Royal University of Phnom Penh

IT Project Management

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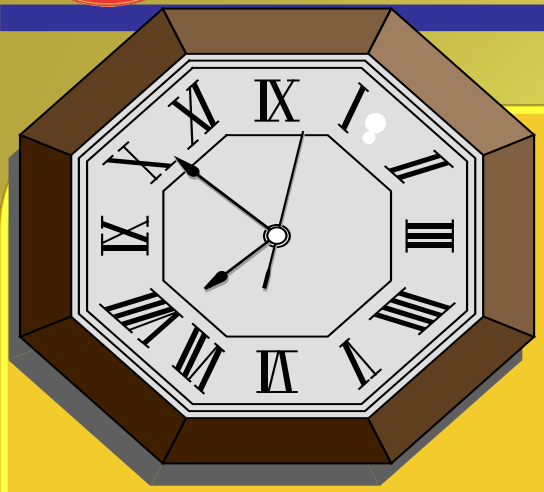
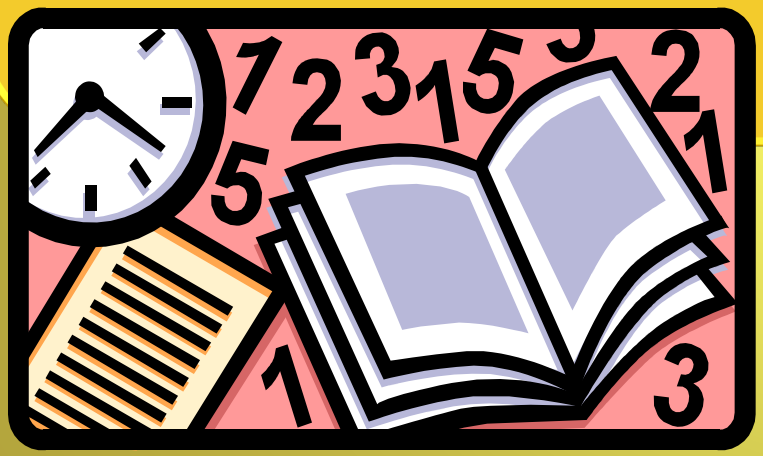
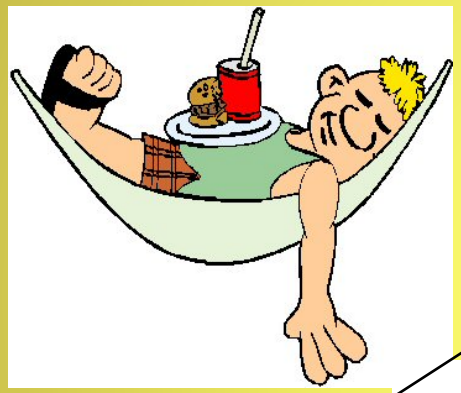


Chapter 4

Project Time Management



Why manage your time?



Is this the picture that represents you in your normal state?

Or is it more like…

- **We need to manage time because:**
  - ?
  - ?
  - ?
- **What is your reason?**

Understand your time

- Time is your most valuable resource.
- Analyze your time to understand the most efficient way to use it.

To understand the value of time

Value Every Minute

- **To realize the value of one year:**
  - Ask a student who has failed a final exam.
- **To realize the value of one month:**
  - Ask a mother who has given birth to a premature baby.
- **To realize the value of one week:**
  - Ask an editor of a weekly newspaper.
- **To realize the value of one hour:**
  - Ask the lovers who are waiting to meet.
- **To realize the value of one minute:**
  - Ask the person who has missed the train, bus or plane.
- **To realize the value of one second:**
  - Ask a person who has survived an accident.
- **To realize the value of one millisecond:**
  - Ask the person who has won a silver medal in the Olympics.
- **Time waits for no one.**
- **Treasure every moment you have. You will treasure it even more when you can share it with someone special.**

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
- Judgment type people prefer to follow schedules, meet deadlines and have closure. Perception types prefer to keep things open and flexible; deadlines are a signal to start rather than to complete a project
- Different cultures and even entire countries have different attitudes about schedules

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
- **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

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 Definition

- **The basis for creating a project schedule is derived from four project time management processes**
  - Activity definition – further defining the scope
  - Activity sequencing – further defining the time
  - Activity resource and activity duration (further defining the time and cost)

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 <u>significant</u> event that normally has no duration**
  - Not every deliverable or output created for a project is a milestone
- **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 such as software modules or the installation of new hardware**

Activity Sequencing

- **After defining project activities, the next step is activity sequencing**
  - Involves reviewing the activity list and attributes, project scope statement, milestone list and approved change requests to determine the relationships between activities
- **A dependency or relationship is the sequencing of project activities or tasks**
- **You *must* determine dependencies in order to use critical path analysis**

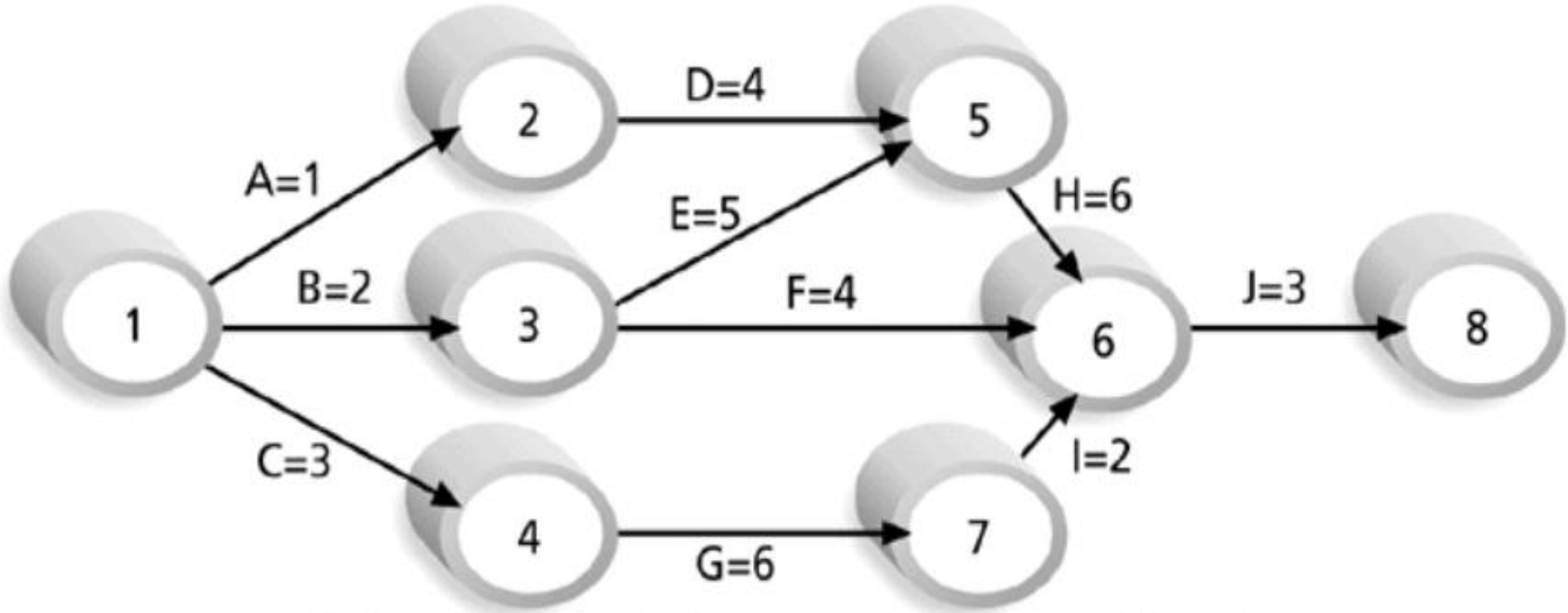
Three Types of Dependencies

- **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**
  - 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

