Risk Management

Risk Management

- Risk management
  - Risk identification – what are the risks to a project?
  - Risk analysis – which ones are really serious?
  - Risk planning – what shall we do?
  - Risk monitoring – has the planning worked?

Some Definitions of Risk

'the chance of exposure to the adverse consequences of future events' - PRINCE2

- Project plans have to be based on some assumptions
- Risk is the possibility that an assumption is wrong
- When the risk happens, it becomes a problem or an issue

A framework for dealing with risk

The planning for risk includes these steps:

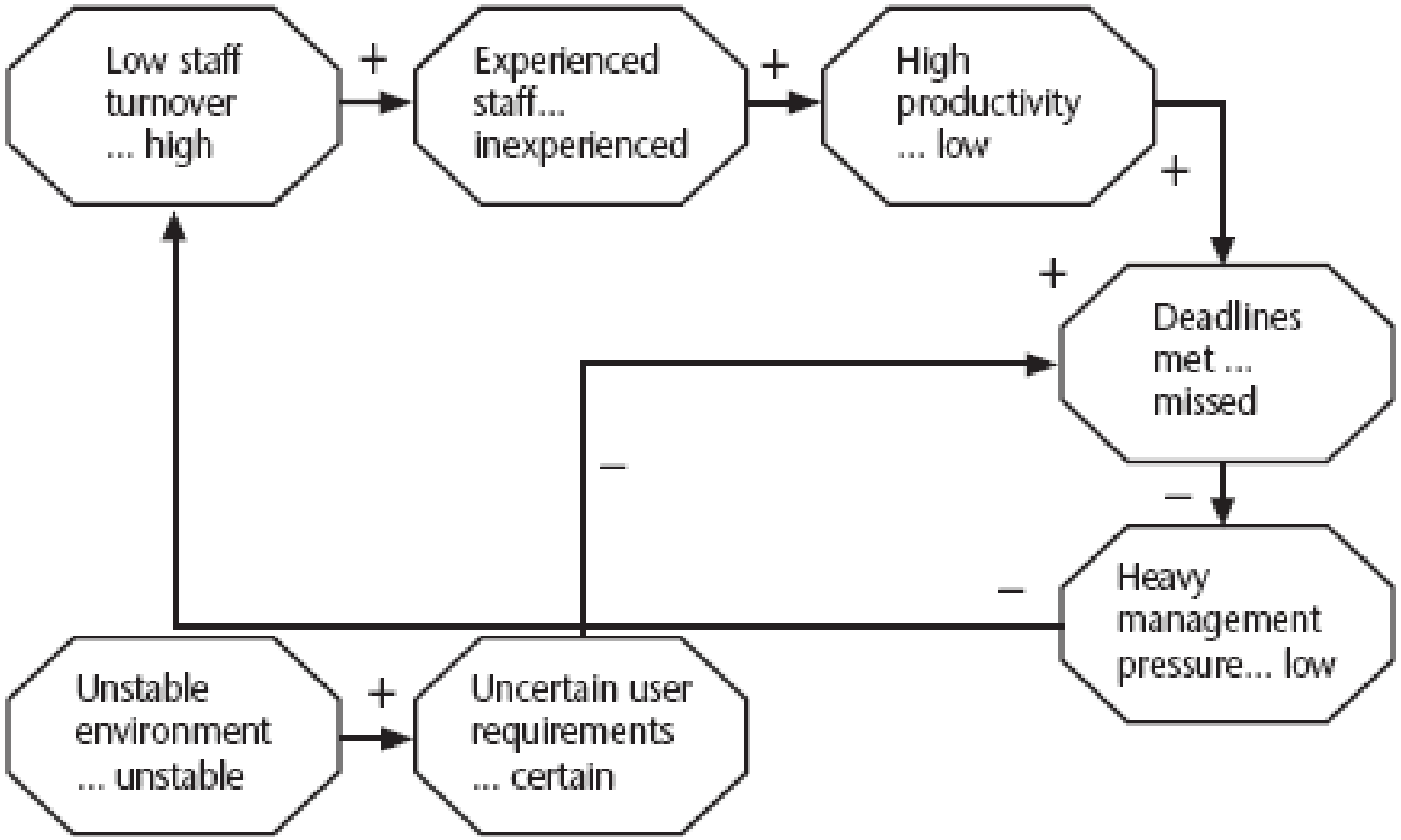
- Risk identification – what risks might there be?
- Risk analysis and prioritization – which are the most serious risks?
- Risk planning – what are we going to do about them?
- Risk monitoring – what is the current state of the risk?

