UNIT – IV

PROJECT MANAGEMENT

Introduction:

This project management is extremely interesting and important for two reasons. One, it is so simple that it can be applied in our day-to-day life to plan our schedules, review our plans, monitor the progress, and control the performance. Project managers of construction works or software assignments, for instance, these techniques immensely useful.

CONCEPT OF PROJECT MANAGEMENT:

Project: A project can be defined as collection of inter – related tasks (or) activities which must be completed in a specified time according to a specified order on sequence and requires resources such as money, material, man- power, facilities, space etc. **(or)** A project is defined as a set of activities with a specific goal occupying a specific period of time.

Ex: it may be small / big project like construction of college building, lying of a road.

Characteristics of a project:

- Project is a one- time effort non- repetitive in nature.
- It has a definite start and definite end point.

Concept of project:

A project is an investment made on a package of inter-related time – bound activities. Every product has two phases. **i)** Preparation & construction

ii) Its operation.

PROJECT CYCLE:

A project cycle passes through a life cycle that may vary with the size and complexity of the project. Typically a project will pass through the following phases.

- **The concept phase:**

In this the organization realizes that a project may be needed for he organization is requested to propose a plan to perform a project for some customers.

- **Initial planning / feasibility phase:**

In this phase, the project manager plans the project to a level of detail, sufficient for initiate scheduling and budgeting.

❖ **Organization phase:**

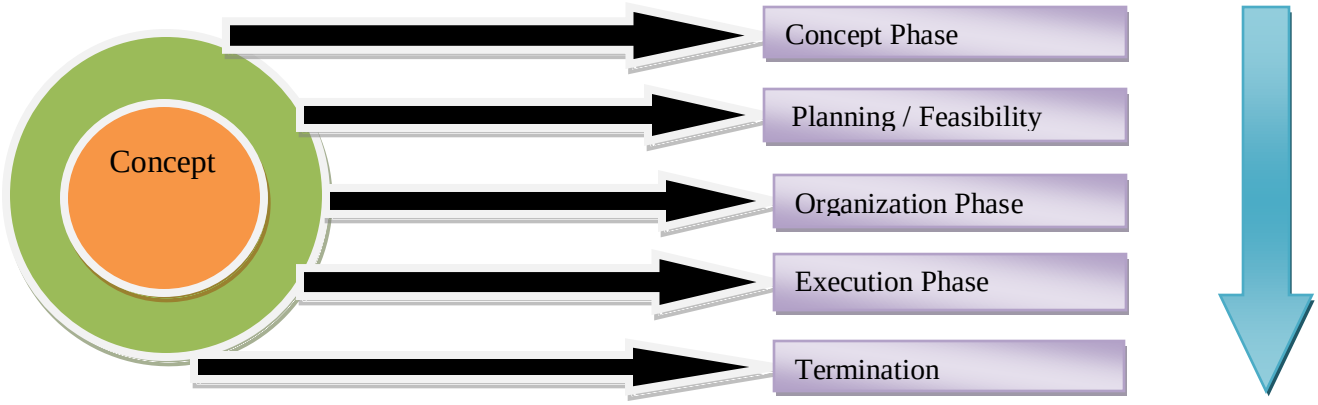
The detailed project definition such as the work breakdown structure (WBS) is examined. A WBS is a document similar to the bill of material and divides the total work in to major packages to be accomplished.

❖ **Execution phase:**

In this phase the various activities planned are completed as per the schedule, utilizing the allotted resources.

❖ **Termination:**

The project is terminated (or) disbanded after completion. The personnel who were working in the project are assigned back to their regular jobs (or) to other jobs in the organization (or) to other project in this phase.



PROJECT CYCLE

In addition to these phases we must considered three elements they are as follows:

→ **Operation:**

Operations are the activities (or) job, which must be performed to meet the project objectives.

→ **Resources:**

It can be classified under man power, methods, material, machine and time. Time and cost estimates are associated with the methods of performance.

