MODULE -I

Management:

"Management is the process of reaching organizational goals by working with and through people and other organizational resources."

Management has the following 3 characteristics:

1. It is a process or series of continuing and related activities.
2. It involves and concentrates on reaching organizational goals.
3. It reaches these goals by working with and through people and other organizational resources.

Characteristics of Management:

1. Management is goal oriented process:

- Management always aims at achieving the organizational objectives.
- The functions and activities of manager lead to the achievement of organizational objectives.
- Example, if the objective of a company is to sell 1000 computers then manager will plan the course of action, motivate all the employees and organize all the resources keeping in mind the main target of selling 1000 computers.

2. Management is Pervasive:

- Management is a universal phenomenon.
- The use of management is not restricted to business firms only it is applicable in profit-making, non-profit-making, business or non-business organizations; even a hospital, school, club and house has to be managed properly.
- Concept of management is used in the whole world whether it is USA, UK or India.

3. Management is Multidimensional:

Management does not mean one single activity but it includes three main activities:

a) Management of work:

- All organizations are set up to perform some task or goal.
- Management activities aim at achieving goals or tasks to be accomplished.

- The task or work depends upon the nature of Business for example, work to be accomplished in a school is providing education, in hospital is to treat patient, in industry to manufacture some product.
- Management makes sure that work is accomplished effectively and efficiently.

b) Management of people:

- People refer to Human resources and Human resources are the most important assets of an organization.
- An organization can win over competitor with efficient employees only because two organizations can have same physical, technological and financial resources but not human resources.
- Management has to get task accomplished through people only.

c) Management of operations:

- Operations refer to activities of production cycle such as buying inputs, converting them into semi-finished goods, finished goods.
- Management of operations concentrates on mixing management of work with management of people, i.e., deciding what work has to be done, how it has to be done and who will do it.

4. Management is a continuous process:

- Management is a continuous or never ending function.
- All the functions of management are performed continuously.
- Example planning, organizing, staffing, directing and controlling are performed by all the managers all the time. Sometimes, they are doing planning, then staffing or organizing etc.
- Managers perform ongoing series of functions continuously in the organization.

5. Management is a group activity:

- Management always refers to a group of people involved in managerial activities.
- The management functions cannot be performed in isolation.
- Each individual performs his/her role at his/her status and department, and then only management function can be executed.
- Even the result of management affects every individual and every department of the organization so it always refers to a group effort and not the individual effort of one person.

6. Management is a dynamic function:

- Management has to make changes in goal, objectives and other activities according to changes taking place in the environment.
- The external environment such as social, economic, technical and political environment has great influence over the management.

7. Intangible:

- Management function cannot be physically seen but its presence can be felt.

- The presence of management can be felt by seeing the orderliness and coordination in the working environment.
- It is easier to feel the presence of mismanagement as it leads to chaos and confusion in the organization.

8. Composite process:

- Management consists of series of functions which must be performed in a proper sequence.
- These functions are not independent of each other.
- They are inter-dependent on each other. As the main functions of management are planning, organizing, staffing, directing and controlling; organizing cannot be done without doing planning, similarly, directing function cannot be executed without staffing and planning and it is difficult to control the activities of employees without knowing the plan.
- All the functions inter-dependent on each other that is why management is considered as a composite process of all these functions.

9. Balancing effectiveness and efficiency:

- Effectiveness means achieving targets and objectives on time.
- Efficiency refers to optimum or best utilization of resources.
- Managements always try to balance both and get the work done successfully.
- Only effectiveness and only efficiency is not enough for an organization: a balance must be created in both.

Functions of Management:

Effective management and leadership involve creative problem solving, motivating employees and making sure the organization accomplishes objectives and goals. There are five functions of management and leadership: planning, organizing, staffing, coordinating and controlling. These functions separate the management process from other business functions such as marketing, accounting and finance.

1. Planning

- The planning function of management controls all the planning that allows the organization to run smoothly.
- Planning involves defining a goal and determining the most effective course of action needed to reach that goal.
- Typically, planning involves flexibility, as the planner must coordinate with all levels of management and leadership in the organization.
- Planning also involves knowledge of the company's resources and the future objectives of the business.

2. Organizing

- The organizing function of leadership controls the overall structure of the company.

- The organizational structure is the foundation of a company; without this structure, the day-to-day operation of the business becomes difficult and unsuccessful.
- Organizing involves designating tasks and responsibilities to employees with the specific skill sets needed to complete the tasks.
- Organizing also involves developing the organizational structure and chain of command within the company.

3. Staffing

- The staffing function of management controls all recruitment and personnel needs of the organization.
- The main purpose of staffing is to hire the right people for the right jobs to achieve the objectives of the organization.
- Staffing involves more than just recruitment; staffing also encompasses training and development, performance appraisals, promotions and transfers.
- Without the staffing function, the business would fail because the business would not be properly staffed to meet its goals.

4. Coordinating

- The coordinating function of leadership controls all the organizing, planning and staffing activities of the company and ensures all activities function together for the good of the organization.
- Coordinating typically takes place in meetings and other planning sessions with the department heads of the company to ensure all departments are on the same page in terms of objectives and goals.
- Coordinating involves communication, supervision and direction by management.

5. Controlling

- The controlling function of management is useful for ensuring all other functions of the organization are in place and are operating successfully.
- Controlling involves establishing performance standards and monitoring the output of employees to ensure each employee's performance meets those standards.
- The controlling process often leads to the identification of situations and problems that need to be addressed by creating new performance standards.
- The level of performance affects the success of all aspects of the organization.

Importance of Planning in Management:

Planning is the first and most important function of management. It is needed at every level of management. In the absence of planning all the business activities of the organization will become meaningless. The importance of planning has increased all the more in view of the increasing size of organizations and their complexities. Planning has again gained importance because of uncertain and constantly changing business environment. In the absence of planning, it may not be impossible but certainly difficult to guess the uncertain events of future.

1. Planning Provides Direction:

- Under the process of planning the objectives of the organization are defined in simple and clear words.
- The obvious outcome of this is that all the employees get a direction and all their efforts are focused towards a particular end.
- In this way, planning has an important role in the attainment of the objectives of the organization.
- For example, suppose a company fixes a sales target under the process of planning. Now all the departments, e.g., purchase, personnel, finance, etc., will decide their objectives in view of the sales target and work on the same to achieve planned target.

2. Planning Reduces Overlapping and Wasteful Activities:

- Under planning, future activities are planned in order to achieve objectives.
- Consequently, the problems of when, where, what and why are almost decided.
- This puts an end to disorder and suspicion.
- In such a situation coordination is established among different activities and departments.
- It puts an end to overlapping and wasteful activities.
- Consequently, wastages moves towards nil, efficiency increases and costs get to the lowest level.

3. Planning Promotes Innovative Ideas:

- It is clear that planning selects the best alternative out of the many available.
- All these alternatives do not come to the manager on their own, but they have to be discovered.
- While making such an effort of discovery, many new ideas emerge and they are studied intensively in order to determine the best out of them.
- In this way, planning imparts a real power of thinking in the managers.
- It leads to the birth of innovative and creative ideas.
- For example, a company wants to expand its business. This idea leads to the beginning of the planning activity in the mind of the manager.

