Chapter Two

Software Project management

Introduction

- Projects need to be managed because they are subjected to organizational budget and schedule constraints.
- Goal of project management is
  - Deliver the software to the customer at the agreed time.
  - Keep overall costs within budget.
  - Deliver software that meets the customer's expectations.
  - Maintain a happy and well-functioning development team

Responsibility of Software Project Managers

- Project managers take responsibility at some stage for some or all of the following activities:
  - Project planning
  - Reporting Project
  - Risk management
  - People management
  - Proposal writing

Project planning

- Planning, estimating and scheduling project development, and assigning people to tasks
- Supervise the work to ensure that it is carried out to the required standards and
- Monitor progress to check that the development is on time and within budget.

Reporting Project

- Reporting the progress of a project to customers and to the managers of the company developing the software.
  - detailed technical information to management summaries.

Risk management

- Project managers have to assess the risks that may affect a project, monitor these risks, and take action when problems arise.

Risk	Affects	Description
Staff turnover	Project	Experienced staff will leave the project before it is finished.
Management change	Project	There will be a change of organizational management with different priorities.
Hardware unavailability	Project	Hardware that is essential for the project will not be delivered on schedule.
Requirements change	Project and product	There will be a larger number of changes to the requirements than anticipated.
Specification delays	Project and product	Specifications of essential interfaces are not available on schedule.
Size underestimate	Project and product	The size of the system has been underestimated.
CASE tool underperformance	Product	CASE tools, which support the project, do not perform as anticipated.
Technology change	Business	The underlying technology on which the system is built is superseded by new technology.
Product competition	Business	A competitive product is marketed before the system is completed.

People management

- Project managers are responsible for managing a team of people.
- They have to choose people for their team and establish ways of working that lead to effective team performance.

Proposal writing

- The first stage in a software project may involve writing a proposal to win a contract to carry out an item of work.
- It describes
  - objectives of the project and how it will be carried out
  - Cost and schedule
  - justifies why the project contract should be awarded to a particular organization or team.

More on project planning

- Project planning includes the following activities:
  - Describing project scope, alternatives and feasibility:
  - Dividing the project into manageable tasks
  - Estimating resource and creating resource plan
  - Developing a preliminary schedule
  - Developing a communication plan
  - Determining project standard and procedure

- Identifying and assessing risk
- Creating a preliminary budget
- Developing a project scope statement
- Setting a baseline project plan

Describing project scope, alternatives and feasibility

- **Scope** : Helps to understand the content and complexity of a project.
- **Feasibility study**: determine if the information system makes sense for the organization from an economic and operational standpoint.

Dividing the project into manageable tasks

- **Work break down structure:** defining task and their sequence. (Some tasks can be parallel/or sequential).
  - *Example:* Work break down structure for gathering/defining requirements

Defining Requirements

- **Interview**
  - Designing Interview Form
  - Schedule Appointments
  - Conduct interview
- **Review Current Reports**
  - Collect reports
  - Review reports
- **Summarize Results**

Estimating resource and creating resource plan

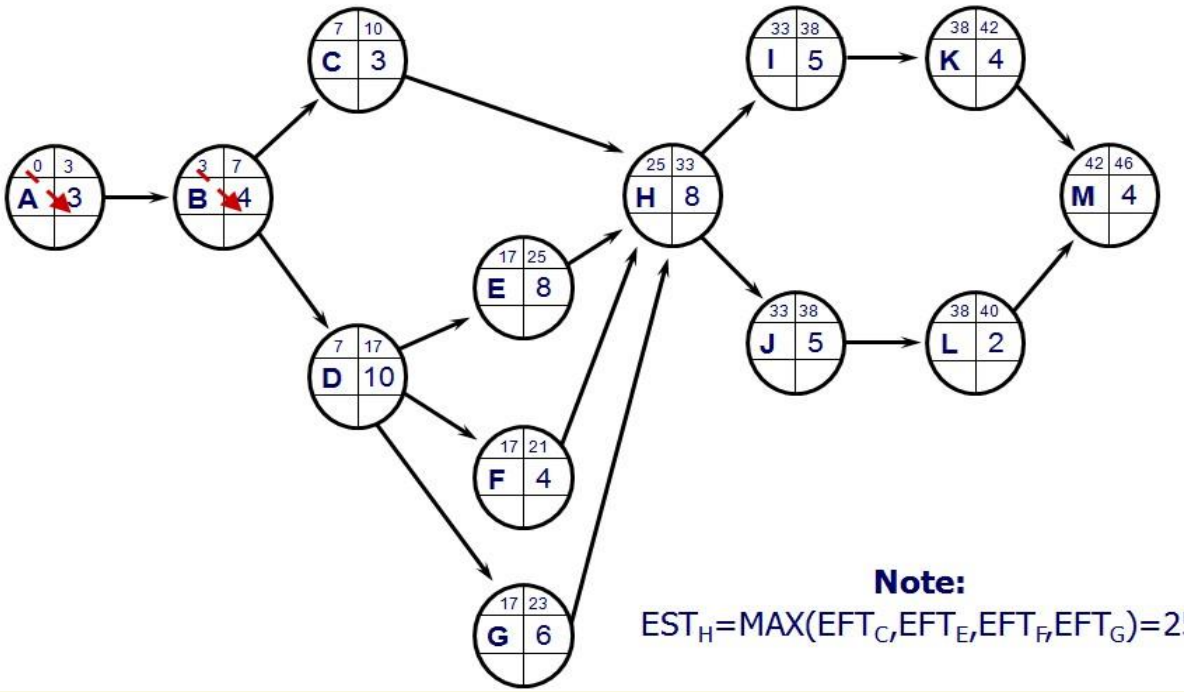
- estimate resource requirements for each project activity and use this information to create a project resource plan.