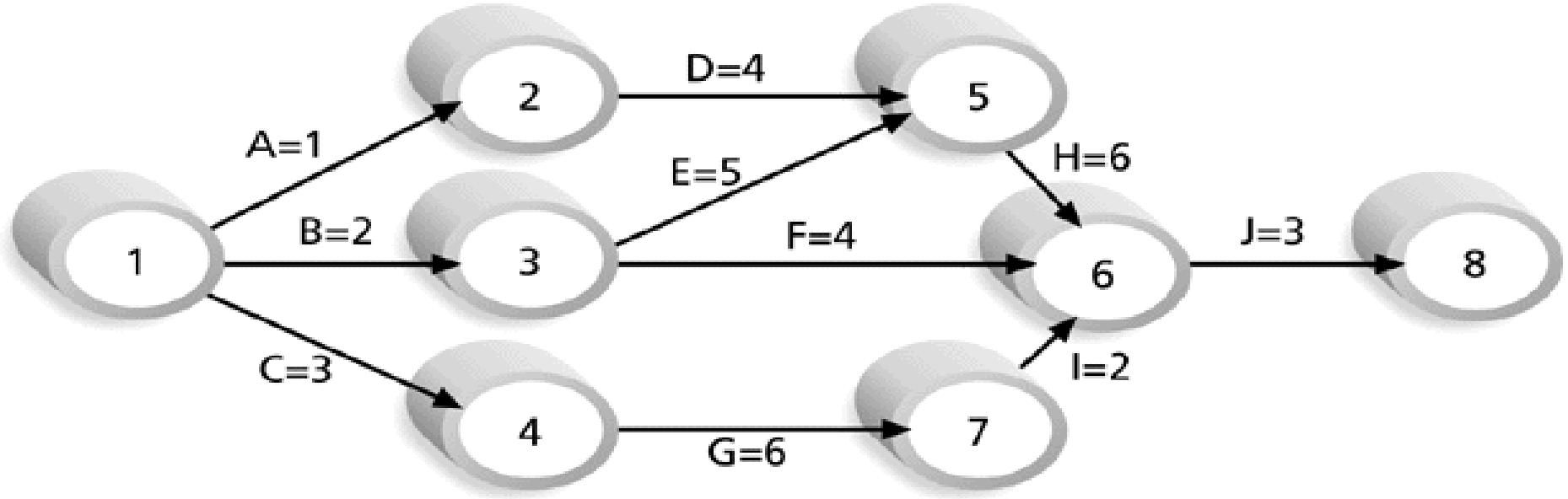
- Network diagrams are the preferred technique for showing activity sequencing
- A network diagram is a schematic display of the logical relationships among, or sequencing of, project activities
- Two main formats are the arrow and precedence diagramming methods

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.

Example of Calculating Critical Path



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.

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
- Can omit activities that have no dependencies

Process for Creating AOA Diagrams

1. **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. **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. **3. Continue drawing the project network diagram until all activities are included on the diagram that have dependencies**
4. **4. As a rule of thumb, all arrowheads should face toward the right, and no arrows should cross on an AOA network diagram**

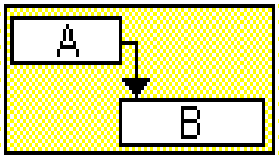
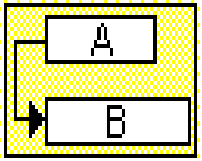
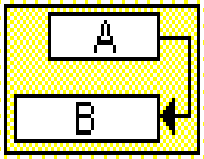
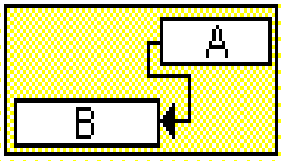
Precedence Diagramming Method (PDM)

- 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

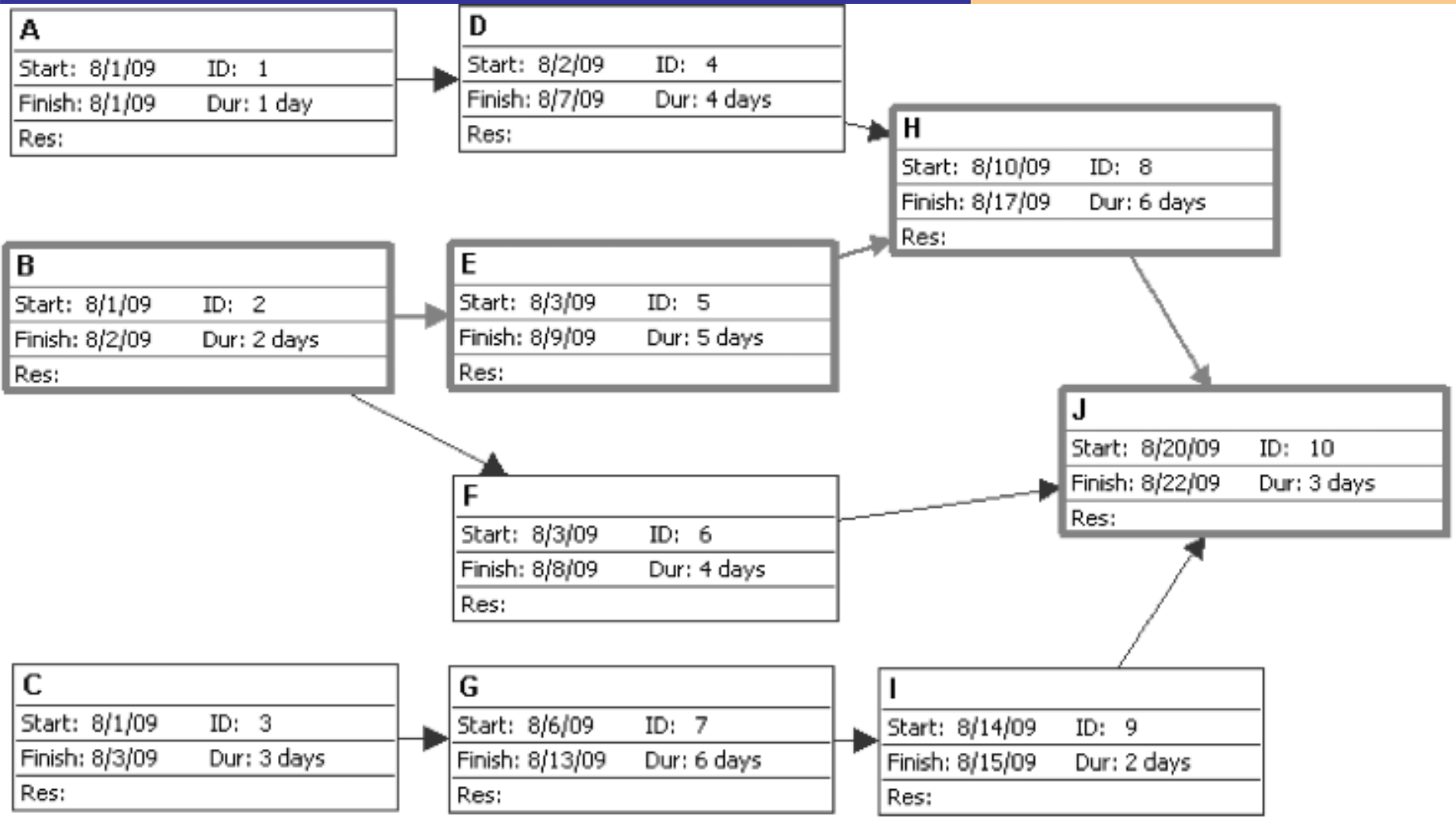
Task Dependency Types

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.

