Chapter 6:
Project Time Management

Lecture: 3

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Information Technology Project Management, Fifth Edition

Project Time Management Processes

- **Activity definition**: identifying the specific activities/tasks that the project team members and stakeholders must perform to produce the project deliverables

- **Activity sequencing**: identifying and documenting the relationships between project activities

Project Time Management Processes

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- **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

Project Time Management Summary

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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 Lists and Attributes
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- 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, resource requirements, constraints, imposed dates, and assumptions related to the activity

Milestones

- A **milestone** is a significant event that normally has no duration
  - Not every deliverable or output created for a project is a milestone

- Examples include obtaining customer sign-off on key documents or completion of specific products such as software modules or the installation of new hardware

Activity Sequencing

- 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,
- Ex: you can not test code until after the code is written

- **Discretionary dependencies**: defined by the project team; sometimes referred to as soft logic

  - EX: Don't start detailed design work until users sign-off on all the analysis – good practice but can delay project

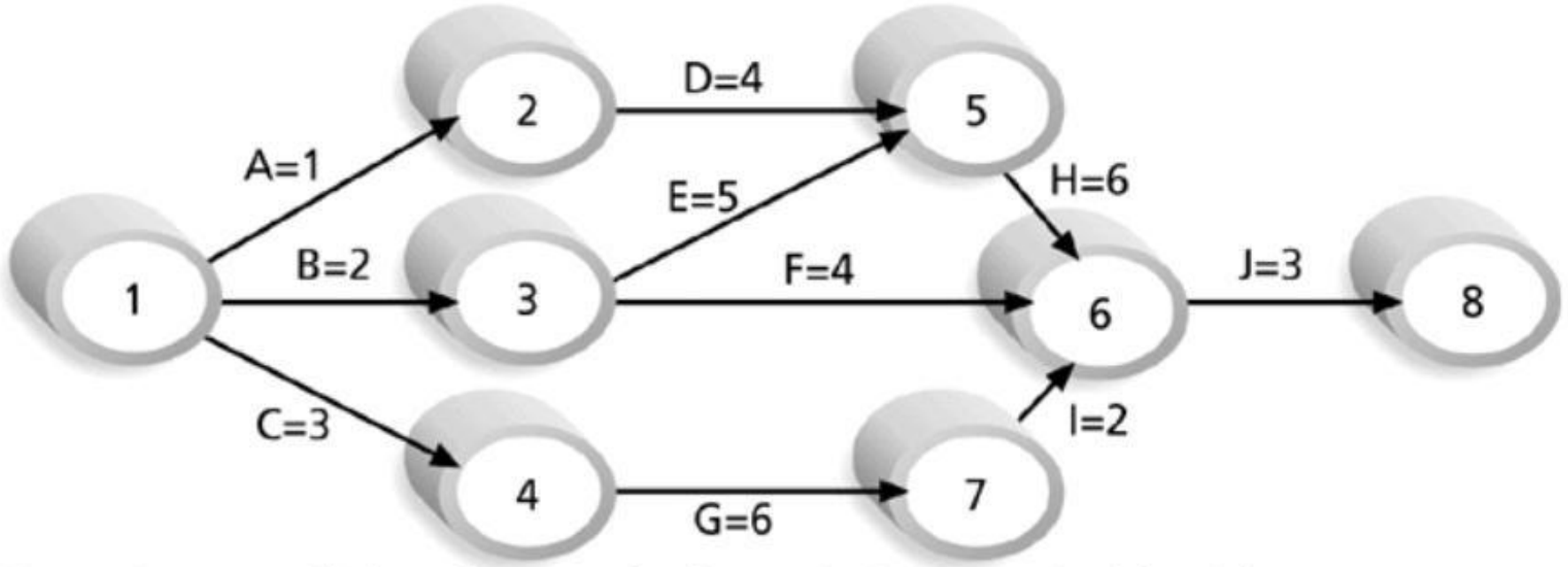
- **External dependencies**: involve relationships between project and non-project activities
  - Delivery of new hardware; if delayed can impact project schedule

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
- Two main formats are the arrow and precedence diagramming methods ([AoA , ADM] or PDM)

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)

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- 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
- Can omit activities that have no dependencies

Precedence Diagramming Method (PDM)

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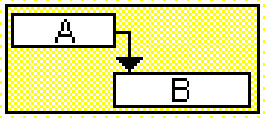
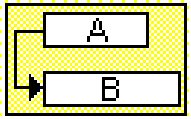
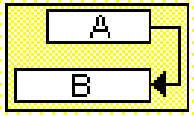
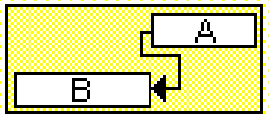
- More popular than ADM method and used by project management software
- Activities are represented by boxes
- Arrows show relationships between activities
- Better at showing different types of dependencies

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.

