

Methods of Scheduling

- There are various methods of planning, scheduling and controlling constructional activities in a project. Some of the important methods are given below :-
- Bar charts or Gantt charts
 - Milestone charts
 - PERT (program Evaluation and Review Technique)
 - CPM (Critical Path Method)
- Bar charts and milestone charts are generally used for small projects whereas PERT and CPM are two important management tools, which are quite common now-a-days and used for large projects.

BAR CHARTS (GANTT CHARTS)

Bar chart is a pictorial representation of various activities of a project developed by Henry Gantt in the beginning of twentieth century to deal with complex projects.

- It is also known as Gantt charts.
 - In this various activities or jobs related to project construction are represented in form of bars.
 - The length of bar indicates the duration or time taken by an activity to complete.
- e.g. Activity A₁ takes 3 weeks to complete, whereas activity A₂ takes only 2 weeks to complete.
- It is also important to note that activities A₁ and A₂:

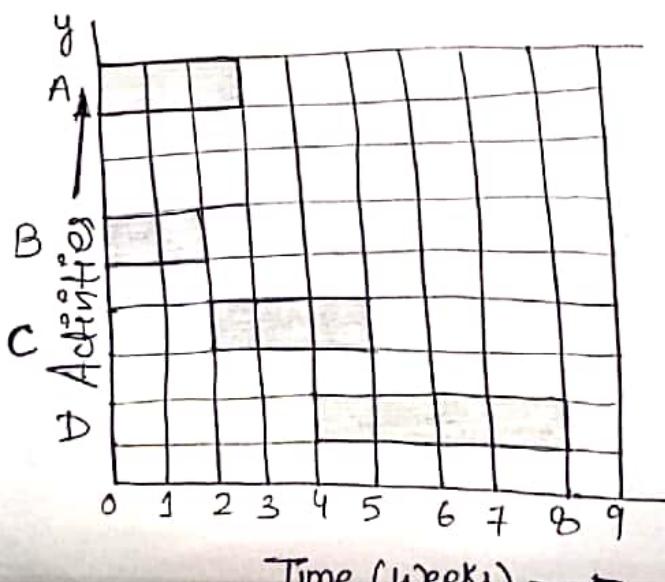


fig. Bar chart.

Activity A → Site clearance (takes 3 weeks)

Activity B → Digging Foundation (takes 2 weeks to complete)

Activity C → Erecting side boards (

Activity D → pouring concrete

Thus A and B can start simultaneously & Activity C can start only after activity A.

Milestone charts

Milestone charts are modified form of bar charts (Gantt charts) and have been devised to remove certain shortcomings or weaknesses. This modification method of changing long bars into key events for identifying progress of work is termed as milestone charts.

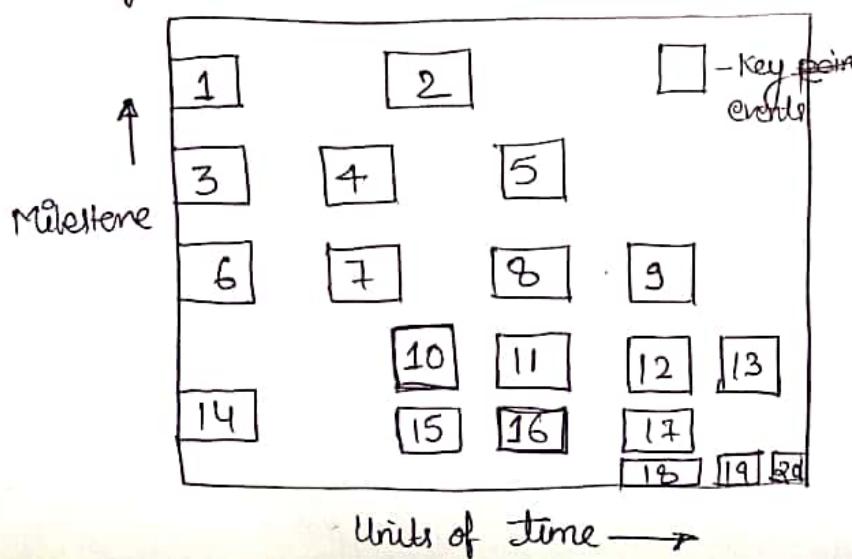
- The milestone chart are important connecting link, showing transformation of Gantt charts into networks techniques like PERT and CPM

Note

Milestones may be defined as important key points or major events in time, which can be easily identified on completion as the project progresses.

