Critical Path Method

The critical path method is a method used for project analysis. In this method, different activities are considered for the project analysis rather than the consideration of the events. In the CPM method, different tasks are identified for the project analysis. The critical path in the CPM is high scoring section of the GATE syllabus and is the longest path with duration wise.

For example, the construction of buildings, the construction of highways, etc. These projects are handled with the help of the critical path method. This method is generally used for repetitive types of projects. The CPM analysis method calculates float associated with an activity for the project analysis.

What is the Critical Path in Project Management?

Project management is the technique for properly managing, scheduling and controlling a project. There are commonly two methods used for project management: the critical path method and the program evaluation review technique (PERT). The critical path method is based on the critical path, which is explained below.

Critical Path

In CPM analysis, the path along which total floats are zero or minimum is called the critical path. All activities on this path are critical. In a project network, more than one critical path is also possible. In a project, network activities can be critical, subcritical or supercritical. It will be explained below.

Subcritical Path: It is the path that joins all the subcritical activities in the network. A total float is greater than zero for a subcritical activity, i.e., $F_T > 0$.

Supercritical Path: It is the path that joins all super-critical activities of a project network. For a supercritical activity total float is less than zero, i.e., $F_T < 0$.

Different Terminologies Used in Critical Path Method

Different terms of the critical path method are the various terms that are used to define the method properly. These different terms are explained below with their detailed information.

Event Times in CPM

Earliest occurrence time (T_E): It is the time when an event may occur at the earliest as possible.

Latest allowable time (T_L): It is the time for an event at which it can be completed for the latest possible, but it will not affect the overall project completion time.

Activity times in CPM

Earliest start time(EST): This time refers to the earliest time to start an activity.

Earliest finish time (EFT): This time refers to the possible earliest time for which activity in the project network may be completed.

For an activity i-j

$EFT = EST + t_{ij} = T^i_E + t_{ij}$

t_{ij} = Activity duration

Latest start time(LST): The maximum possible time for an activity to start without any delay in the overall project duration.

$\therefore$ LST = LFT - Activity duration

$\therefore$ LST $= T^i_L - t_{ij}$

LFT = latest finish time of activity i – j $= T^i_L$

Latest finish time (LFT): The latest possible time by which an activity must be completed without affecting the project completion time.

For an activity i – j, the latest allowable time of the head event j, i.e., T^j_L is the LFT of activity i–j.

Note: LST of the activity is to be calculated based on the latest occurrence time of its head event and not on the brass of the latest occurrence time of its tail event.

Float

- Float is related to the activity times.
- The term float is similar to the slack in PERT analysis.
- Float is the maximum available time for an activity to be delayed without affecting overall project duration.

Floats can be classified into the following 4 types:

Total Float

The total available time span by which the finishing or starting of an activity may be delayed without affecting the total completion time of the project is called the total float of the activity. Total float is the maximum available time above the activity completion time.

$F_T = (T^J_L – T^i_E) – t_{ij}$

$F_T = (T^J_L) – (T^j_E – t_j)$

$F_T = (T^J_L) – (T^j_E – t_j)$

$F_T = LFT – EFT$

$F_T = (T^J_L – t_{ij}) – T^i_E$

$F_T = LST – EST$

F_T gives the total float.

The total float of an activity affects the total float of succeeding and preceding activities.

Free float (FF)

It is the available time for an activity to be delayed by this much without affecting the succeeding activities. Free float affects only the preceding activities. In calculating the free float, It is assumed that all the project network activities start as early as possible.

Free float is given by

$\Rightarrow F_F = F_T – S_j$

where S_j is head event slack.

In free float, the preceding activity is not allowed to occur at its latest time, and hence total float of the preceding activity is affected. However, the succeeding activity can start at its earliest start time, so its total float is not affected.

Independent float (F$_{ID}$)

It is the minimum freely available time for which completion of the preceding or succeeding activities does not affect. It can be represented as below.

$F_{ID} = F_F – S_i,$

Where S_i is the tail event slack.

Interfering float (F$_{INT}$)

It is similar to head event slack.

F$_{INT}$ = S$_j$ = F$_T$ – F$_F$
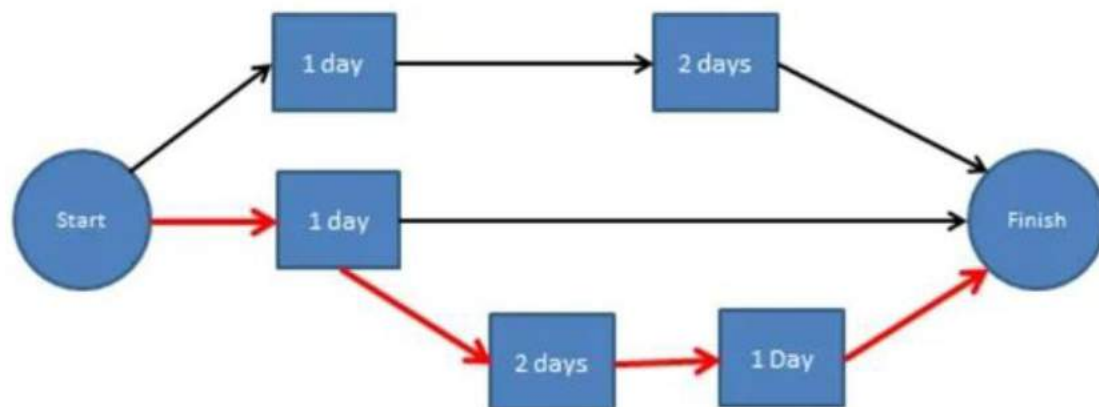
Difference Between CPM and PERT

Critical Path Method and Program Evaluation and Review Technique manage the project network. But these techniques have different meanings and are used for different purposes. Here are a few differences between these two methods, which help to strengthen the understanding.

1. CPM uses an activity-oriented approach, but PERT uses an event-oriented approach.
2. CPM has a deterministic approach, but PERT has a probabilistic approach.
3. CPM has only one time calculated, i.e., activity duration "t," but PERT has three-time estimates, known as optimistic time, pessimistic time and most likely time.
4. CPM is suitable for repetitive work where time and cost can be evaluated with a fair degree of accuracy. But PERT is used for research and development types of projects.

Example of the Critical Path Method

The Critical Path Method is a project management technique for controlling, scheduling, and executing the project. This method is best suitable for the repetitive type of project. The critical Path Method is based on the calculation of the critical path. This can be properly understood by solving an example of this method. Here such an example is shown, which strengthens your concepts.

The critical path method can be sued for Construction work, Maintenance work, Civil engineering projects etc.

Critical Path = 4 Days