Project Management Technique

Project Management

- A project consists of interrelated activities which are to be executed in a certain order before the entire task is completed.
- The activities are interrelated in a logical sequence which is known as precedence relationship.
- Project is represented in the form of a network for the ~~pro~~ purpose of artificial treatment to get solutions for scheduling and controlling its activities.

Techniques

① CPM — Critical Path Method.

② PERT — Project Evaluation and Review Technique.

Phases of Project management:

① Planning: ⊙ Dividing the project into distinct activities.

~~⊙ Estimating~~

⊙ Estimating time requirement for each activity.

① Establishing precedence relationships among the activities.
② Construction of the arrow diagram. (network)

② Scheduling: Determines the start and end time of each and every activity.

③ Controlling: Uses the arrow diagram and time chart for continuous monitoring and progress reporting.

Guidelines for network construction:

① The starting event and ending event of an activity are called tail event and head event respectively.

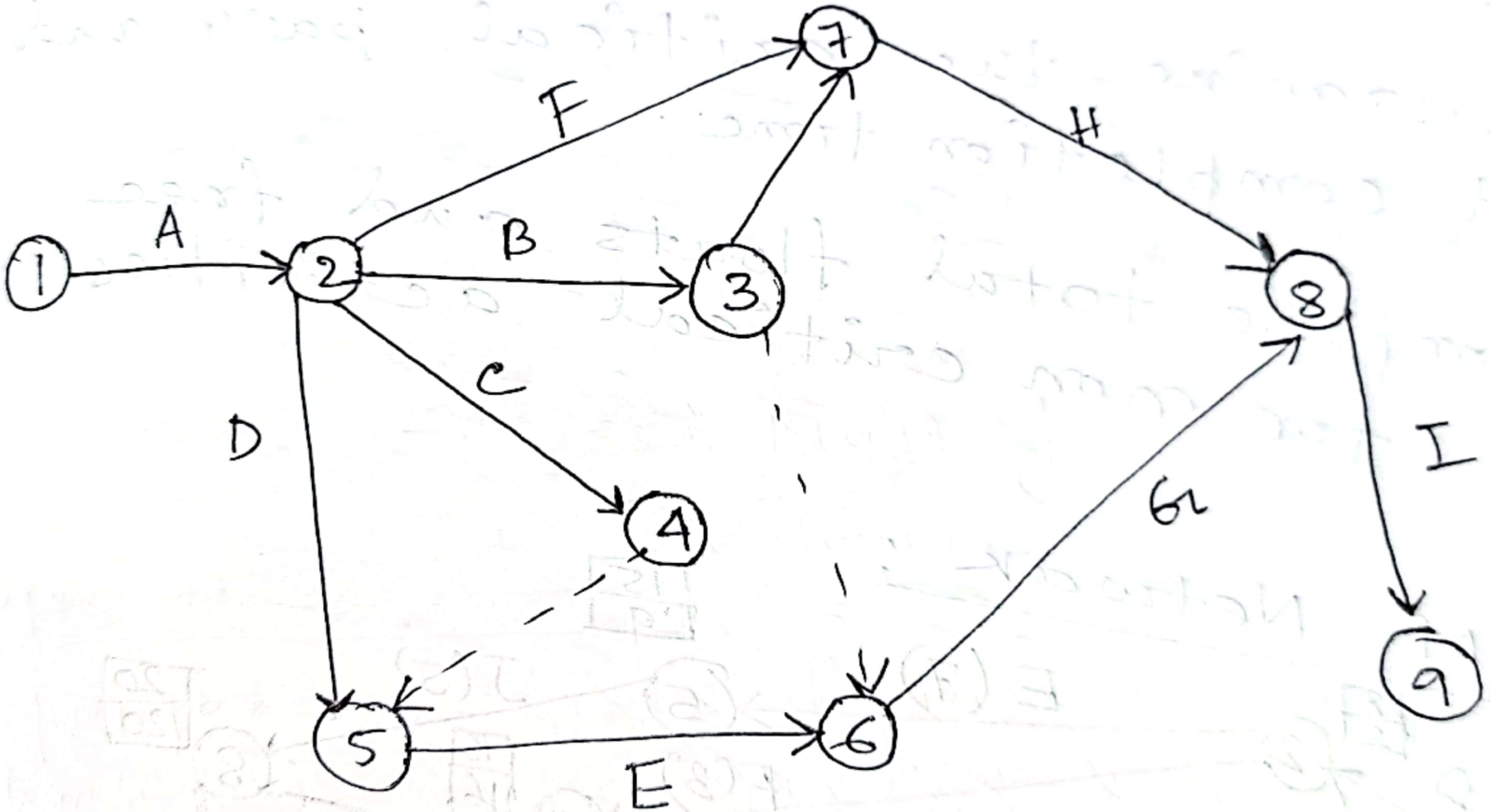
② The network should have a unique starting node. (tail event)