- Each event of milestone chart is properly numbered

Fig. below show the bar chart & the milestone chart for the same project work.



PERT and CPM Networks (Introduction to network Technique)

Network Technique :- The method or technique through which large complex projects can be broken down into smaller, but individual specific events and arranged in a logical sequence of events is termed as a network technique.

The two imp. management techniques are :-

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

Other technique

PEP - programme Evaluation procedure

LESS - Least Cost Estimating & Scheduling

SCANS - Scheduling and controlling by Automated Network System

Characteristics of Network Techniques

PERT and CPM are the two important management tools

- (a) It helps in planning scheduling & controlling of all activities.
- (b) It helps to coordinate various activities within the project & successfully achieved the desired objectives in time.
- (c) It helps in identifying those key events or jobs, which controls the project completion.
- (d) It helps to reduce the total time taken by project.
- (e) Used for large projects, unlike bar & milestone charts.
- (f) The two basic elements of network planning are the activities & the events. The activity is the time consuming part of the project work representing a job, whereas event is beginning or end of the job.

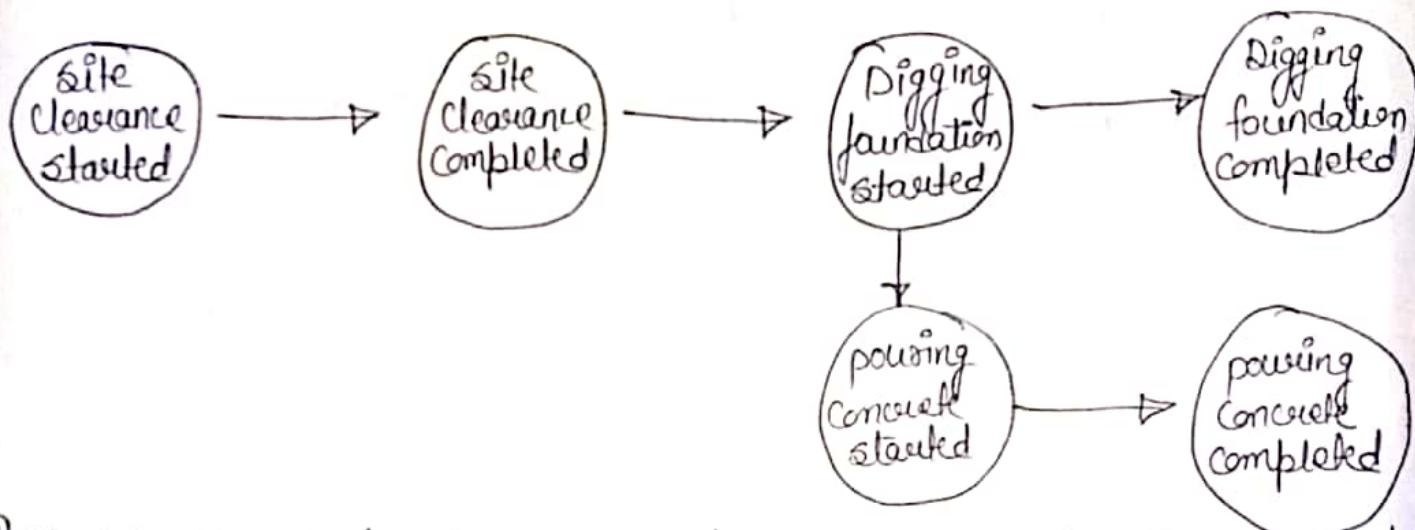
→ denotes activities.

Circle or Rectangle denotes events

they both are connected in a logical sequence to form a network.

PERT

PERT is an event oriented network technique of management science. In PERT, the main emphasis is laid upon the beginning or completion of events, rather than on activities or jobs. The main drawback of this system is that the activities taking place in between events are not specified. For eg event oriented network is shown



Thus, we see that, the above network shows only start or completion of events. It does not consume time or resource.

CPM

CPM is an activity based network technique used to analyse management problems. CPM stands for critical path Method. This network technique is built on the basis of activities or jobs involved whereas PERT puts emphasis on events.

