

Chapter 6: Project Time Management

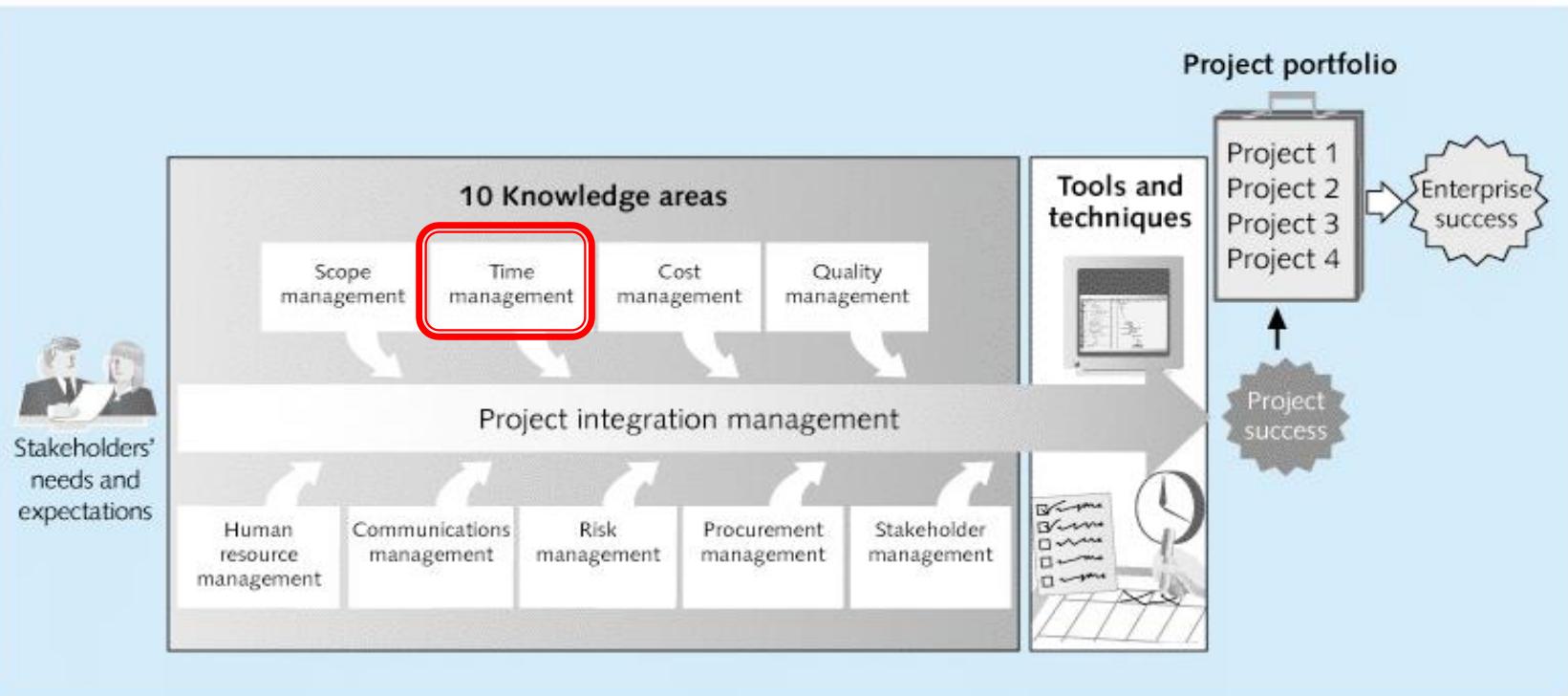
Information Technology Project
Management, Seventh Edition



Information Technology
PROJECT MANAGEMENT | 7e

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Learning Objectives

- ↳ The importance of project schedules and good project time management
- ↳ Discuss the process of planning schedule management
- ↳ Understand the relationship between estimating resources and project schedules
- ↳ Explain how various tools and techniques help project managers perform activity duration estimates

Learning Objectives

- ↑▼ Learning some methods for planning and tracking schedule information such as Gantt, PERT, Network Diagram,
- ↑▼ Describe how project management software can assist in project time management.

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

Project Time Management Processes

↑▼6.1. Planning schedule management:

determining the policies, procedures, and documentation that will be used for planning, executing, and controlling the project schedule

↑▼6.2. Defining activities: identifying the specific activities that the project team members and stakeholders must perform to produce the project deliverables

Project Time Management Processes

- ↳ ▼ **6.3. Sequencing activities:** identifying and documenting the relationships between project activities
- ↳ ▼ **6.4. Estimating activity resources:** estimating how many **resources** a project team should use to perform project activities
- ↳ ▼ **6.5. Estimating activity durations:** estimating the number of work periods that are needed to complete individual activities

Project Time Management Processes

- ↑▼ **6.6. Developing the schedule:** analyzing activity sequences, activity resource estimates, and activity duration estimates to create the project schedule
- ↑▼ **6.7. Controlling the schedule:** controlling and managing changes to the project schedule

Figure 6-1. Project Time Management Summary

Planning

Process: **Plan schedule management**

Outputs: Schedule management plan

Process: **Define activities**

Outputs: Activity list, activity attributes, milestone list, project management plan updates

Process: **Sequence activities**

Outputs: Project schedule network diagrams, project documents updates

Process: **Estimate activity resources**

Outputs: Activity resource requirements, resource breakdown structure, project documents updates

Process: **Estimate activity durations**

Outputs: Activity duration estimates, project documents updates

Process: **Develop schedule**

Outputs: Schedule baseline, project schedule, schedule data, project calendars, project management plan updates, project documents updates

Monitoring and Controlling

Process: **Control schedule**

Outputs: Work performance information, schedule forecasts, change requests, project management plan updates, project documents updates, organizational process assets updates

Project Start

Project Finish

6.1. Planning Schedule Management

- ↑▼ The project team uses expert judgment, analytical techniques, and meetings to develop the schedule management plan
- ↑▼ A schedule management plan includes:
 - Project schedule model development
 - The scheduling methodology
 - Level of accuracy and units of measure
 - Rules of performance measurement
 - Reporting formats
 - Process descriptions

6.2.Defining Activities

- ↑▼ An **activity** or **task** is an element of work normally found on the work breakdown structure (WBS) that has an expected duration, a cost, and resource requirements
- ↑▼ 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

- an activity identifier or number
- the activity name
- 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 a date or time associated with it.
- ↑▼ It can be a key document or completion of specific products.
- ↑▼ It can also be a point in time when work to
- ↑▼ To start work on a project.
- ↑▼ End of a project.

6.3. Sequencing Activities

- ↑▼ 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

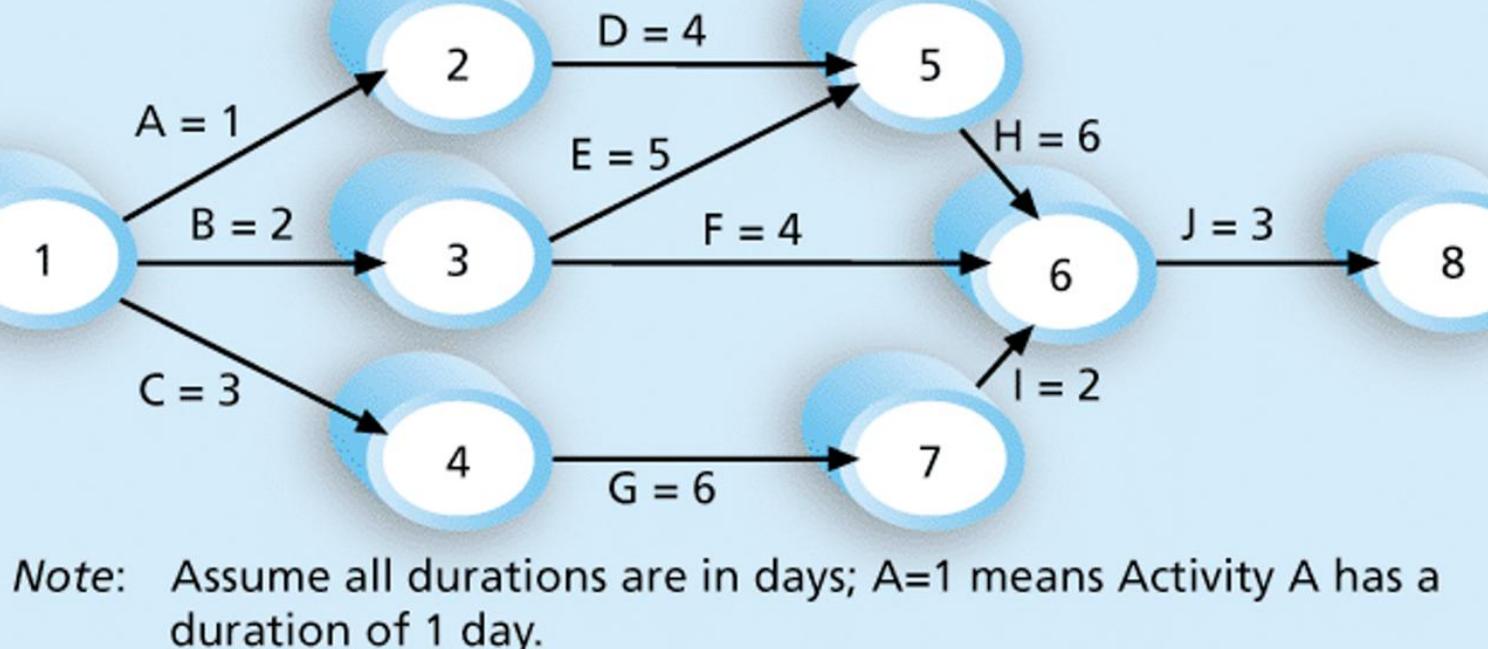
Three types of Dependencies

- ↑▼ **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 non-project activities
- ↑▼ The tools are used to define the type of dependencies: **network diagrams** and **critical path analysis.**

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:
 - the **arrow** diagramming method - ADM
 - and **precedence** diagramming method - PDM

Figure 6-2. Network Diagram 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
 - **Starting Value < ending value**
- ↳ Can only show finish-to-start dependencies

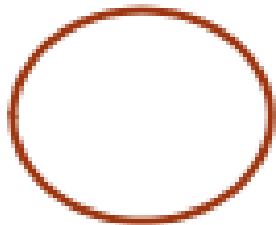
Process for Creating AOA Diagrams



↑▼Activity or Task



↑▼Virtual Activity (relationship)