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

Three-Point Estimates
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- 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,
- Three-point estimates are needed for PERT and Monte Carlo simulations

Schedule Development

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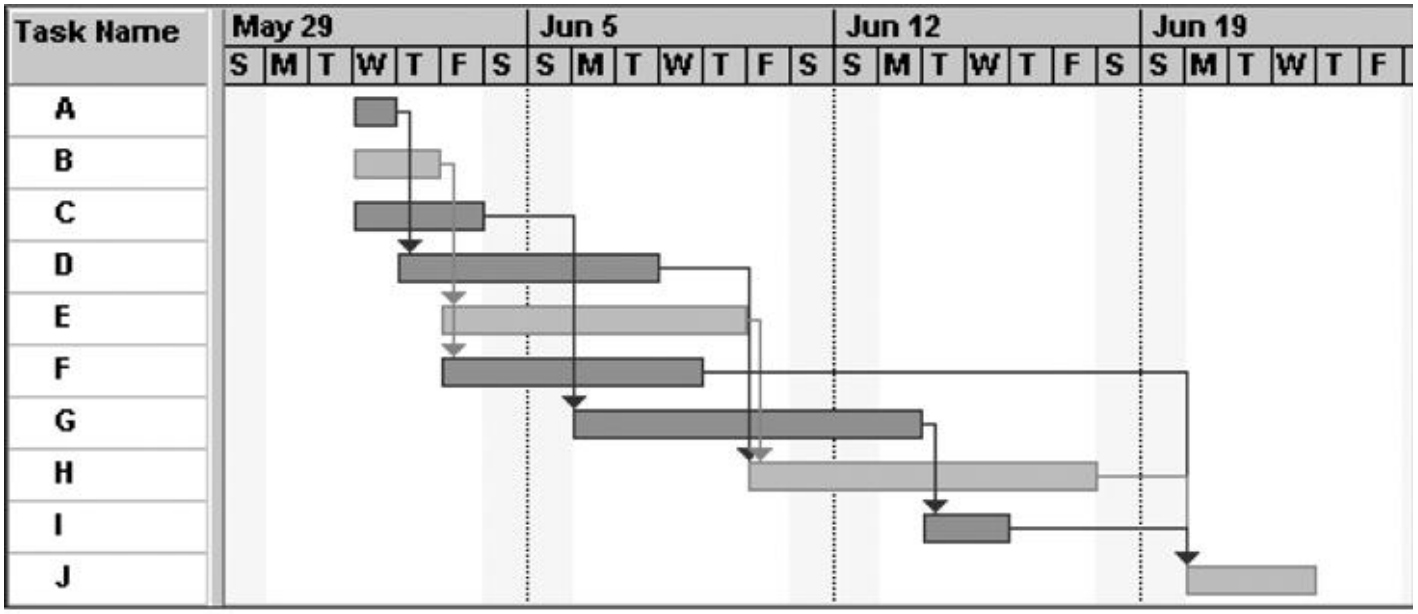
- Important tools and techniques include Gantt charts, critical path analysis, critical chain scheduling, and PERT analysis

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

Figure 6-5: Gantt Chart for Project X

Read Only



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

Symbols include:

- Black diamonds: milestones
- Thick black bars: summary tasks
- Lighter horizontal bars: durations of tasks
- Arrows: dependencies between tasks