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 or need to be acquired?
- **A resource breakdown structure is a hierarchical structure that identifies the project's resources by category and type**

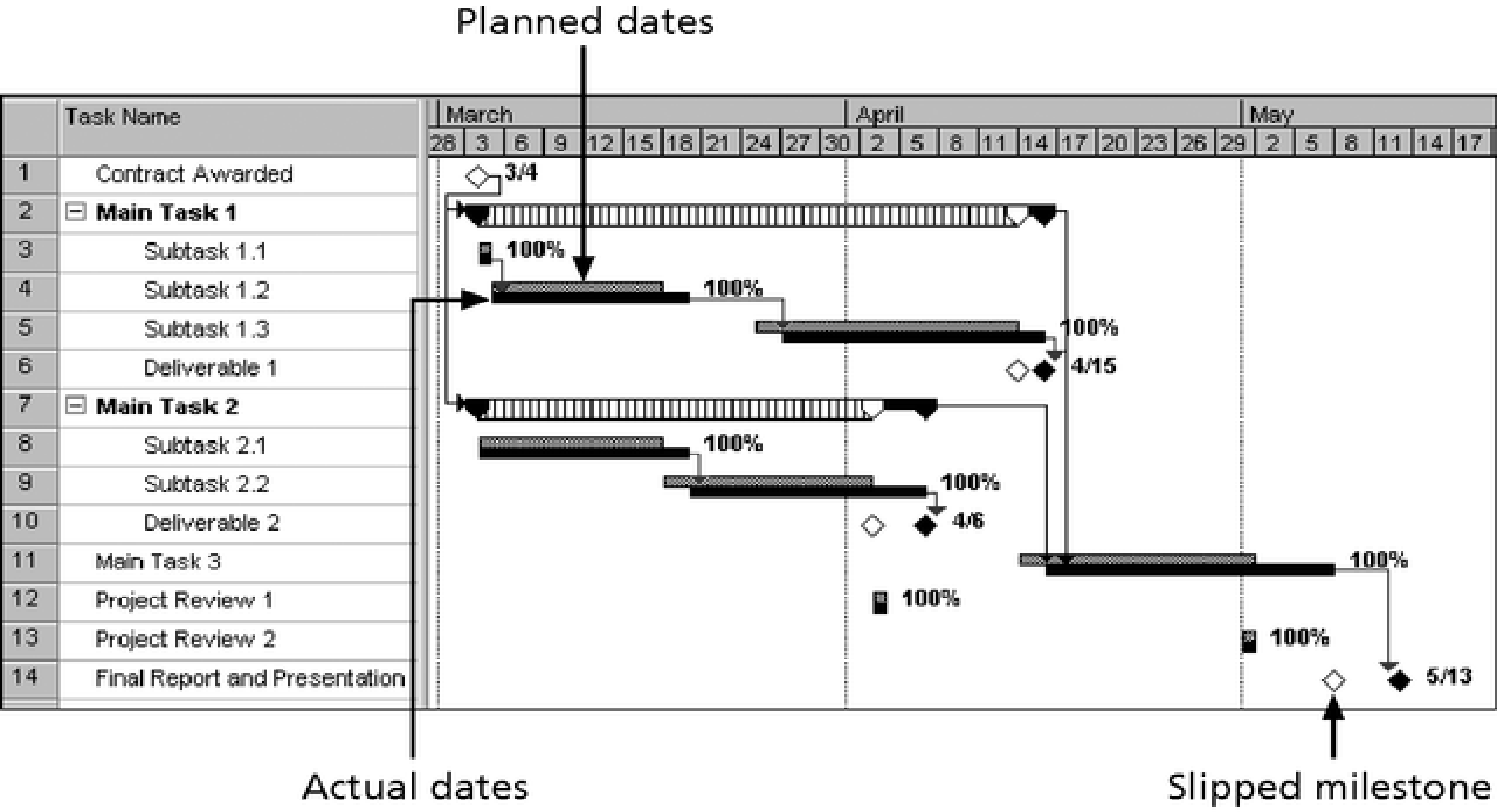
Activity Duration Estimating

- **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**

SMART Criteria

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

Sample Tracking Gantt Chart



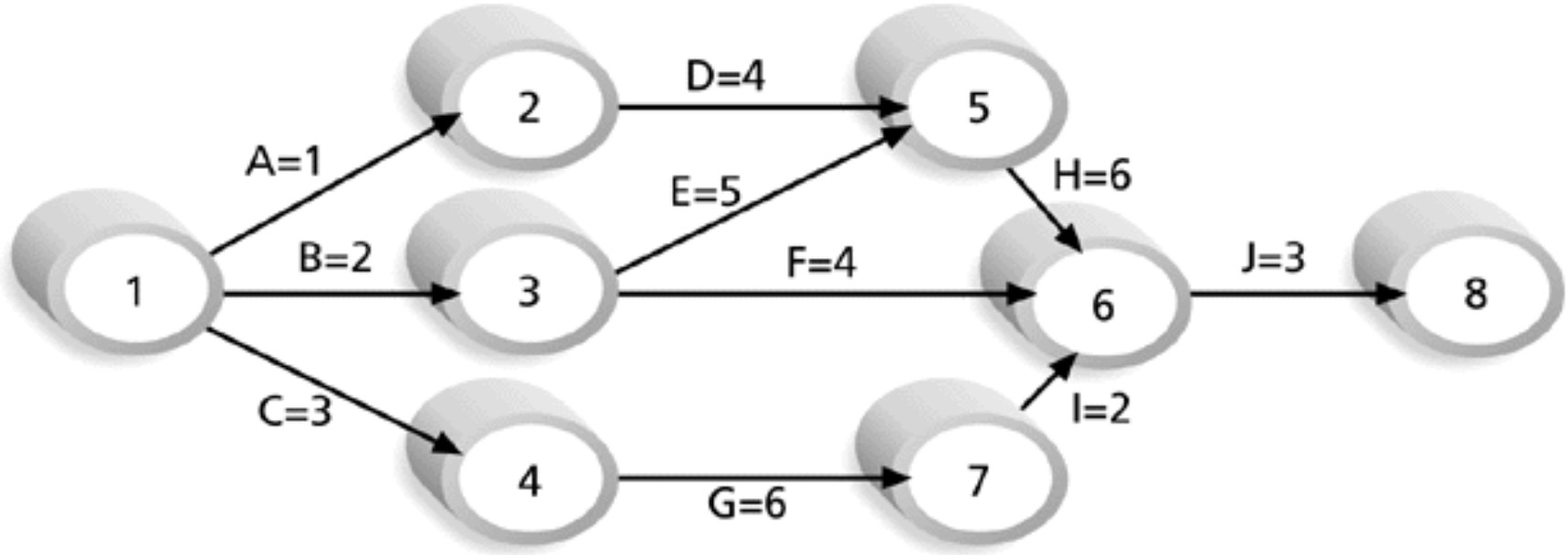
What is Critical Path?

