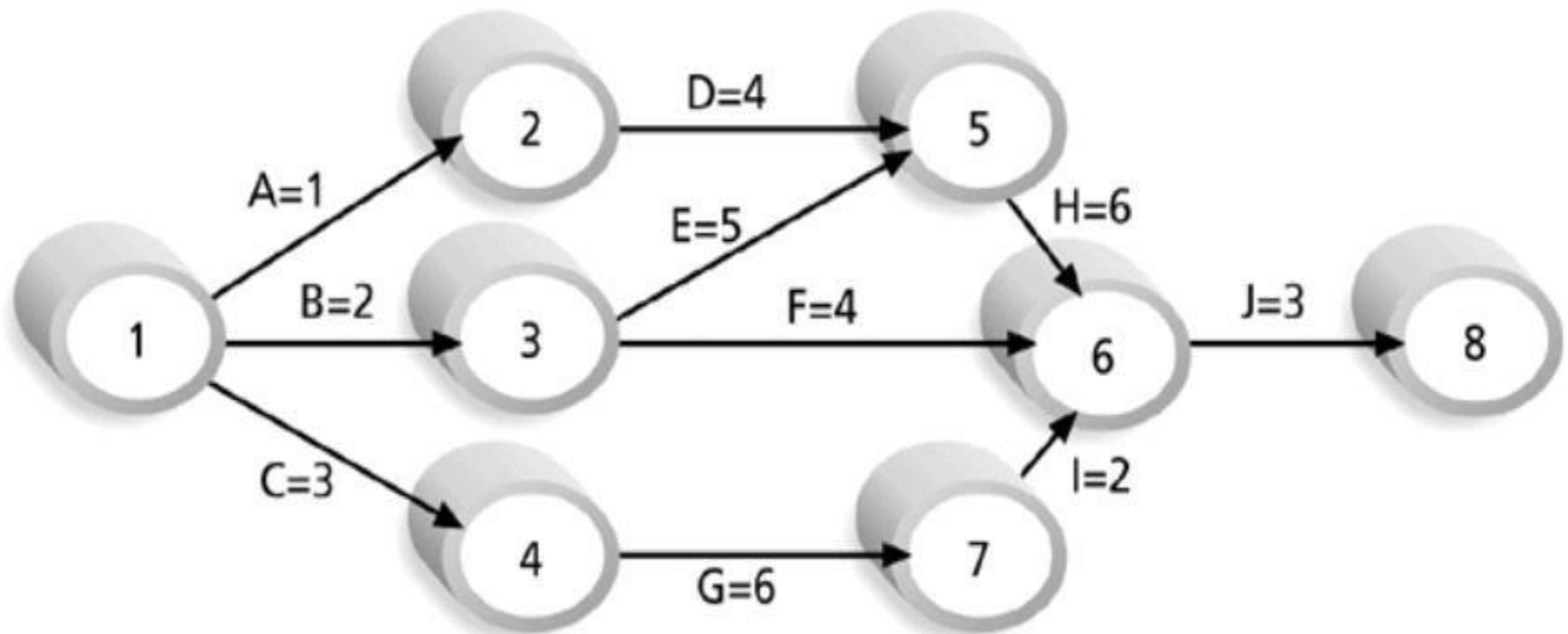
Three Types of Dependencies

- **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 because they may limit later scheduling options.
- **External dependencies:** Involve relationships between project and non-project 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.

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 diagram.
- 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. Continuing drawing the network diagram, working from left to right. Look for bursts and merges. A **burst** occurs 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 that have dependencies are included in the diagram.
4. As a rule of thumb, all arrowheads should face toward the right, and no arrows should cross in an AOA network diagram.