Gantt Chart for Software Launch Project

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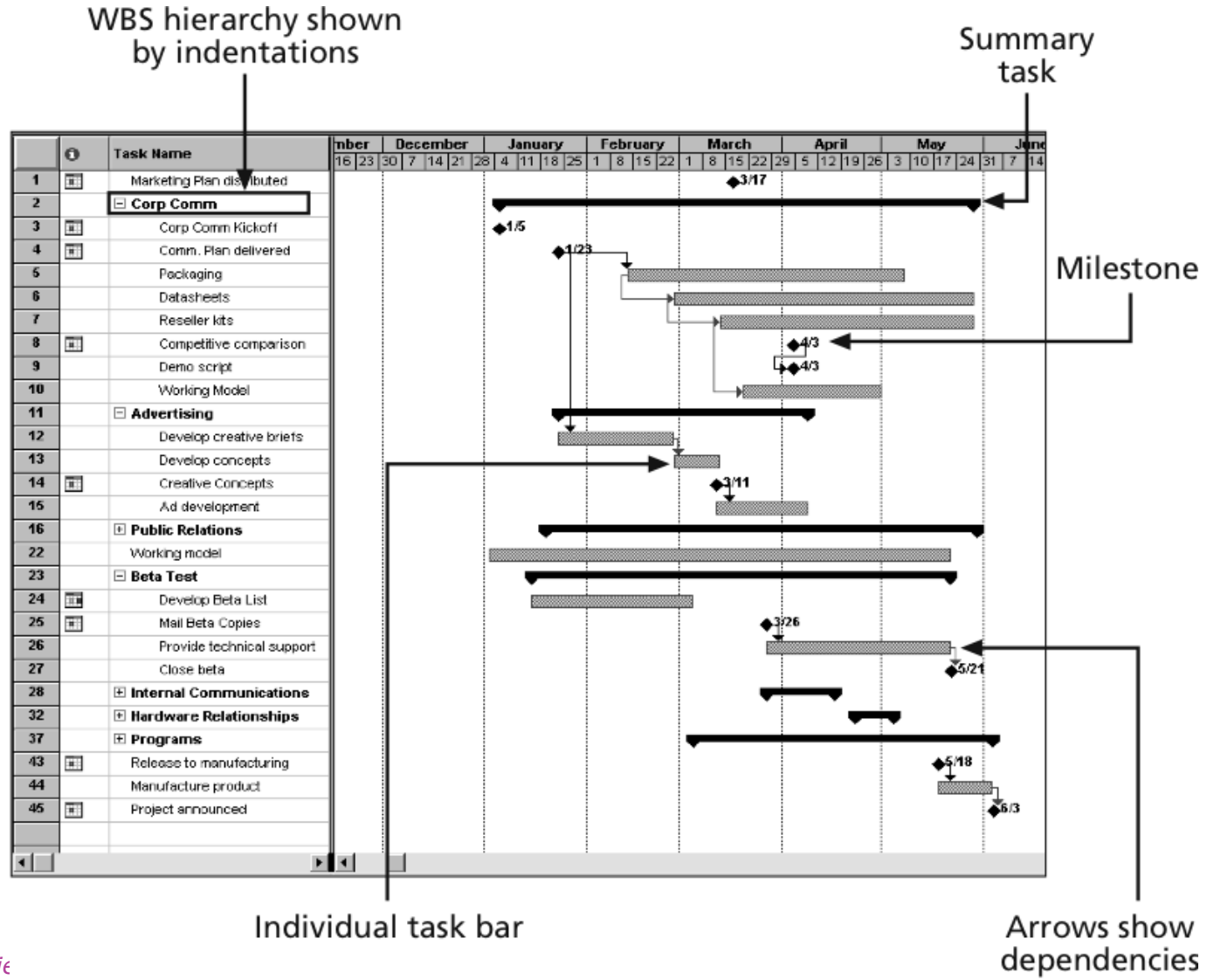

Adding Milestones to Gantt Charts

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- 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

Milestones

- Milestones emphasize important events or accomplishments on projects
- Milestones should be:
  - **S**pecific
  - **M**easurable
  - **A**ssignable
  - **R**ealistic

A slipped milestone means the milestone activity was actually completed later than originally planned.