Risk identification

Approaches to identifying risks include:

- Use of checklists – usually based on the experience of past projects
- Brainstorming – getting knowledgeable stakeholders together to pool concerns
- Causal mapping – identifying possible chains of cause and effect

Causal mapping



Risk prioritization

Risk Exposure (RE)

= (Potential Damage) x (Probability of Occurrence)

Ideally:

Potential damage: a money value e.g. a flood would cause £0.5 millions of damage

Probability 0.00 (absolutely no chance) to 1.00 (absolutely certain)

e.g. 0.01 (one in hundred chance)

Risk probability: qualitative descriptors

Probability level	*Range*
High	Greater than 50% chance of happening
Significant	30-50% chance of happening
Moderate	10-29% chance of happening
Low	Less than 10% chance of happening

Qualitative descriptors of impact on cost and associated range values

Impact level	*Range*
High	Greater than 30% above budgeted expenditure
Significant	20 to 29% above budgeted expenditure
Moderate	10 to 19% above budgeted expenditure
Low	Within 10% of budgeted expenditure.

Risk planning

Risks can be dealt with by:

- Risk acceptance
- Risk avoidance
- Risk reduction
- Risk transfer
- Risk mitigation/contingency measures

Risk Reduction Leverage

Risk Reduction Leverage (RRL) =

$(RE_{before} - RE_{after}) / (\text{cost of risk reduction})$

RE_{before} is risk exposure before risk reduction e.g. 1% chance of a fire causing 200k damage

RE_{after} is risk exposure after risk reduction e.g. fire alarm costing 500 reduces probability of fire damage to 0.5%

RRL = (1% of 200k)-(0.5% of 200k)/500 = 2

RRL > 1.00 , Worth Doing

Project Management

Project Management

- Manages large complex projects
- Has three phases:
  - Project planning
  - Project scheduling
  - Project controlling

Phase 1: Project Planning

1. What is the project goal or objective?
2. What are the activities (or tasks) involved?
3. How are activities linked?
4. How much time is required for each activity?
5. What resources are required for each activity?

Phase 2: Project Scheduling

1. When will the entire project be completed?
2. What is the scheduled start and end time for each activity?
3. Which are the “critical” activities?
4. Which are the noncritical activities?
5. How late can noncritical activities be without delaying the project?
6. After accounting for uncertainty, what is the probability of completing the project by a specific deadline?

Phase 3: Project Controlling

At regular intervals during the project, the following questions should be considered:

- Is the project on schedule? Early? Late?
- Are costs equal to the budget? Over budget? Under budget?
- Are there adequate resources?
- What is the best way to reduce project duration at minimum cost?

Identifying Activities

- Subdivides a large project into smaller units
- Each activity should have a clearly defined starting point and ending point
- Each activity is clearly distinguishable from every other activity
- Each activity can be a project in itself

Work Breakdown Structure (WBS)

Divides the project into its various subcomponents and defines hierarchical levels of detail

Level	
1	Project
2	Major tasks in project
3	Subtasks in major tasks
4	Activities to be completed

Example Work Breakdown Structure

Level	Level ID Number	Activity
1	1.0	Develop/launch Windows Longhorn operating system
2	1.1	Development of GUIs
2	1.2	Ensure compatibility with earlier Windows versions
3	1.21	Compatibility with Windows XP
3	1.22	Compatibility with Windows 2000
3	1.23	Compatibility with Windows 98
4	1.231	Ability to import files

Identify Each Activity

- Which other activities must be completed previously (predecessors)
- Time required for completion
- Resources required

This completes the project planning phase.