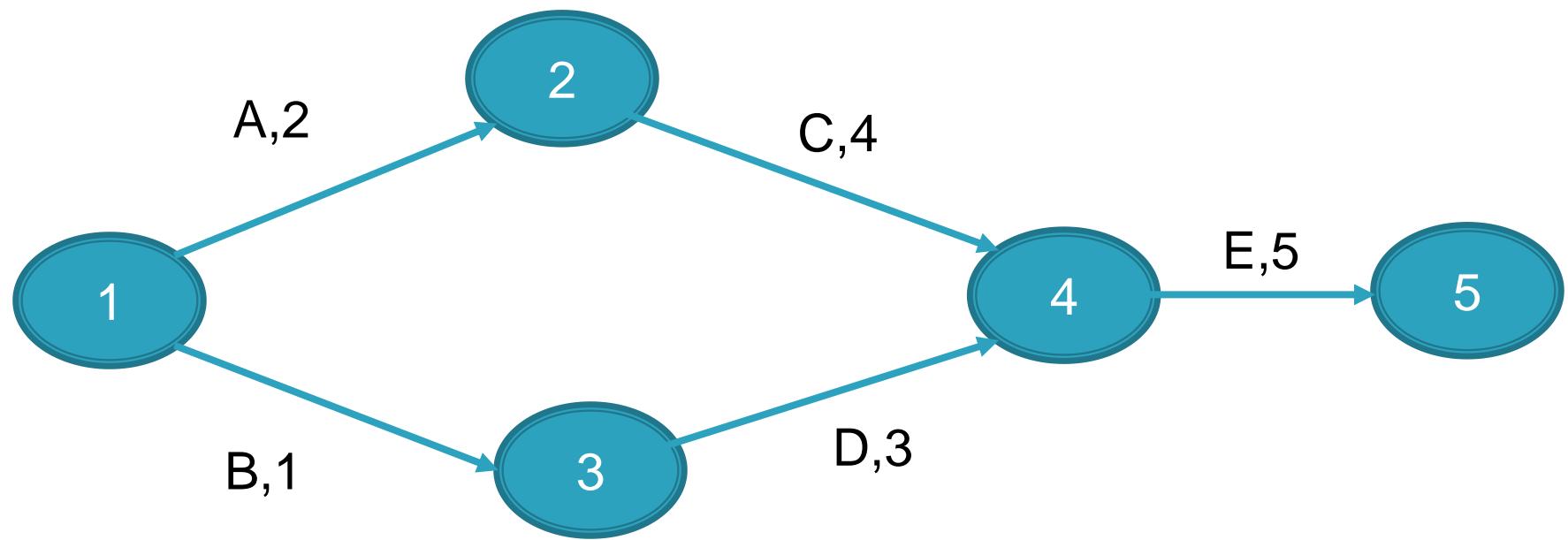


↑▼The starting and ending points of activities

Process for Creating AOA Diagrams

No	Task	Predecessors	Duration
1	A	-	2
2	B	-	1
3	C	A	3
4	D	B	4
5	E	C,D	5

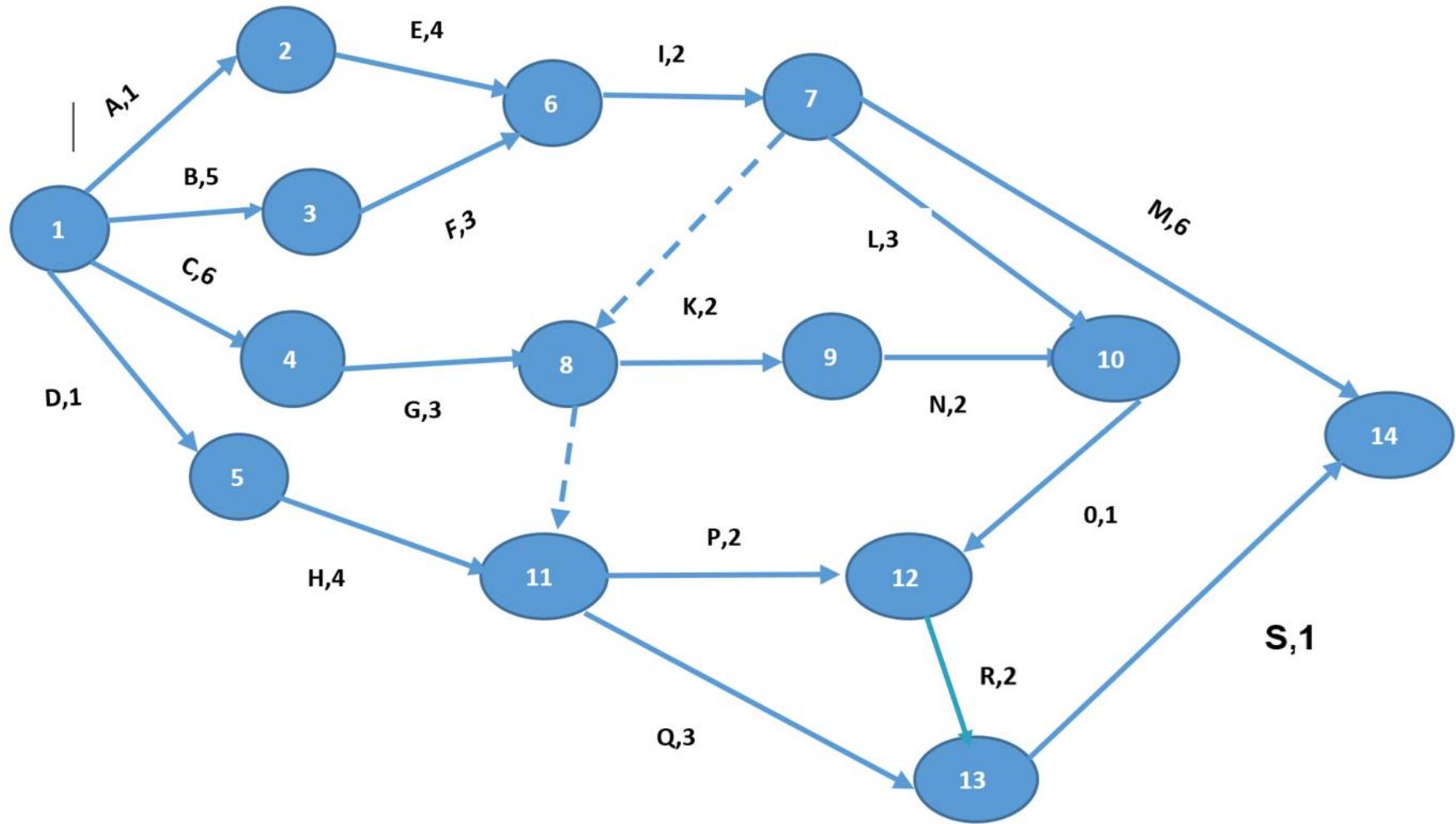
Process for Creating AOA Diagrams



Excercise

Task	Pre	Duration
A		1
B		5
C		6
D		4
E	A	4
F	B	3
G	C	3
H	D	4
I	E, F	2

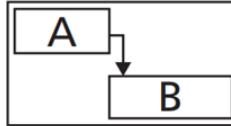
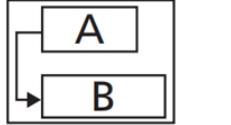
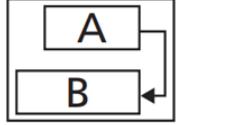
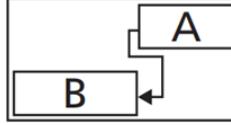
Task	Pre	Duration
K	G,I	2
M	I	6
L	I	3
N	K	2
O	L,N	1
P	G,I,H	2
Q	G,I,H	3
R	O,P	2
S	R,Q	1



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 dependency	Example	Description
Finish-to-start (FS)	 A diagram showing two rectangular boxes labeled 'A' and 'B'. Box A is positioned above box B. A vertical arrow points from the bottom of box A down to the top of box B, indicating that task B cannot start until task A has finished.	Task (B) cannot start until task (A) finishes.
Start-to-start (SS)	 A diagram showing two rectangular boxes labeled 'A' and 'B'. Both boxes have arrows pointing to their left edges, indicating they start at the same time.	Task (B) cannot start until task (A) starts.
Finish-to-finish (FF)	 A diagram showing two rectangular boxes labeled 'A' and 'B'. Box A is positioned above box B. A vertical arrow points from the bottom of box A down to the bottom of box B, indicating that task B cannot finish until task A has finished.	Task (B) cannot finish until task (A) finishes.
Start-to-finish (SF)	 A diagram showing two rectangular boxes labeled 'A' and 'B'. Box B is positioned below box A. A vertical arrow points from the top of box B up to the top of box A, indicating that task B cannot finish until task A has started.	Task (B) cannot finish until task (A) starts.