Developing a preliminary schedule

- During this activity, you use the information on tasks and resource availability to assign time estimates to each activity in the work breakdown structure.
  - create target starting and ending dates for the project.
  - Target dates can be revisited and modified until a schedule produced is acceptable to the customer.
  - Gantt chart or network diagram

No	Tasks name	Duration of each tasks	Oct.6-11	Oct 11-26		Oct 26-Nov 6		Nov 6-12		
1	Project proposal	5 days								
2	Requirement and design	15 days								
3	Testing and Coding	10 days								
4	implementation	6 days								

Results of the Forward Pass



Note:

$EST_H = MAX(EFT_C, EFT_E, EFT_F, EFT_G) = 25$

Developing a communication plan

- this activity is to outline the communication procedures among management, project team members, and the customer.
- Includes
  - when and how written and oral reports will be provided by the team, how team members will coordinate work
- **Example:** of the project communication matrix

Stakeholder	Document	Format	Team Contact	Date Due
Team Members	Project Status Report	Project Intranet	Juan Kim	First Monday of Month
Management Supervisor	Project Status Report	Hard Copy	Juan Kim	First Monday of Month
User	Project Status Report	Hard Copy	James Kim	First Monday of Month
Internal IT Staff	Project Status Report	E-mail	Jackie James	First Monday of Month
IT Manager	Project Status Report	Hard Copy	Juan Jeremy	First Monday of Month
Contract Programmers	Software Specifications	E-mail/Project Intranet	Jordan Kim	October 4, 2012
Training Subcontractor	Implementation and Training Plan	Hard Copy	Jordan James	January 10, 2013

Determining project standard and procedure

- various deliverables are produced and tested by you and your project team.
- For example,
  - the team must decide on which tools to use,
  - how the standard SDLC (System Development Life Cycle) might be modified
  - how team members will report the status of their assigned activities, and terminology…..

Identifying and assessing risk

- Identify sources of project risk and to estimate the consequences of those risks.
- Risks might arise from
  - the use of new technology,
  - prospective users' resistance to change,
  - availability of critical resources

Creating a preliminary budget

- preliminary budget that outlines the planned expenses and revenues associated with your project.

Developing a project scope statement

- occurs near the end of the project planning phase
- Developed primarily for the customer, this document outlines work that will be done and clearly describes what the project will deliver.

Setting a baseline project plan

- End of project plan
  - provides an estimate of the project's tasks and resource requirements and is used to guide the next project phase execution. As new information is acquired during project execution, the baseline plan will continue to be updated

Project scheduling and staffing

- There are so many uncertainties that it is impossible to estimate system development costs accurately during the early stages of a project.
  - use new development technology
  - The people involved in the project and their skills will probably not be known……

- There are two types of technique that can be used to do estimate cost
  - *Experience-based techniques:* The estimate of future effort requirements is based on the manager's experience of past projects and the application domain.
  - *Algorithmic cost modeling*: In this approach, a formulaic approach is used to compute the project effort based on estimates of product attributes (size, process characteristics…)

Experience-based techniques

- Manager's experience of past projects and the actual effort expended in these projects
- Identify
  - the deliverables to be produced in a project and
  - the different software components or systems that are to be developed
- document these in a spreadsheet, estimate them individually, and compute the total effort required.