→ **Restraints:**

It refers to the externally imposed conditions (or) restraints, like supply of materials, machines, and designs by outside agencies.

Project Management:

Def: Project management can be defined as successful completion of project on time with in the budgeted cost as per the technical specifications to satisfy the end – users.

Project management is the organizing and managing of resource in such a way that these resources deliver all the work required to complete a project with in defined scope, time and cost constraints.

Project management has certain major administrative issues such as:

- ♣ Executive responsibilities
- ♣ Project selection.
- ♣ Project manager selection.
- ♣ Organizational structure.
- ♣ Manage with in functional unit.
- ♣ Assign a coordinator.
- ♣ Use a matrix organization with a project leader.

Key Success Factors of Project Management:

- → Top – down commitment.
- → Having a capable project manager.
- → Having time to plan.
- → Good communications.

NETWORK ANALYSIS

Network: It is a graphical representation of projects operations from starting to completion. it is composed of activities. **(Or)** This is the combination of activities, dummy activities, and events in a logical sequence, according to the rules for drawing networks.

Network analysis:

Network analysis refers to number of techniques for the planning and control of complex projects. "The basis of network planning is the representation of sequential relationship between activities by means of a network of lines and circles".

- → The idea is to link the various activities in such a way that the overall time spent on the project is kept to a minimum.
- → Network analysis (or) network scheduling is a technique used for planning and scheduling large projects in the fields of construction, maintenance, fabrication, purchase, computer system installation, research and development designs etc.,

→ Network analysis helps in designing, planning, coordinating, controlling and decision making in order to accomplish the project economically in the minimum available time with the limited available resources.

Objectives of Network Analysis:

- Develops powerful coordinating tool for planning, scheduling, & controlling of projects.
- Effective utilization of resources.
- Minimization of idle resources.
- Minimization of production delays.
- Provides a comprehensive idea of the project.

Applications of network analysis:

- ✓ The construction of buildings, bridges, factories, highways, stadiums, irrigation projects etc.
- ✓ Budget and auditing procedures.
- ✓ Installation of large computers and machinery.
- ✓ Advertisement programmes and for launching a new product.
- ✓ Research and development
- ✓ Preparing inventory plans.
- ✓ Organization of big public work, conferences etc.,

Advantages of network analysis:

- They provide a logical picture of the layout & sequence of a complex project.
- They help to identify the activities and events which are critical to the entire project.
- They provide a basis for working out times, cost and resources involved in the project.

Terminology / terms used in network analysis:

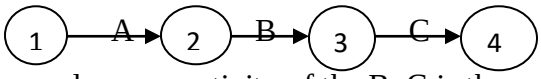
- **Activity:** An activity is a task / job of work, which takes time and resources for accomplishment.

Ex: providing electrical connections, digging of land etc. It is represented by ⟶

The **head** of the arrow indicates where the task **ends**. And the **tail** of the arrow indicates where the task **begins.**

The activities are mainly following types they are as follows:

- **Predecessor activity:** An activity that must be occur / completed immediately before anther activity can began is called Predecessor activity.
- **Successor activity:** An activity that must be occur / required to be performed after the performance of another activity is called successor activity.

Ex: 

A – is the predecessor activity of the B; C is the successor activity of the B.

- **Dummy activity:** An activity that consumes no time (zero time duration) but shows predence between events. These activities don't consume time or resources.

(OR)

In network analysis when two / more activities in a project have the same head and tail events, dummy activity is introduced. The head events (or) tail events are joined by dotted line arrow and this is known as **"dummy activity".** It is represented by dotted arrow - - - - - - →

Use of dummy activity:

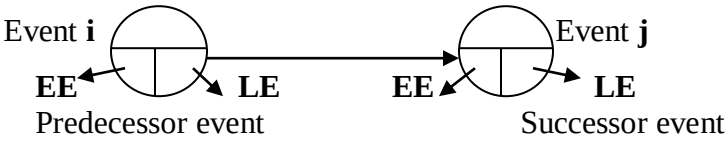
→ Maintain an undue numbering system for different activities.