Task Dependency Types



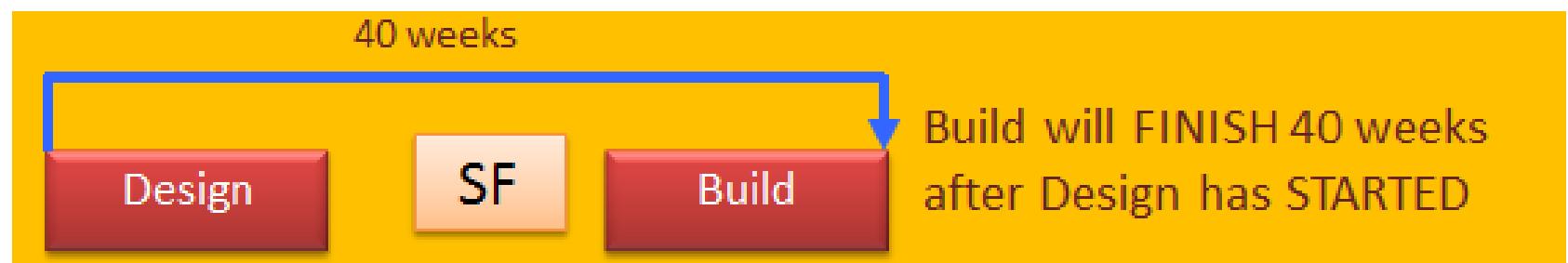
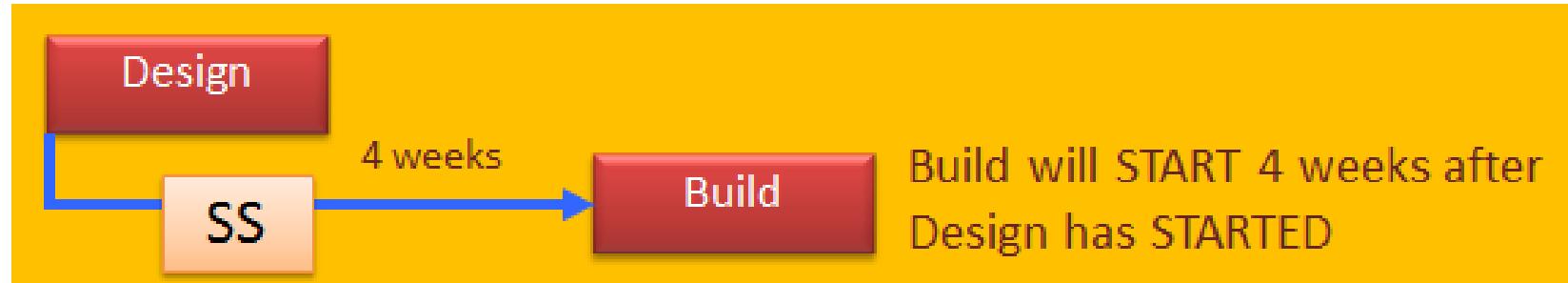
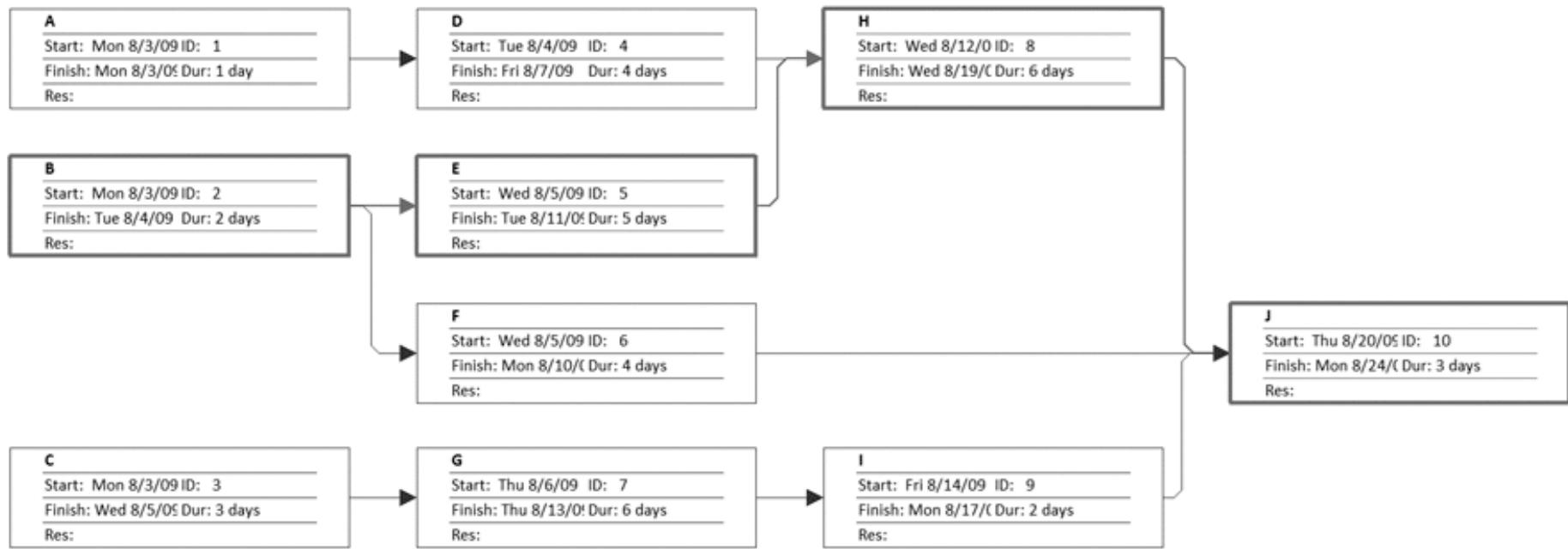


Figure 6-4. Sample PDM Network Diagram



6.4. Estimating Activity Resources

- ↑▼ Before estimating activity durations, you must have a good idea of the quantity and type of resources that will be assigned to each activity; **resources** are people, equipment, and materials (Later)
- ↑▼ A **resource breakdown structure** is a hierarchical structure that identifies the project's resources by category and type

6.5.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
- ↑▼ Estimating methods (time and cost)
 - People doing the work should help create estimates, and an expert should review them
 - Three - point estimates
 - PERT Estimates

Three-Point Estimates

↑▼ Three-point estimate

- O = Optimistic estimate
- M = Most likely estimate
- P = Pessimistic estimate.
- $E = \text{Expected amount of time or cost}$,

$$E = (O + M + P) / 3$$

↑▼ Example: the activity

- O=3 weeks
- M=4 weeks → Time $E = (O + M + P) / 3 = 4$ weeks
- P=5 weeks

PERT Estimates

$$E = (O + 4*M + P) / 6$$

↑▼ Example: the activity

- O=3 weeks
- M=4 weeks
- P=5 weeks



$$E = (O + 4*M + P) / 6 = 4 \text{ weeks}$$

6.6.Developing the Schedule

- ↑▼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,
 - 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:

- A black diamond: a milestones
- Thick black bars: summary tasks
- Lighter horizontal bars: durations of tasks
- Arrows: dependencies between tasks

Figure 6-5. Gantt Chart for Project X

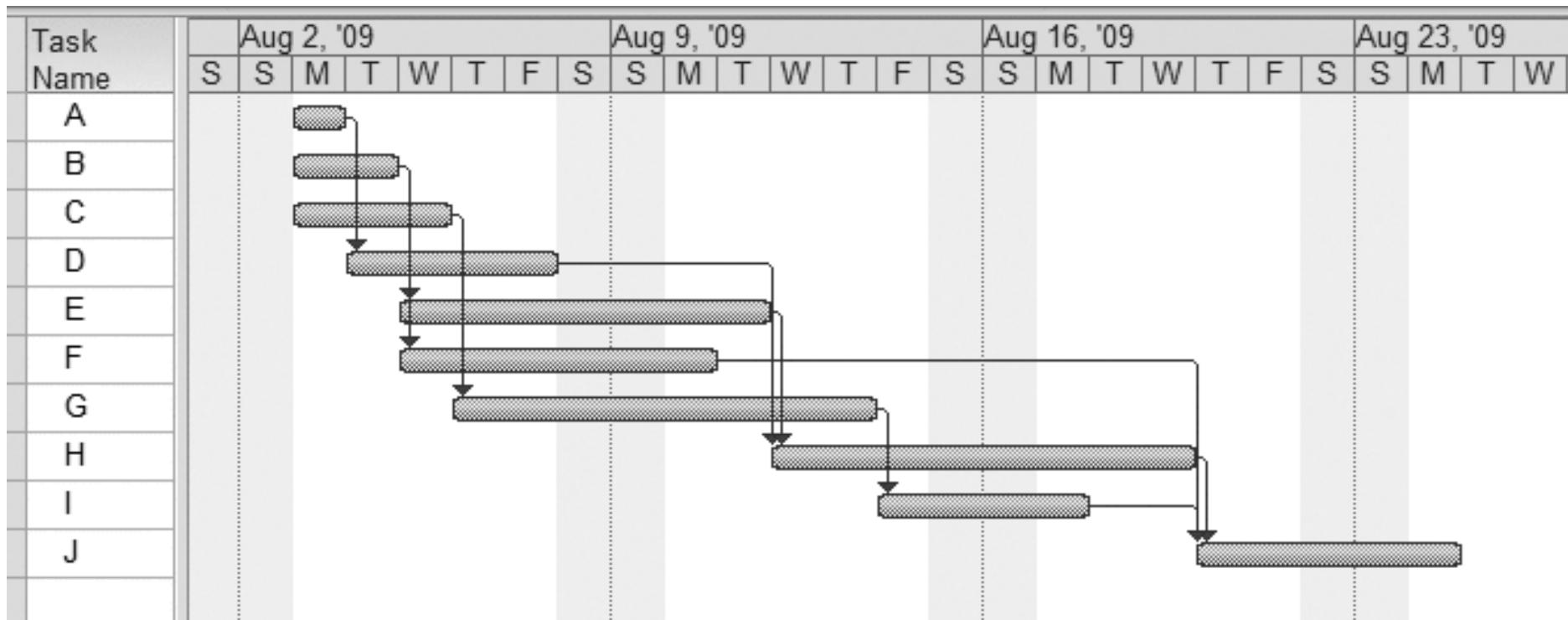
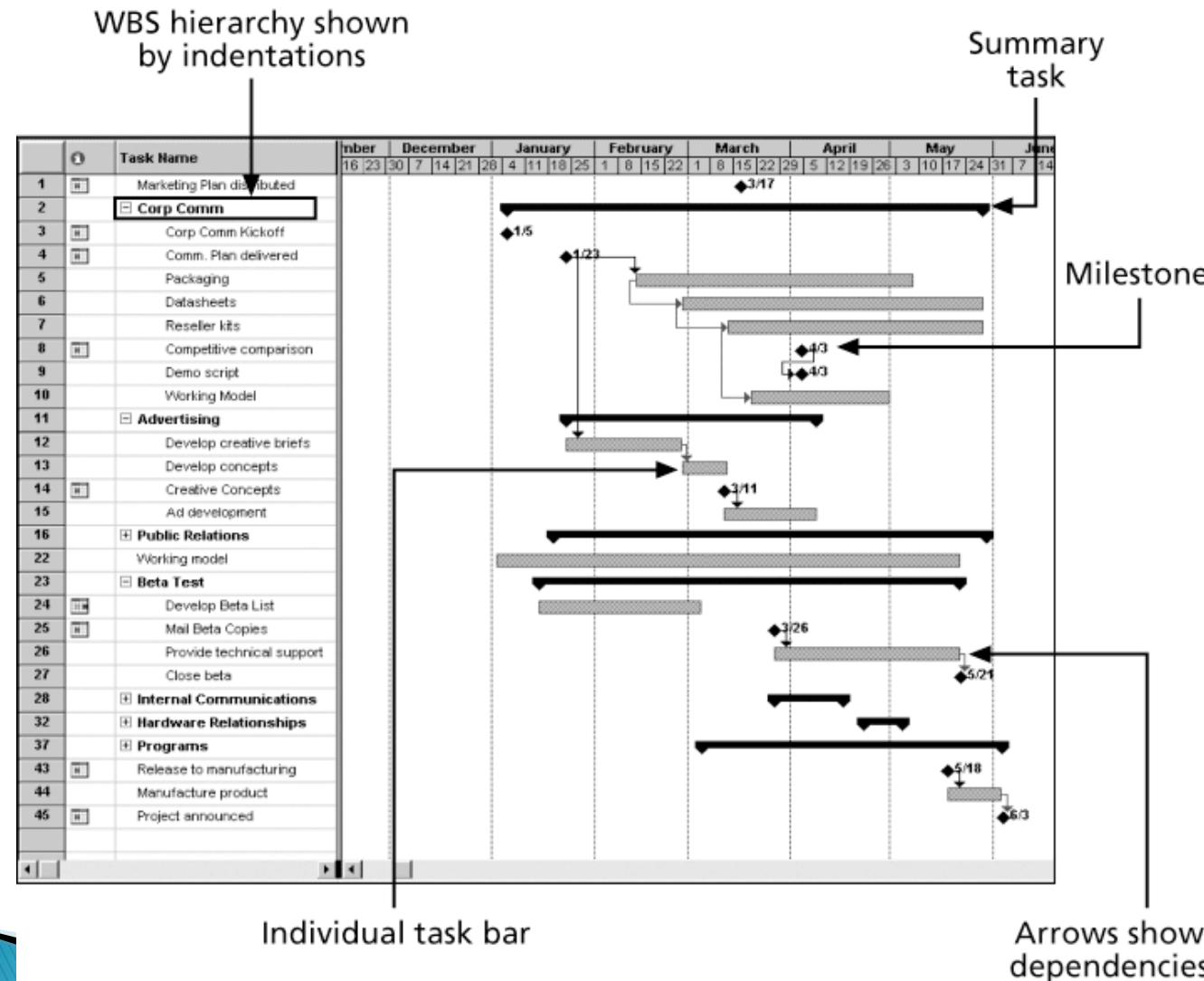