Project Scheduling Phase

Commonly used techniques:

- Program Evaluation and Review Technique (PERT)
- Critical Path Method (CPM)

NETWORK TECHNIQUES

PERT

-Program Evaluation and Review Technique
- developed by the US Navy with Booz Hamilton Lockheed
- on the Polaris Missile/Submarine program 1958

CPM

- Critical Path Method
- Developed by El Dupont for Chemical Plant Shutdown Project
- About same time as PERT

CPM - Critical Path Method

- Activities are shown as a network of precedence relationships using activity-on-node network that provides:
  - Single estimate of activity time
  - Deterministic activity times

USED IN: Production management - for the jobs of repetitive in nature where the activity time estimates can be predicted with considerable certainty due to the existence of past experience.

Project Evaluation & Review Techniques

- Definition: Activities in **PERT** are shown as a network of precedence relationships using activity-on-arrow network that provides:
  - Multiple time estimates
  - Probabilistic activity times

USED IN : Project management - for non-repetitive jobs (research and development work), where the time and cost estimates tend to be quite uncertain. This technique uses probabilistic time estimates.

Critical Path Method (CPM)

- For fairly simple projects, the critical path is usually the longest path through the project.
- For projects with several parallel and interlinked activities, this may not always be the case.
- For more complicated projects, the critical path can be determined with an ‘earliest time’ forward sweep through the diagram followed by a ‘latest time’ reverse sweep.

Project Management Example: General Foundry Inc.

- Have 16 weeks to install a complex air filter system on its smokestack
- May be forced to close if not completed within 16 weeks due to environmental regulations
- Have identified 8 activities

ACTIVITY	DESCRIPTION	IMMEDIATE PREDECESSORS
A	Build internal components	—
B	Modify roof and floor	—
C	Construct collection stack	A
D	Pour concrete and install frame	A, B
E	Build high-temperature burner	C
F	Install pollution control system	C
G	Install air pollution device	D, E
H	Inspect and test	F, G

Activity Time Estimates

ACTIVITY	DESCRIPTION	TIME (WEEKS)
A	Build internal components	2
B	Modify roof and floor	3
C	Construct collection stack	2
D	Pour concrete and install frame	4
E	Build high-temperature burner	4
F	Install pollution control system	3
G	Install air pollution device	5
H	Inspect and test	2
	Total time (weeks)	25

Determining the Project Schedule

- Some activities can be done simultaneously so project duration should be less than 25 weeks
- **Critical path analysis** is used to determine project duration
- The **critical path** is the *longest* path through the network

Critical Path Analysis

Need to find the following for each activity:

- Earliest Start Time (EST)
- Earliest Finish Time (EFT)
- Latest start time (LST)
- Latest Finish Time (LFT)

Forward Pass

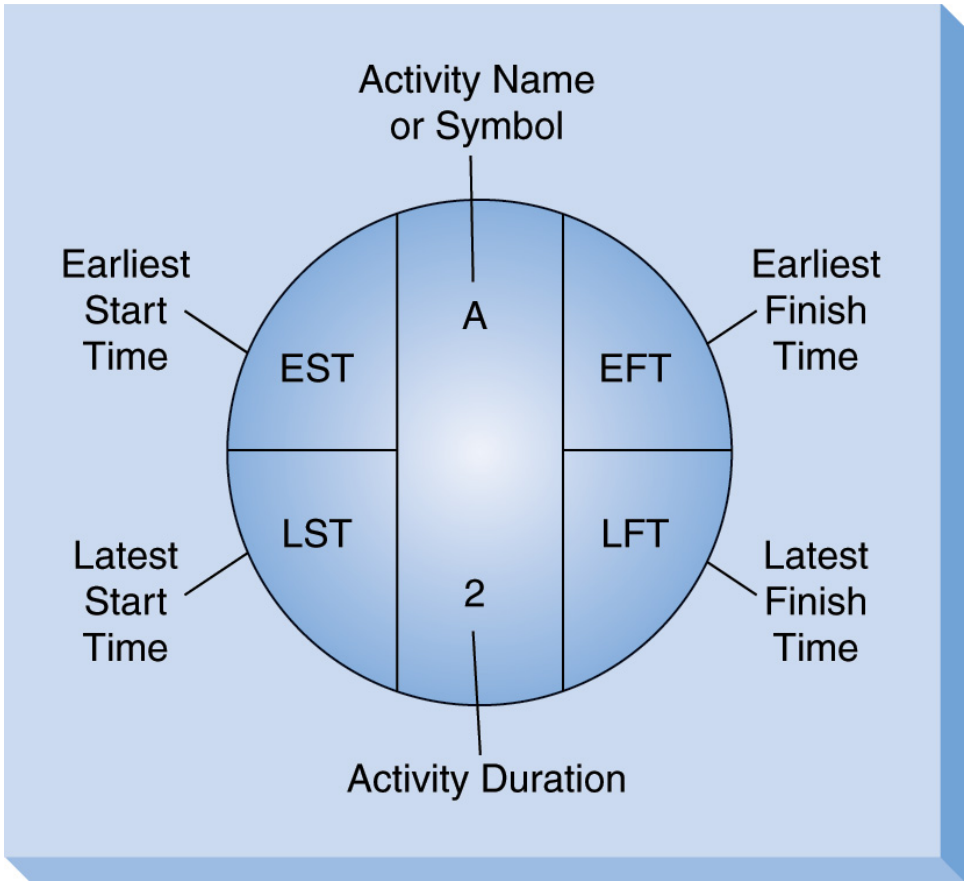
- Identifies earliest times (EST and EFT)
- **EST Rule:** All immediate predecessors must be done before an activity can begin
  - If only 1 immediate predecessor, then