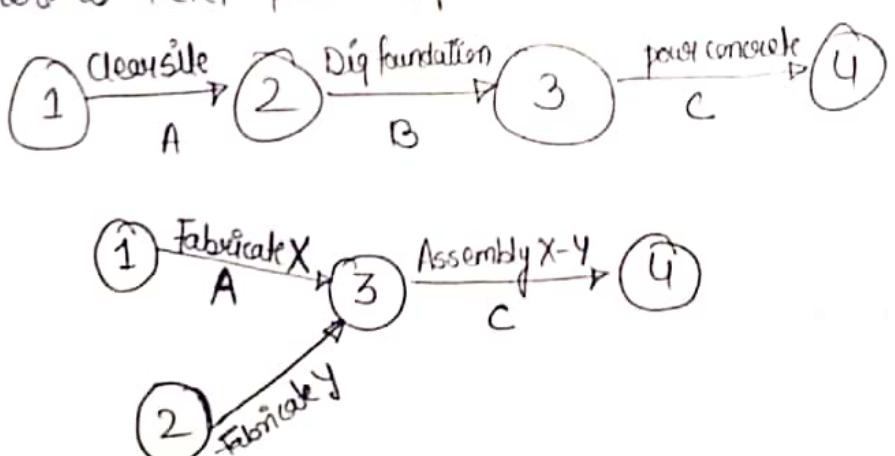


Fig. CPM Network

PERT

- ① It is event oriented network
- ② uses 3 time estimates for each activity
 - ie. optimistic time
 - pessimistic time
 - most likely time
- ③ Considers the uncertainties
- ④ In this network, times are not related to costs
- ⑤ It is less deterministic model, as uncertainties

- CPM
- activity oriented network
 - uses only one time estimate for different activities. ie. it doesn't take into account the uncertainties involved in the estimation of time for the execution of a job
 - In this network, times are related to costs.
 - more deterministic model, as no uncertainties are taken into account.