Figure 6-6. Gantt Chart for Software Launch Project



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

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

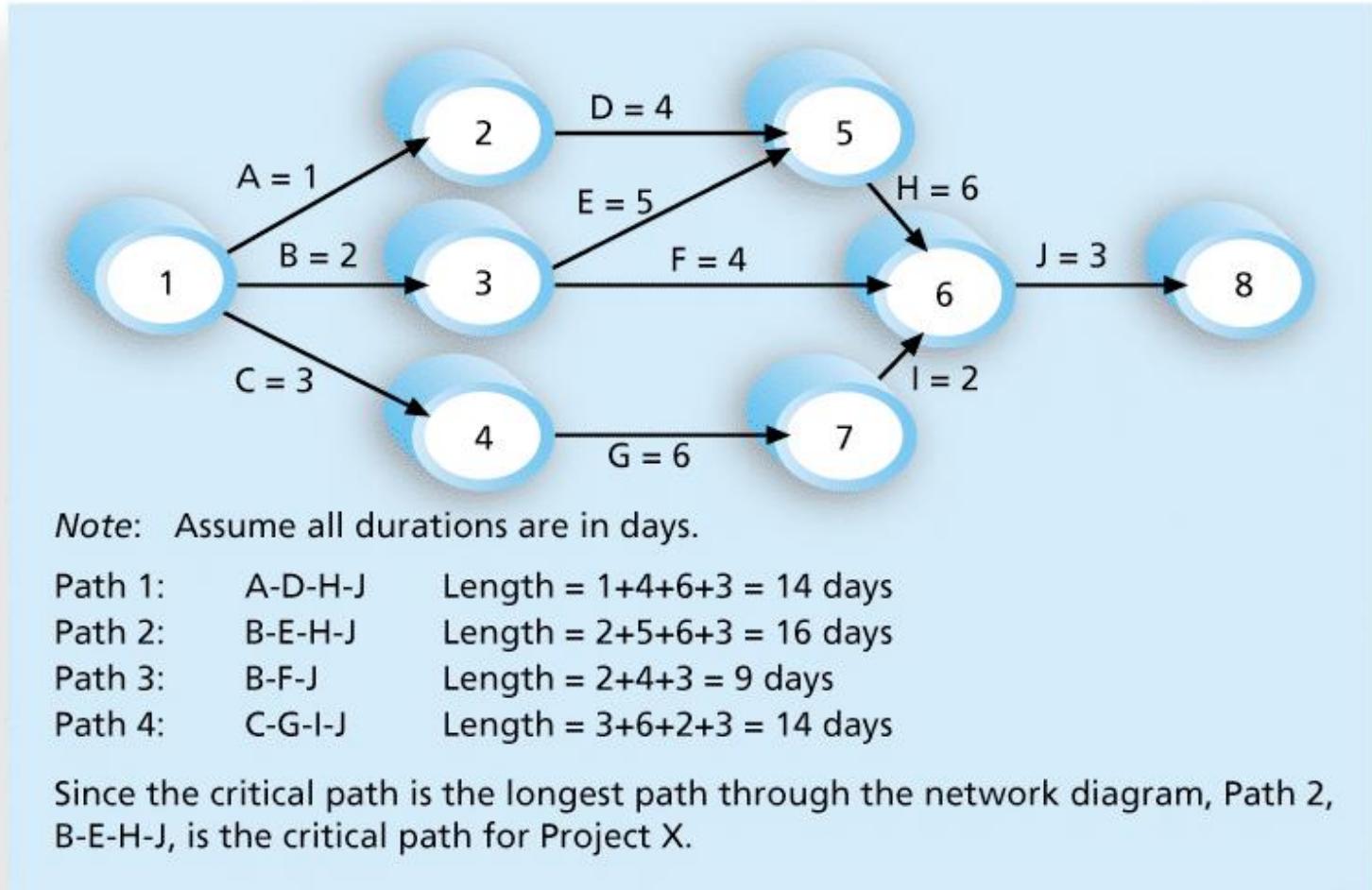
Calculating the Critical Path

- ↑▼ **Slack or float** is the amount of time an activity may be delayed without delaying a succeeding activity or the project finish date
- ↑▼ Develop a good network diagram (ADM or PDM)
- ↑▼ Add the duration estimates for all activities on each path through the network diagram
- ↑▼ The ***longest path*** is the ***critical path***

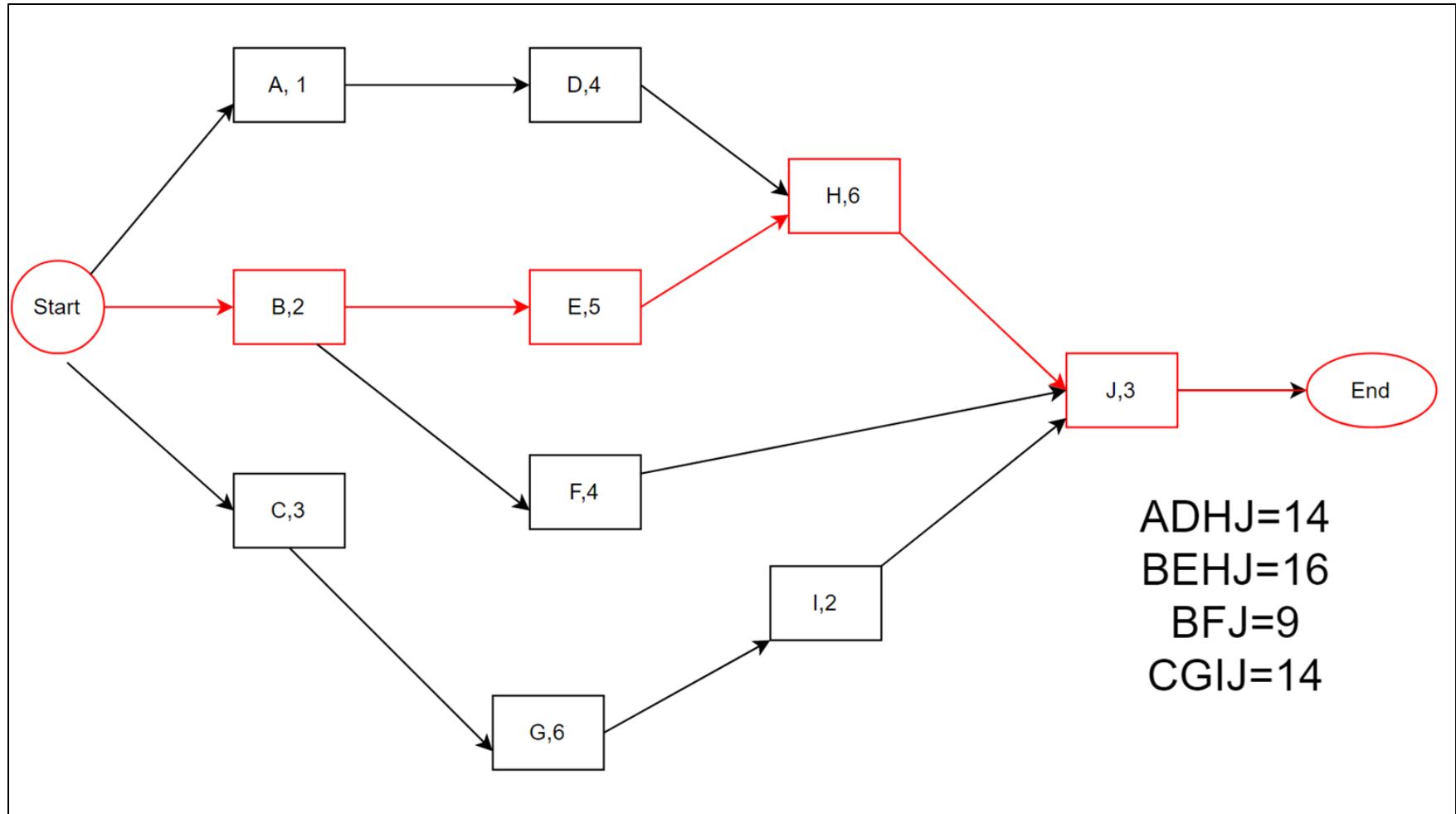
Determining the Critical Path for Project X

No	Task	Pre-Activities	Duration
1	A	-	1
2	B	-	2
3	C	-	3
4	D	A	4
5	E	B	5
6	F	B	4
7	G	C	6
8	H	D,E	6
9	I	G	2
10	J	H,F,I	3