Sample Tracking Gantt Chart

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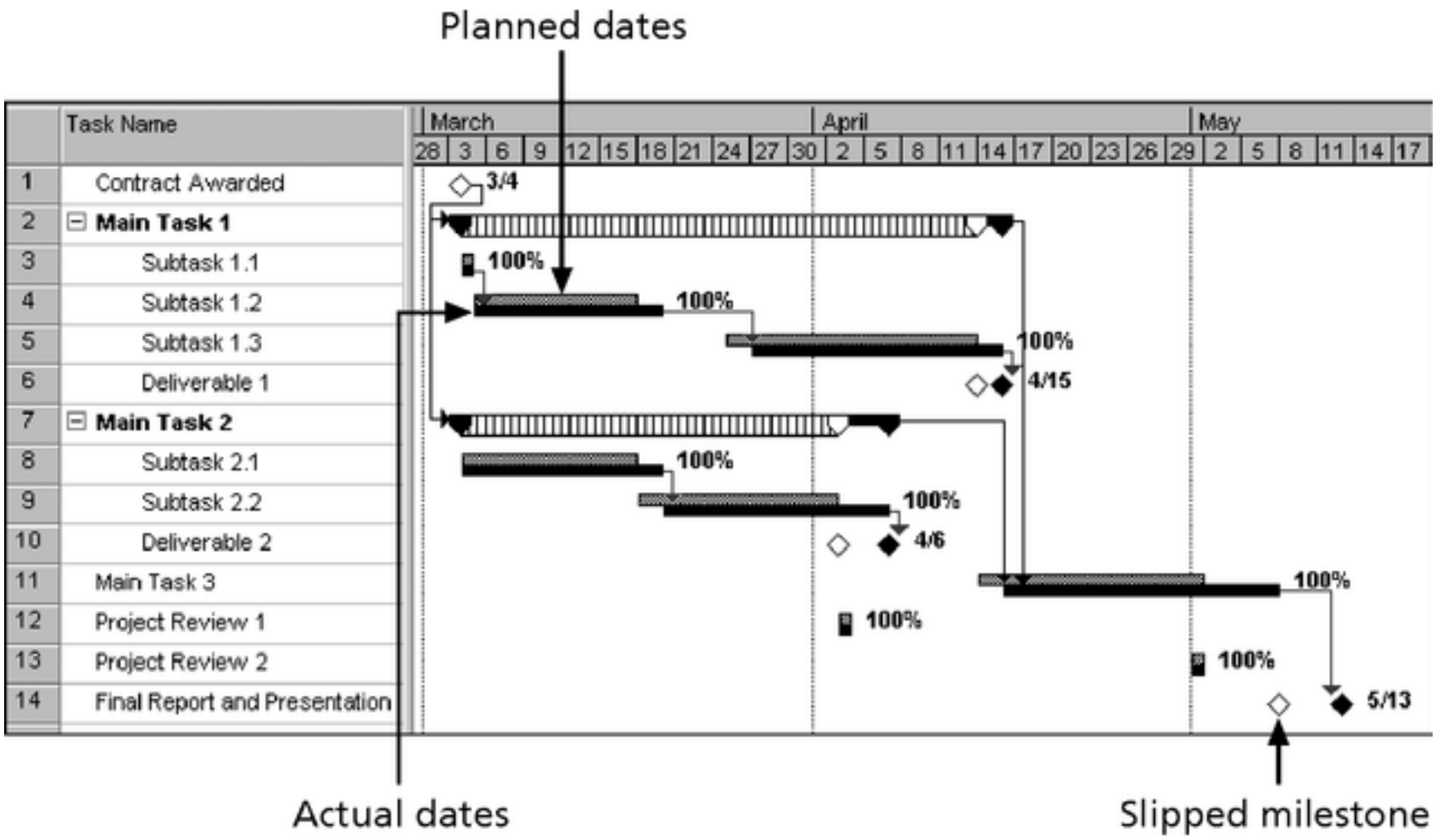

Critical Path Method (CPM)