- Difficulty of this method is:
  - new software project may not have much in common with previous projects.
  - Software development changes very quickly and a project will often use unfamiliar techniques

Algorithmic cost modeling

- uses a mathematical formula to predict project costs based on estimates of the
  - project size;
  - the type of software being developed; and
  - other team, process, and product factors.

- This is an empirical model that was derived by collecting data from a large number of software projects.
- COCOMO (Constructive COst MOdel)is a well-documented and nonproprietary estimation model.

Constructive COst MOdel (COCOMO)

- Estimates the total effort in terms of person-months
- Steps:
  - Obtain an initial estimate (nominal estimate) of the development effort from the estimate of thousands of delivered lines of source code (KLOC).
  - Determine a set of 15 multiplying factors from different attributes of the project.
  - Adjust the effort estimate by multiplying the initial estimate with all the multiplying factors.

- $E_i = a * (KLOC)^{\wedge b}$…… initial effort person per month
- The value of the constants *a* and *b* depend on the project type.
- Project types can be
  - Organic: relatively straightforward and developed by a small team
  - Semidetached:
  - Embedded: ambitious and novel, with stringent constraints from the environment and high requirements

System	a	b
Organic	3.2	1.05
Semidetached	3.0	1.12
Embedded	2.8	1.20

- The multiplying factors for 15 cost drivers which is given in the following table are multiplied to get the effort adjustment factor (EAF).

Cost Drivers	*Rating*				
	Very Low	Low	Nom-inal	High	Very High
Product Attributes					
RELY, required reliability	.75	.88	1.00	1.15	1.40
DATA, database size		.94	1.00	1.08	1.16
CPLX, product complexity	.70	.85	1.00	1.15	1.30
Computer Attributes					
TIME, execution time constraint			1.00	1.11	1.30
STOR, main storage constraint			1.00	1.06	1.21
VITR, virtual machine volatility		.87	1.00	1.15	1.30
TURN, computer turnaround time		.87	1.00	1.07	1.15
Personnel Attributes					
ACAP, analyst capability	1.46	1.19	1.00	.86	.71
AEXP, application exp.	1.29	1.13	1.00	.91	.82
PCAP, programmer capability	1.42	1.17	1.00	.86	.70
VEXP, virtual machine exp.	1.21	1.10	1.00	.90	
LEXP, prog. language exp.	1.14	1.07	1.00	.95	
Project Attributes					
MODP, modern prog. practices	1.24	1.10	1.00	.91	.82
TOOL, use of SW tools	1.24	1.10	1.00	.91	.83
SCHED, development schedule	1.23	1.08	1.00	1.04	1.10

- The final effort estimate, E, is obtained by multiplying the initial estimate by the EAF. That *is*, $E = EAF * E_i$.
- For planning and monitoring purposes, estimates of the effort required for the different phases

- In COCOMO, effort for a phase is a defined percentage of the overall effort.
- The percentages for an organic software project are given in the following table.

Phase	Size			
	Small 2 KLOC	Intermediate 8 KLOC	Medium 32 KLOC	Large 128 KLOC
Product design	16	16	16	16
Detailed design	26	25	24	23
Code and unit test	42	40	38	36
Integration and test	16	19	22	25

Example

- Suppose a system for office automation has to be designed.
- From the requirements, it is clear that there will be four major modules in the system:
  - data entry, data update, query, and report generator.
- It is also clear from the requirements that this project will fall in the organic category.
- The sizes for the different modules and the overall system are estimated to be:

- Data Entry 0.6 KLOC
- Data Update 0.6 KLOC
- Query 0.8 KLOC
- Reports 1.0 KLOC
- TOTAL 3.0 KLOC

- From the requirements, the ratings of the different cost driver attributes are assessed. These ratings, along with their multiplying factors, are:
  - Complexity High 1.15
  - Storage High 1.06
  - Experience Low 1.13
  - Programmer Capability Low 1.17

- Calculate initial effort
  - $E_i = 3.2 * 3^{1.05} = 10.14$Person Month (PM)
  - EAF = 1.15*1.06*1.13*1.17 = 1.61.
  - E = 1.61* 10.14 = 16.3PM.

