Project Time Management

Project Time Management Processes

- Project time management involves the processes required to ensure timely completion of a project.
- Processes include:
  1) Activity definition
  2) Activity sequencing
  3) Activity duration estimation
  4) Schedule development
  5) Schedule control

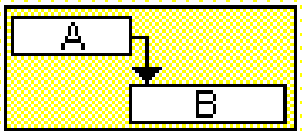
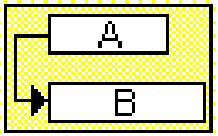
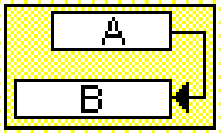
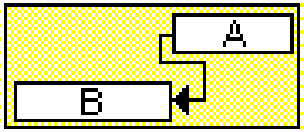
Where Do Schedules Come From? Defining Activities

- Project schedules grow out of the basic document 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:- identifying the specific activities that must be performed to produce the various project deliverables.

Activity Sequencing

- Involves reviewing activities and determining dependencies
  - **Mandatory dependencies**: inherent in the nature of the work; hard logic
  - **Discretionary dependencies:** defined by the project management team; soft logic
  - **External dependencies:** involve relationships between project and non-project activities
- You *must* determine dependencies in order to use critical path analysis

Task Dependency Types

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.

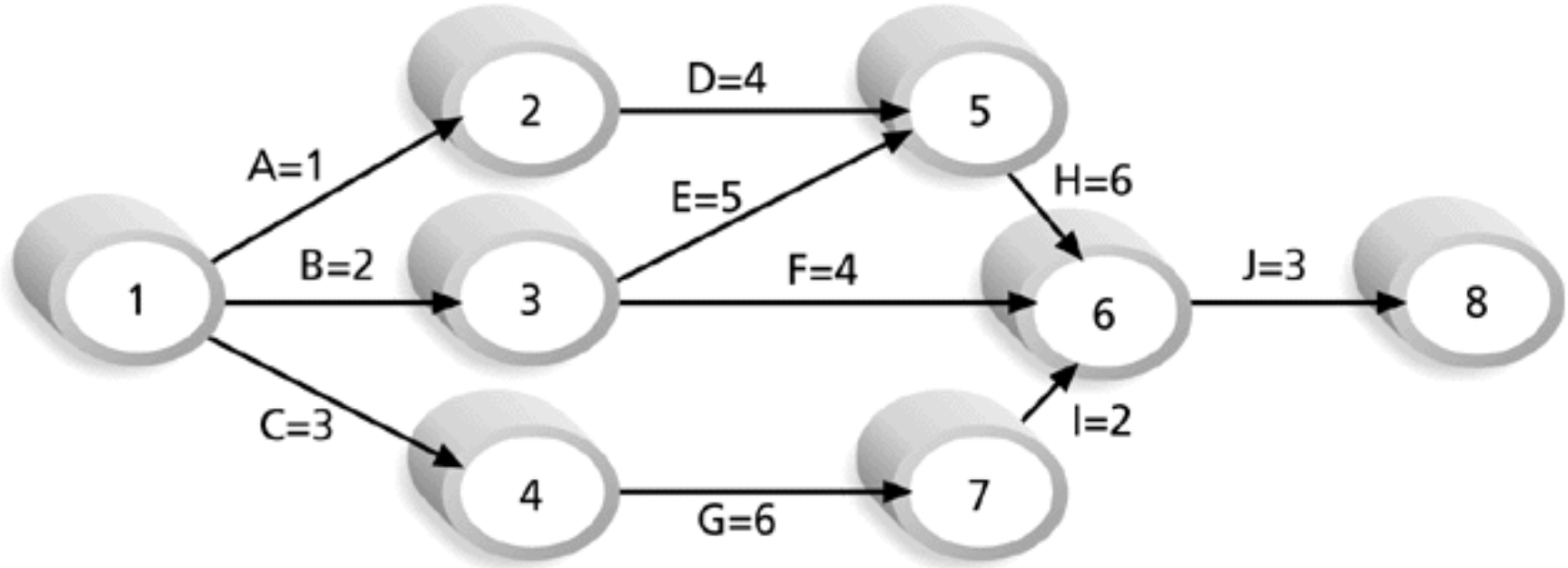
Project Network Diagrams

- Project network diagrams are the preferred technique for showing activity sequencing
- A project network diagram is a schematic display of the logical relationships among, or sequencing of, project activities

Activities	Immediate Predecessors	Expected time(day)
A	-	1
B	-	2
C	-	3
D	A	4
E	B	5
F	B	4
G	C	6
H	D,E	6
I	G	2
J	F,H,I	3

A. Draw Network diagram for the above data (AoA).
B. Identify the critical path.
C. Compute the total time to complete this project.
D. Compute slack time of this project.