- **The critical path method (CPM)** is an algorithm for scheduling a set of project activities
- 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
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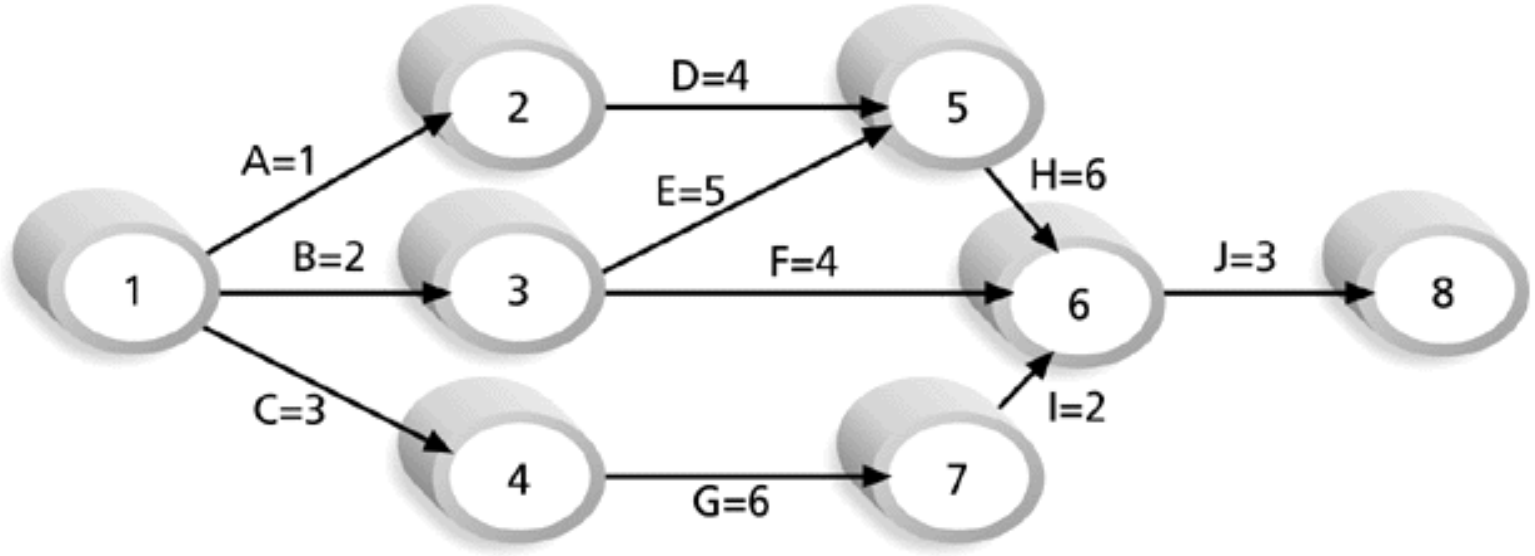
- First develop a good network diagram
- Add the duration estimates for all activities on each path through the network diagram
- If one or more of the activities on the critical path takes longer than planned, the whole project schedule will slip *unless* the project manager takes corrective action
- 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.

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
- A **forward pass** through the network diagram determines the early start and finish dates
- A **backward pass** determines the late start and finish dates

How to Find the Critical Path

- To find the critical path, need to determine the following quantities for each activity in the network

1. *Earliest start time* (*ES*): the earliest time an activity can begin without violation of immediate predecessor requirements
2. *Earliest finish time* (*EF*): the earliest time at which an activity can end
3. *Latest start time* (*LS*): the latest time an activity can begin without delaying the entire project
4. *Latest finish time* (*LF*): the latest time an activity can end without delaying the entire project

How to Find the Critical Path

- In the nodes, the activity time and the early and late start and finish times are represented in the following manner

ACTIVITY	*t*
ES	EF
LS	LF

- Earliest times are computed as

Earliest finish time = Earliest start time + Expected activity time

$$EF = ES + t$$

Earliest start = Largest of the earliest finish times of immediate predecessors

ES = Largest EF of immediate predecessors

How to Find the Critical Path

- Latest times are computed as

Latest start time = Latest finish time – Expected activity time

$$LS = LF - t$$

Latest finish time = Smallest of latest start times for following activities

LF = Smallest LS of following activities

- For activity *H*

$$LS = LF - t = 15 - 2 = 13 \text{ weeks}$$

How to Find the Critical Path

- Once ES, LS, EF, and LF have been determined, it is a simple matter to find the amount of *slack time* that each activity has

$$\text{Slack} = \text{LS} - \text{ES}, \quad \text{or} \quad \text{Slack} = \text{LF} - \text{EF}$$

- From Table 13.3 we see activities *A*, *C*, *E*, *G*, and *H* have no slack time
- These are called *critical activities* and they are said to be on the *critical path*
- The total project completion time is 15 weeks
- Industrial managers call this a boundary timetable

Activity Networks and Critical Path Analysis

- Project Scheduling
  - Earliest start time (EST)
  - Latest start time (LST)
  - Earliest finish time (EFT)
  - Latest finish time (LFT)
  - Float (Slack)