- Effort for different phases
  - We use interpolation
- if X, X_0, X_1, $f(X_0)$, $f(X_1)$ are given we can interpolate $f(X)$.

$$f(X) = f(X_0) + \left(\frac{f(X_1) - f(X_0)}{X_1 - X_0} \right) (X - X_0)$$

- The office automation system's size estimate is 3 KLOC that is between 2KLOC & 8KLOC

	Product design	Detailed design	Code and unite test	Integration
X_0.=2KLOC	$f(X_0)=16$	$f(X_0)=26$	$f(X_0)=42$	$f(X_0)=16$
X_1=8KLOC	$f(X_1)=16$	$f(X_1)=25$	$f(X_1)=40$	$f(X_1)=19$

- Product design
  - $f(X_0)=16\%=0.16$
  - $f(X_1)=16\%=0.16$
  - X=3KLOC
  - f(3)=0.16+((0.16-0.16)/8KLOC-2KLOC)*(3KLOC-2KLOC)=0.16

- Detailed design
  - $f(X_0)=26\%=0.26$
  - $f(X_1)=25\%=0.25$
  - X=3KLOC
  - f(3)=0.26+((0.25-0.26)/8KLOC-2KLOC)*(3KLOC-2KLOC)=0.258

- Code & unit test
  - $f(X_0)=42\%=0.42$
  - $f(X_1)=40\%=0.4$
  - X=3KLOC
  - f(3)=0.42+((0.4-0.42)/8KLOC-2KLOC)*(3KLOC-2KLOC)=0.4166

- Integration
  - $f(X_0)=16\%=0.16$
  - $f(X_1)=19\%=0.19$
  - X=3KLOC
  - f(3)=0.16+((0.19-0.16)/8KLOC-2KLOC)*(3KLOC-2KLOC)=0.165

- With these, the effort estimates for the different phases are:
  - System Design 0.16 * 16.3 = 2.6 PM
  - Detailed Design 0.258 * 16.3 = 4.2 PM
  - Code and Unit Test 0.4166 * 16.3 = 6.8 PM
  - Integration 0.165 * 16.3 = 2.7 PM.

Project Scheduling and Staffing

- **Gantt Chart**
- graphical representation of a project that shows each task as a horizontal bar whose length is proportional to time.
- do not show how tasks must be ordered (precedence) but simply show when an activity should begin and end.

No	Tasks name	Duration of each tasks	Oct.6-11	Oct 11-26		Oct 26-Nov 6		Nov 6-12		
1	Project proposal	5 days								
2	Requirement and design	15 days								
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4	implementation	6 days								

Network diagram

- Show the order of activities by connecting a task to its predecessors and successor task.
- It is a critical path scheduling
  - it means it refers to a sequence of tasks activities whose ordering or duration directly affects the completion date of the project

- PERT (Program Evaluation Review Technique) is a technique that uses
  - optimistic, pessimistic, and realistic time estimates
- to calculate the expected time for a particular task.

- The optimistic (*o*) times--- reflect the minimum possible periods of time for an activity to be completed
- pessimistic (p) times--- reflect the maximum possible periods of time for an activity to be completed

- The realistic time (*r*) --- project manager's best guess
- Once each of these estimates is made for an activity, an expected completion time (ET) can be calculated for that activity.

$$ET = \frac{O + 4r + p}{6}$$

Where,

ET- Expected time for the completion for an activity

o- Optimistic completion time for an activity

r- Realistic completion time for an activity

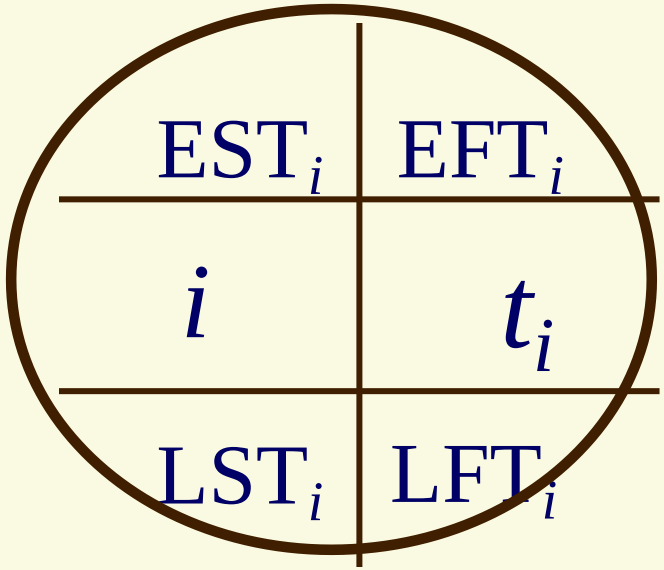
p- Pessimistic completion time for an activity

Example

- The following table contains the summary of activities of a certain project.