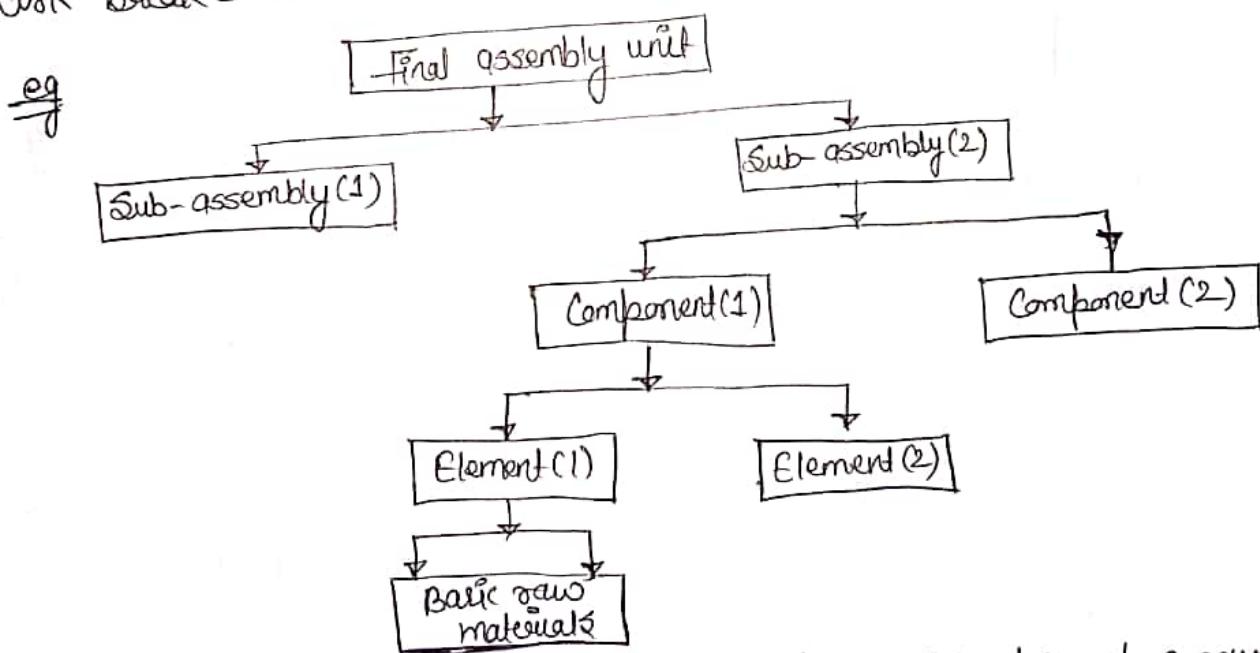
Some important Definition

1. Activity :- denoted by arrow → (write yourself)

2. Event :- begining or end of a job or activity.

3. Network :- (write yourself) break work in hierarchical order

4. Work breakdown structure :- break work in hierarchical order



5. Dummy :- An activity connecting two events, which does not consume any time or expenditure of other resources, but only depicts that, event following it cannot be started unless the preceding event is completed. It is termed as dummy activity. It is represented by a dashed line →

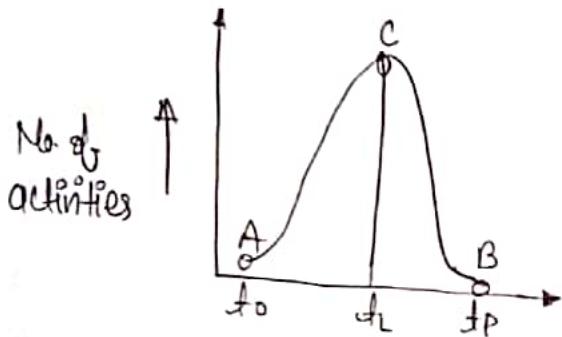
Dummy is used only to show that particular activity is completed after that activity.

- It don't take time

6. optimistic time estimate (to): The minimum possible time in which job or operation can be completed under ideal existing conditions is called as OTE.

7. pessimistic time estimate (tp) :- The maximum possible time taken by an activity to accomplish its job under worst conditions is termed pessimistic time estimate.

8. Most likely time estimate (tl) : It is time estimate which lie in between the optimistic & pessimistic time estimates.

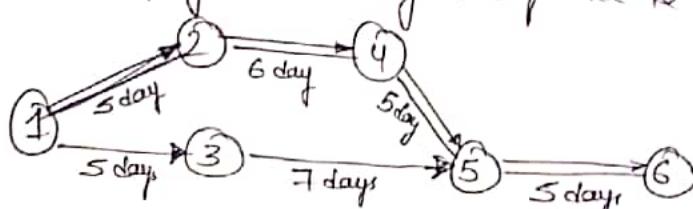


9. Expected time or average Time (te)

$$te = \frac{to + 4tl + tp}{6}$$

It is defined as average time taken for the completion of an activity.

10. Critical path :- The path which determines the maximum time required to complete the project in a logical sequence is termed as critical path.



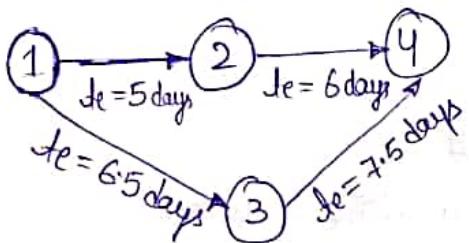
path A $\rightarrow 1-2-4-5-6 \Rightarrow 5+6+5+5 = 21 \text{ days}$

path B $\rightarrow 1-3-5-6 = 5+7+5 = 17 \text{ days}$.

Hence, path A is longest path so it is critical path.

1. earliest expected time (TE) :- "a time when an event can be expected to be completed." It may be understood that no event can be considered complete, until all the activities leading to that event are completed.

for ex



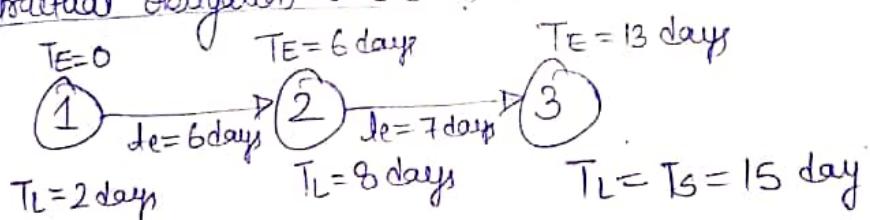
Consider path 1-2-4, the earliest expected time for event(4) is $5+6=11$ days

For path 1-3-4, the earliest expected time for event(4) is $6.5+7.5=14$ days

Note But earliest expected time for event(4) is 14 days because it is critical path (longest path)

12. Latest start time (TL) :- It is the latest time by which an event must take place to keep the project on schedule.

13. Contractual obligation time (Ts) :-



14. float :- It is the difference between the maximum time available for the completion of a job & the actual time it takes to do so.