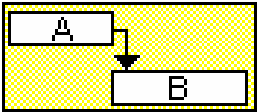
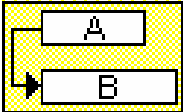
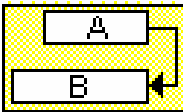
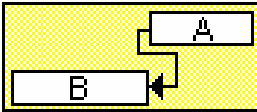
Precedence Diagramming Method (PDM)

- 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

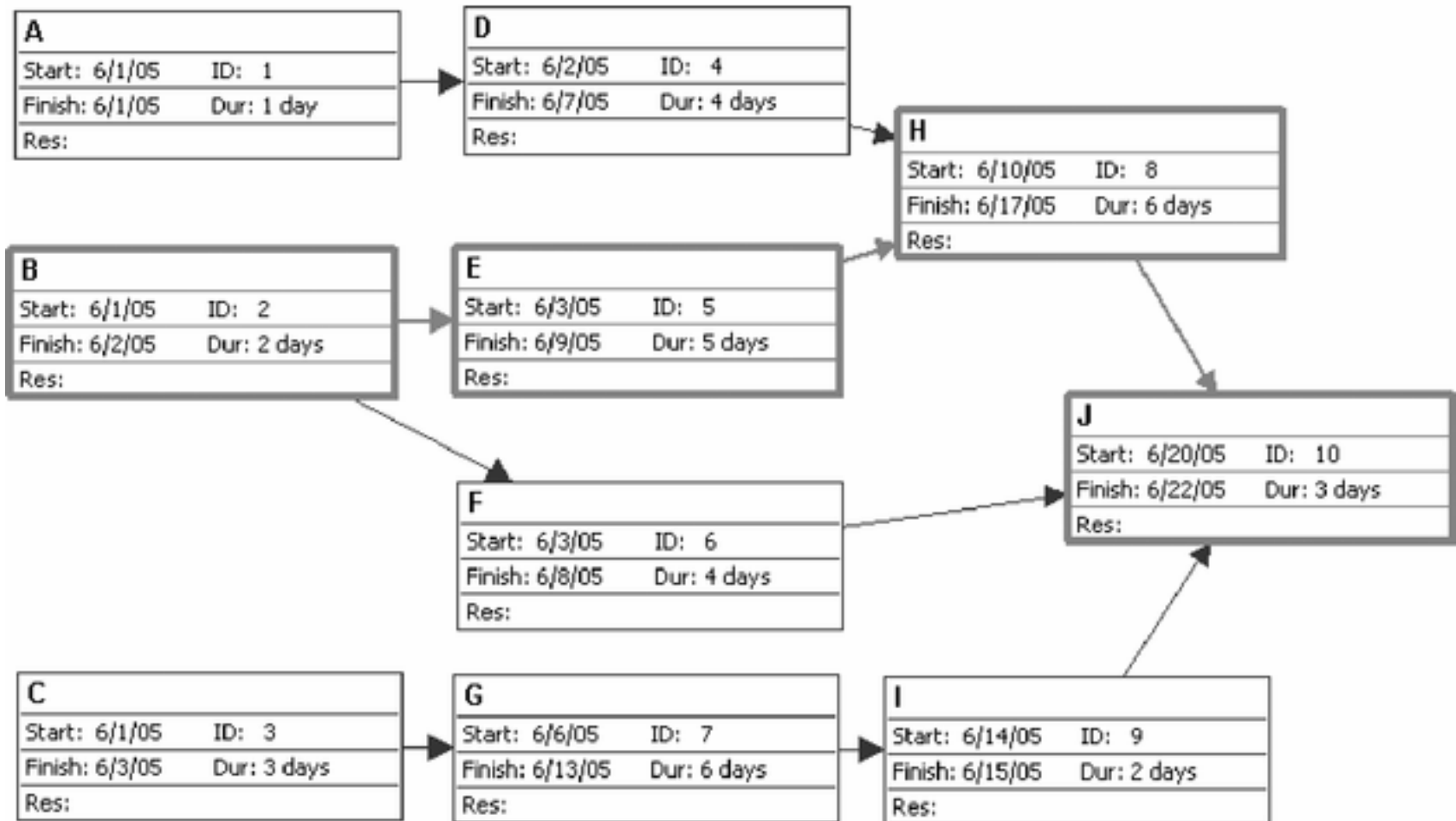
Task Dependency Types

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. |

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 complete specific activities on this project?
 - What is the organization's history in doing similar activities?
 - Are the required resources available?

6.5. Estimating Activity Durations

- **Duration** includes the actual amount of time worked on an activity plus the 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 estimates and Monte Carlo simulations.