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) project 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

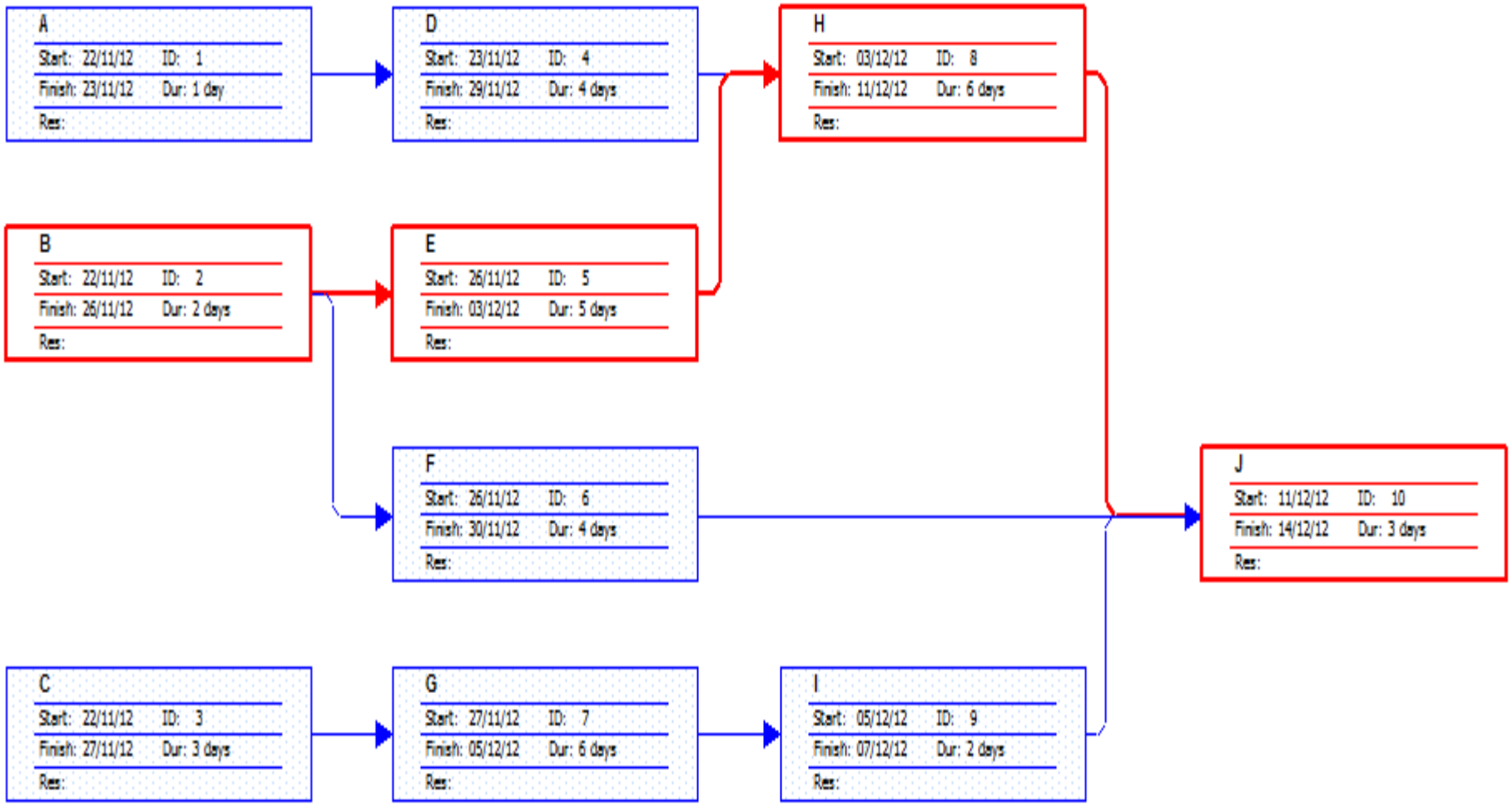
PROCESS FOR CREATING AOA DIAGRAMS

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

SAMPLE NETWORK DIAGRAM (AoN)