ADM

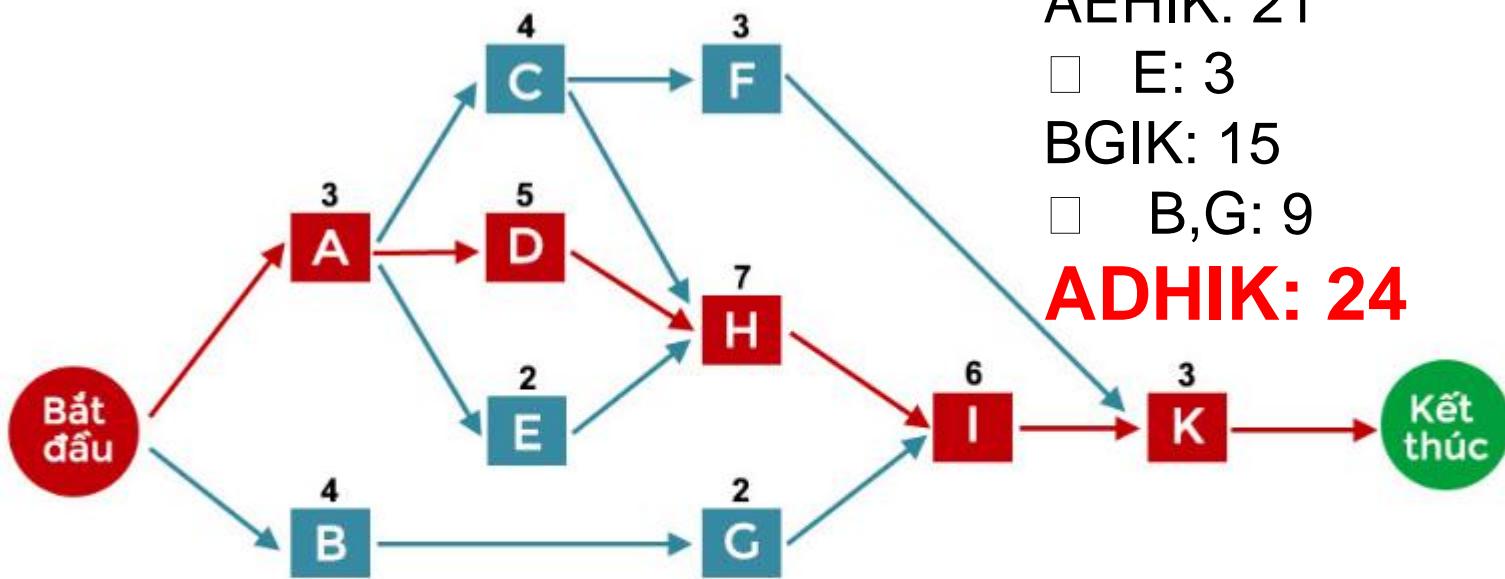


PDM



Ex 1:

No	Task	Pre-Tasks	Duration
1	A	-	3
2	B	-	4
3	C	A	4
4	D	A	5
5	E	A	2
6	F	C	3
7	G	B	2
8	H	C,D,E	7
9	I	H,G	6
10	K	F,I	3



Chữ cái: Các công việc

Chữ số: Số ngày thực hiện công việc

Critical path = 24 ngày



ACFK: 13

□ C,F: 11

AEHIK: 21

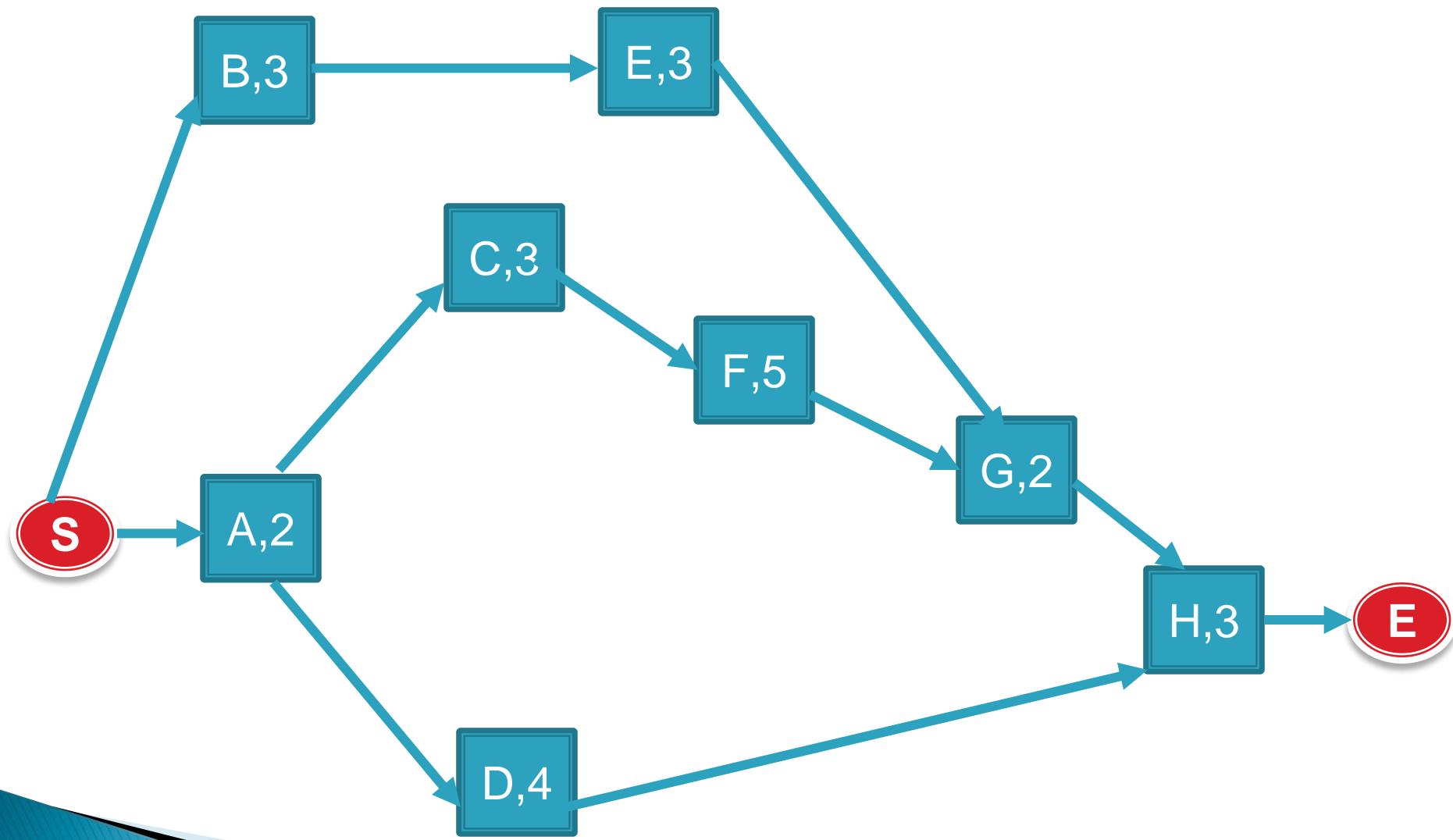
□ E: 3

BGIK: 15

□ B,G: 9

Ex 2

No	Task	Pre-Tasks	Duration
1	A	-	2
2	B	-	3
3	C	A	3
4	D	A	4
5	E	B	3
6	F	C	5
7	G	E, F	2
8	H	D, G	3



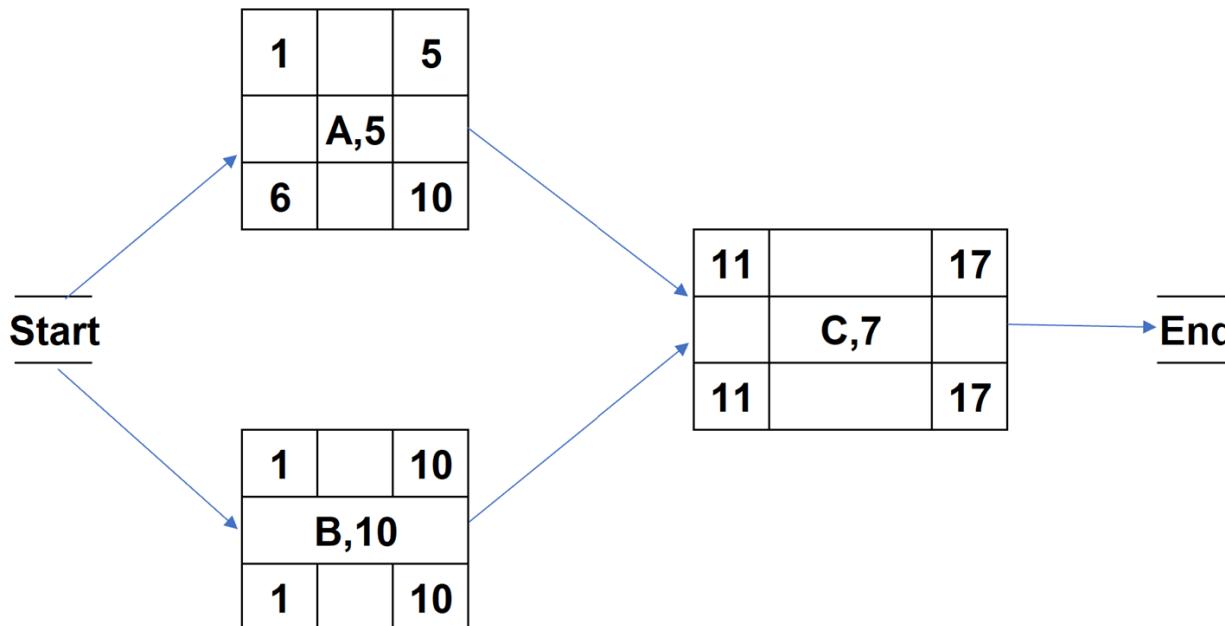
Using Critical Path Analysis to Make Schedule Trade-offs

- ↑▼ **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

Calculating Early and Late Start and Finish Dates

ES = early start
EF = early finish
LS = late start
LF = late finish

ES		EF
Name, Dur		
LS		LF



Formular to calculate ES, EF, LS, LF

↑▼ A forward pass: **ES, EF**

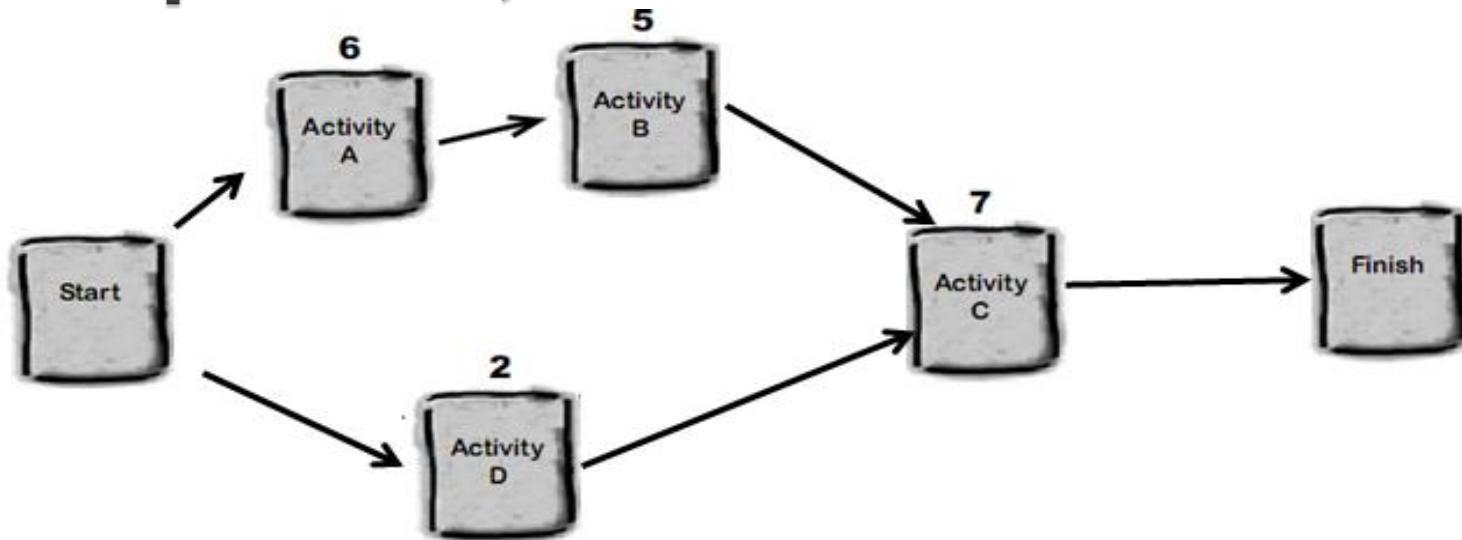
↑▼ The First Activity:

- **ES=1**
- **EF= ES + duration -1**

↑▼ The Next Activity

- **ES=EF (previous Activity) +1**
- **EF= ES + duration -1**

Example: ES, EF at the first Activity

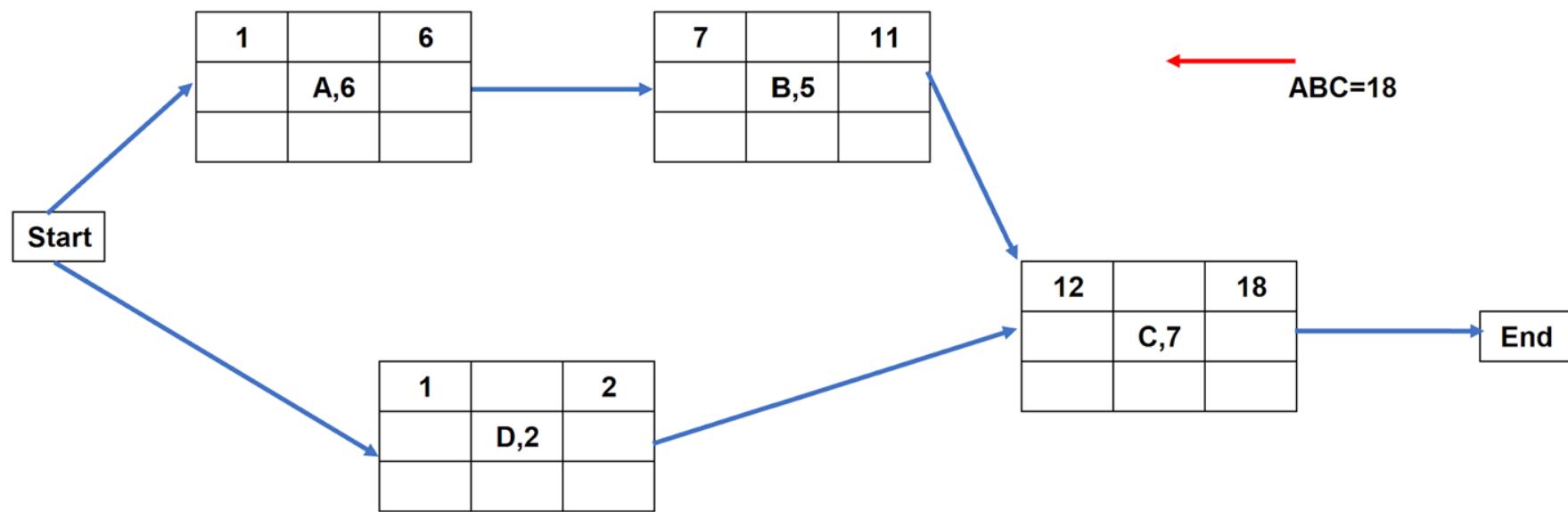
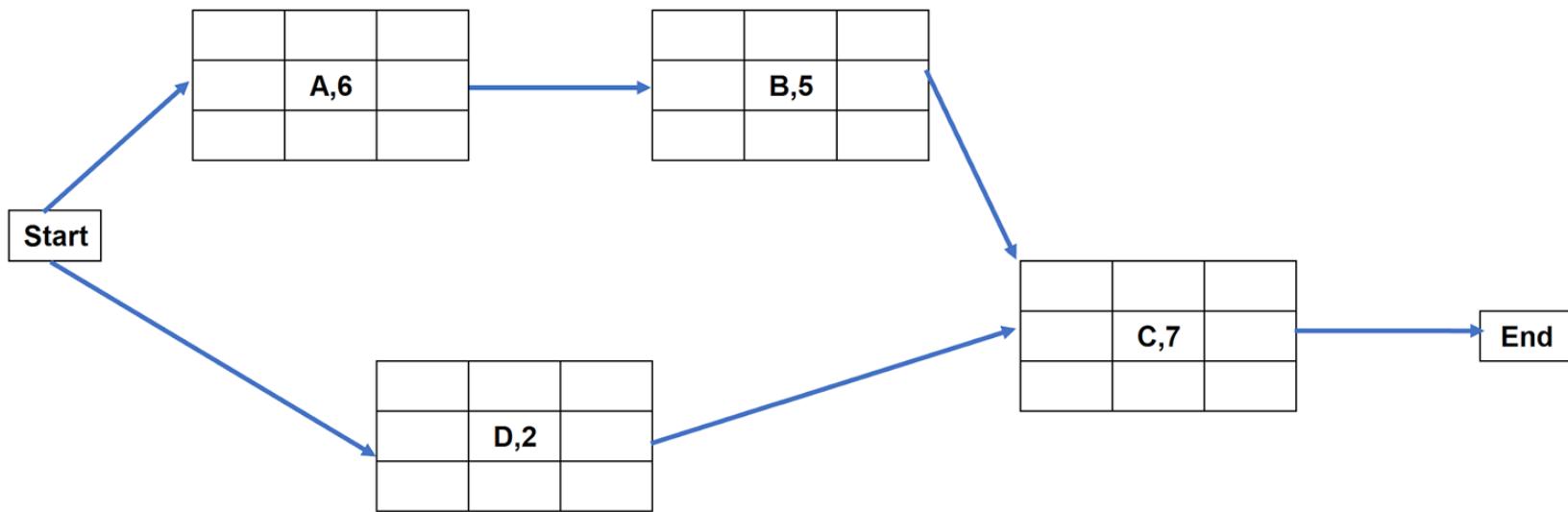


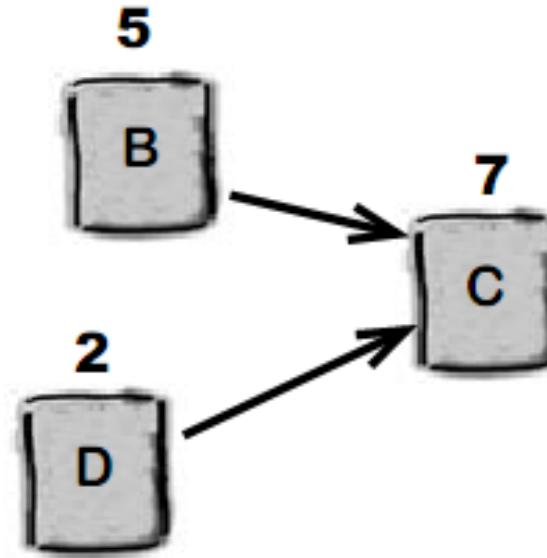
$$\uparrow \downarrow CP = ABC = 6+5+7 = 18$$

$$\uparrow \downarrow \text{Activity A (1st)} : ES = 1, EF = 1 + 6 - 1 = 6$$

$$\uparrow \downarrow \text{Activity D (1st)} : ES = 1, EF = 1 + 2 - 1 = 2$$

$$\uparrow \downarrow \text{Activity B (previous A)} : ES = EF_{(A)} + 1 = 6+1=7, EF=7+5-1=11$$





Activity C (previous B and D)

At B: ES = 7, EF = 11

At D: ES = 1, EF = 2

EF_(B) = 11 > EF_(D) = 2 □ choose EF_(B)

At C: ES = 11 + 1 = 12, EF = 12 + 7 - 1 = 18

Formular to calculate ES, EF, LS, LF

↑▼ A backward pass: LS, LF

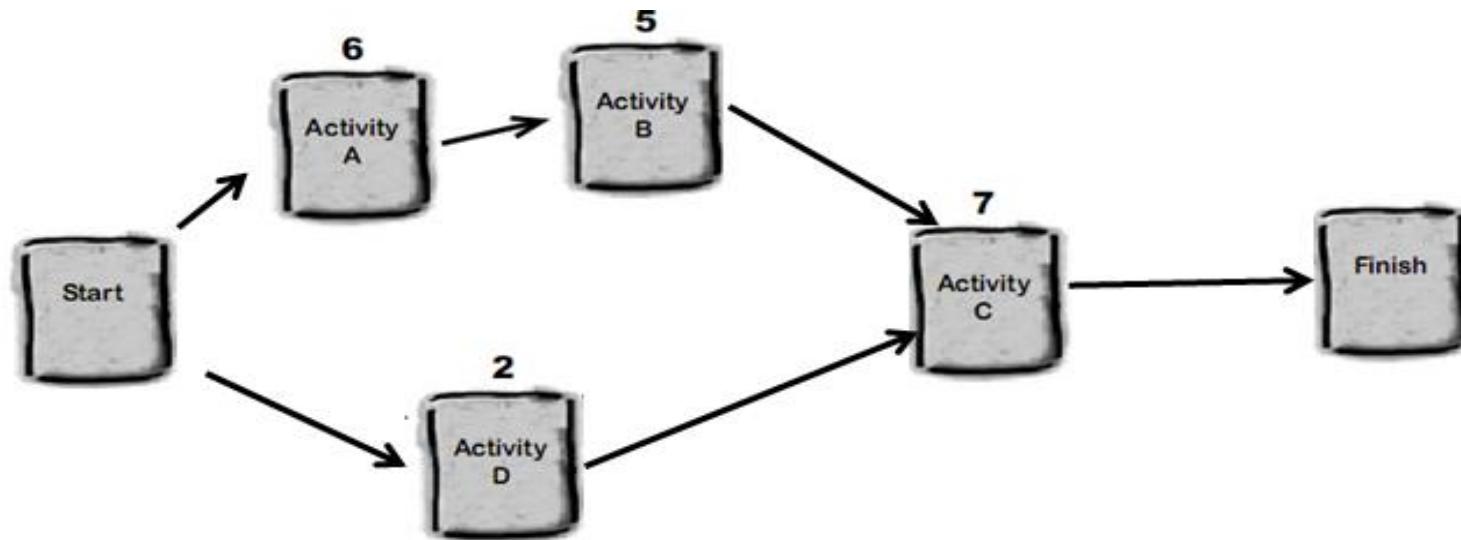
↑▼ The Last Activity:

- **LF = EF = Total Duration (CP)**
- **LS = LF - duration + 1**

↑▼ The Previous Activity

- **LF = LS (next Activity) – 1**
- **LS = LF - duration + 1**

Example: LF, LS at last activity



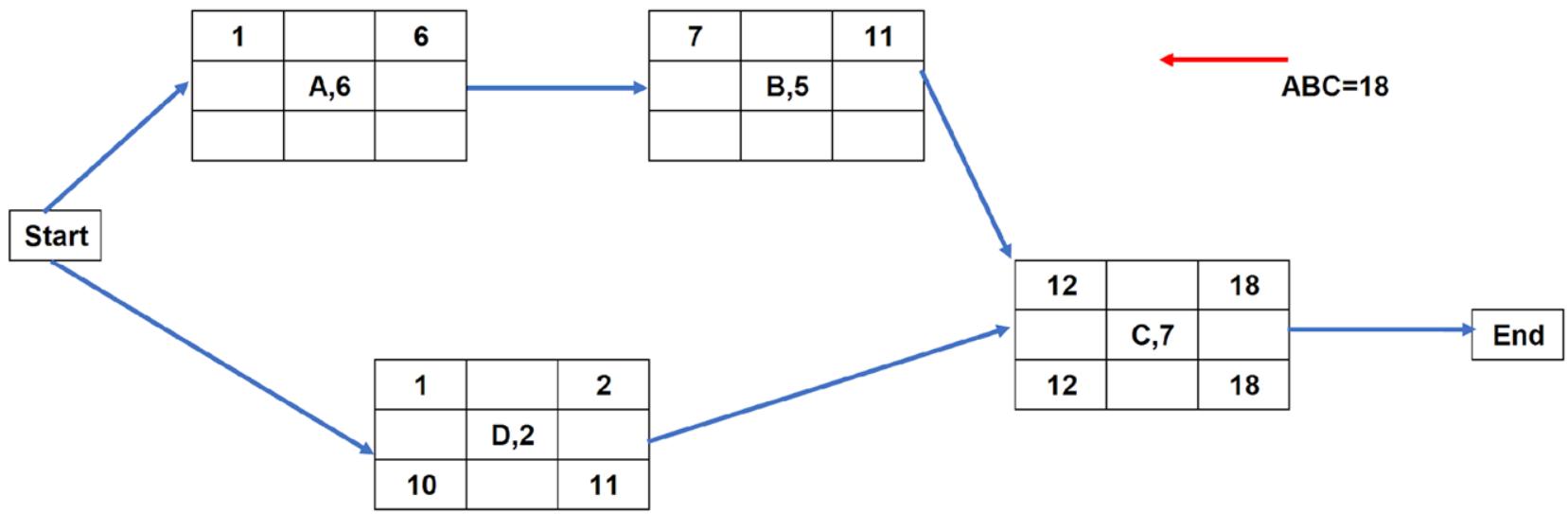
$$\text{CP} = \text{ABC} = 6+5+7 = 18$$

Activity C (last) : LF = EF = CP = 18, LS = 18-7+1=12

Activity B(next C): LF= 12-1=11, LS = 11-5+1=7

Activity D(next C): LF= 12-1=11, LS = 11-2+1=10

Activity A(next B): LF=7-1=6, LS=6-6+1=1



Calculating the Total Slack or Total Float

↑▼ First Method

Total float = duration of CP – duration of the non-CP

↑▼ Second Method:

Activities **are not** the critical path

- Total float = LF – EF = LS – ES

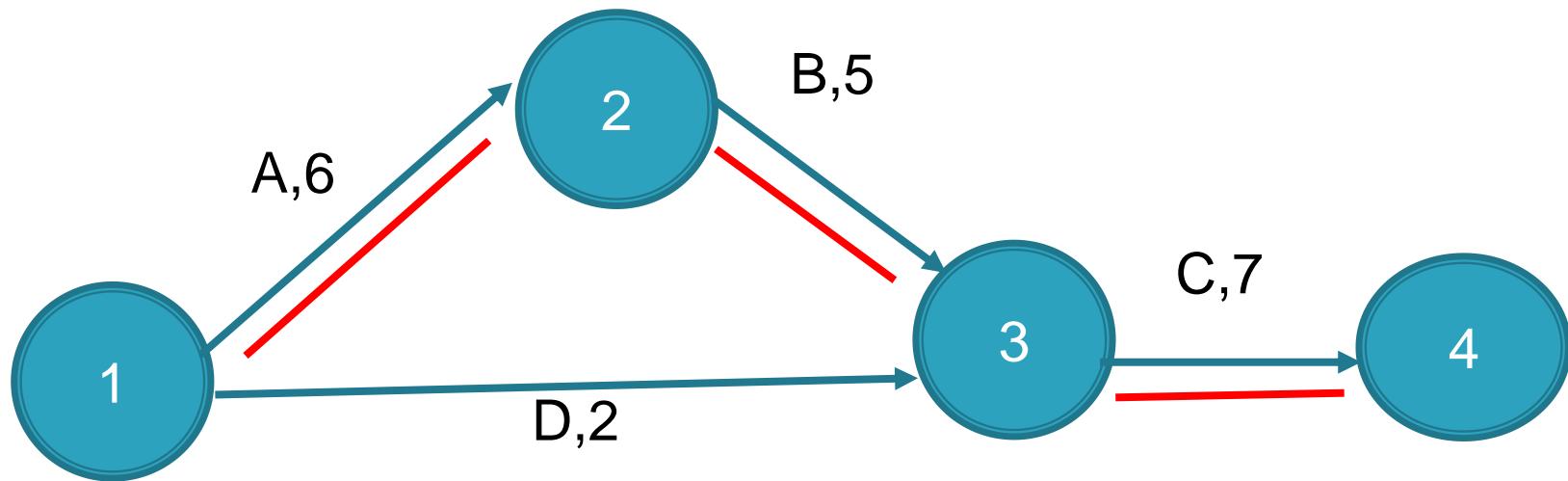
Calculating Free Slack or Free Float

- ↑▼ All activities are on the critical path, free float = 0
- ↑▼ The activities are not on the critical path which have a free float.

$$\text{Free float}_{\text{Activity}} = \text{ES}_{\text{next activity}} - \text{EF}_{\text{Activity}} - 1$$

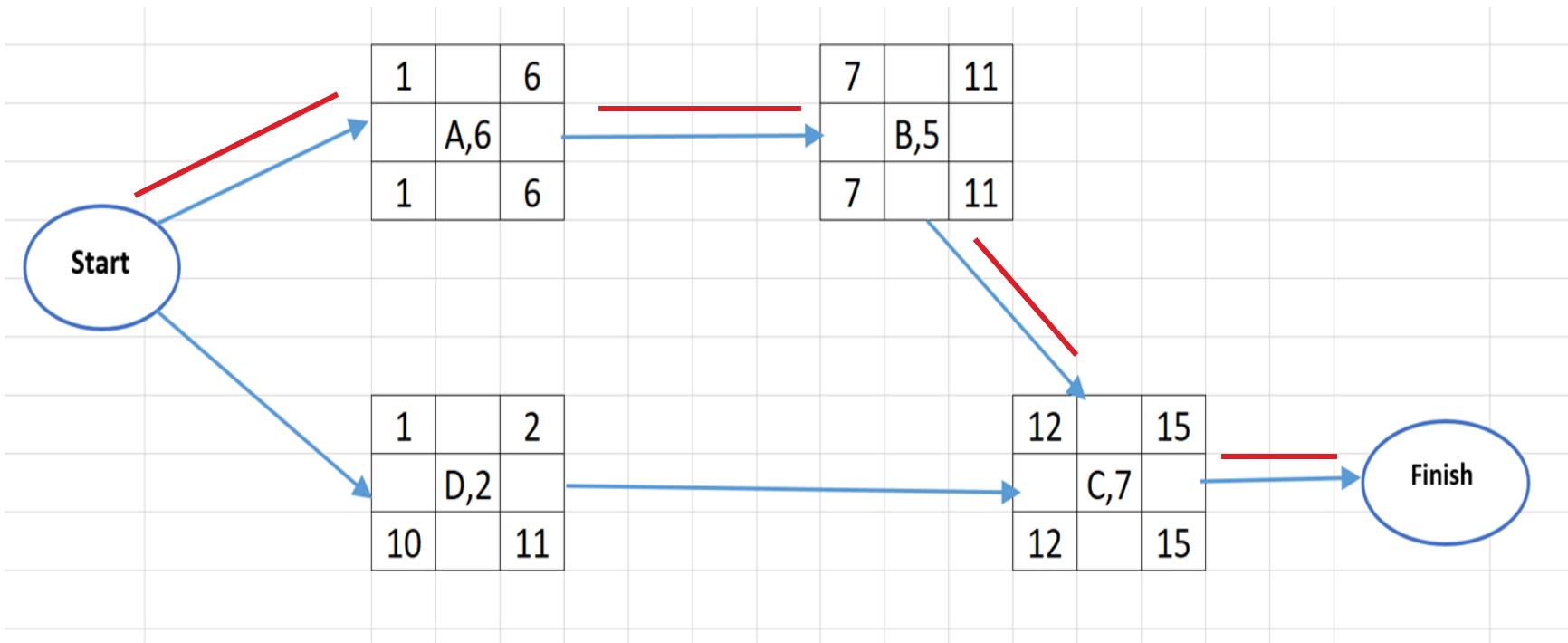
Example:

Task	Duration	Pre
A	6	-
B	5	A
C	7	B,D
D	2	-



$A - B - C = 6+5+7 = 18$: critical path

$D - C = 2+7 = 9$: non critical path



Task	Duration	Pre	ES	EF	LS	LF	Total Float	Float
A	6	-	1	6	1	6	0	0
B	5	A	7	11	7	11	0	0
C	7	B,D	12	18	12	18	0	0
D	2	-	1	2	10	11	9	9