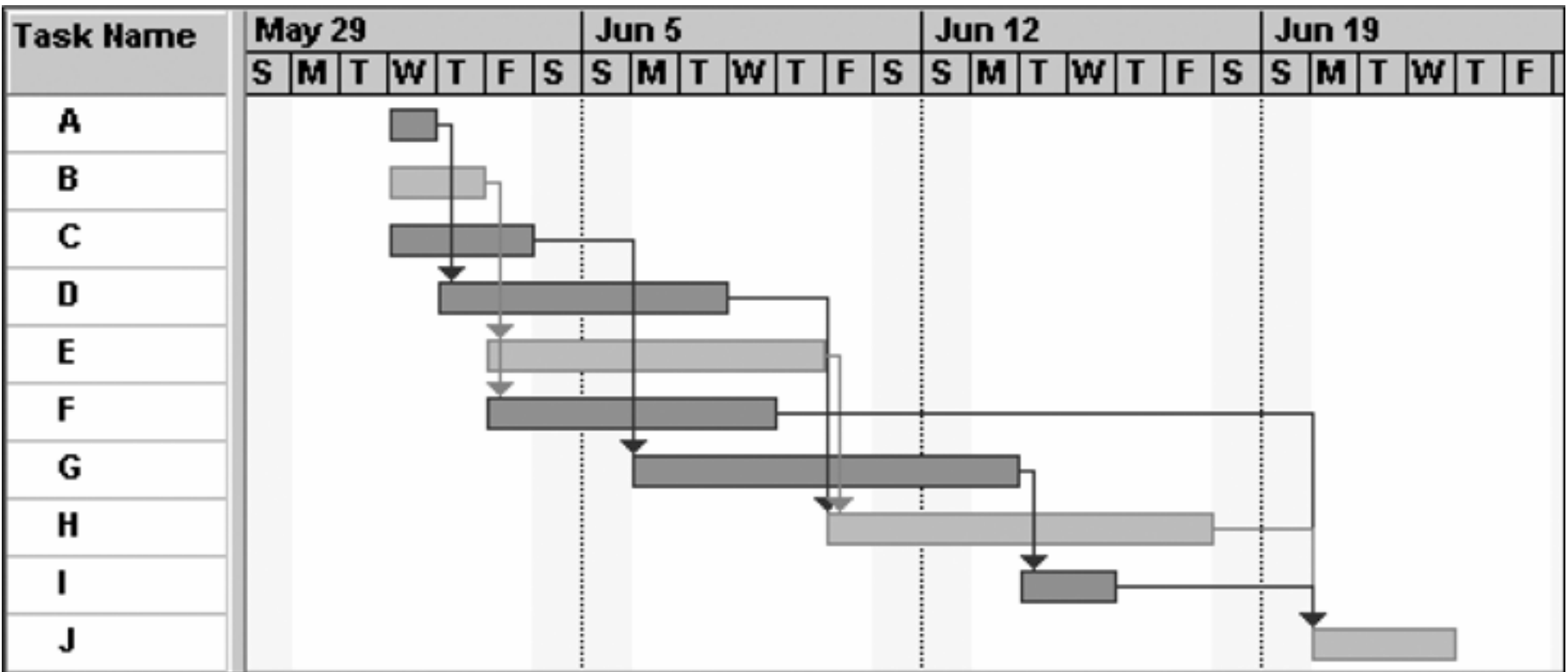
6.6. Developing the Schedule

- Uses results of the other time management processes to determine the start and end dates 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