    EST = EFT of predecessor
  - If >1 immediate predecessors, then

    EST = Max {all predecessor EFT's}
- **EFT Rule:**

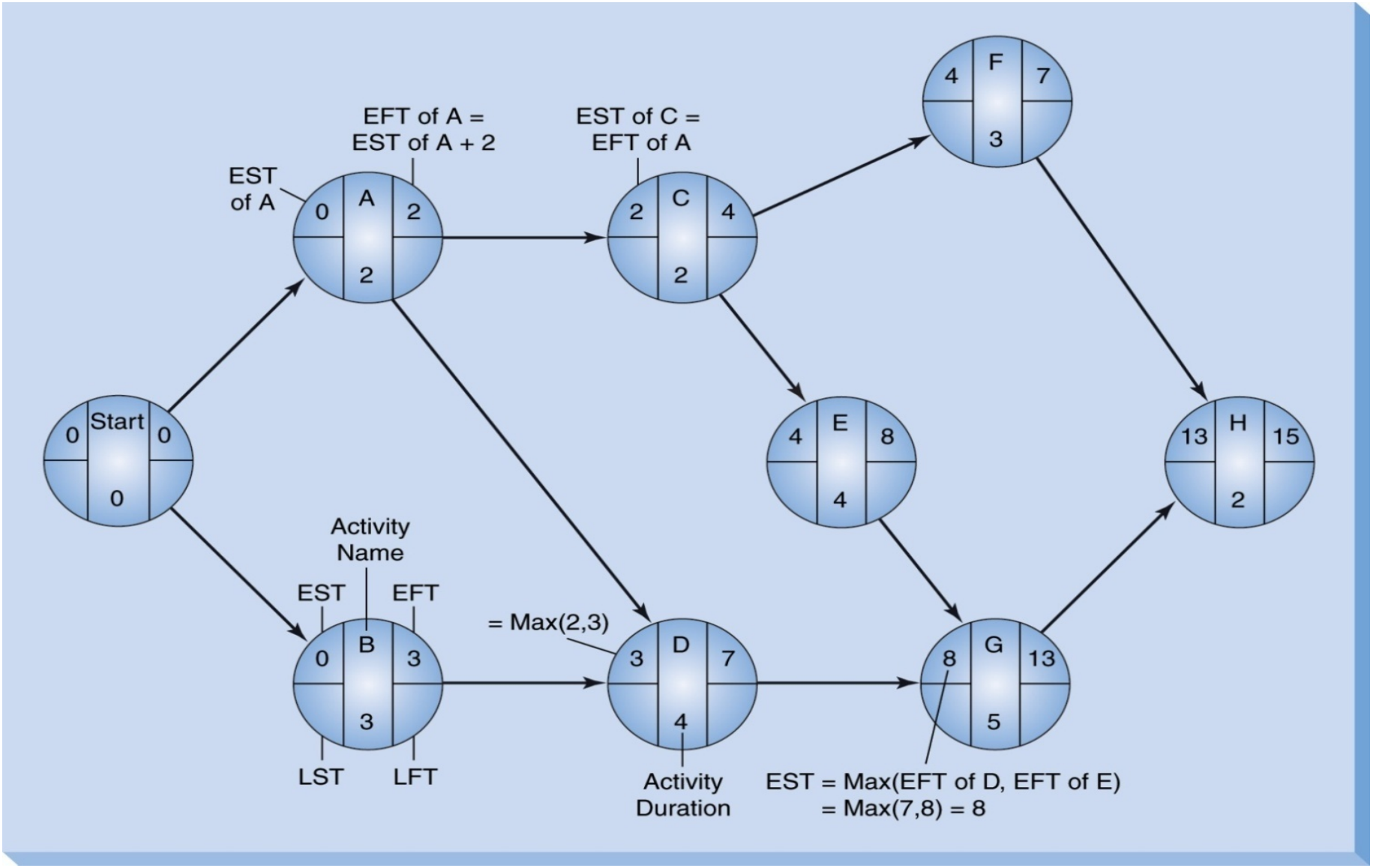
  EFT = EST + activity time

Node Notation:



ACTIVITY	DESCRIPTION	IMMEDIATE PREDECESSORS	TIME (WEEKS)
A	Build internal components	-	2
B	Modify roof and floor	-	3
C	Construct collection stack	A	2
D	Pour concrete and install frame	A, B	4