- Critical path is the sequential activities from start to the end of a project.
- If there is a delay in any of the activities under the critical path, there will be a delay of the project deliverables.
- Critical path method is based on mathematical calculations and it is used for scheduling project activities.

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

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
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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**
- **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**

Advantages of Calculating Critical Path

- Offers a visual representation of the project activities.
- Presents the time to complete the tasks and the overall project.
- Tracking of critical activities
- help you to schedule and manage complex projects.
- useful for assessing the importance of problems faced during the implementation of the plan

Critical Path Analysis

Critical Path Analysis is an effective and powerful method of assessing:

- **What tasks must be carried out.**
- **Where parallel activity can be performed.**
- **The shortest time in which you can complete a project.**
- **Resources needed to execute a project.**
- **The sequence of activities, scheduling and timings involved.**
- **Task priorities.**
- **The most efficient way of shortening time on urgent projects.**

How to Find the Critical Path

- To find the critical path, need to determine the following quantities for each activity in the network
- *Earliest start time* (*ES*): the earliest time an activity can begin without violation of immediate predecessor requirements
- *Earliest finish time* (*EF*): the earliest time at which an activity can end
- *Latest start time* (*LS*): the latest time an activity can begin without delaying the entire project
- *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

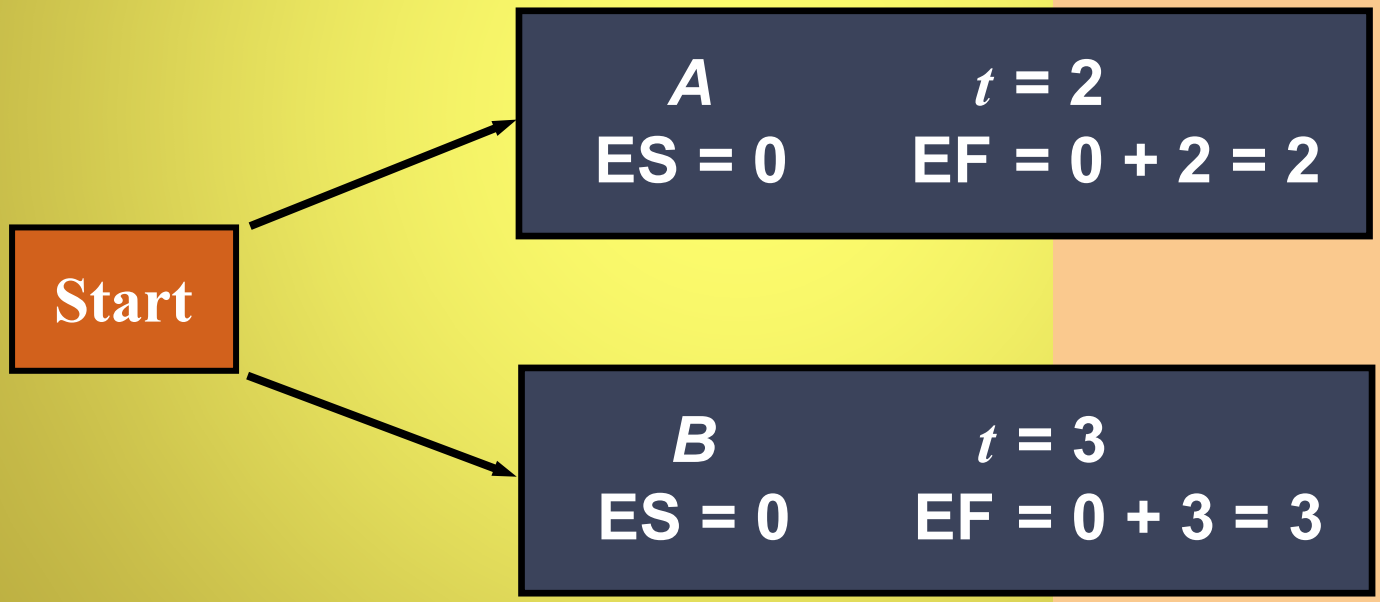
Earliest finish time =Earliest start time + Expected activity time

EF = ES + *T*

- **Earliest start =Largest of the earliest finish times of immediate predecessors**
- **ES =Largest EF of immediate predecessors**

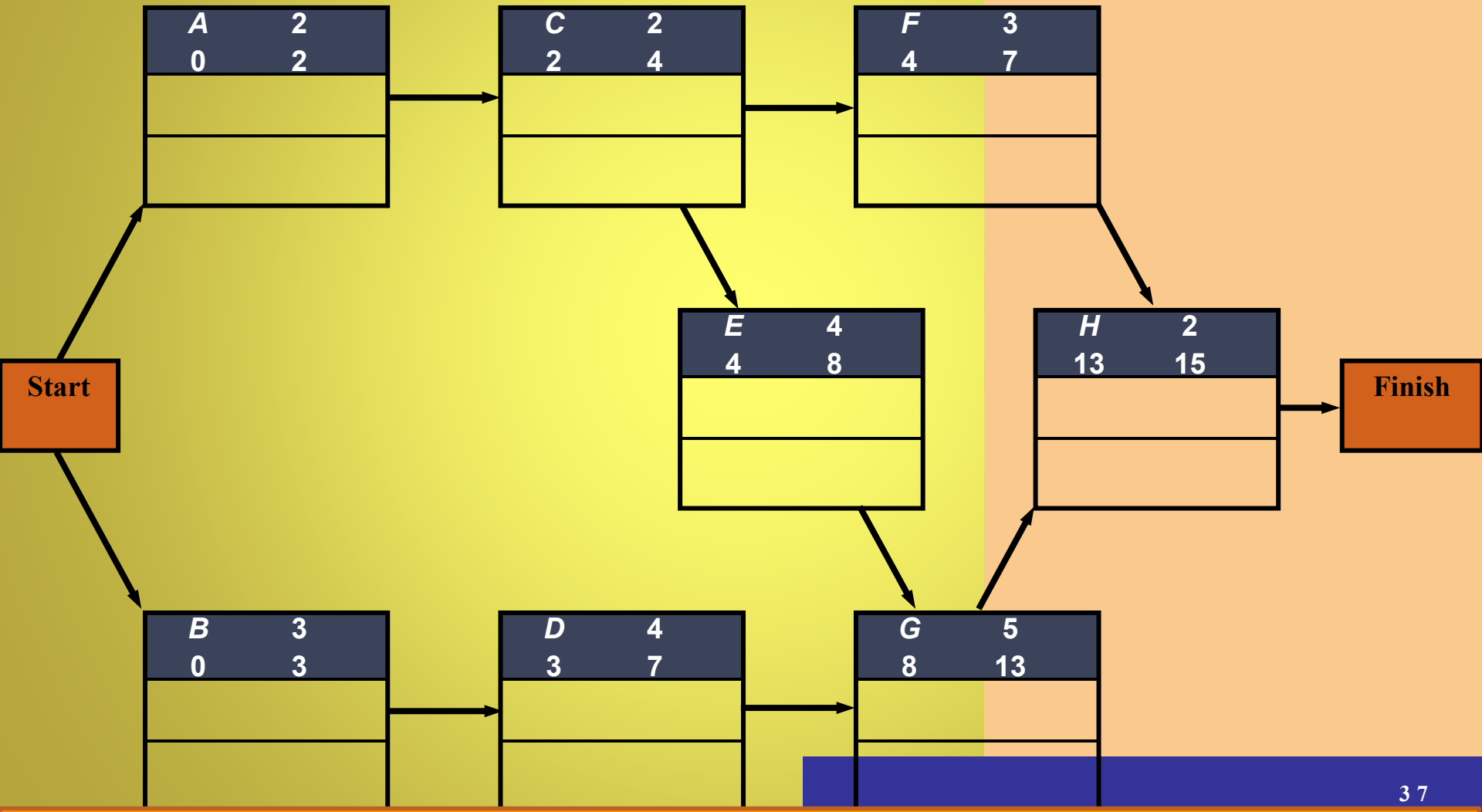
How to Find the Critical Path

- At the start of the project we set the time to zero
- Thus ES = 0 for both *A* and *B*