He will think like this:

a) Should some other varieties of the existing products be manufactured?
b) Should retail sales be undertaken along with the wholesales?

c) Should some branch be opened somewhere else for the existing or old product?
d) Should some new product be launched?

In this way, many new ideas will emerge one after the other. By doing so, he will become habituated to them. He will always be thinking about doing something new and creative. Thus, it is a happy situation for a company which is born through the medium of planning.

4. Planning Facilitates Decision Making:

- Decision making means the process of taking decisions.
- Under it, a variety of alternatives are discovered and the best alternative is chosen.
- The planning sets the target for decision making.
- It also lays down the criteria for evaluating courses of action.
- In this way, planning facilitates decision making.

5. Planning Establishes Standards for Controlling:

- By determining the objectives of the organization through planning all the people working in the organization and all the departments are informed about 'when', 'what' and 'how' to do things.
- Standards are laid down about their work, time and cost, etc.
- Under controlling, at the time of completing the work, the actual work done is compared with the standard work and deviations are found out and if the work has not been done as desired the person concerned are held responsible.
- For example, a laborer is to do 10 units of work in a day (it is a matter of planning), but actually he completes 8 units. Thus there is a negative deviation of 2 units. For this, he is held responsible. (Measurement of actual work, knowledge of deviation and holding the laborer responsible falls under controlling.) Thus, in the absence of planning controlling is not possible.

Types of Plans:

1. Operational Planning:

- "Operational plans are about how things need to happen."
- This type of planning typically describes the day-to-day running of the company.
- Operational plans are often described as single use plans or ongoing plans.
- Single use plans are created for events and activities with a single occurrence (such as a single marketing campaign).
- Ongoing plans include policies for approaching problems, rules for specific regulations and procedures for a step-by-step process for accomplishing particular objectives.

2. Strategic Planning:

- "Strategic plans are all about why things need to happen," Story said.
- "Its big picture, long-term thinking. It starts at the highest level with defining a mission and casting a vision."

- Strategic planning includes a high-level overview of the entire business.
- It's the foundational basis of the organization and will dictate long-term decisions.
- The scope of strategic planning can be anywhere from the next two years to the next 10 years.
- Important components of a strategic plan are vision, mission and values.

3. Tactical Planning:

- "Tactical plans are about what is going to happen," Story said.
- "Basically at the tactical level, there are many focused, specific, and short-term plans, where the actual work is being done, that support the high-level strategic plans."
- Tactical planning supports strategic planning.
- It includes tactics that the organization plans to use to achieve what's outlined in the strategic plan.
- Often, the scope is less than one year and breaks down the strategic plan into actionable chunks.
- Tactical planning is different from operational planning in that tactical plans ask specific questions about what needs to happen to accomplish a strategic goal; operational plans ask how the organization will generally do something to accomplish the company's mission.

4. Contingency Planning:

- Contingency plans are made when something unexpected happens or when something needs to be changed.
- Business experts sometimes refer to these plans as a special type of planning.
- Contingency planning can be helpful in circumstances that call for a change.
- Although managers should anticipate changes when engaged in any of the primary types of planning, contingency planning is essential in moments when changes can't be foreseen.
- As the business world becomes more complicated, contingency planning becomes more important to engage in and understand.

Project Formulation:

1. Taking a first look carefully and critically at the project idea.
2. Carefully weighing its various components.
3. Analyzing with the assistance of specialists or consultants.
4. Assessment of the various aspects of an investment proposition.
5. It is an important stage in the pre-investment phase

Construction Project Management:

"A project is a temporary endeavor undertaken to create a unique product or service".

Each and every project has its own start date and a specific end date. So it is called as temporary. It is unique because the product or the service it is providing will be different in some or the other way when compared to other products.

- Temporary means each project will be having its own beginning and a definite end.
- The end is said to be achieved when the purpose of the project is served or the objective of the project has been achieved.
- Durations of the project need not be same for all the projects.
- It will be different for different projects.
- Even similar projects durations get varied.
- The word temporary doesn't mean that duration of project is very small.
- Some projects get over in short periods/duration and some last for several years.
- But every project has a definite end and projects are not ongoing efforts.

"Management is the science and art of planning, organizing, leading and controlling the work of organization members and of using all available organization resources to reach stated organizational goals."

Construction management deals with economical consumption of the resources available in the least possible time for successful completion of construction project. 'Men', 'materials', 'machinery' and 'money' are termed as resources in construction Management.

- Construction management is best done by people with a detailed knowledge of building construction, such as civil engineers or architects.
- However some aspects of this work, such as financial planning or procurement, can be done by people who do not have a construction background.
- With enough training and experience, a layman can gain enough expertise to work as a construction project manager.

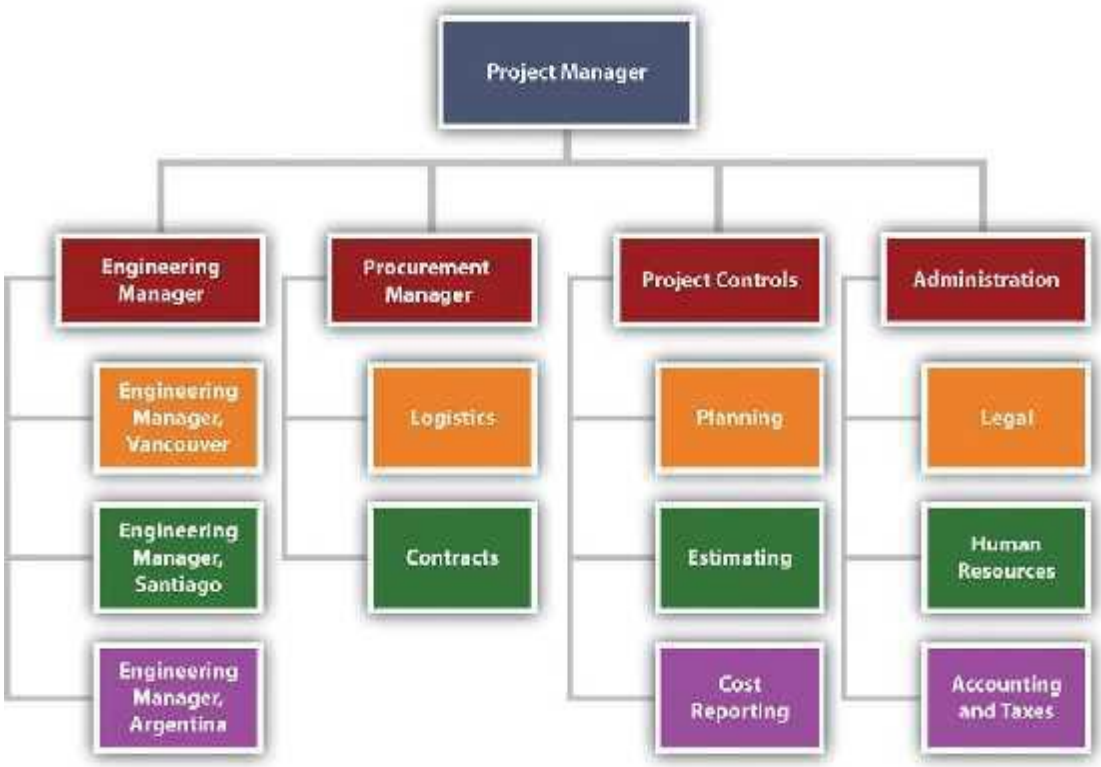
Objectives of Construction Management:

The main objectives of construction management are,

1. Completing the work within estimated budget and specified time.
2. Maintaining a reputation for high quality workmanship
3. Taking sound decisions and delegation of authority
4. Developing an organization that works as a team.