E	Build high-temperature burner	C	4
F	Install pollution control system	C	3
G	Install air pollution device	D, E	5
H	Inspect and test	F, G	2
	Total time (weeks)		**25**

Forward Pass: Earliest Start and Finish Times



Backward Pass

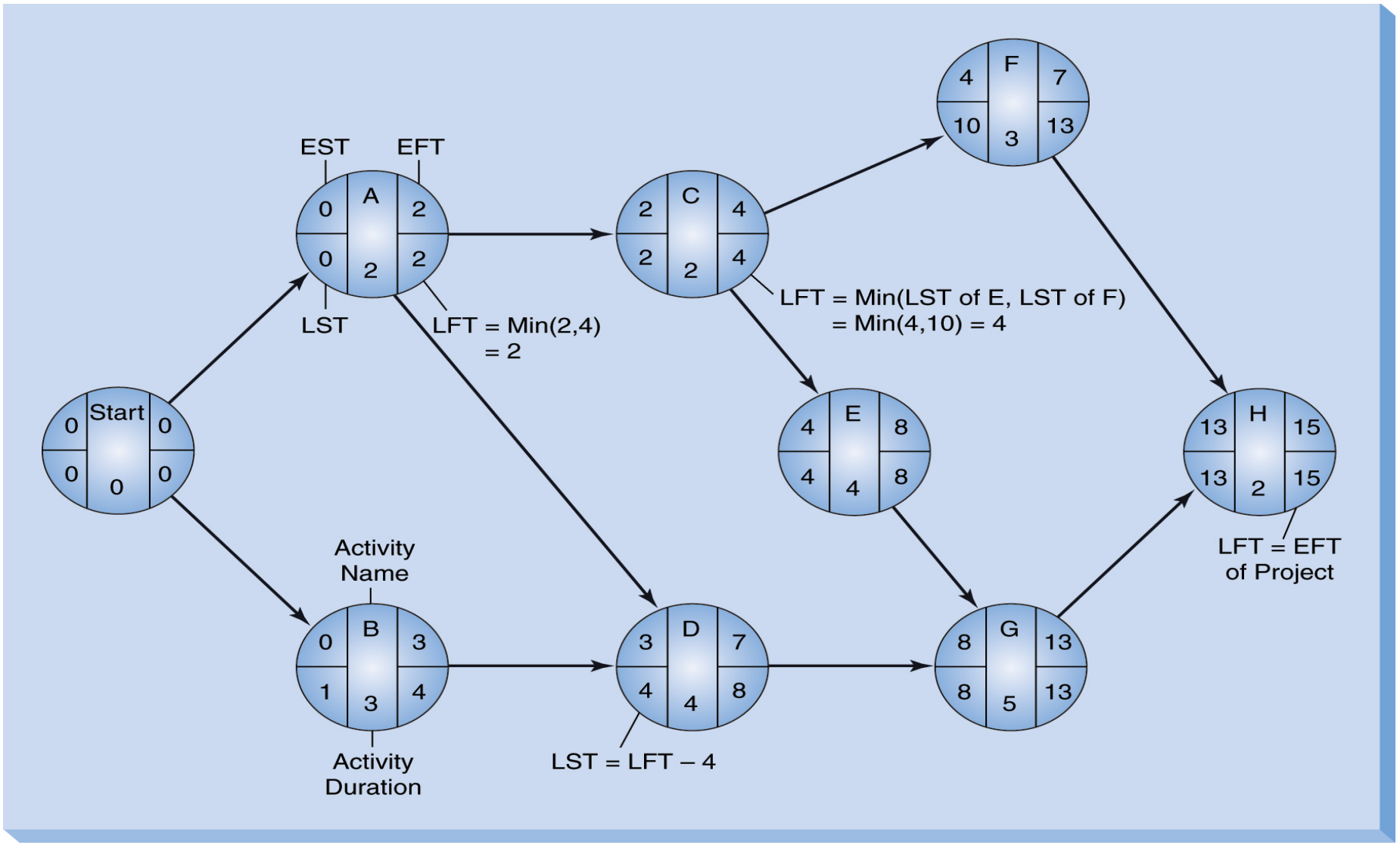
- Identifies *latest* times (LST and LFT)
- **LFT Rule:**
  - If activity is the immediate predecessor to only 1 activity, then