How to Find the Critical Path

- **General Foundry's ES and EF times**



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

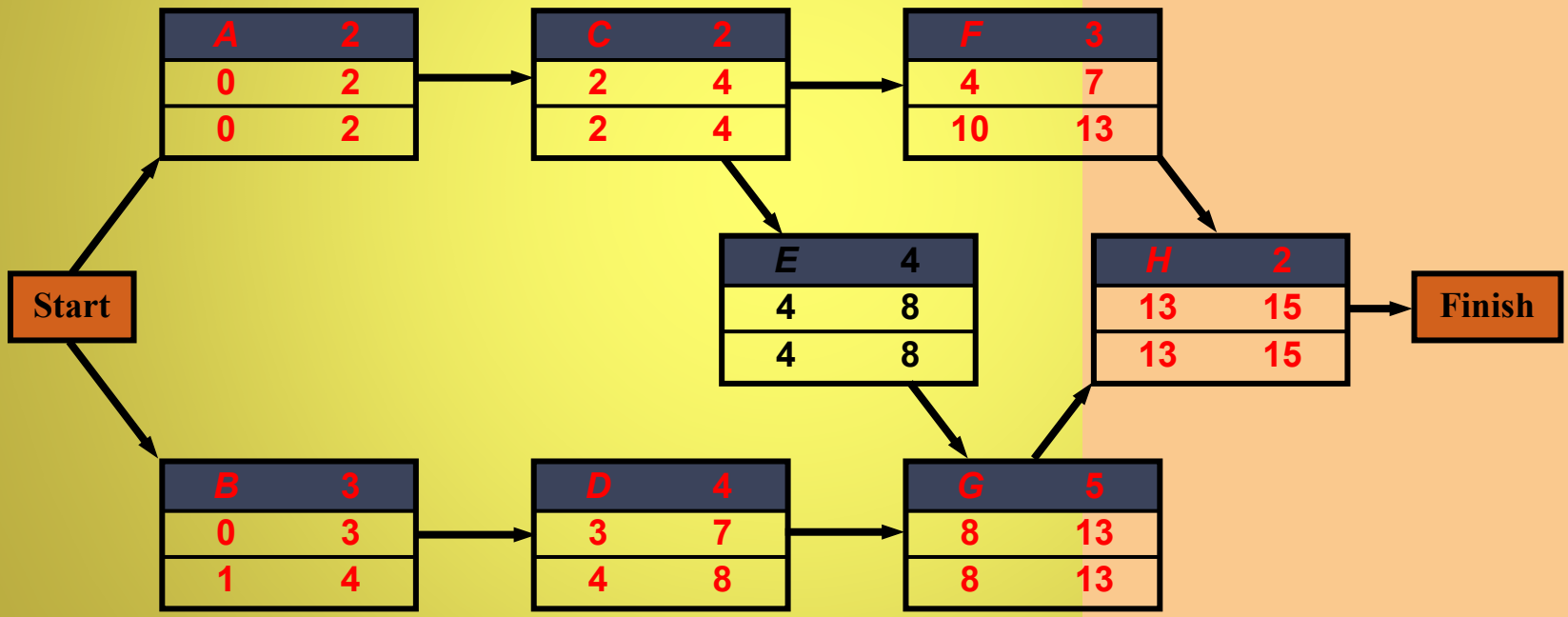
LF = Smallest LS of following activities

- **For activity *H***

LS = LF – *T* = 15 – 2 = 13 weeks

How to Find the Critical Path

- **General Foundry's LS and LF times**



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

Slack = LS – ES, or Slack = LF – 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

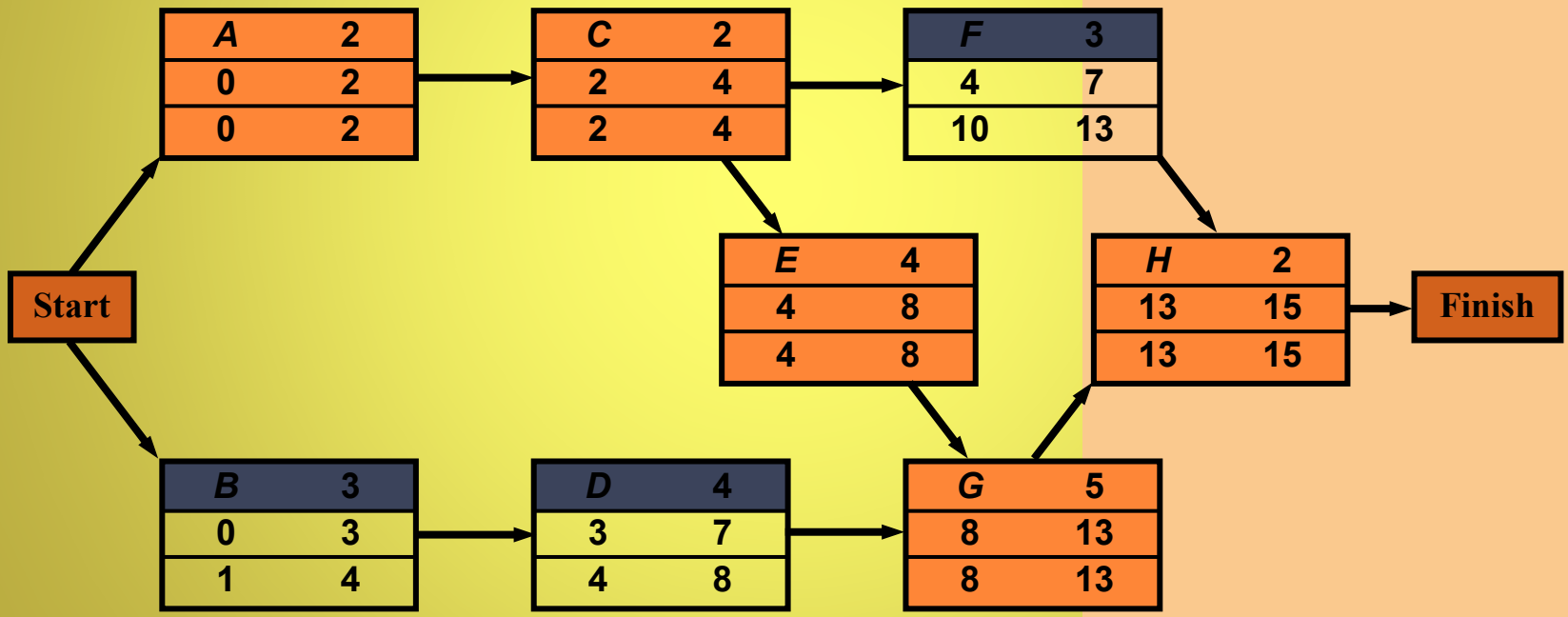
How to Find the Critical Path

❖ General Foundry's schedule and slack times

ACTIVITY	EARLIEST START, ES	EARLIEST FINISH, EF	LATEST START, LS	LATEST FINISH, LF	SLACK, LS – ES	ON CRITICAL PATH?
A	0	2	0	2	0	Yes
B	0	3	1	4	1	No
C	2	4	2	4	0	Yes
D	3	7	4	8	1	No
E	4	8	4	8	0	Yes
F	4	7	10	13	6	No
G	8	13	8	13	0	Yes
H	13	15	13	15	0	Yes