Example: Activity Networks and Critical Path Analysis

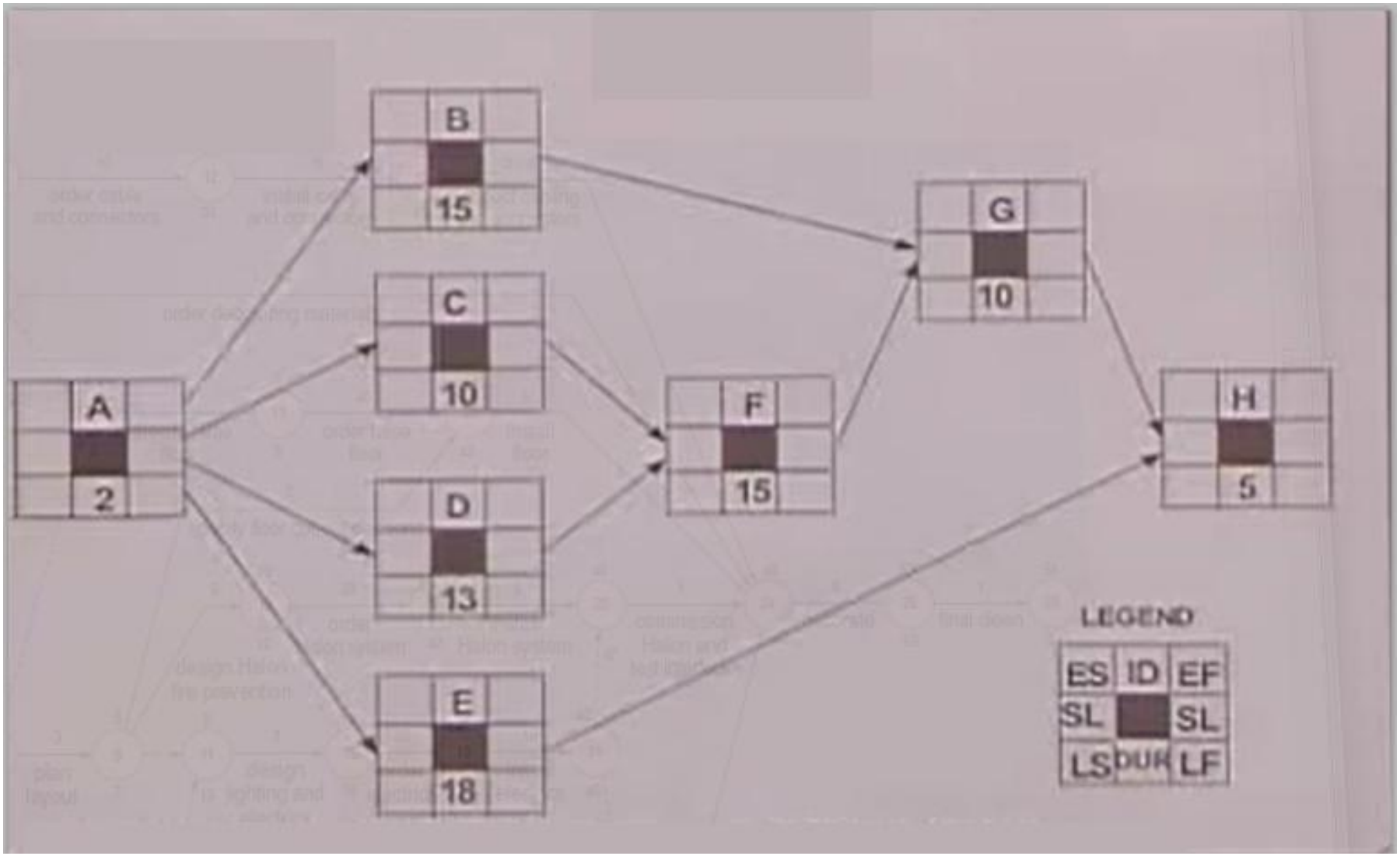
Activity	Preconditions	Duration
A	-	2
B	A	15
C	A	10
D	A	13
E	A	18
F	C,D	15
G	B,F	10
H	E,G	5

Using the above table:

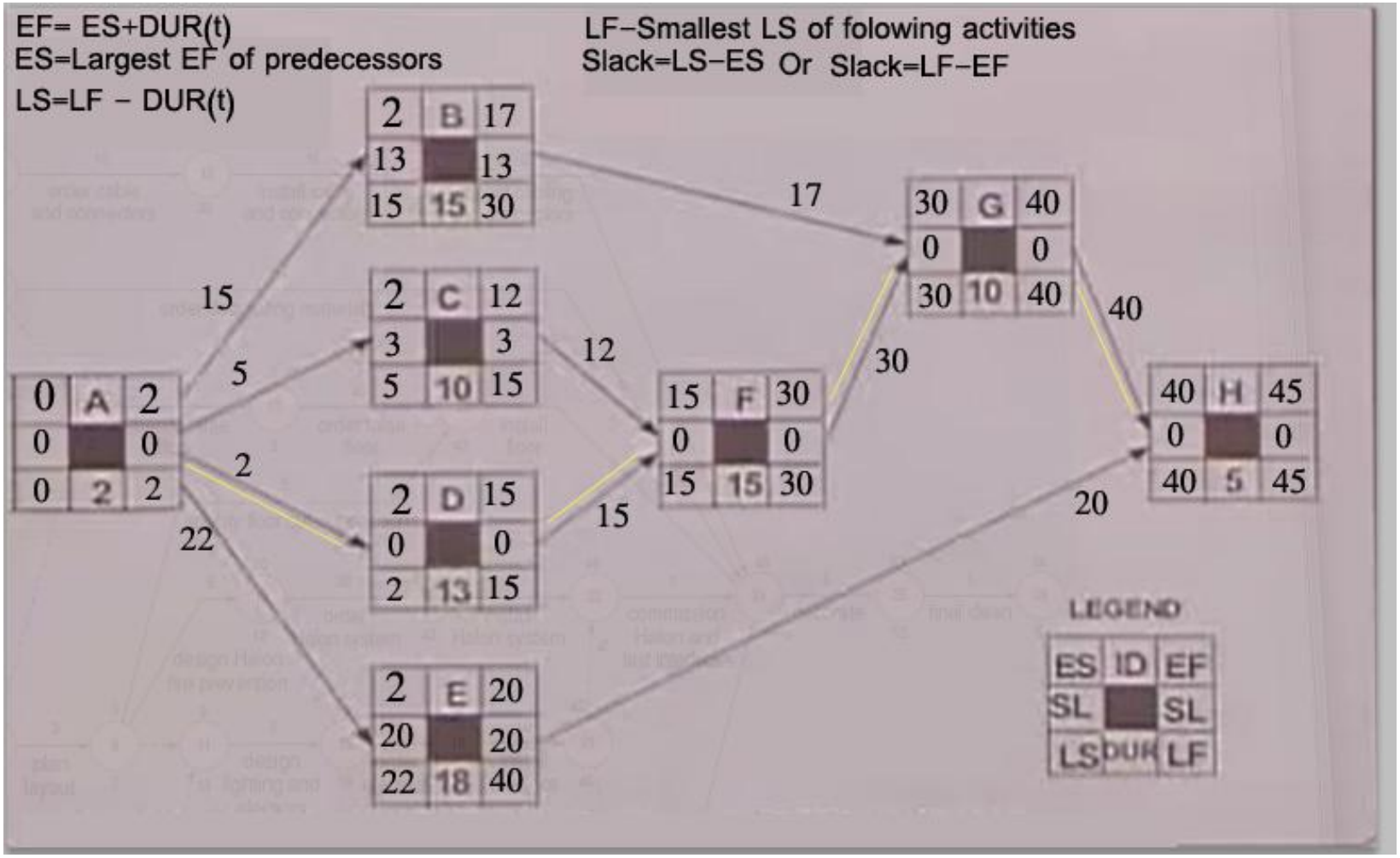
1- Draw the network

2- calculate ES, LS, EF, LF, and Critical Path(CP)

Answer (1)



Answer (2)


EF= ES+DUR(t)
ES=Largest EF of predecessors
LS=LF – DUR(t)
LF–Smallest LS of folowing activities
Slack=LS–ES Or Slack=LF–EF
0 A 2
0 0
0 2 2
2 B 17
13 13
15 15 30
2 C 12
3 3
5 10 15
2 D 15
0 0
2 13 15
2 E 20
20 20
22 18 40
15 F 30
0 0
15 15 30
30 G 40
0 0
30 10 40
40 H 45
0 0
40 5 45
15
5
2
22
17
12
15
30
40
20
LEGEND
ES ID EF
SL SL
LS DUR LF