Activity	Time Required (in days)	Immediate Predecessor activities
A	3	--
B	4	A
C	3	B
D	10	B
E	8	D
F	4	D
G	6	D
H	8	C,E,F,G
I	5	H
J	5	H
K	4	I
L	2	J
M	4	K,L

- **<u>Task one:</u>** by using the above table construct the network diagram and fill each node as follows



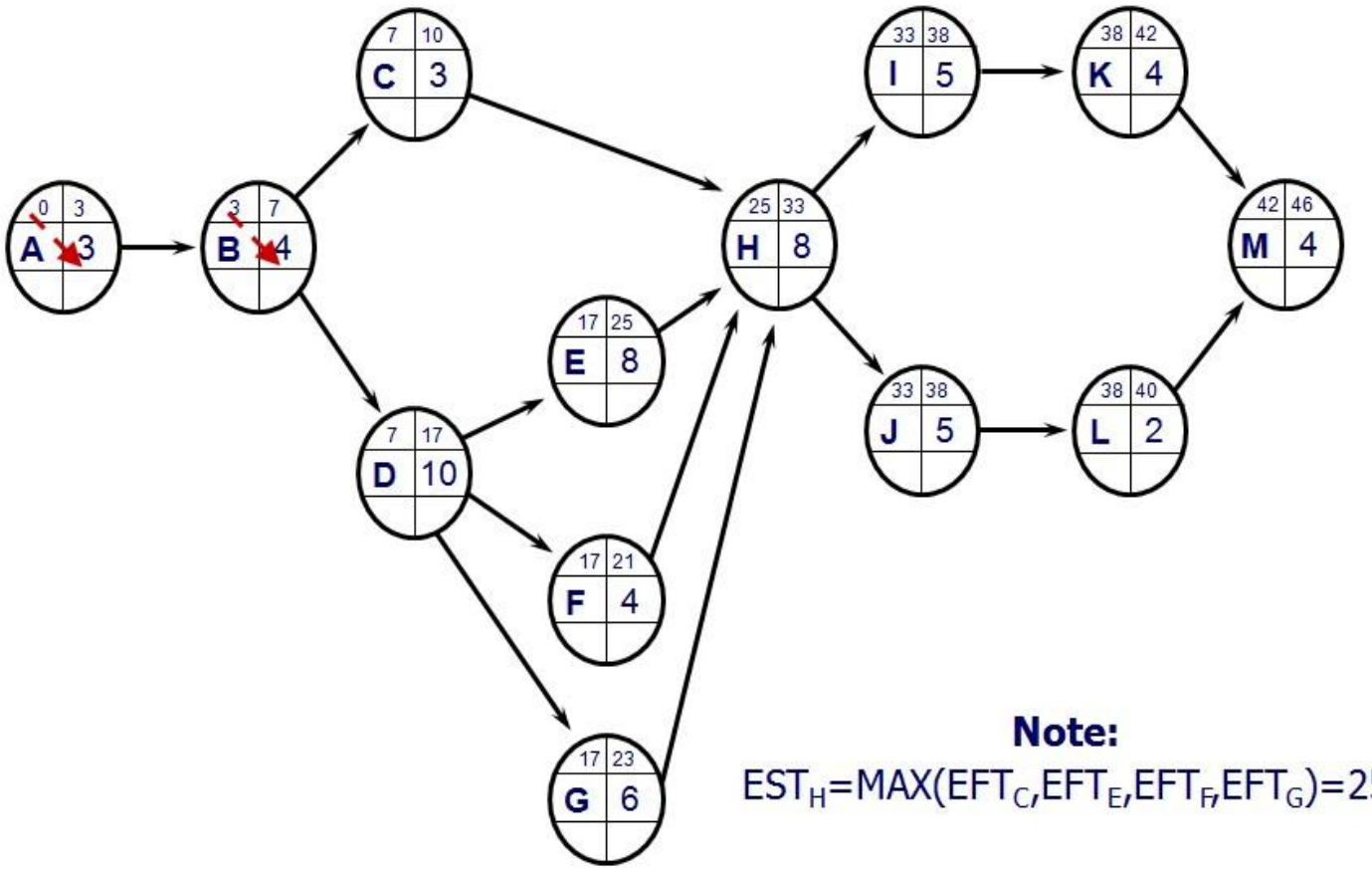
- t_i = DURATION required to perform activity *i*
- EST_i = earliest possible start for activity *i*
- EFT_i = earliest possible finish for activity *i*
- LST_i = latest possible start for activity *i*
- LFT_i = latest possible finish for activity *i*

- **Task two:** calculate the forward and the backward pass.