How to Find the Critical Path

- **General Foundry's critical path**



Critical Path Method

- The most widely used scheduling techniques is the critical path method(CPM) for scheduling.
- This method calculates the minimum completion time for a project along with the possible start and finish times for the project activities.

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

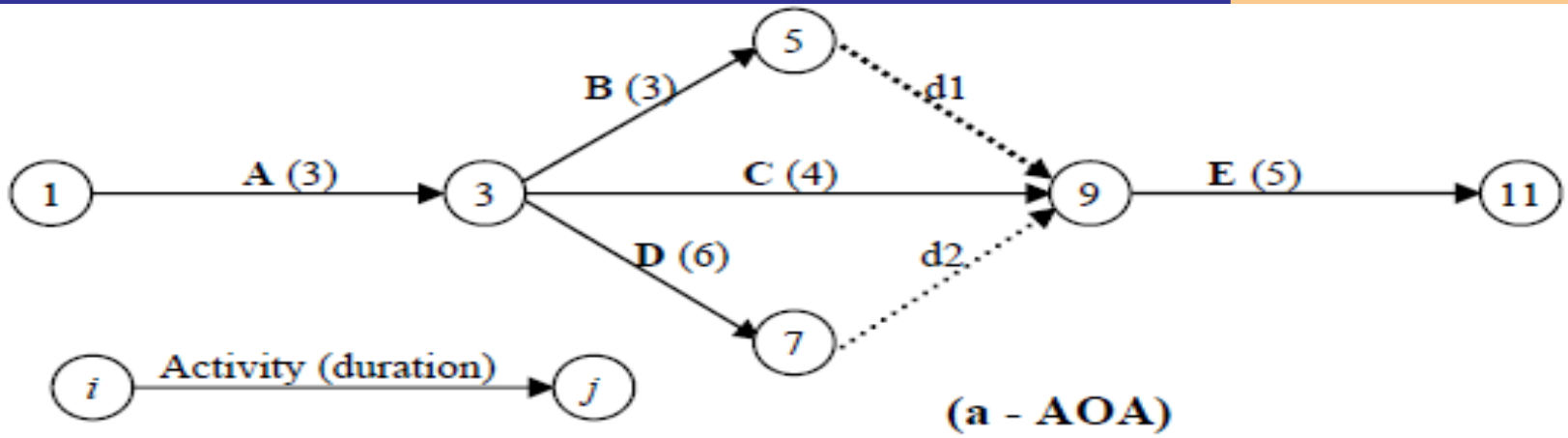
Step of Critical Path Method

- A forward path to determine activities early-start time
- A backward path to determine activities late-finish time
- Float/Slack calculation
- Identifying critical activities

Calculations for the Critical Path Method

- **First develop a good network diagram**
  - **AOA(Activity-On-Arrow)**
  - **AON(Activity-On-Node)**
- **Add the duration estimates for all activities on each path through the network diagram**
- **The longest path is the critical path**

Example of Network Diagram



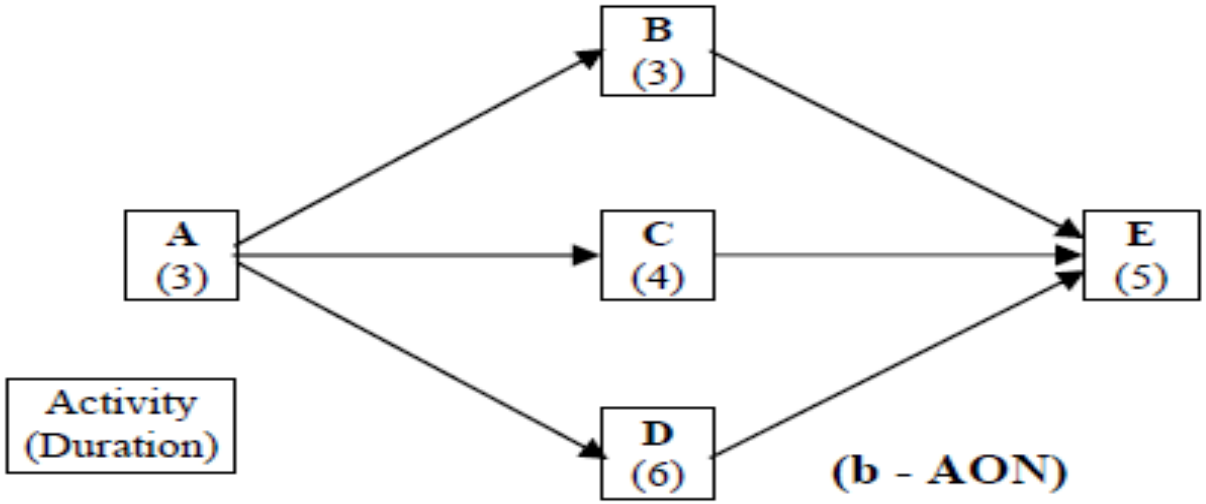


Figure 1: Network example

Activity-on-node networks calculations

- The objective of arrow network analysis is to compute for each event in the network its early and late timing. These times are defined as:
- Early event time(ET)- is the earliest time at which an event can occur, considering the duration of preceding activities.
- Late event time(LT)-is the latest time at which an event can occur if the project is to be completed on schedule.
- That node is also a point at which some activities start (tail arrows of successor activities).
- All successor activities can start only after the latest predecessor is finished.

Forward Path

- The forward path determines the early-start times of activities.
- The forward path precedes from the most left node in the network(node 1-Figure 2) and moves to the right, putting the calculations inside the shaded boxes to the left.
- Each node in the network, in fact, is a point at which some activities end (head arrows coming into the node), as shown in Figure 3.