Example: ES,EF,LS,LF

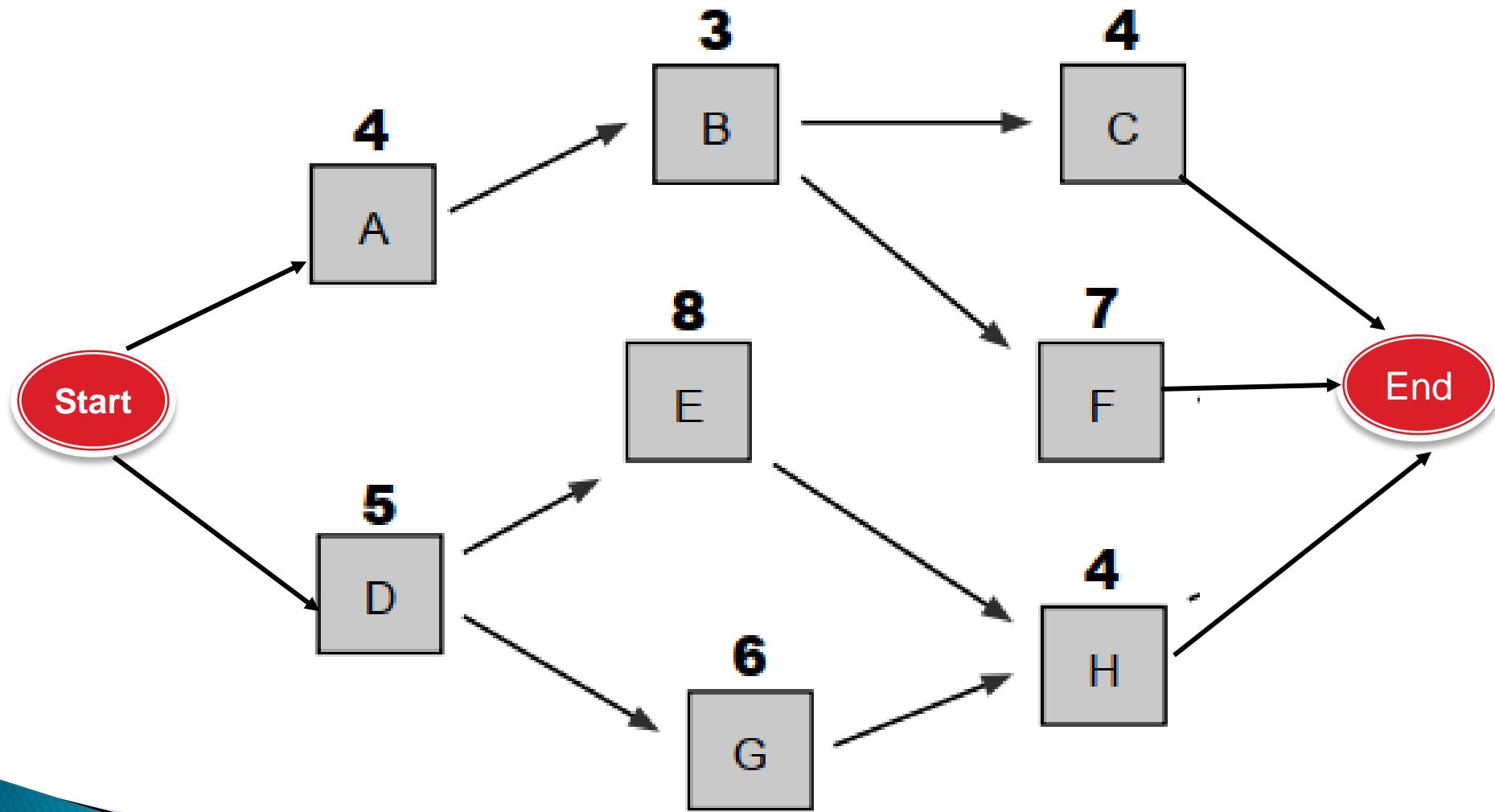
No	Task	Pre	Dur
1	A	-	5
2	B	A	10
3	C	A	2
4	D	B,C	5

No	Task	Pre	Dur	ES	EF	LS	LF
1	A	-	5	1	5	1	5
2	B	A	10	6	15	6	15
3	C	A	2	6	7	14	15
4	D	B,C	5	16	20	16	20

No	Task	Pre	Dur
1	A	-	10
2	B	A,D	12
3	C	B	9
4	D	-	5
5	E	D,G	7
6	F	E	6
7	G	-	3

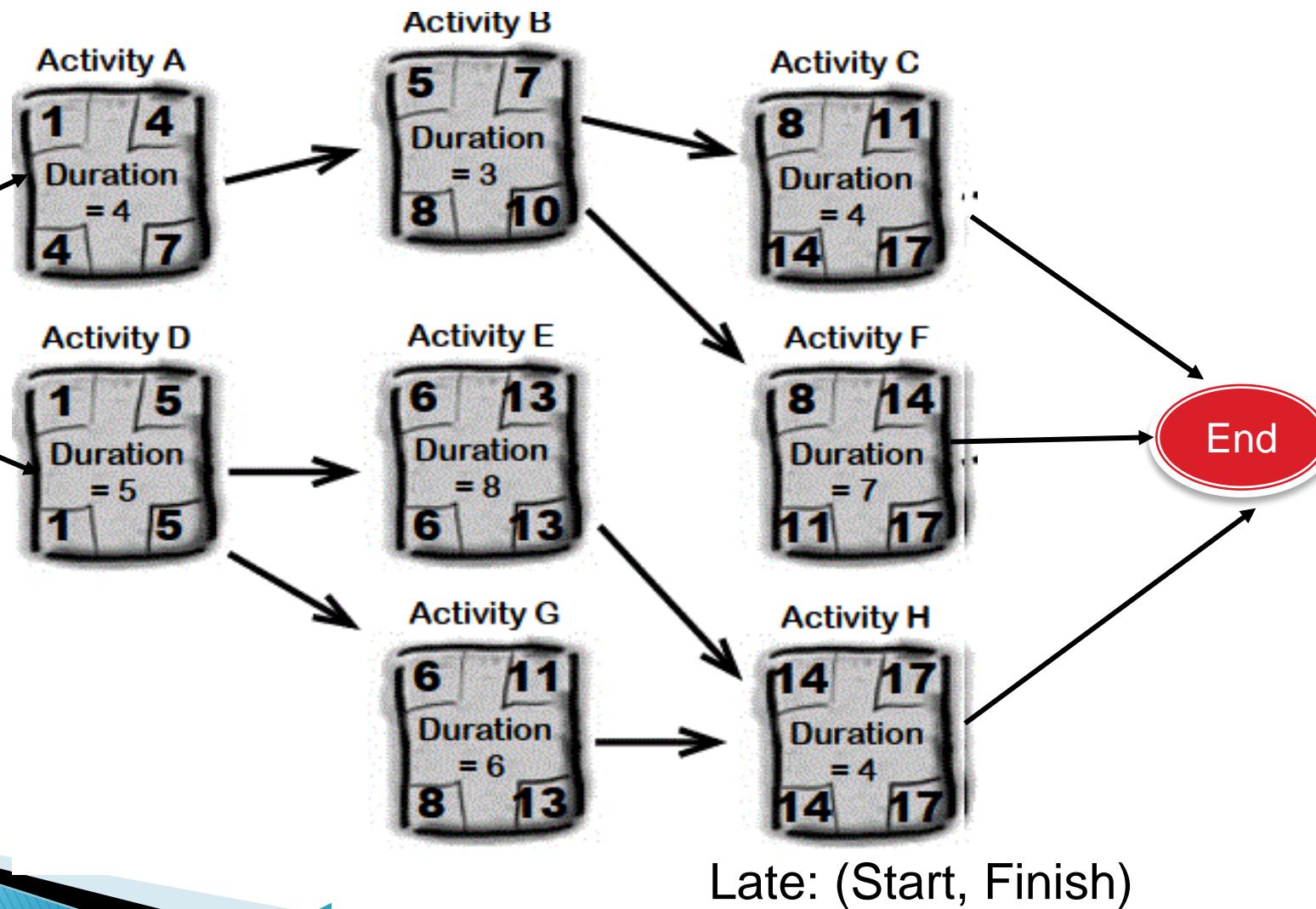
No	Task	Pre	Dur	ES	EF	LS	LF
1	A	-	10	1	10	1	10
2	B	A,D	12	11	22	11	22
3	C	B,C	9	23	31	23	31
4	D	-	5	1	5	6	10
5	E	D,G	7	6	12	19	25
6	F	E	6	13	18	26	31
7	G	-	3	1	3	16	18

Practice 1:



Solution

Early: (Start, Finish)



Practice 2: Calculate ES, EF, LS, LF

No	Task	Pre Tasks	Duration	ES	EF	LS	LF	Float
1	A		5					
2	B		6					
3	C	A	4					
4	D	A	5					
5	E	B,D	5					
6	F	C	10					
7	G	E, F, A	4					
8	H	G	5					

6.7. Controlling the Schedule

- ↑▼ 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

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
 - Plan schedule management
 - Define activities
 - Sequence activities
 - Estimate activity resources
 - Estimate activity durations
 - Develop schedule
 - Control schedule

Exercises: ES, EF, LS, LF ? ->Float

Ex1:

CP=73

No	Task	Duration	Pre - Task
1	A	10	-
2	B	8	A
3	C	12	A
4	D	15	A
5	E	21	B,C
6	F	12	D
7	G	8	D
8	H	6	E,F,G
9	I	9	H
10	K	15	I,E

↑▼Ex 2

↑▼CP=13

8

No	Task	Duration	Pre - Task
1	A	15	-
2	B	22	-
3	C	11	A,B
4	D	31	A
5	E	12	C
6	F	34	C
7	G	22	E,F,H
8	H	24	D
9	I	16	D,H
10	K	21	H,I,G
11	L	25	K
12	M	1	K,G

Float Time=LS-ES = LF-EF

	ES	EF	LS	LF	Float
B	1	22	4	25	3
C	23	33	26	36	3
E	34	45	59	70	25
F	34	67	37	70	3
I	71	86	77	92	6
M	114	114	138	138	24

↑▼Ex 3

↑▼CP:13

2

No	Task	Duration	Pre - Task
1	A	10	-
2	B	13	A
3	C	21	B
4	D	22	B
5	E	15	A
6	F	31	E
7	G	18	E
8	H	15	C,E,F,G
9	I	22	H
10	J	24	H
11	K	17	J
12	L	20	K,G

↑▼Ex 4

No	Task	Duration	Pre - Task
1	A	10	-
2	B	13	A
3	C	21	A
4	D	22	B
5	E	15	B,C,D
6	F	31	E
7	G	18	E
8	I	22	E
9	J	24	D
10	K	17	F,G,I,J
11	L	20	K
12	M	18	L,F

No	Task	Duration	Pre - Task	Float Time
1	A	10	-	0
2	B	13	A	0
3	C	21	A	14
4	D	22	B	0
5	E	15	B,C,D	0
6	F	31	E	0
7	G	18	E	13
8	I	22	E	9
9	J	24	D	22
10	K	17	F,G,I,J	0
11	L	20	K	0
12	M	18	L,F	0

ABDEFKLM= 146

Ôn tập

- ↑▼ Trong quy trình quản lý thời gian, giai đoạn nào thực hiện việc xác định các công việc?
- ↑▼ Các công việc trong dự án có những mối quan hệ gì?
- ↑▼ Các phương pháp thực hiện để xác định thời gian thực hiện dự án và thể hiện mối quan hệ giữa các công việc trong dự án?
- ↑▼ Thời gian trôi của các công việc được tính toán dựa trên các phương pháp nào?

Đường tới hạn (CP) là gì?