The Forward Pass

- The earliest start (EST) for the initial activity in a project is “time zero”;
- The EST of an activity is equal to the latest (or maximum) early finish of the activities directly preceding it;
- The EFT of an activity is equal to its EST plus the duration required performing the activity

Results of the Forward Pass



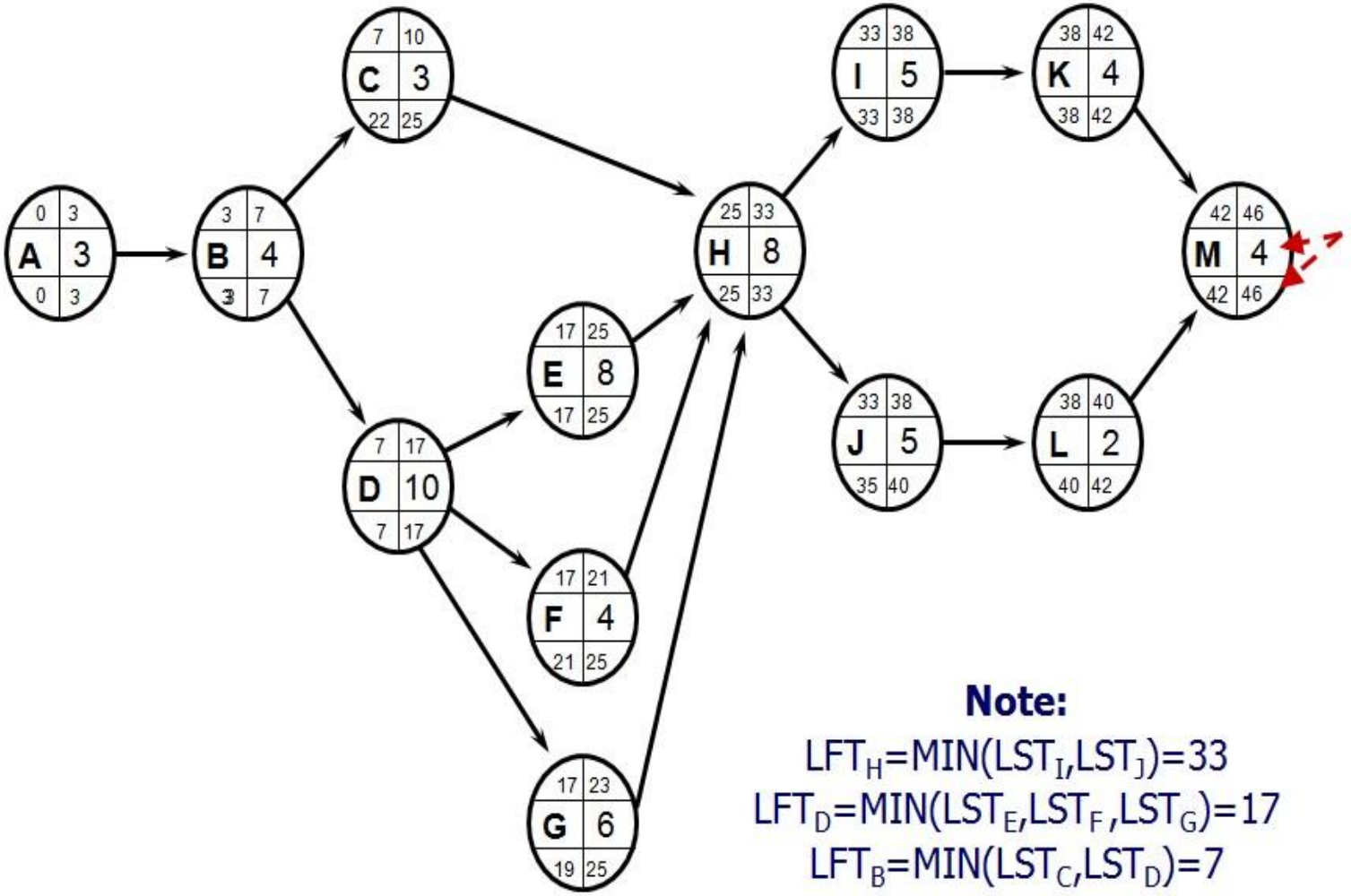
Note:

$EST_H = MAX(EFT_C, EFT_E, EFT_F, EFT_G) = 25$

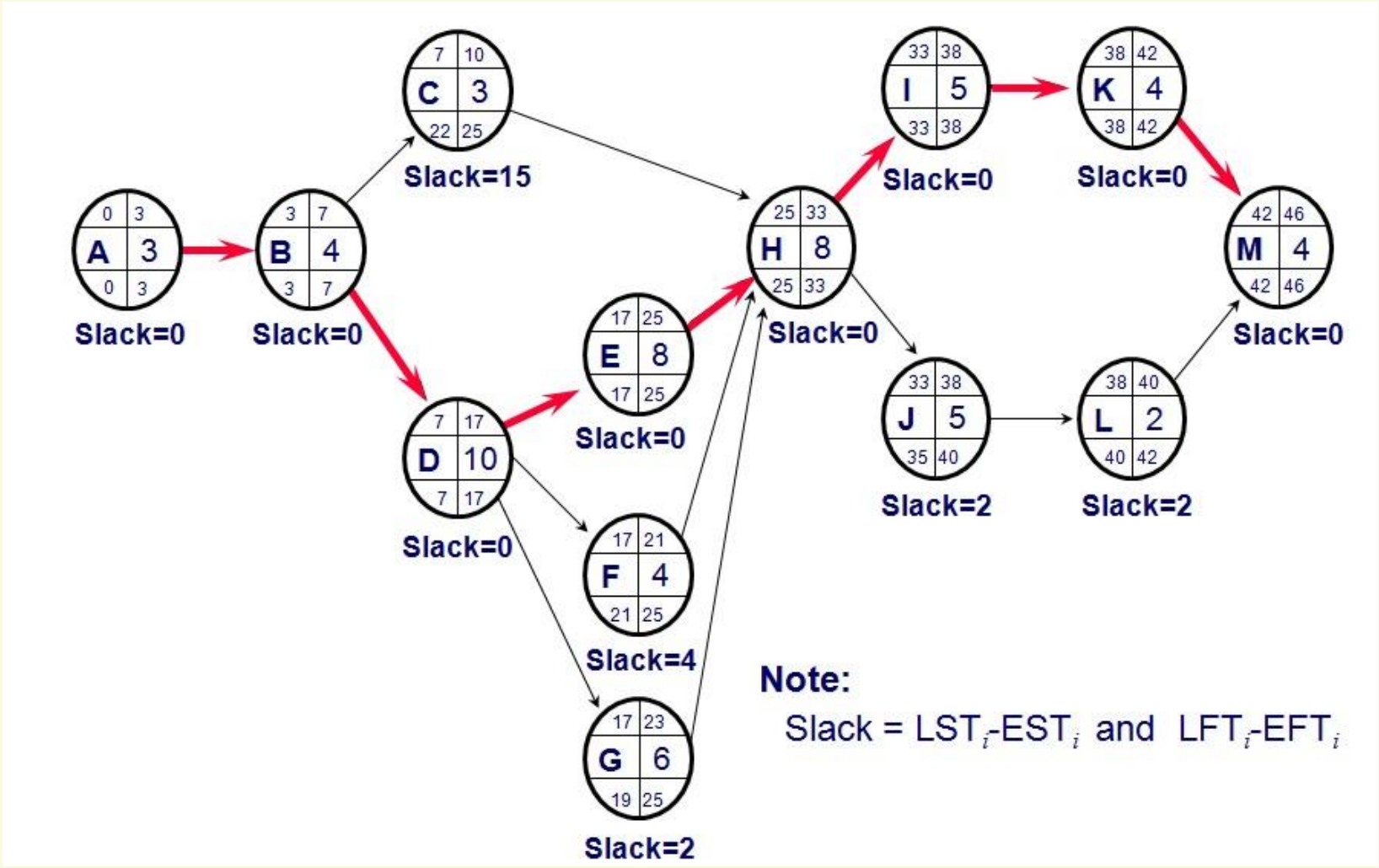
The Backward Pass

- The latest finish (LFT) for the final activity in a project is equal to its EFT as determined by the forward pass;
- The LFT for any other activity is equal to the earliest (or minimum) LST of the activities directly following (or succeeding) it;
- The LST of an activity is equal to its LFT minus the time required to perform the activity.

Results of the Backward Pass



- **Task three:** determine the critical path
  - Critical activities have zero slack and cannot be delayed without delaying the completion of the project;
  - The slack for non-critical activities represents the amount of time by which the start of these activities can be delayed without delaying the completion of the entire project (assuming that all predecessor activities start at their earliest start times);