Gantt Chart for Project X

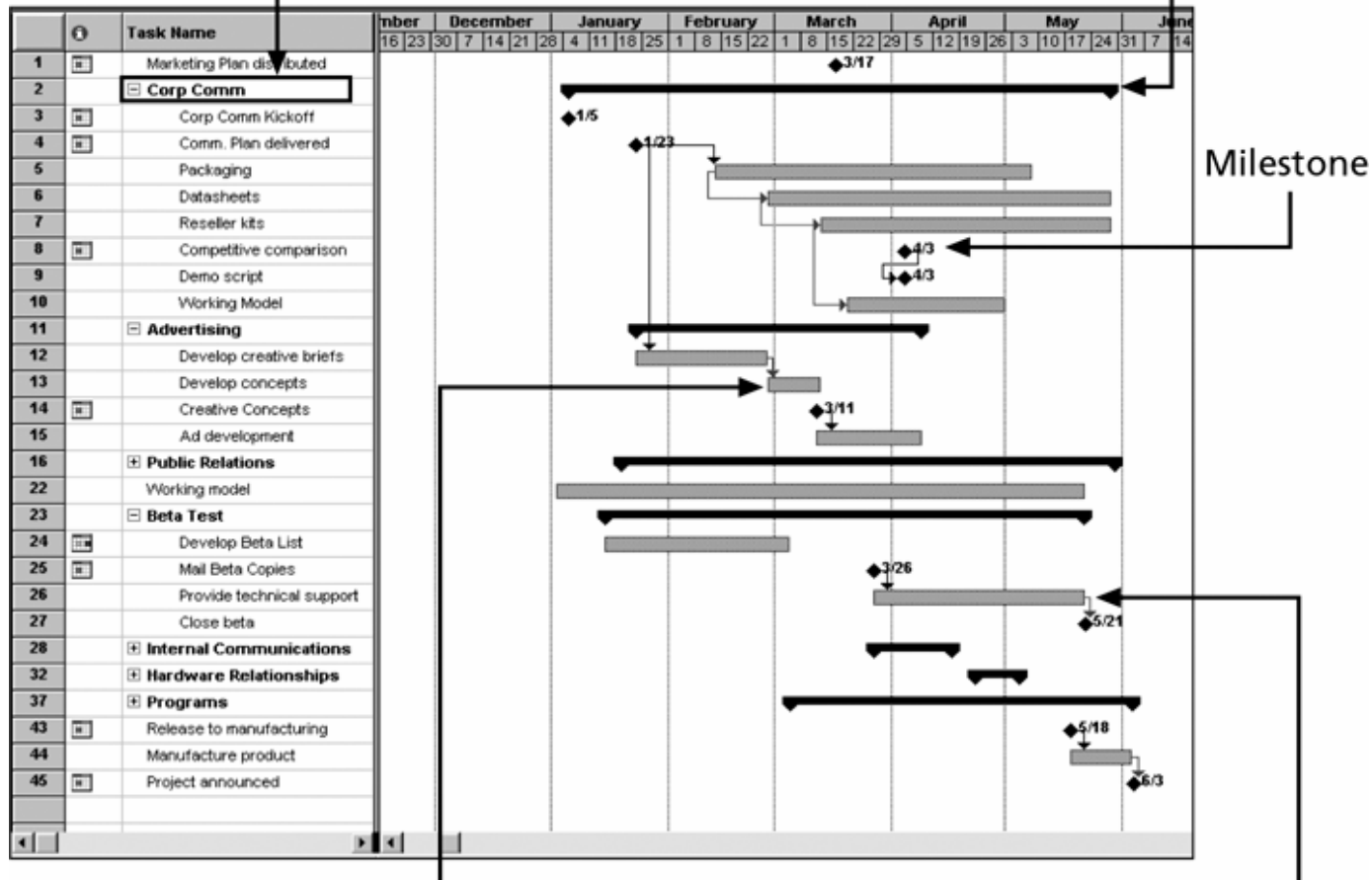


Note: In Project 2003 darker bars are red to represent critical tasks.