MS Project 2007 file

Activity Duration Estimating

- After defining activities and determining their sequence, the next step in time management is duration estimating
- Duration includes the actual amount of time worked on an activity *plus* elapsed time
- People doing the work should help create estimates, and an expert should review them

PERT

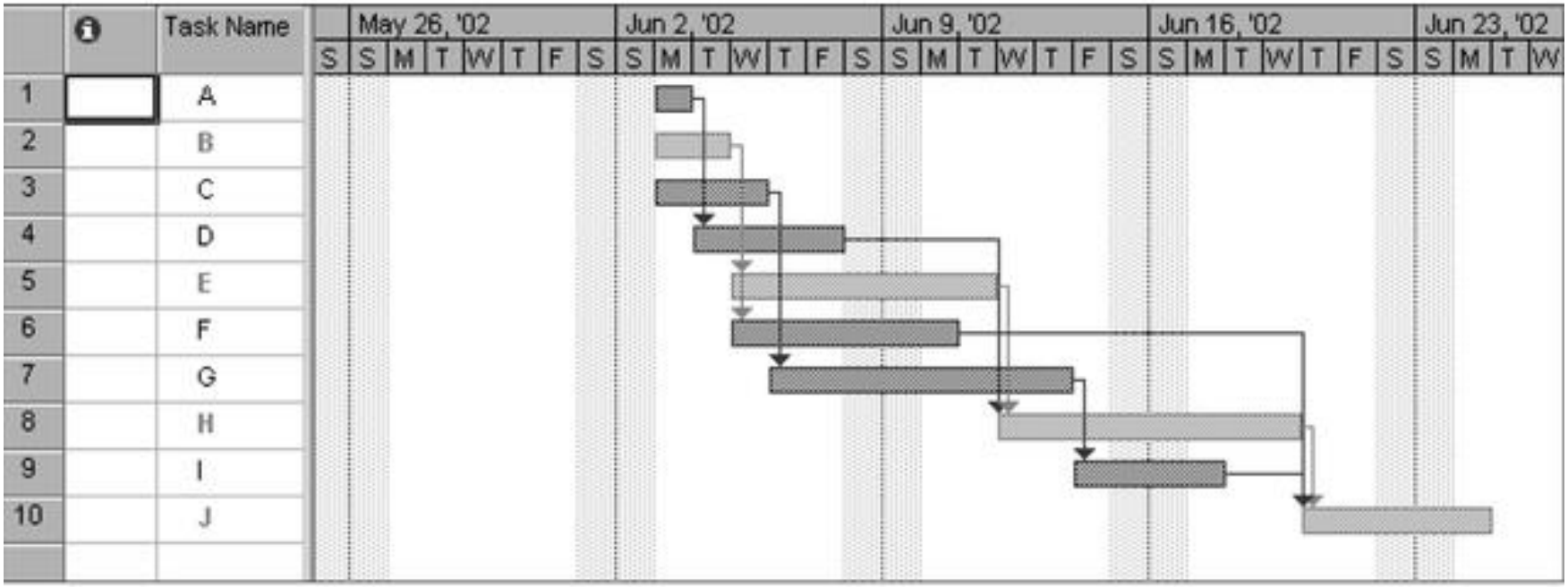
Schedule Development

- Schedule development uses results of the other time management processes to determine the start and end date of the project and its activities
- Its 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, PERT analysis, critical path analysis, and critical chain scheduling