Project Organization:

- The Project Organization defines the human infrastructure of the project.
- This task is designed to define the project organization chart, the roles, and the relationships of the project team.
- The organizational structure clearly identifies roles and responsibilities of each position, augmenting the existing role definitions where necessary to cover all of the responsibilities.
- The Project Organization technique that is used in this step provides a standard set of roles and responsibilities which can be customized for a particular project.
- This should cover all personnel resources required, both full and part time.



Guidelines for Project Organization:

1. Roles are clearly defined sets of responsibilities that need to be performed for a project to be successful.
2. People are assigned to roles and so are assigned responsibilities.
3. Roles do not necessarily correlate to positions that exist in the functional organization; they are typically project-specific positions that are temporary and exist for the length of the project.
4. While defining the Project Organization it will be necessary to ensure that each person in the Project Organization understands his/her responsibilities and has the time available to carry out those responsibilities.

Functions of Construction Management:

1. Planning in Construction Management:

It is the process of selecting a particular method and the order of work to be adopted for a project from all the possible ways and sequences in which it could be done. It essentially covers the aspects of 'What to do' and 'How to do it'.

Importance of construction project planning:

a) Planning helps to minimize the cost by optimum utilization of available resources.

b) Planning reduces irrational approaches, duplication of works and inter departmental conflicts.

c) Planning encourages innovation and creativity among the construction managers.

d) Planning imparts competitive strength to the enterprise.

2. Scheduling in Construction Management:

Scheduling is the fitting of the final work plan to a time scale. It shows the duration and order of various construction activities. It deals with the aspect of 'when to do it'.

Importance of construction project scheduling:

Scheduling of the programming, planning and construction process is a vital tool in both the daily management and reporting of the project progress.

3. **Organizing:**

Organizing is concerned with decision of the total construction work into manageable departments/sections and systematically managing various operations by delegating specific tasks to individuals.

4. **Staffing:**

Staffing is the provision of right people to each section / department created for successful completion of a construction project.

5. **Directing:**

It is concerned with training sub ordinates to carryout assigned tasks, supervising their work and guiding their efforts. It also involves motivating staff to achieve desired results.

6. **Controlling:**

It involves a constant review of the work plan to check on actual achievements and to discover and rectify deviation through appropriate corrective measures.

7. **Coordinating:**

It involves bringing together and coordinating the work of various departments and sections so as to have good communication. It is necessary for each section to aware of its role and the assistance to be expected from others.

Importance of Construction Management:

1. Construction management practices invariably lead to “maximum production at least cost”.
2. A good construction management, results in completion of a construction project with in the stipulated budget.
3. Construction management provides importance for optimum utilization of resources. In other words, it results in completion of a construction project with judicious use of available resources.
4. Construction management provides necessary leadership, motivates employees to complete the difficult tasks well in time and extracts potential talents of its employees.
5. Construction management is beneficial to society as the effective and efficient management of construction projects will avoid, escalation of costs, time overrun, wastage of resources, unlawful exploitation of labor and pollution of environment.

Management Styles:

In an organization, managers perform many functions and play many roles. They are responsible for handling many situations and these situations are usually different from one another. When it comes to handling such situations, managers use their own management styles. Some management styles may be best for the situation and some may not be. Therefore, awareness on different types of management styles will help the managers to handle different situations the optimal way. In short, a management style is a leadership method used by a manager. Let's have a look at four main management styles practiced by managers all over the world.

1. **Autocratic**
   - In this management style, the manager becomes the sole decision maker.
   - The manager does not care about the subordinates and their involvement in decision making.
   - Therefore, the decisions reflect the personality and the opinion of the manager.
   - The decision does not reflect the team's collective opinion.
   - In some cases, this style of management can move a business towards its goals rapidly and can fight through a challenging time.
   - If the manager has a great personality, experience and exposure, the decisions made by him or her could be better than collective decision making.
   - On the other hand, subordinates may become dependent upon the manager's decisions and may require thorough supervision.
   - There are two types of autocratic managers:

   a) **Directive autocrat**. This type of managers make their decisions alone and supervise the subordinates closely.

   b) **Permissive autocrat**. This type of managers make their decisions alone, but allows subordinates to freely execute the decisions.

2. **Democratic:**
   - In this style, the manager is open to other's opinions and welcome their contribution into the decision making process.
   - Therefore, every decision is made with the majority's agreement.
   - The decisions made reflect the team's opinion.
   - For this management style to work successfully, robust communication between the managers and the subordinates is a must.
   - This type of management is most successful when it comes to decision making on a complex matter where a range of expert advice and opinion is required.
   - Before making a business decision, usually a series of meetings or brainstorming sessions take place in the organizations.
   - These meetings are properly planned and documented.
   - Therefore, organization can always go back to the decision making process and see the reasons behind certain decisions.
   - Due to the collective nature, this style of management gives more employee satisfaction.

- If decision making through the democratic style takes too long for a critical situation, then it is time to employ autocrat management style before it is too late.

3. Paternalistic

- This is one of the dictatorial types of management.
- The decisions made are usually for the best interest of the company as well as the employees.
- When the management makes a decision, it is explained to the employees and obtains their support as well.
- In this management style, work-life balance is emphasized and it eventually maintains a high morale within the organization.
- In the long run, this guarantees the loyalty of the employees.
- One disadvantage of this style is that the employees may become dependent on the managers.
- This will limit the creativity within the organization.

4. Laissez-faire

- In this type of management, the manager is a facilitator for the staff.
- The employees take the responsibility of different areas of their work.
- Whenever the employees face an obstacle, the manager intervenes and removes it.
- In this style, the employee is more independent and owns his or her responsibilities.
- The manager has only a little managerial tasks to perform.
- When compared with other styles, a minimum communication takes place in this management style between the employees and the managers.
- This style of management is the best suited for companies such as technology companies where there are highly professional and creative employees.

Construction Planning:

Planning of a project is one of the most important task before starting any construction project. Here the duration required for each activity is calculated based on the quantity of work to be done.

- Planning of a projects can be done manually or with the help of Project Management Software's like MSP and Primavera.
- But this becomes complicated when we have to manage several projects together, thus its better using project management software.
- Construction planning is the most important and hazardous task in all the construction projects.
- It usually includes the selection of the technology, work task definition, calculation of durations and resources of different tasks and also identifies the relationship between different work tasks.
- Project planning generally require the necessary aspects like including the generation of required activities, analyzing how these activities may be implicated and choosing the best among the available methods of performing these activities.
- A planner should be having the imagination of the final design and bring it in the plans and specifications.