    LFT = LST of immediate follower
  - If activity is the immediate predecessor to multiple activities, then

    LFT = Min {LST of all immediate followers}
- **LST Rule:**

  LST = LFT – activity time

Backward Pass: Latest Start and Finish Times



Slack Time and Critical Path(s)

- **Slack** is the length of time an activity can be delayed without delaying the project

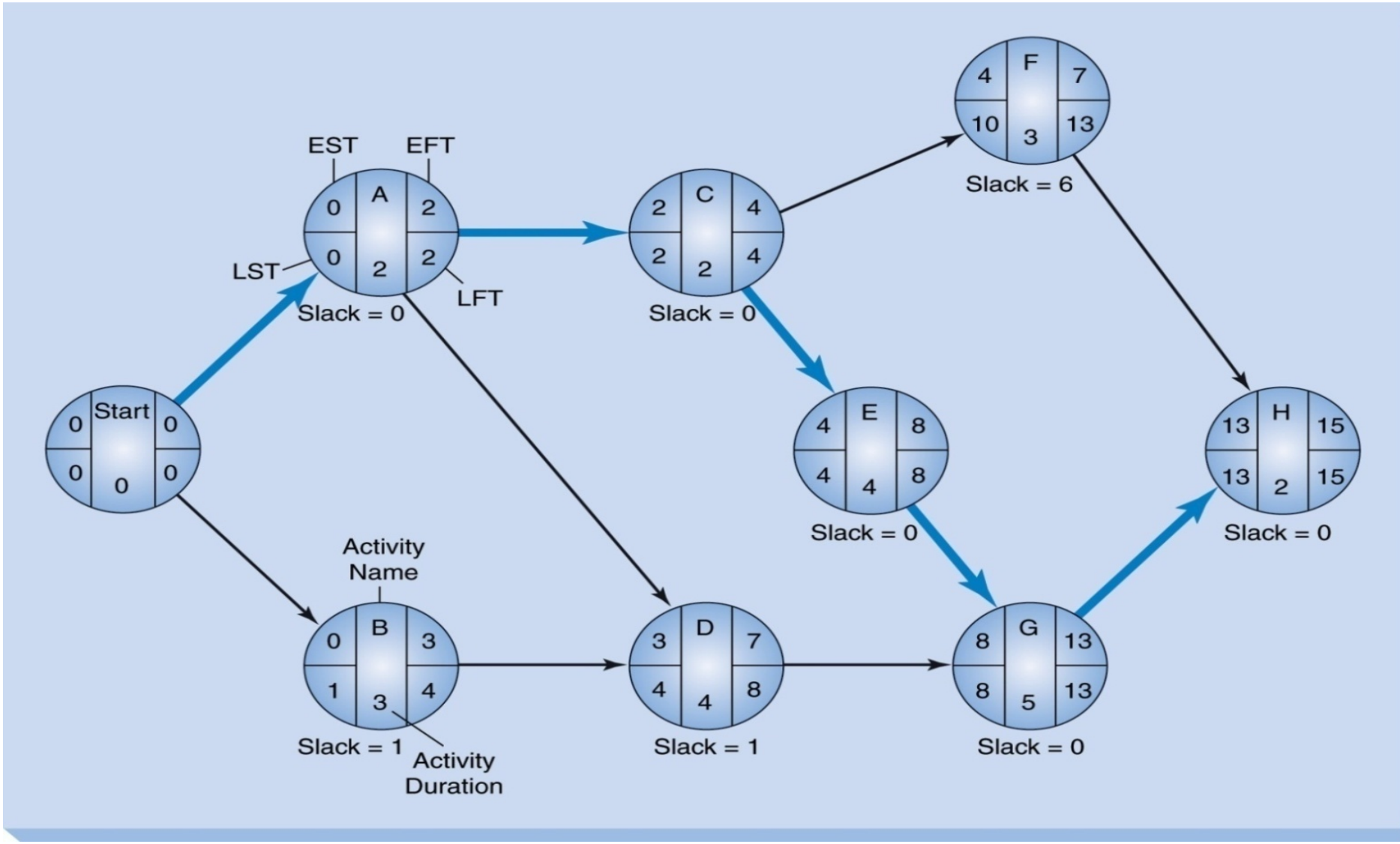
  Slack = LST – EST

- Activities with 0 slack are **Critical Activities**
- The **Critical Path** is a continuous path through the network from start to finish that includes only critical activities

Project Schedule and Slack Times

ACTIVITY	EST	EFT	LST	LFT	SLACK, LST–EST	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

Critical Path and Slack Times



Total Slack Time vs. Free Slack Time

- **Total slack time** is shared by more than 1 activity

  Example: A 1 week delay in activity B will leave 0 slack for activity D

- **Free slack time** is associated with only 1 activity

  Example: Activity F has 6 week of free slack time

Example ?

Activity	Duration	Precedence
A	3	-
B	3	A
C	4	-
D	1	C
E	3	B, D
F	2	A, B, D
G	2	C, F
H	4	G
I	1	C
J	3	E, G
K	5	F, H, I

Example