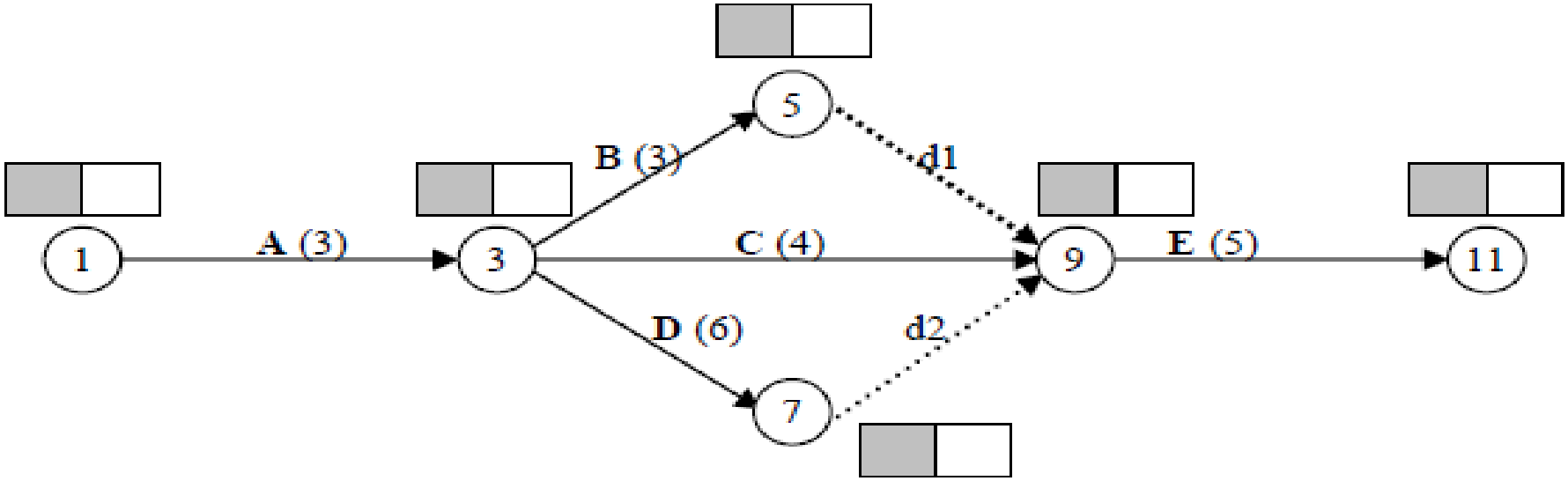


Figure 2: Preparation for the forward path

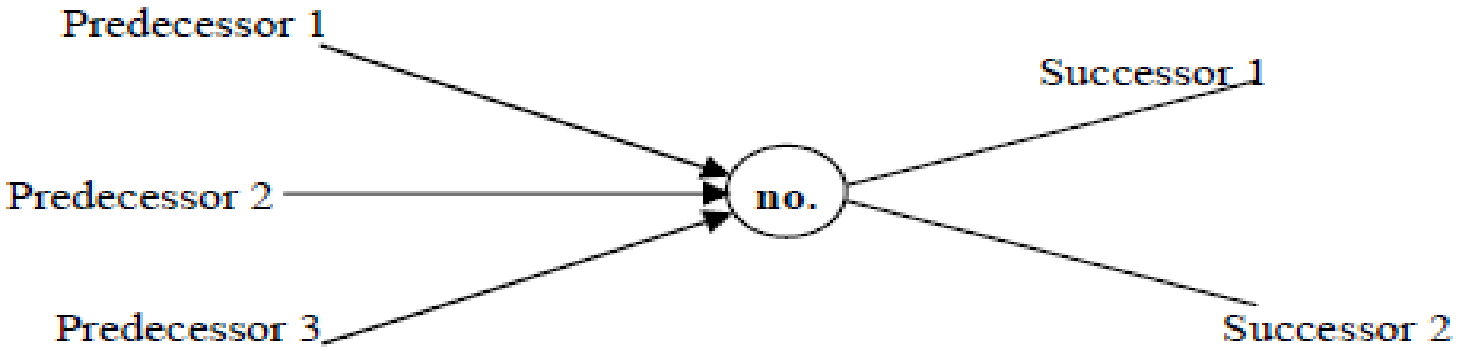


Figure 3: A node in an AOA network

The Forward Path Calculation

- We begin at node 1, the start node of the project and assign it an early-start time of zero (ES=0)
- Now we move node 3. this node receive one head arrow then it has one predecessor, Activity A. Since the predecessor started on time zero and has 3 days duration then
- Early-Finish(EF)= ES+d (0 +3)=3
- Accordingly, the ES time of all successor activities to node 3 (activities B,C and D) is time 3 as showed in the shaded box on the top of node 3 in Figure 4.
- We now move forward to success node 5,7 and 9. since node 9 is linked to nodes 5 and 9 by dummy activities then we begin with nodes 5 and 7.

The Forward Path Calculation (Con't)

- Node 5 receives one head arrow from its predecessor activity B then EF time of B (EF= Es(3) +d (3)= 6). Similarly, the EF time at node 7 is

  EF= ES(3)+d(6)=9)

- Moving to node 9 Then EF time of its 3 predecessors (d1, C, d2) as time 6, 7, 9 respectively.
- As the ES time of successor activities is the largest value =9 is used to calculate and all other values not used

  then EF= ES+d= 9+0=9

- Finally we move to the last node 11. it receives one head arrow, activity E which an ES value =9 then EF= ES+d= 9+5=14
- Since node 11 is the last node, the EF of this node become the end of the project, reaching a total project duration of 14 days.