Importance is given to cost and schedule during developing a construction plan in any construction project. But some construction projects will be cost oriented which are primarily divided into expense categories associated more with cost than schedule. In these types of construction plans, differentiation is made between cost incurred directly in the performance of the activity and directly for completing the project. Some construction plans are schedule oriented. These types of plans are made for the projects where time is more critical factor, which helps in efficient scheduling of the available resources. In this type of plans critical path scheduling procedure is followed. But in most construction projects, construction planning will be done by considering both cost and schedule overtime, so that planning, monitoring and record keeping must be considered.

Key aspects of construction planning:

Project managers are responsible for maintaining a wide-angle view of each and every job site, while at the same time managing a variety of critical elements, including:

1. Scope of the project
2. Integration of all project elements
3. Time management and project scheduling
4. Cost estimates and budget control
5. Quality control
6. Efficient use of human resources
7. Effective internal and external communications
8. Mitigation and analysis of risk
9. Procurement of resources from external providers

Successful project planners are those who are not only capable of managing each of these elements, but can also effectively communicate the construction plan to team members and stakeholders.

Construction Scheduling:

Scheduling is determining the time required for completion of each event in the project that is when and which task will be performed. In simple words it can be said that it represents the plan of the project. Planning in other words means how to do, what has to be done and who should do and scheduling means when it has to be done and its purpose. Scheduling may also be called as a detailed plan of the project activities with specific durations.

- A schedule may act as very good tool between all the people involved in the project.
- The overall progress of the project should be given by the schedule it is very difficult to explain the person who is not familiar with the project that what is going on in the project and what can be expected from the project.
- A construction project may be seen in different ways by different people involved in the project like owners, engineers carrying out designs, site engineers, and contractors.
- Schedule of the project, provides time required for completion of a particular activity in the project.
- It may also be called as a schedule values of the project, which the contractors submit based on which monthly payment is made.

- The sequence and phasing of the activities involved in the completion of the project may also be given by the schedule.
- The activities in a project should be sequential in relationship so that the work is carried out in sequence and effective manner.

Project Scheduling Steps:

To carry out the project in a sequential manner there should be a proper planning and scheduling to any construction project. Thus schedule making for a construction project which is efficient and workable involve several steps. Following are the steps for project scheduling.

- The time required to carry out each activity should be estimated.
- Using this estimation, the overall time required for completion of the project may be calculated.
- Time interval within which each activity must start and finish within the specified time/duration is estimated.
- Many activities together form a project. Each activity is different from one another. Thus the quantity of work to be done in each activity is estimated.
- Some activities in the project are very crucial. Thus such activities should be identified.
- Shorten the project duration at minimum possible cost if completion of project date is not constant with contract.
- Most activities posses' surplus of float times. This should be utilized. If there are any conflicts, then minimize it by adjusting the start and finish times of selected activities and level the resources.
- Prepare schedule of the project which show the duration required for each activity involved in the project.

Work Breakdown Structure:

"Dividing complex projects to simpler and manageable tasks is the process identified as Work Breakdown Structure (WBS)."

Usually, the project managers use this method for simplifying the project execution. In WBS, much larger tasks are broken down to manageable chunks of work. These chunks can be easily supervised and estimated.

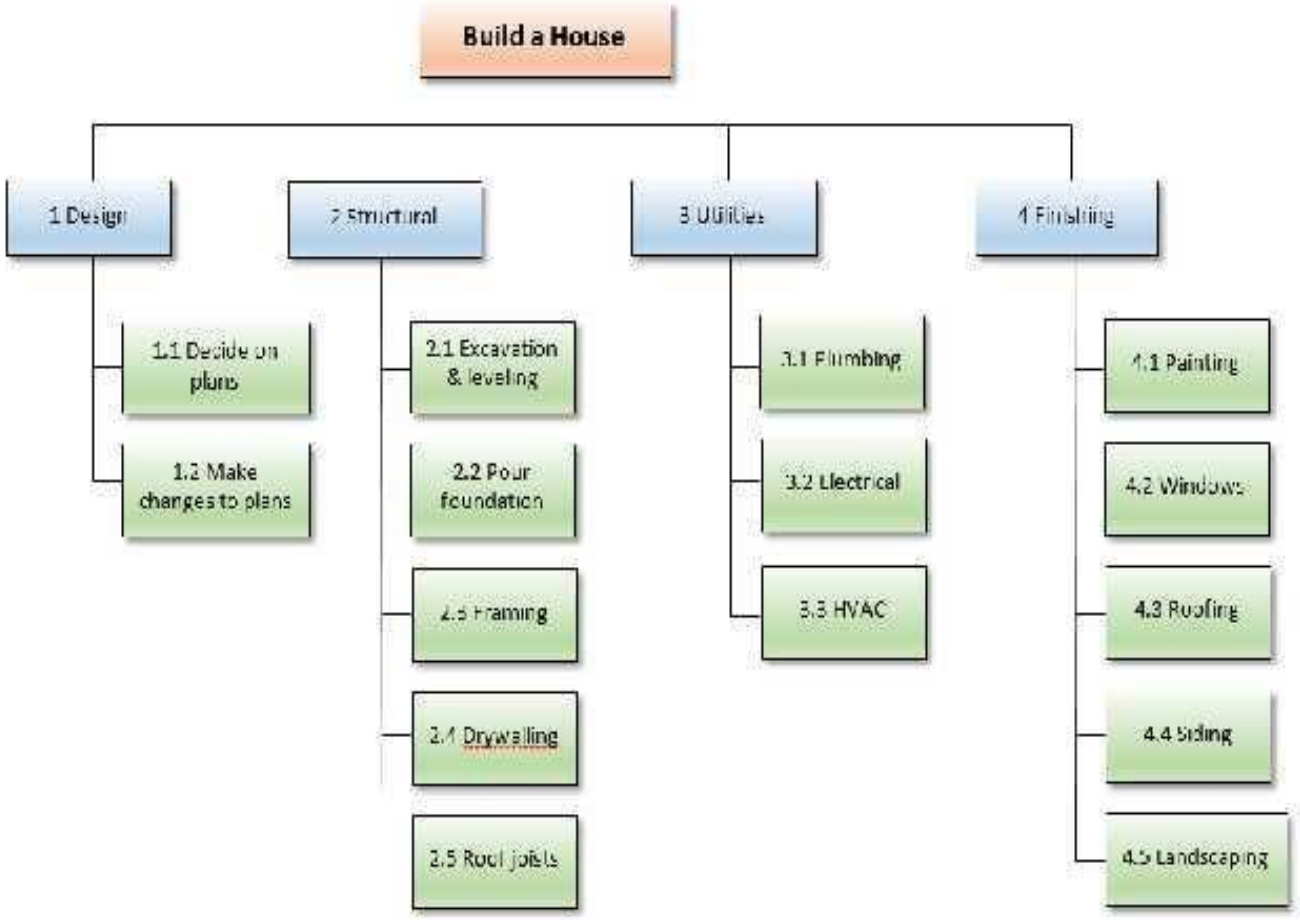
WBS is not restricted to a specific field when it comes to application. This methodology can be used for any type of project management.