③ The network should have a unique completion node (head event)

④ No activity should be represented by more than one arc in the network

⑤ No two activities should have the same starting and the same ending node.

⑥ Dummy activity is an imaginary activity indicating precedence relationship only. Duration of a dummy activity is zero.



Example of Network Model

Critical path

The critical path of a project network is the longest path in the network. This can be identified by simply listing out all the possible paths from the start node of the project to the end node of the project and then selecting the path with the maximum sum of activity times on that path.

Two phases:

i) Determines earliest start times (ES) of all the nodes. This is called forward pass.

ii) Determines latest completion times (LC) of various nodes. This is called backward pass.

Determination of earliest start times:

$$ES_j = \max_i (ES_i + D_{ij})$$

j — ending activity

i — starting activity.

Determination of Latest completion times (LCi)

$$LC_i = \min_j (LC_j - D_{ij})$$

Conditions of critical path

$$ES_i = LC_i, \quad ES_j = LC_j$$

$$ES_j - ES_i = LC_j - LC_i = D_{ij}$$

Total floats: It is the amount of time that the completion time of an activity can be delayed without affecting the project completion time.

$$TF_{ij} = LC_j - ES_i - D_{ij}$$

Free floats: It is the amount of time that the activity completion time can be delayed without affecting the earliest start time of immediate successor activities in the network.