Gantt Chart for Software Launch Project

WBS hierarchy shown by indentations

Summary task



Individual task bar

Arrows show dependencies

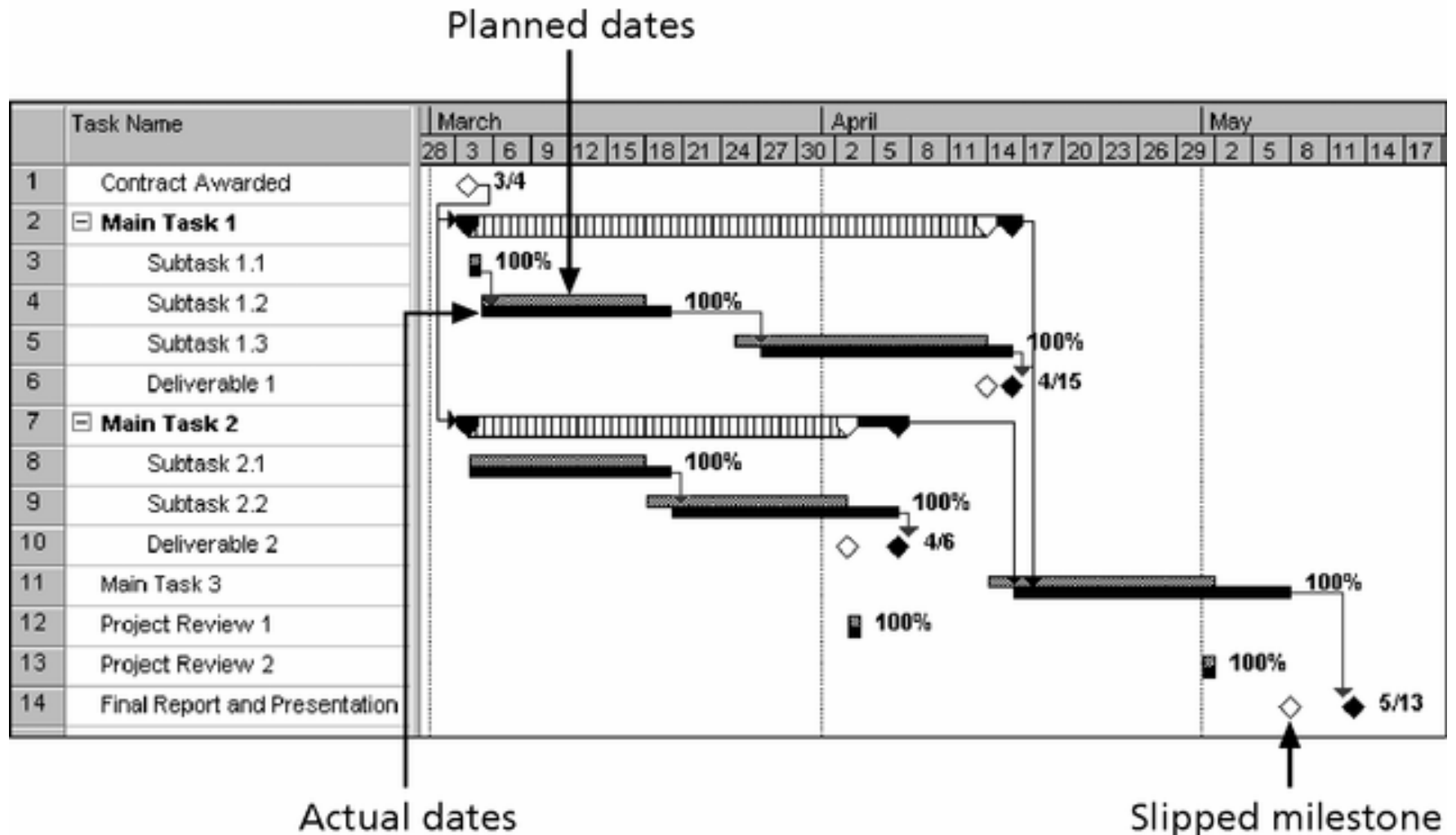
Adding Milestones to Gantt Charts

- Many people like to focus on meeting milestones, especially for large projects.
- Milestones emphasize important events or accomplishments in projects.
- You typically create milestone by entering tasks that have 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