Following are a few reasons for creating a WBS in a project:

1. Accurate and readable project organization.
2. Accurate assignment of responsibilities to the project team.
3. Indicates the project milestones and control points.
4. Helps to estimate the cost, time and risk.
5. Illustrate the project scope, so the stakeholders can have a better understanding of the same.

Construction of a WBS:

- Identifying the main deliverables of a project is the starting point for deriving a work breakdown structure.
- This important step is usually done by the project managers and the subject matter experts (SMEs) involved in the project.
- Once this step is completed, the subject matter experts start breaking down the high-level tasks into smaller chunks of work.
- In the process of breaking down the tasks, one can break them down into different levels of detail.
- One can detail a high-level task into ten sub-tasks while another can detail the same high-level task into 20 sub-tasks.
- Therefore, there is no hard and fast rule on how you should breakdown a task in WBS.
- Rather, the level of breakdown is a matter of the project type and the management style followed for the project.



Grant Chart:

When planning a construction project, a **Gantt chart** is likely to come in handy. *Gantt Chart in very simple terms, is a bar chart that is used to illustrate a variety of details about any construction project, such as when is should be started and completed, and what activities are included as part of it.*

- By using a Gantt chart, it becomes easier for any project manager to ensure that things are going ahead as planned, and that any individual activities that make up part of the project are completed in the right sequence, thus bringing the project further towards completion.
- Whatever the type of project being completed, a Gantt chart can be extremely helpful, whether it is **developing a building project** or planning a comprehensive marketing strategy.

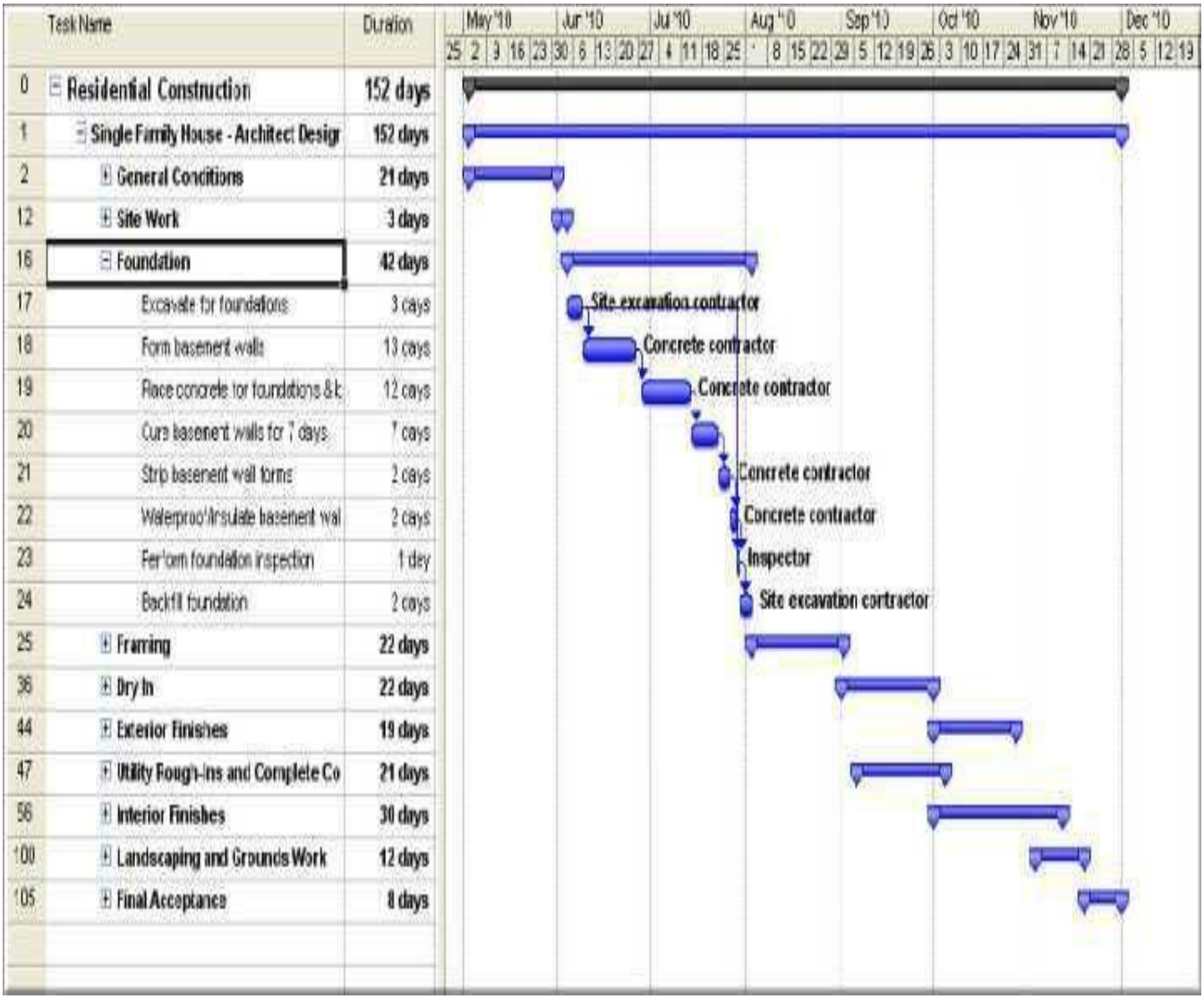
There are several different advantages to using a Gantt chart, including the following:

1. The ability to help a general audience understand the phases and activities involved in any project.
2. The ability to highlight any critical goals or points on the chart by using colored outlines and bolds.
3. The ability to update the chart regularly, keeping to schedule, and avoiding falling back on any project.
4. The ability to use computer software in order to keep the chart updated more easily.

- One of the main features of any Gantt chart is the ability to establish which activities are of highest priority when completing any project.
- In addition, the Chart will also help establish which activities rely on others, highlighting the dependency between them.
- By using these two elements, it is possible to create a chart that includes completion times for specific tasks, all working towards a logical progression and completion for the whole project.
- In general, a Gantt chart will be represented by a horizontal chart, with each task accounted for in its body.
- At the same time, each activity will have a definitive starting and finishing point, thus helping the project become as time efficient as possible.
- In addition, tasks that can be completed together, and others that need to be done in sequence, will be noted.

Overall, the Gantt chart can be used by a variety of construction professionals and in a variety of circumstances, including these:

1. To communicate the status of any project.
2. To monitor tasks.
3. To demonstrate which tasks need to be done in sequence.
4. To understand task duration.


Task Name
Duration
May '10
Jun '10
Jul '10
Aug '10
Sep '10
Oct '10
Nov '10
Dec '10
0 Residential Construction 152 days
1 Single Family House - Architect Desigr 152 days
2 General Conditions 21 days
12 Site Work 3 days
16 Foundation 42 days
17 Excavate for foundations 3 days
18 Form basement walls 13 days
19 Place concrete for foundations & b 12 days
20 Cure basement walls for 7 days 7 days
21 Strip basement wall forms 2 days
22 Waterproof/insulate basement wal 2 days
23 Perform foundation inspection 1 day
24 Backfill foundation 2 days
25 Framing 22 days
36 Dry In 22 days
44 Exterior Finishes 19 days
47 Utility Rough-Ins and Complete Co 21 days
56 Interior Finishes 30 days
100 Landscaping and Grounds Work 12 days
105 Final Acceptance 8 days
Site excavation contractor
Concrete contractor
Concrete contractor
Concrete contractor
Concrete contractor
Inspector
Site excavation contractor

Project Network:

A network is a graphical representation of the project activities and their relationships. A project network is a set of arrows and nodes. Before drawing the network, it is necessary to ensure that the project has a unified starting and ending point. The need for this start activity arises when there is more than one activity in the project that has no predecessors and the end activity is needed when there is more than one activity that has no successors. Also, networks should be continuous (i.e., each activity except the first and the last has both preceding and succeeding activities).