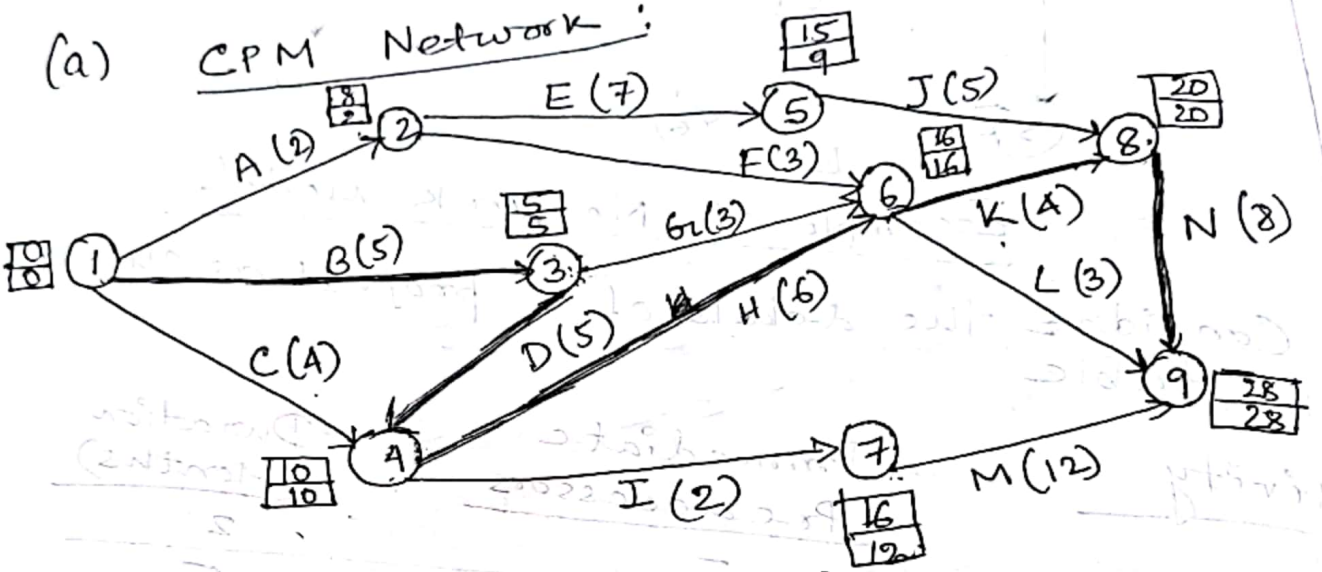
$$FF_{ij} = ES_j - ES_i - D_{ij}$$

Ex. Consider the details of a project as shown in the table

Activity	Immediate Predecessors	Duration (Months)
A	–	2
B	–	5
C	–	4
D	B	5
E	A	7
F	A	3
G	B	3
H	C, D	6
I	C, D	2
J	E	5
K	F, G, H	4
L	F, G, H	3
M	I	12
N	J, K	8

(a) Construct the CPM network.
(b) Determine the critical path and project completion time.
(c) Compute total floats and free floats for non critical activities.

(a) CPM Network:



$ES_j = \max_i (ES_i + D_{ij})$

For node 1, $ES_1 = 0$
node 2, $ES_2 = 0 + 2 = 2$
node 3, $ES_3 = 0 + 5 = 5$
node 4, $ES_4 = 5 + 5 = 10$
node 5, $ES_5 = 2 + 7 = 9$
node 6, $ES_6 = 10 + 6 = 16$
node 7, $ES_7 = 10 + 2 = 12$
node 8, $ES_8 = 16 + 4 = 20$
node 9, $ES_9 = 20 + 8 = 28$

$LC_i = \min_j (LC_j - D_{ij})$

For node 9, $ES_1 = LC_9 = 28$.

node 8, $LC_8 = LC_9 - D_{8,9}$
$= 28 - 8 = 20$

node 7, $LC_7 = LC_9 - D_{7,9}$
$= 28 - 12 = 16$

node 6, $LC_6 = LC_8 - D_{8,6}$
$= 20 - 4 = 16$

node 5, $LC_5 = 20 - 5 = 15$

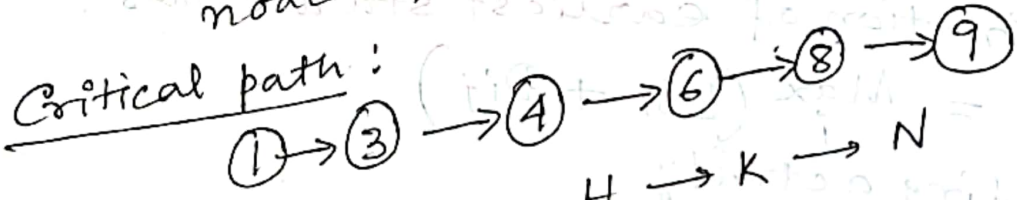
node 4, $LC_4 = 16 - 6 = 10$

node 3, $LC_3 = 10 - 5 = 5$

node 2, $LC_2 = 15 - 7 = 8$

node 1, $LC_1 = 5 - 5 = 0$.

Critical path:



B → D → H → K → N

Total duration = 5 + 5 + 6 + 4 + 8 = 28 (Project completion time)

Any critical activity will have zero total float and zero free float, based on this property, we can determine critical activities.

$= LS_j - D_{ij}$

Summary of total floats and free floats

Activity (i,j)	Duration (D_{ij})	Total float (TF_{ij})	Free float (FF_{ij})
A 1-2	2	8-0-2=6	2-0-2=0
(B) 1-3	5	5-0-5=0 ✓	5-0-5=0 ✓
C 1-4	4	10-0-4=6	10-0-4=6
(D) 3-4	5	10-5-5=0 ✓	10-5-5=0 ✓
E 2-5	7	15-2-7=6	9-2-7=0
F 2-6	3	16-2-3=11	16-2-3=11
G 3-6	3	16-5-3=8	16-5-3=8
(H) 4-6	6	16-10-6=0 ✓	16-10-6=0 ✓
I 4-7	2	16-10-2=4	12-10-2=0
J 5-8	5	20-9-5=6	20-9-5=6
(K) 6-8	4	20-16-4=0 ✓	20-16-4=0 ✓
L 6-9	3	28-16-3=9	28-16-3=9
M 7-9	12	28-12-12=4	28-12-12=4
(N) 8-9	8	28-20-8=0 ✓	28-20-8=0 ✓