Sample Tracking Gantt Chart



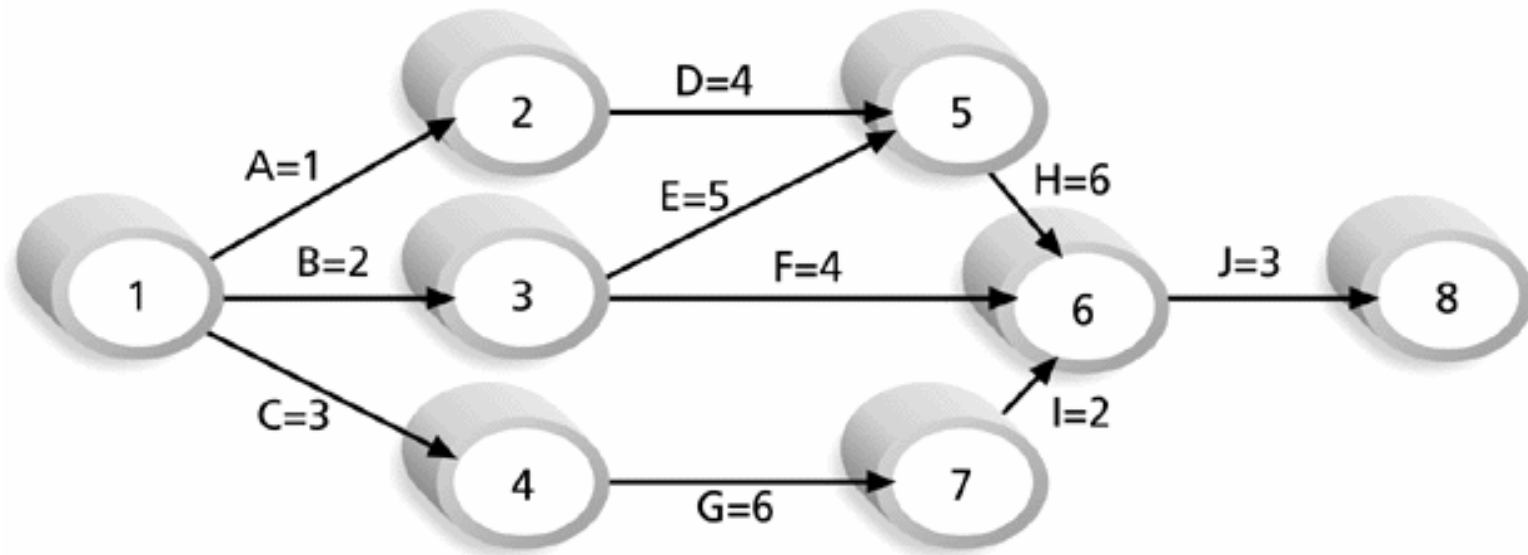
Critical Path Method (CPM)

- **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 can be delayed without delaying a succeeding activity or the project finish date.

Calculating the Critical Path

- 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.

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.