Networks are of two types:

- PERT Network – Event Oriented
- CPM Network – Activity Oriented

Fundamentally both CPM and PERT networks are techniques of Project Management involving Graphical and Diagrammatic representation, which management can use as an aid in Planning, Scheduling and Controlling of operations in a project.

Characteristics of CPM/PERT Projects:

1. The project to be planned by network technique should consist of clearly recognizable jobs or operations, usually called activities.
2. These jobs, operations or activities must have definite commencement and completion. The start or end of a job or operation or activity is called an Event.
3. The event must occur in a definite pattern and must be performed in a technological sequence.

The basic elements of a Project Network are:

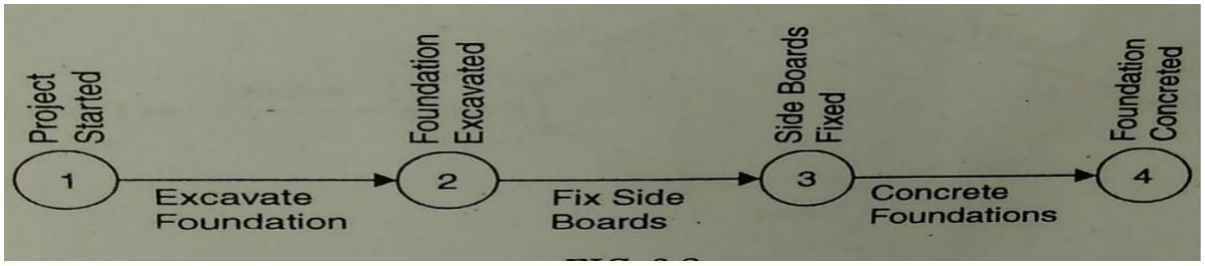
1. Event
2. Activity

Example 1:

The project consists of following well defined operations

a) Excavation of Foundation
b) Fixing Side Boards
c) Concreting Foundation

All three operations are to be performed in a sequential order. The network will be shown as below.



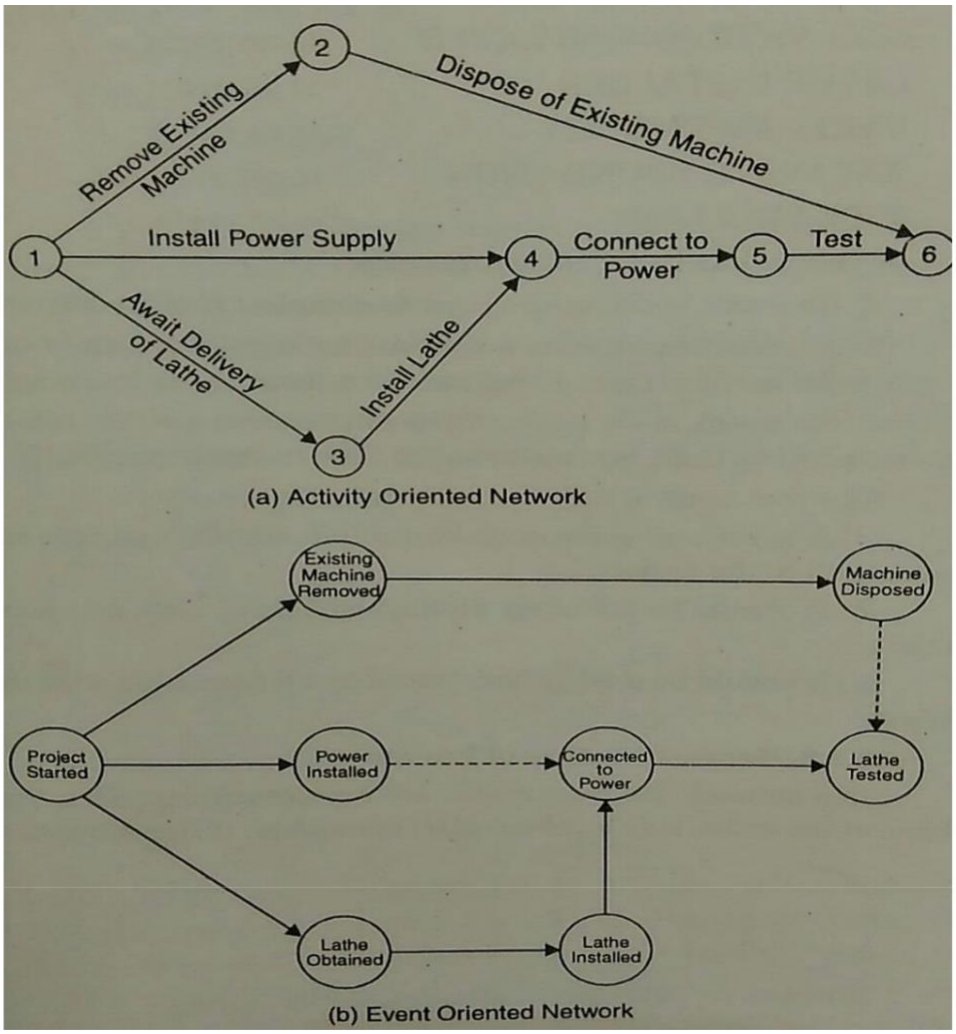
In the above figure, the activities (Excavation of Foundation, Fixing Side Boards, Concreting Foundation) have been shown by arrows. The beginning and the end of Activities are shown by Circles provided at the nodes. The events of the Project are a) Project Started b) Foundation Excavated c) Side Boards Fixed d) Foundation Concreted.

Example 2:

Consider the project of purchasing a new heavy duty Lathe and disposing of the Old Lathe. The project consists of following Activities.

1. Await the delivery of lathe
2. Remove existing lathe
3. Install power supply
4. Install lathe
5. Connect to power
6. Test
7. Dispose of existing lathe

The above project can be represented by a network shown below



Event:

An event is a specific instant of time, which makes the start or end of an activity. Event consumes neither time nor resources.

Examples:

Design Completed: is an event

Excavation completed: is an event

Excavate Foundation: is not an event

An event has 3 basic properties:

1. An event is either the start or completion of an activity.
2. An event represent a noteworthy, significant and recognizable point in the project.
3. An event is an accomplishment occurring at an instantaneous point of time, but requiring no time or resource itself.

Representation of Events:

In a network diagram, events are represented by Nodes. The shape of the nodes may be

Circular Square Rectangular Oval

Specifying the Events:

A particular event out of various events on the network diagram may be specified as:

1. **Tail Event:** it is the one which marks the beginning of an Activity. If a particular tail event represents the commencement of the project, it is known as the Initial Event.
2. **Head Event:** all activities have an ending i.e. again a specific point of time and is marked by an event. Such an event is known as Head Event. If the particular event marks the completion of the project it is known as Final Event or End Event.
3. **Dual Role Event:** these events are head event to some activity and tail event to other activity. All events except initial and final events are Dual Role Events.