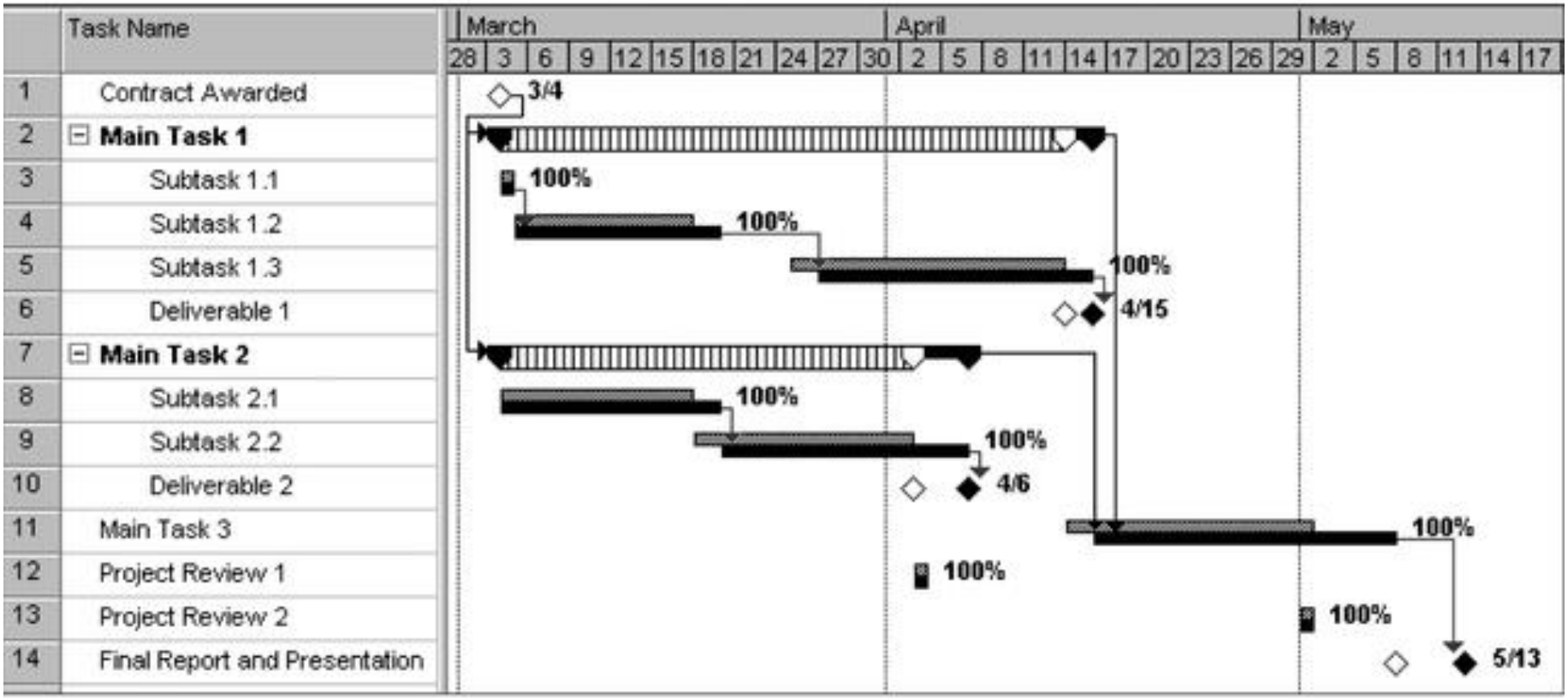
Gantt Charts

- 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:
  - A black diamond: milestones or significant events on a project with zero duration
  - Thick black bars: summary tasks
  - Lighter horizontal bars: tasks
  - Arrows: dependencies between tasks