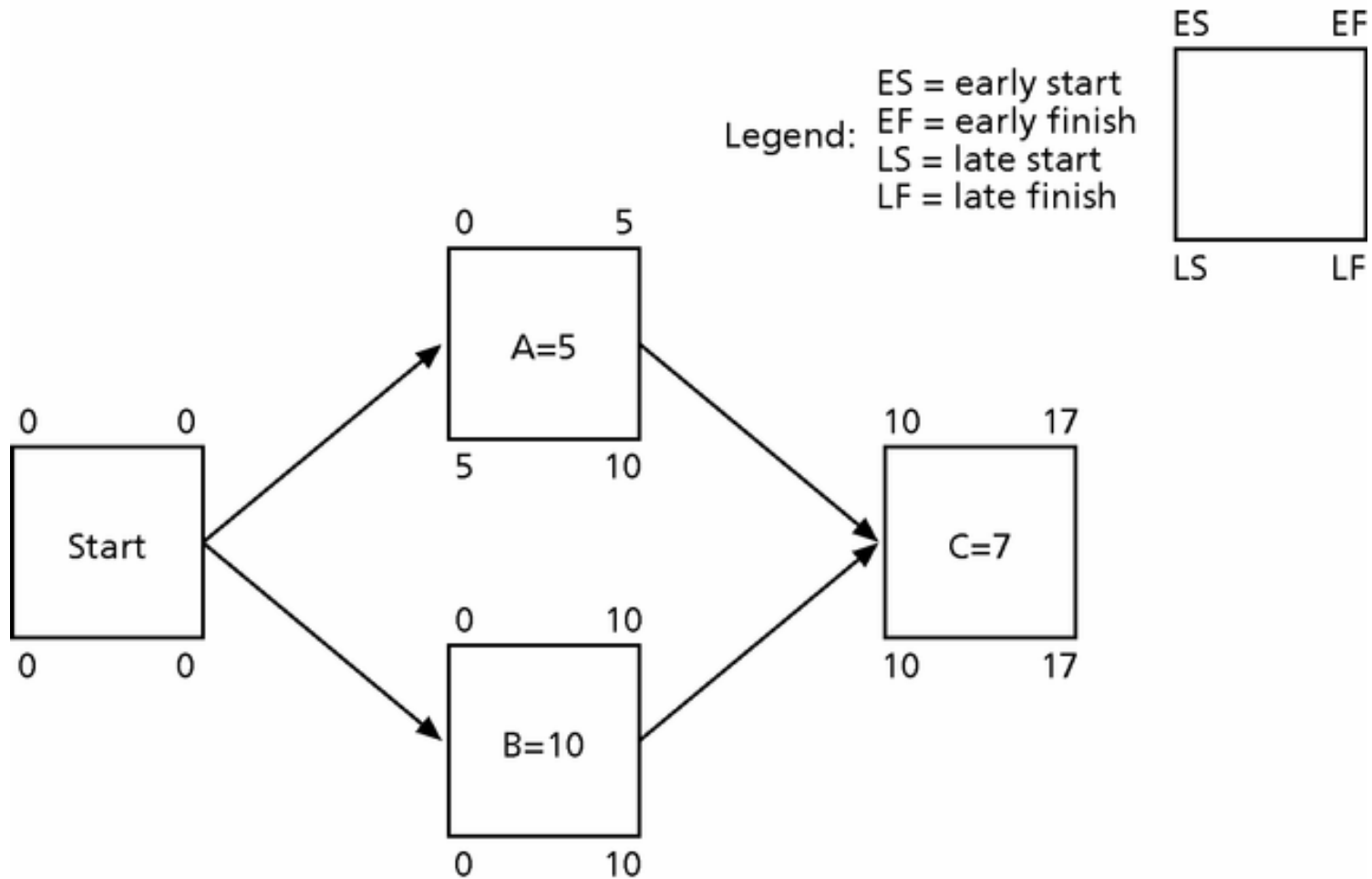
More on the Critical Path

- A project team at Apple computer put a stuffed gorilla on top of the cubicle of the person who was currently managing a critical task.
- The critical path does not necessarily contain all the critical activities; it only accounts for time.
- Remember the example in which **growing grass** was 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 can 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.

Calculating Early and Late Start and Finish Dates



Free and Total Float or Slack for Project X

| TASK NAME | START | FINISH | LATE START | LATE FINISH | FREE SLACK | TOTAL SLACK |
|--------------|---------|---------|------------|-------------|------------|-------------|
| A | 6/1/05 | 6/1/05 | 6/3/05 | 6/3/05 | 0d | 2d |
| B | 6/1/05 | 6/2/05 | 6/1/05 | 6/2/05 | 0d | 0d |
| C | 6/1/05 | 6/3/05 | 6/3/05 | 6/7/05 | 0d | 2d |
| D | 6/2/05 | 6/7/05 | 6/6/05 | 6/9/05 | 2d | 2d |
| E | 6/3/05 | 6/9/05 | 6/3/05 | 6/9/05 | 0d | 0d |
| F | 6/3/05 | 6/8/05 | 6/14/05 | 6/17/05 | 7d | 7d |
| G | 6/6/05 | 6/13/05 | 6/8/05 | 6/15/05 | 0d | 2d |
| H | 6/10/05 | 6/17/05 | 6/10/05 | 6/17/05 | 0d | 0d |
| I | 6/14/05 | 6/15/05 | 6/16/05 | 6/17/05 | 2d | 2d |
| J | 6/20/05 | 6/22/05 | 6/20/05 | 6/22/05 | 0d | 0d |

Using the Critical Path to Shorten a Project Schedule

- Three main techniques for shortening schedules:
- **Shortening** the duration of critical activities or 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.

Many Horror Stories Related to Project Schedules

- Creating realistic schedules and sticking to them is a key challenge of project management.
- Crashing and fast tracking often cause more problems, resulting in longer schedules.
- Organizational issues often cause schedule problems.
See the “What Went Wrong?” example that describes the need to take more time to implement Customer Relationship Management (CRM) software so that users will accept it.

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.

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

where:

optimistic time = 8 days

most likely time = **10 days**

pessimistic time = 24 days

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

6.7. Controlling the Schedule

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

Controlling the Schedule (cont.)

- 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, such as the tracking Gantt chart.
 - Variance analysis, such as analyzing float or slack.
 - Performance management, such as earned value (see Chapter 7).

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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