Activity:

An activity is the actual performance of the task and requires time and resources for its completion. It is the work required to complete a specific task. The resources may be Manpower, Materials, Space, and Facilities etc.

Examples:

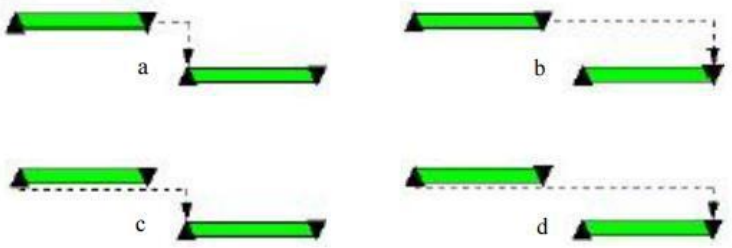
Excavate Trench: is an activity
Mix Concrete: is an activity
Lathe Installed: is not an activity
Design Completed: is not an activity
A project may consist of number of Activities. Depending upon the Interdependency, we can categorize activities as

1. **Parallel Activities:** Activities which can be performed simultaneously and independently to each other are known as Parallel Activities.
2. **Serial Activities:** Activities which are to be performed one after the other in succession are called Serial Activities. These activities cannot be performed independently to each other.
3. **Predecessor Activities:** Activity which has to be performed before another activity can begin are called Predecessors Activities to that activity.
4. **Successor Activities:** Activities that cab be performed after the performance of other activity are known as Successor Activities to that Activity.

Types of Activities Relationships:

Four types of relationships among activities can be defined as described and illustrated below. Typically, relationships are defined from the predecessor to the successor activity.

1. **Finish to Start (FS):** The successor activity can begin only when the current activity completes.
2. **Finish to Finish (FF):** The finish of the successor activity depends on the finish of the current activity.
3. **Start to Start (SS):** The start of the successor activity depends on the start of the current activity.
4. **Start to Finish (SF):** The successor activity cannot finish until the current activity starts.

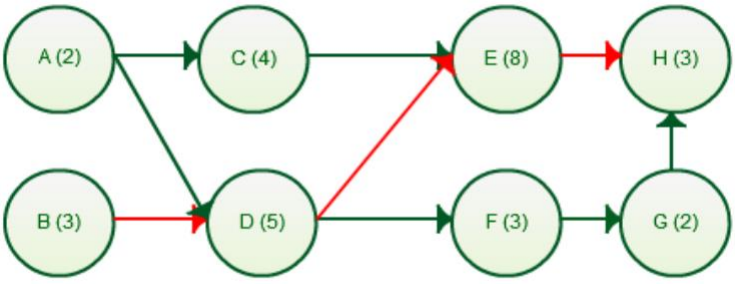


Critical Path:

The Critical Path is the longest-duration path through the network. The significance of the Critical Path is that the Activities that lie on it cannot be delayed without delaying the Project. Because of its impact on the entire project, Critical Path analysis is an important aspect of project planning

Activity	Duration (Days)	Immediate Predecessor Activities
A	2	-
B	3	-
C	4	A
D	5	A & B
E	8	C & D
F	3	D
G	2	F
H	3	G

A table to do critical path analysis



The network diagram with the critical path highlighted

Critical Path Method:

The Critical Path Method (CPM) can help you keep your projects on track.

Critical path schedules...

- Help you identify the activities that must be completed on time in order to complete the whole project on time.
- Show you which tasks can be delayed and for how long without impacting the overall project schedule.
- Calculate the minimum amount of time it will take to complete the project.
- Tell you the earliest and latest dates each activity can start on in order to maintain the schedule.

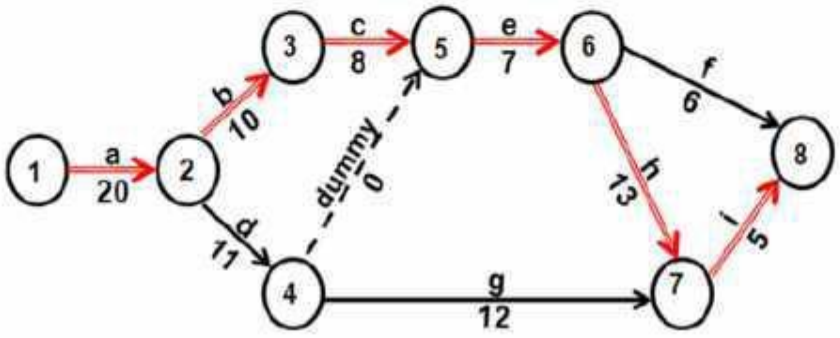
The Process:

Here's how the process of creating a CPM schedule unfolds:

1. Create a list of all activities required on the project.
2. Decide the right sequence for the activities you've listed.
3. Create a diagram showing the sequence of activities.
4. Estimate the time needed for each activity.
5. Determine the earliest start time, earliest end time, latest end time, and latest start time. These times give you a date range (or float time) in which you can start each activity and get it finished before the next activity has to begin.
6. Finally, update your diagram as the project progresses, reflecting any changes from each phase of the build.

List of all possible sequences (chain/path) of activities (Enumeration method):

Path / Sequence			Total duration
a-b-c-e-f	1-2-3-5-6-8	20+10+8+7+6	= 51 days
a-b-c-e-h-i	1-2-3-5-6-7-8	20+10+8+7+13+5	= 63 days (Critical Path)
a-d-e-f	1-2-4-5-6-8	20+11+0+7+6	= 44 days
a-d-e-h-i	1-2-4-5-6-7-8	20+11+0+7+13+5	= 56 days
a-d-g-i	1-2-4-7-8	20+11+12+5	= 48 days



Benefits of the Critical Path Method:

The following are a few benefits of the critical path method:

1. It shows the graphical view of the project.
2. It discovers and makes dependencies visible.
3. It helps in project planning, scheduling, and controlling.
4. It helps in contingency planning.
5. It shows the critical path, and identifies critical activities requiring special attention.
6. It helps you assign the float to activities and flexibility to float activities.
7. It shows you where you need to take action to bring project back on track.

Although the critical path is very useful tool in project planning, it also has some limitations and drawbacks.