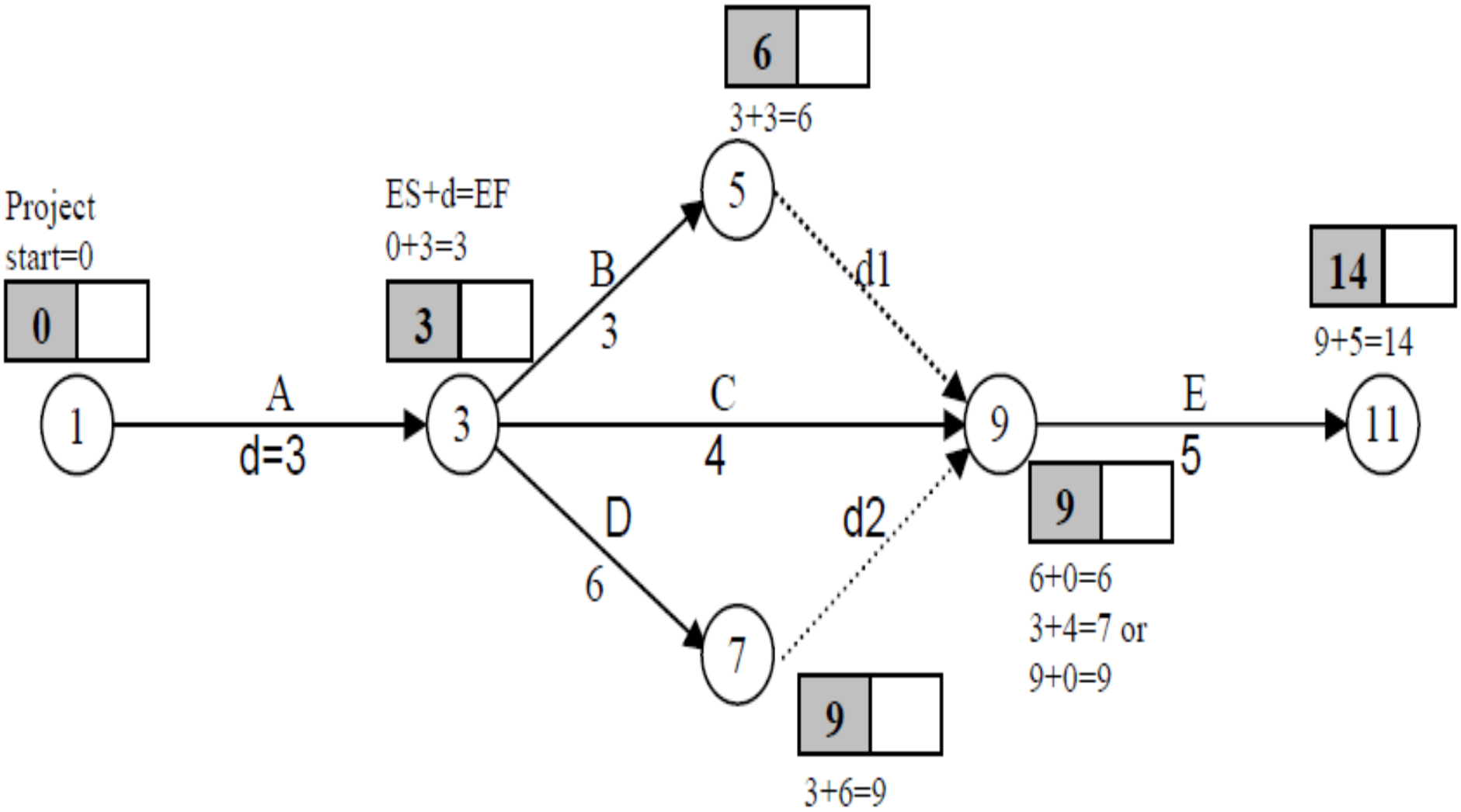


Figure 4: Forward path calculations in AOA networks

The Backward Path Calculation

- The backward path determines the late-finish (LF) times of activities by proceeding backward from the end node to the starting node of the AOA network.
- We put the LF value in the right side boxes adjacent to the nodes as shown in Figure 6.

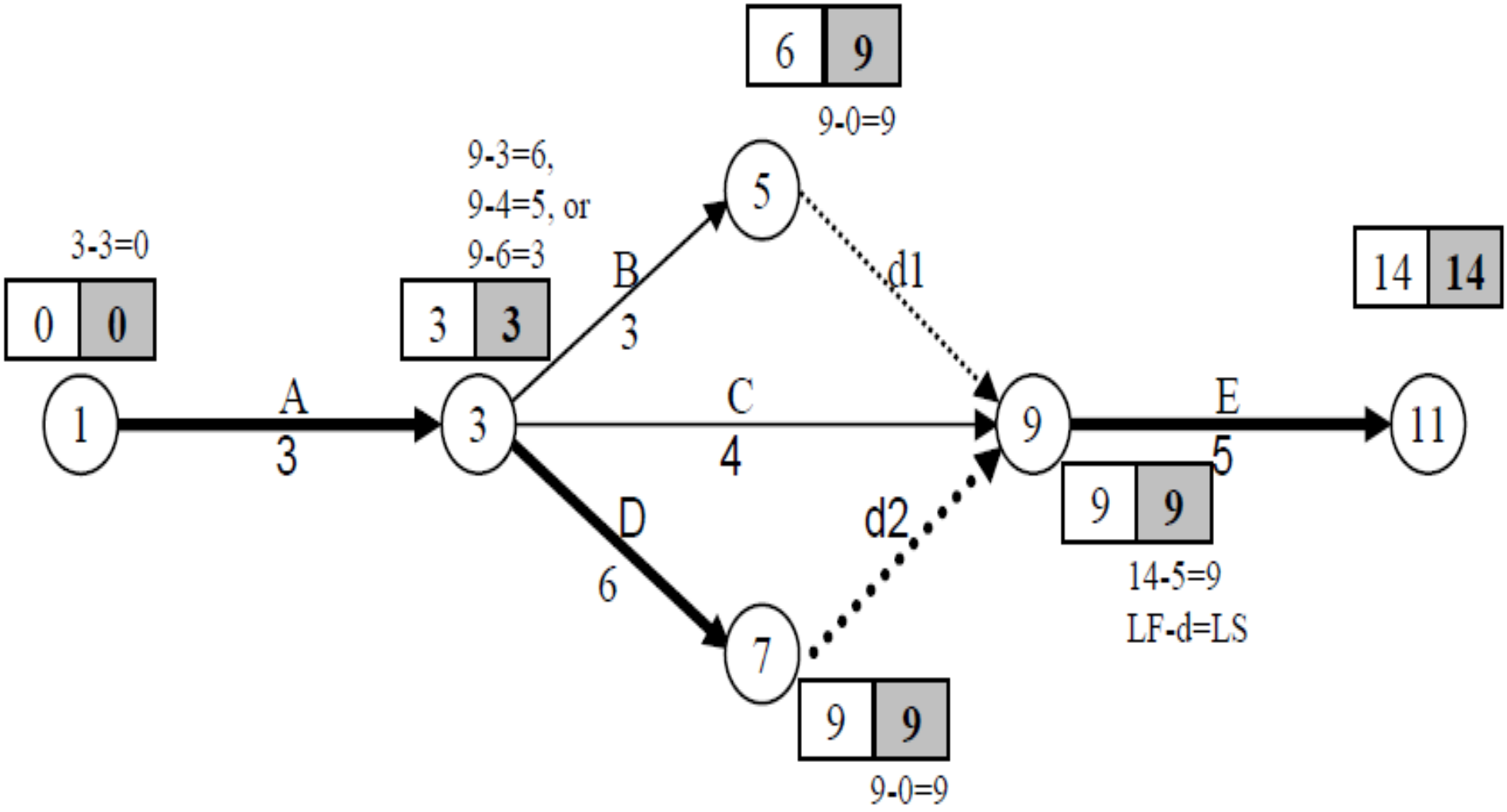


Figure 6: Backward path calculations in AOA networks

The detail Solution

- We begin at the last node of the network (node 11) and we transfer the early-finish value from the left box to be the late-finish (LF) value the right side box.
- Then move backward to node 9 which has only one tail arrow of activity E. with the LF time of being time= 14 then LS= LF-d= 14-5=9
- Moving backward to predecessor nodes 5 and 7 as node 5 has one tail arrow of the dummy activity d1 then LF= 9. similarly LF value of node 7= 9
- Moving to node 3, as LS time of its 3 successor activities B, C and D (6,5,3) as at node 3 is the smallest value with other LS values not used then LS= LF- d= 3-3

What is Float/Slack?

- **Float/Slack** is number of days that an activity, event, or lag can be delayed or extended without impacting the overall completion of the project
- **Total Float/Slack** : number of days that the duration of a specific activity can be increased without impacting the project completion

  Total slack= LF-ES-Duration
- **Free Float/Slack** : number of days that an activity can be delayed without taking float away from any other activity

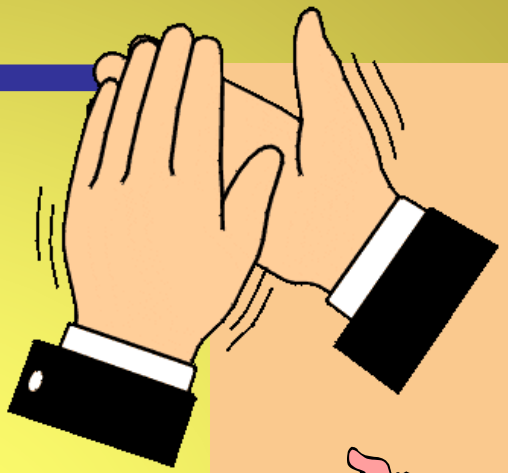
Free Slack= $ES_{successor}$- $ES_{predecessor}$-Duration

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, be proactive and negotiate with the project sponsor and stakeholders

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



End of Chapter 4

Thank You