→ Keep the logical sequence of activities and their inter- relationship correct.

- **Event:** An event is a point in time during a project that signifies the starting or completion of an activity. Activity starting and finishing points are events. Event consumes neither nor resources. It is represented by circle in the network.  **'Event'**

Predecessor Event: The event that occurs before another event is predecessor event to that event.

Successor Event: The event that follows another event is called successor event to that event.



EE = Earliest time of the event. LE = Latest time of the event.

- **Critical Activity:** A critical activity is an activity that if delayed, affects the completion of entire project. An activity o critical path will be critical activity. An activity for total float is zero is a critical activity.
- **Critical path:** the longest time path through a network is called the critical path. It is the longest path in the network which consumes maximum resources and maximum time. It is denoted by heavy (double) line.
- **Activity duration:** In CPM, this means the best estimate of the time to complete an activity. In PERT, the expected time (or) average time (or) average to complete an activity.
- **Float (or) Slack:** The amount of time for that an activity (or) group of activities can slip without causing a delay in the completion of the project. It is also known as **"float**". It is used in PERT. Float is the difference between time available for completing an activity and the time necessary to complete the same. **(or)**

Float / Slack mean spare time or a margin of extra time over and above its duration which a non critical activity can consume without delaying the project.

There are three types of floats:

→ **Independent float:** Independent float refers to the time by which an activity can expand without affecting any other preceding or succeeding activity. **Formula:** EE (i) – LE (j) – D

→ **Free float:** Free float to the time by which an activity can expand without affecting succeeding activities. **Formula:** EE (j) – EE (i) – D

→ **Total float:** Total float indicates the time by which an activity can expand. When total float is absorbed at the planning stage, the floats in both preceding and succeeding activities can be reduced. **Formula:** LE (j) – EE (i) – D

Note:

If float and slack values are negative (-) at any activity that value taken as zero **"0".**

Network analysis techniques:

As a tool for project management planning and control the network based methods are used.

- CPM – Critical Path Model.
- PERT – Project / Programme Evaluation and Review Technique.

CPM – CRITICAL PATH MODEL:

The E.I du Pont de Nemours Company (USA) in the year 1958 while working on a chemical plant employed a technique called CPM to schedule and control the project and experienced a good amount of saving.

CPM is an activity oriented approach. In CPM only one time estimate is used. It is easy to use and maintain. CPM is employed in projects where overall costs are of primary importance. The critical path analysis is an important tool in production planning and scheduling. This is suitable for the construction of civil and mechanical projects and for how best to reduce the time required to perform routine production, maintenance and construction and minimize the direct and indirect expenses.

CPM is suitable for application like construction, maintenance, civil projects (bridges, dams, buildings, power plants) etc.

CPM method applicable to both small and large projects. CPM is a technique, used for planning and controlling of logical sequence of operations for accomplishment of a project.

Objectives of CPM:

- To find difficulties and obstacles in the course of production process.
- To assign time for each operation.
- To ascertain starting and finishing time of the work.
- To find the critical path and the minimum duration time for the project as a whole.

In some **situations** CPM is effectively used they are as follows:

→ In production planning.

→ Location of and delivery from a warehouse.

→ Road systems and traffic schedules.

→ Communication network.

Advantages of CPM:

The application of CPM leads to the following advantages:

* It provides an analytical approach to the achievement of project objectives, which are defined clearly.
* It identifies most critical elements and pays more attention to these activities.
* It assists in avoiding waste of time, energy and money on unimportant activities.
* It provides a standard method for communicating project plans, schedules and cost.