15. Free float :- It is defined as earliest start time (TES) of a succeeding activity minus earliest finish time (TEF) of activity under consideration

16. Independent float :-

$$\begin{aligned} &= (\text{earliest start time of succeeding activity} - \text{earliest finish time of preceding job}) \\ &\quad - \text{duration of that activity.} \end{aligned}$$

* Scheduling by Network Techniques
 Bar chart & milestone charts are not suitable for planning & scheduling large scale projects. For such projects, both PERT and CPM tools have been found successful to achieve the desired objectives in time.

1. PERT Network

Event 1: Site location selected

Event 2: Site location completed

Event 3: Building for consultancy office selected

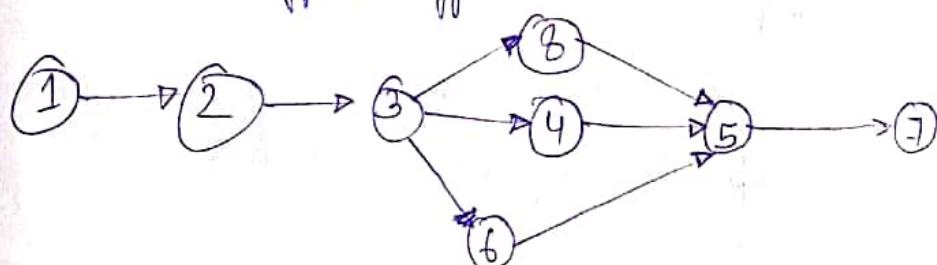
Event 4: Interior renovation started

Event 5: Interior renovation completed

Event 6: Opening of office advertised

Event 7: Consultancy office opened.

Event 8: Office staff recruited



Thus, we see from the above PERT analysis that events (6) and (8) can be taken earlier after the building for office has been selected to reduce overall time.

2. CPM Network

Activity A:- Locate site for office in a posh locality

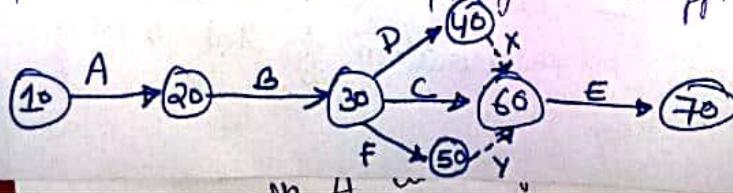
Activity B:- Select a building, where consultancy office can be accommodated

Activity C :- purchase the furniture, & complete interior renovation work.

Activity D :- properly advertise the opening of office through print & electronic media

Activity E :- Open the consultancy office formally.

Activity F :- Recruit the staff for the office



Ques:- Determine the expected time or average time

⑨ 10

S.NO	Activity or job	Time estimate in days		
		t_o	t_L	t_p
1.	Site clearance	6	10	15
2.	Digging excavation	10	16	32
3.	Erecting side boards	8	14	20
4.	Pouring concrete	12	18	36
5.	Curing concrete	7	12	18

6011 Expected Time (t_e)

$$1. \text{ For site clearance } (t_e) = \frac{t_o + 4t_L + t_p}{6} = \frac{6 + 4 \times 10 + 15}{6} = 10.5 \approx 11 \text{ days}$$

$$2. \text{ For digging excavation } (t_e) = \frac{10 + 4 \times 16 + 32}{6} = 17.67 \approx 18 \text{ days}$$

$$3. \text{ for erecting side boards } (t_e) = \frac{12 + 4 \times 18 + 36}{6} = 20 \text{ days}$$

$$4. \text{ for pouring concrete } (t_e) = \frac{12 + 4 \times 18 + 36}{6} = 20 \text{ days}$$

$$5. \text{ for curing concrete } (t_e) = \frac{7 + 4 \times 12 + 18}{6} = 12.17 \approx 13 \text{ days}$$