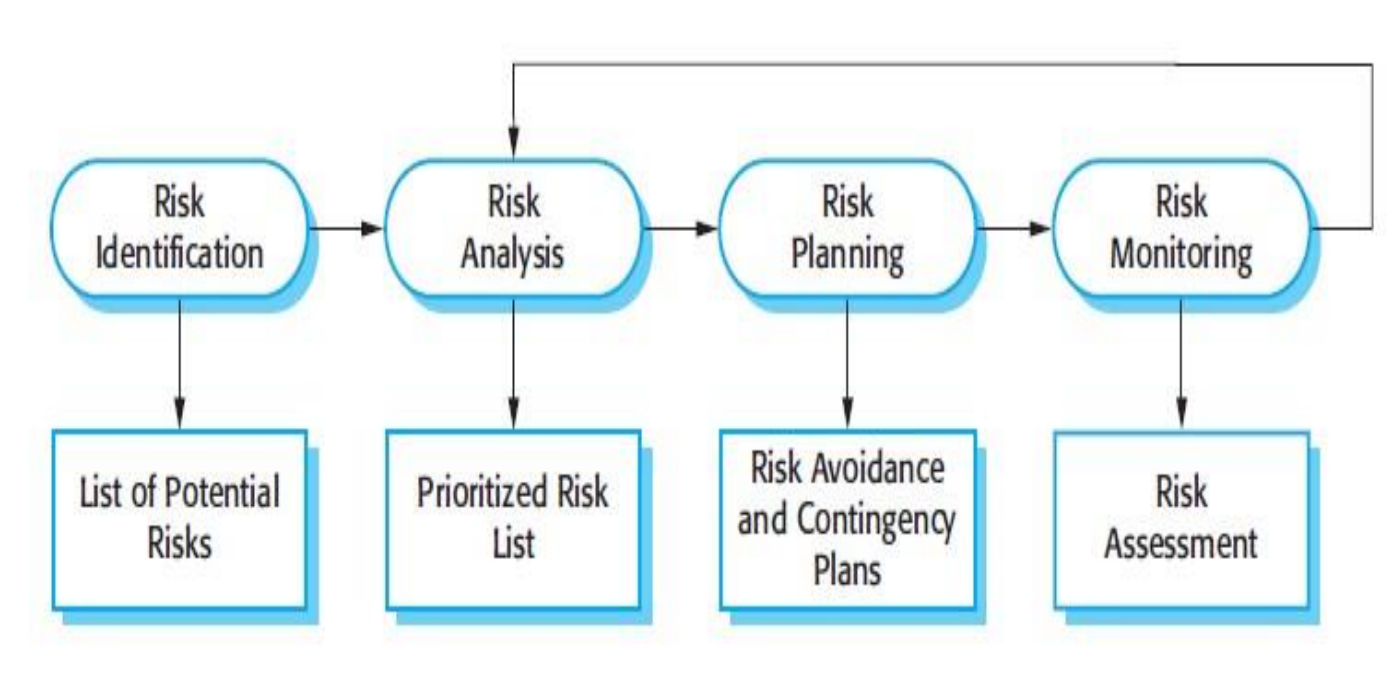

A 3
0 3
0 3
Slack=0
B 4
3 7
3 7
Slack=0
C 3
7 10
22 25
Slack=15
D 10
7 17
7 17
Slack=0
E 8
17 25
17 25
Slack=0
F 4
17 21
21 25
Slack=4
G 6
17 23
19 25
Slack=2
H 8
25 33
25 33
Slack=0
I 5
33 38
33 38
Slack=0
J 5
33 38
35 40
Slack=2
K 4
38 42
38 42
Slack=0
L 2
38 40
40 42
Slack=2
M 4
42 46
42 46
Slack=0
Note:
Slack = LST$_i$-EST$_i$ and LFT$_i$-EFT$_i$

More on Risk management

- It involves anticipating risks that might affect the project schedule or the quality of the software being developed and then taking action to avoid or minimize these risks.

- There are three related categories of risk:
  - Project risks: Risks that affect the project schedule or resources
  - Product risks: Risks that affect the quality or performance of the software being developed.
  - Business risks: Risks that affect the organization developing or procuring the software.
- These risks might overlap

- The process of risk management involves several stages:
  - Risk identification
  - Risk analysis
  - Risk planning
  - Risk monitoring


Risk Identification
Risk Analysis
Risk Planning
Risk Monitoring
List of Potential Risks
Prioritized Risk List
Risk Avoidance and Contingency Plans
Risk Assessment

1. Risk *identification*

- You should identify possible project, product, and business risks.
- risk checklist
  - Technology risks
  - People risks
  - Organizational risks
  - Tools risks
  - Requirements risks
  - Estimation risks

2. Risk Analysis

- Assess the likelihood and consequences of these risks.
  - No easy and formal way doing this
  - Good judgment and experience of previous projects

3. Risk Planning

- Risk management strategies fall into three categories:
  - Avoidance strategies: Following these strategies means that the probability that the risk will arise will be reduced.
  - Minimization strategies: Following these strategies means that the impact of the risk will be reduced.
  - Contingency plans: Following these strategies means that you are prepared for the worst and have a strategy in place to deal with it.

4. Risk monitoring

- You should regularly assess the risk and your plans for risk mitigation and revise these when you learn more about the risk.