Activity	Duration	Earliest Start	Latest Start	Float
A	3	0	0	0
B	3	3	3	0
C	4	0	1	1
D	1	4	5	1
E	3	6	13	7
F	2	6	6	0
G	2	8	8	0
H	4	10	10	0
I	1	4	13	9
J	3	10	16	6
K	5	14	14	0

Scheduling with activity time ?

Activity	Immediate predecessors	Completion Time (week)
A	-	5
B	-	6
C	A	4
D	A	3
E	A	1
F	E	4
G	D,F	14
H	B,C	12
I	G,H	2
	Total ……	51

This information indicates that the total time required to complete activities is 51 weeks. However, we can see from the network that several of the activities can be conducted simultaneously (A and B, for example).

Activity schedule for our example

Activity	Earliest start (ES)	Latest start (LS)	Earliest finish (EF)	Latest finish (LF)	Slack (LS-ES)	Critical path
A	0	0	5	5	0	Yes
B	0	6	6	12	6	
C	5	8	9	12	3	
D	5	7	8	10	2	
E	5	5	6	6	0	Yes
F	6	6	10	10	0	Yes
G	10	10	24	24	0	Yes
H	9	12	21	24	3	
I	24	24	26	26	0	Yes

Summary: CPM Steps

- List all activities and expected durations.
- Construct CPM diagram for activities list.
- Determine EARLIEST start time for each event (working forward from project start).
- Determine LATEST start time for each event (working backwards from project end).
- Identify the CRITICAL PATH (and the ‘float’ time for any non-critical activities).