PROGRAMME EVALUATION AND REVIEW TECHNIQUE (PERT):

PERT was first introduced in 1957 it was developed by U.S Navy department. PERT is a technique used for scheduling and controlling the projects. PERT is a time –event network analysis technique designed to watch to how the parts of a programme fit together during the passage of time and events.

PERT is a tool to evaluate a given programme and review the progress made in time to time. It is commonly employed for conducting the initial review of a project. PERT anticipates potential areas of problem which may disturb program objectives. Because timely action can be taken to prevent their occurrence.

PERT is mainly concerns with events and it is thus event oriented system. In PERT time estimates are used calculate expected activity time. Because of uncertainty in activity timings, PERT considered as probabilistic model. Dummy activities are required in PERT.

Time estimates of PERT: In PERT three time estimates are used to calculate they are as follows:

- **Optimistic time (to):** the time for completing an activity if all goes well / under ideal conditions used in PERT.
- **Pessimistic time (tp):** It is the time which an activity will take to complete if every thing goes wrong, used in PERT.
- **Most likely time (tm):** The time taken for completing an activity, under normal conditions. This is the consensus best estimate, PERT. It lies between the optimistic time and pessimistic time.
- **Expected time (Te):** Expected time or average time (Te) for an activity to calculate by combining statistically all the three time estimates to, tp, and tm.

Formula:

$$Te = \frac{to + 4tm + tp}{6}$$

- **Variance:** It is a measure of the dispersion. Larger the variance, greater will be the uncertainty.

Formula:

$$\sigma = \frac{tp - to}{6}$$

Applications of PERT:

→ Research and development.
→ Marketing programmes and advertising programmes.
→ Defense projects.
→ Installation of machinery.
→ Construction programmes.
→ Instituting inventory control.

Advantages of PERT:

- It forces managers and subordinate managers to make a plan for production because time event analysis is quite impossible without planning and seeing how the piece fit together.
- PERT encourages management control by exception. It concentrates attention on critical elements that may need correction.
- It provides graphic display of activities and identifies critical activities and slack activities.
- It enables forward-working control as a delay will affect the succeeding events and possibly the whole project. The production manger can somehow make up the time by shortening that of some other event.
- The network system with its sub-systems creates a pressure for action at the right spot and level and at the time.
- PERT can be effectively used for rescheduling the activities.

Limitations of PERT:

- It is a time-consuming and expensive technique.
- It is based on beta distribution and the assumption of beta distribution may not always be true.
- PERT is not suitable when programme is not precise and a reasonable estimate of time schedule is not possible.
- It is not useful for routine planning of recurring events such as mass production because once a repetitive sequence worked out; elaborate and continuing control is not required.
- The expected time and the corresponding variance are only estimated values.
- Important activities may be omitted or the precedence relationships may not be correct.

Differences between CPM and PERT:

PERT	CPM
A probabilistic model with uncertainty activity duration.	A deterministic model with well-known activity.
Approach is event-oriented.	Approach is activity-oriented.
Uses words like network diagram, event and slack.	Employs words like arrow diagram, nodes and floats.
Dummy activities are used to represent proper sequencing.	Dummy activities are not necessary for usage. The arrow diagram thus becomes slightly simpler.
Does not democrat between critical and non-critical activities.	Marks critical activities.
Find application in all those projects where resources are always made available as and when required.	Find application in all those projects where overall costs are of primary importance.
Suitable especially in defense projects and research and development where the activity times cannot be readily predicated.	Suitable for problem in industrial settings plant maintenance, civil constructions projects.
It has three- times estimates i.e.., Optimistic time(to), Most Likely time (TM) , and Pessimistic Time (TP)	It has one-time estimate.
It is a control device.	It is a planning device.

Probability of Completing the Project:

By using probability of distribution the probability of completing the project by schedule time is given as:

Normal deviate (Z) = $\left(\frac{(TL - TE)}{\sigma} \right)$

Here Z = Normal deviate.

σ = Standard deviation of the entire network.

TL = Given estimate time of the project.