Gantt Chart for Project X



Sample Tracking Gantt Chart



white diamond: slipped milestone

two bars: planned and actual times

MS Project 2007 File

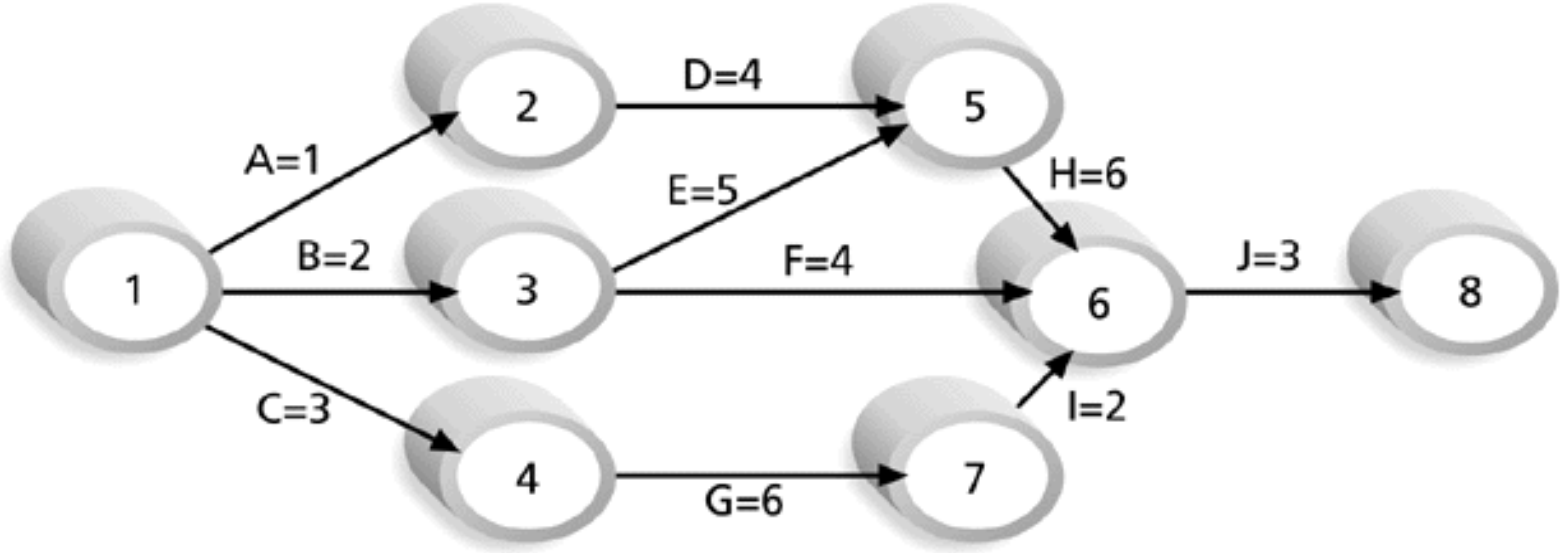
Critical Path Method (CPM)

- CPM is a project network analysis 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*

Finding the Critical Path

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

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

- If one of more activities on the critical path takes longer than planned, the whole project schedule will slip *unless* corrective action is taken
- **Misconceptions:**
  - The critical path is not the one with all the critical activities; it only accounts for time
  - 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

- Knowing the critical path helps you 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

Free and Total Float or Slack for Project X

Task	Start	Finish	Late Start	Late Finish	Free Slack	Total Slack
A	6/2/02	6/2/02	6/4/02	6/4/02	0d	2d
B	6/2/02	6/3/02	6/2/02	6/3/02	0d	0d
C	6/2/02	6/4/02	6/4/02	6/6/02	0d	2d
D	6/3/02	6/6/02	6/5/02	6/10/02	2d	2d
E	6/4/02	6/10/02	6/4/02	6/10/02	0d	0d
F	6/4/02	6/9/02	6/13/02	6/18/02	7d	7d
G	6/5/02	6/12/02	6/9/02	6/16/02	0d	2d
H	6/11/02	6/18/02	6/11/02	6/18/02	0d	0d
I	6/13/02	6/16/02	6/17/02	6/18/02	2d	2d
J	6/19/02	6/23/02	6/19/02	6/23/02	0d	0d

Techniques for Shortening a Project Schedule

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

Importance of Updating Critical Path Data

- It is important to update project schedule information because
  - 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

- Technique that addresses the challenge of meeting or beating project finish dates
- Critical chain scheduling is a method of scheduling that takes ***limited resources*** into account when creating a project schedule and includes ***buffers*** to protect the project completion date
- Critical chain scheduling assumes resources do not multitask because it often delays task completions and increases total durations