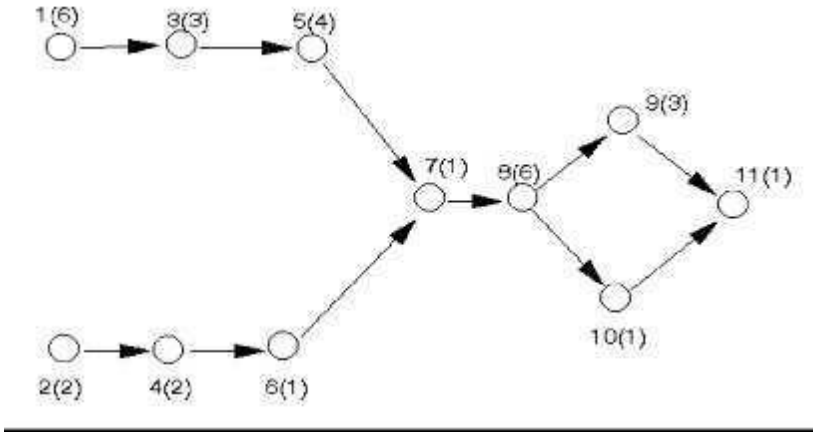
Limitations/drawbacks of the Critical Path Method:

1. The critical path method is an optimal planning tool, which always assumes that all resources are available for the project at all time.
2. It does not consider resource dependencies.
3. There are chances of mis-using float or slack.
4. Less attention on non-critical activities, though sometimes they may also become critical activities.
5. Projects based on the critical path often fail to be completed within the approved time duration.

Program Evaluation and Review Technique (PERT):

"Program Evaluation and Review Technique (PERT) is a project network analysis technique used to plan and control large construction projects."

- PERT focuses on the relationship between the time each activity takes, the costs for each activity and the resulting time and cost for the expected completion of the entire construction project.
- This helps in understanding the performance of the work throughout the course of the project.
- PERT is an event oriented project scheduling techniques.
- The method does not show any kind of inter-dependencies.
- It only shows an event, which is represented in terms of the time and the resources that are necessary for the completion of that event.
- It does not possess any historic chain.
- PERT gains a lot of benefits that facilitates the project management team.
- But it also shows certain disadvantages that must be taken into consideration by the project managers.



Advantages of PERT in Construction Management:

Use of PERT in construction project has following advantages:

1. Facilitate planning of large projects
2. Critical Path of construction project is visible
3. Helps in activity Analysis
4. Better coordination

Facilitate Planning of Large Projects

- The program evaluation and review technique enables the project manager to schedule the project very easily.
- It is mainly active in the case of a large project.
- To be more precise, it such requires three elements to define the event.
- What is the time required to do that event, what comes after the event and what comes before the event? This makes the scheduling easy and clear.

Critical Path is visible

- The PERT method shows the critical path in a clearer manner.
- The critical path is the path whose activities cannot be delayed.
- An easy understanding of slack values with limited conditions of dependencies make the project manager take a fast and good decision which would favour the performance of the project.

Activity Analysis

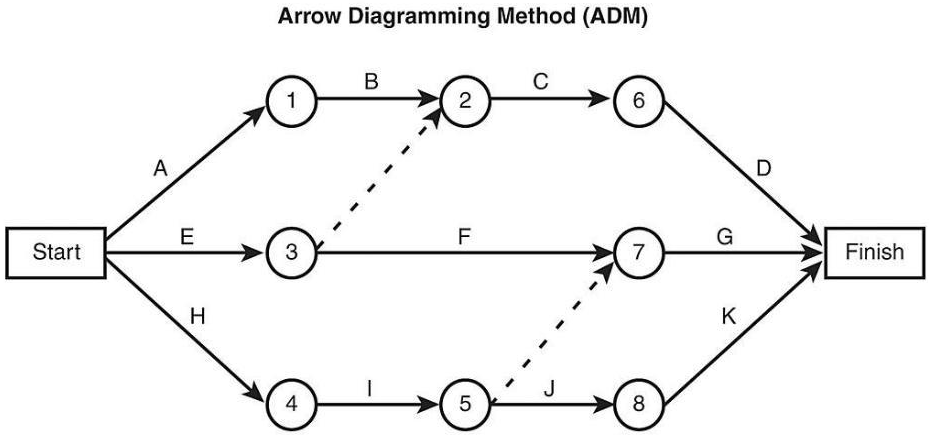
- A project manager views information about the likely completion of a project on time and on a budget by viewing PERT activities and events independently and in combination.
- PERT facilitates integration and data submission from various department of the construction organization.
- This will improve the planning and the decision-making capabilities of the project team.

Differences between CPM and PERT:

CPM	PERT
CPM uses activity oriented network.	PERT uses event oriented Network.
Durations of activity may be estimated with a fair degree of accuracy.	Estimate of time for activities are not so accurate and definite.
It is used extensively in construction projects.	It is used mostly in research and development projects, particularly projects of non-repetitive nature.
Deterministic concept is used.	Probabilistic model concept is used.
CPM can control both time and cost when planning.	PERT is basically a tool for planning.
In CPM, cost optimization is given prime importance. The time for the completion of the project depends upon cost optimization. The cost is not directly proportioned to time. Thus, cost is the controlling factor.	In PERT, it is assumed that cost varies directly with time. Attention is therefore given to minimize the time so that minimum cost results. Thus in PERT, time is the controlling factor.

Activity on Arrow Method:

The activity on arrow diagramming method involves the creation of a network of nodes and joining these nodes are arrows. All activities flow in one direction, typically from the left to the right and the actual activities and their durations are listed in the arrows. The nodes represent milestones, where there isn't any work performed. All relationships are finish to start in an activity on arrow diagram.



Activity on Node:

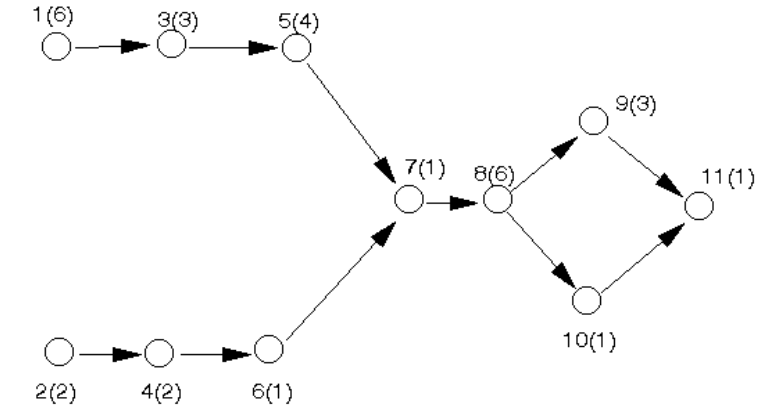
The Activity-on-Node (also called Precedence Diagramming Method) is a method that uses the nodes or boxes to represent activities and the arrows to show the logical dependencies between activities. The activity information is written in the nodes, it is usually numeric. Each activity has a unique number.

There are 4 relationships between activities:

- finish-to-start,
- start-to-start,
- finish-to-finish,
- Start-to-finish.

The Activity-on-Node (AON) that shows which activities must be completed in order to other activities will start is called "finish-to-start". It is the most used relationship.

This sample shows the Activity on node network diagramming method.



Some Important Terms:

Early Start Time (EST): It is the earliest time that an activity can begin.

Late Start Time (LST): It is the latest time that an activity can begin without delaying the project.

Early Finish Time (EFT): It is the earliest time that an activity can end.

Late Finish Time (LFT): It is the latest time that an activity can finish without delaying the project.

Float Time or Slack: It is the amount of time that an activity can be delayed without causing any delay in the subsequent activity.

Free Float: It is the amount of time that a scheduled activity can be delayed without delaying the early start of subsequent activity.

Total Float: It is the total amount of time that a scheduled activity may be delayed from its early start date without delaying the completion of project.