TE = Expected time of the project.

Steps involved in determining the probability:

→ Determine the standard deviation for each activity. $\left(\frac{tp - to}{6} \right)$

→ Determine variance $\left(\frac{tp - to}{} \right)^2$

→ Determine the square root of the sum of variances. This gives the standard deviation for entire project. (i.e. calculate the standard deviation for critical path by using the standard deviation for each activity.)

→ By applying the Normal deviate formula we get probability of completing the project within the given time.

Note: We get the value of the normal deviate. This should not be within a range of + / - 3 sigma limits.

→ To arrive the % of probability of completing the project within the given time, the value of the normal deviate has to be converted in to the value of probability by using the table of normal distribution function table. Thus, the probability completing the project is determined.

Normal distribution Function Table:

Normal Deviate (Z)	Probability (%)	Normal Deviate (Z)	Probability (%)
0	50.0	-0	50.0
0.2	57.9	-0.2	42.1
0.4	65.5	-0.4	34.5
0.6	72.6	-0.6	27.4
0.8	78.8	-0.8	21.2
1.0	84.1	-1.0	15.9
1.2	88.5	-1.2	11.5
1.4	91.9	-1.4	8.1
1.6	94.5	-1.6	5.5
1.8	96.4	-1.8	3.6
2.0	97.7	-2.0	2.3
2.2	98.8	-2.2	1.4
2.4	99.2	-2.4	0.8
2.6	99.5	-2.6	0.5
2.8	99.7	-2.8	0.3
3.0	99.9	-3.0	0.1

PROJECT CRASHING:

In PERT / CPM network techniques, time is related to cost and the objective is to develop optimum time – cost relationship. The **ultimate objective** of the network techniques is not only to bring improvement in planning scheduling and controlling of the project but also **to assess possibility of arriving at a feasible desirable time – cost relationship.**

The policy of any organization is to reduce the target time so that time saved can be utilized for additional product or otherwise.

The overall project duration can be minimized by reducing the duration of only the critical activities of the project network. To reduce the schedule time, non – critical activities can be considered as potential point of resources for diverting to critical activities.

The duration of the project can be shortened by systematic analysis of critical path activities, crashing cost and corresponding cost effect of indirect costs.

Formula: **Cost Slope** = $\frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Normal Time} - \text{Crash Time}}$

Increase Cost = Crash Cost – Normal Cost.

Decrease in Time = Normal Time – Crash Time.

Terms in Crashing:

- **Normal cost:** It is lowest cost of completing an activity in the minimum time, employing normal means i.e. not using over time or other special resources. **Or** the expenditure incurred on normal resources for completing any activity in normal time is known as normal cost.
- **Normal cost:** It is the minimum time required to achieve the normal cost. Normal time is associated with the normal resources of the organization to perform the activity.
- **Crash cost:** It is the least cost of completing an activity by employing all possible means like overtime, additional machinery, proper materials, etc. **Or** the total expenditure incurred on additional resources for crashing the time is known as "crash cost".
- **Crash time:** Crash time is the minimum possible time in which an activity can be completed by employing extra resources. Crash time is the time beyond which the activity cannot be shortened by any amount of increase in resources.
- **Cost Slope:** The term cost slope is defined as the "increase in the cost of the activity per unit decrease in the time.

Mathematically the time – cost relationship can be represented as:

$$\text{Cost Slope} = \frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Normal Time} - \text{Crash Time}}$$

PROJECT COSTS:

The total project cost is the sum of direct and indirect costs. Indirect cost consists of overheads, depreciation, insurance, supervisory cost etc.

- **Direct costs:** costs, like manpower, material, etc incurred for project execution. This cost is directly proportional to the quality of resources involved during a period. Direct costs are more in crash time.
- **Indirect costs:** Cost consists of overheads, depreciation, insurance, supervisor's salaries, rent, and establishment charges etc. these costs are directly proportionate to the duration of the project.