Multitasking Example

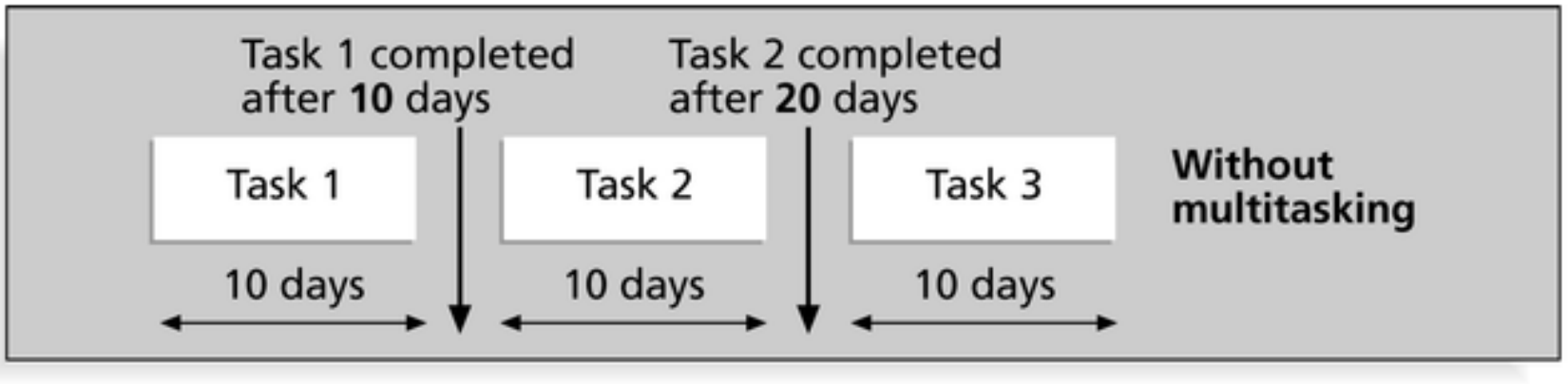


Figure 5-9a. Three Tasks Without Multitasking

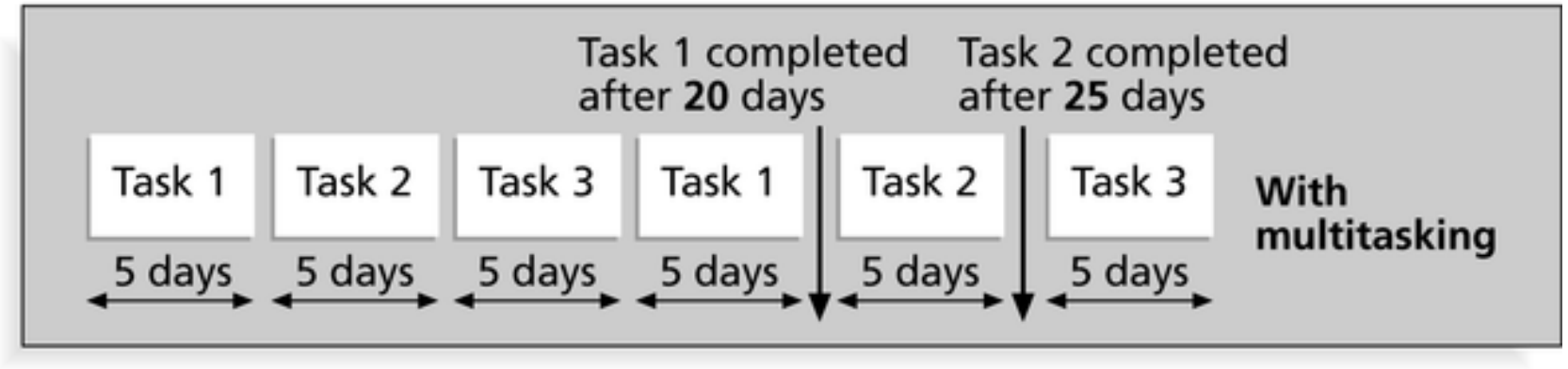


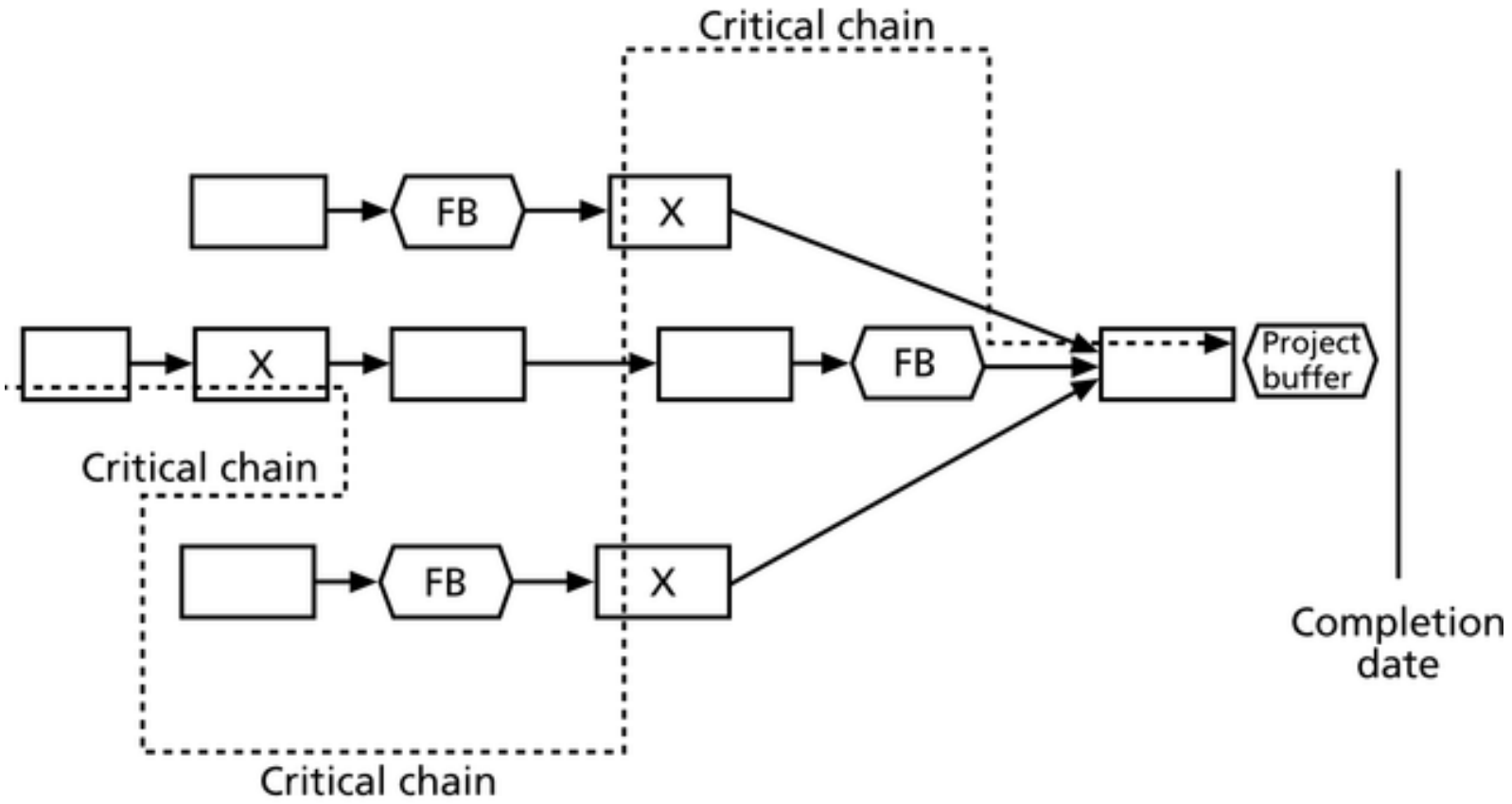
Figure 5-9b. Three Tasks with Multitasking

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***, and Parkinson's Law states that ***work expands to fill the time allowed***.
- In traditional estimates, people often add a buffer and use it if it's needed or not

- Critical chain schedule removes buffers from individual tasks and instead creates
  - A **project buffer**, which is additional time added before the project's due date
  - **Feeding buffers**, which are addition time added before tasks on the critical path

Example of Critical Chain Scheduling



X = Tasks done by limited resource
FB = Feeding buffer

CPM vs 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 based on using optimistic, most likely, and pessimistic estimates of activity durations

PERT Formula and Example

- Uses a three-paint estimate
- PERT weighted average formula:

$$Expected\ time\ (t) = \frac{Optimistic\ time + 4\ x\ Most\ likely\ time + Pessimistic\ time}{6}$$

Example:

PERT weighted average = (8 workdays+4X10 workdays + 24 workdays)/6

= 12 days

Where 8 = optimistic time,

10 = most likely time, and

24 = pessimistic time

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
- Verify schedule progress – just because a team member says a task was completed on time doesn't always mean that it was

Working with People Issues

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

Many thanks!