UNIT-1

INTRODUCTION

What is project?

- Projects are the building blocks to meet the organization's objectives. Project management is essentially involved in executing the projects.
- Project management is integral part of industries like construction, aerospace and defence.
- In today's scenario, Information technology projects commands high value.
- The new design of an Electric vehicle, solar aircraft, Super-fast Computers, New Highway roads, new fly over, metro rail projects etc., are different products bydifferent industries or companies.
- They all have one thing common; they are projects. But they are all purposefully unique.

The basic logic behind on all these projects are:

(a) Investment of Resources for a specific objective and

(b) A cause of irreversible change.

Meaning of Project

- Project is a scientifically right man, for the right work, at the right time.
- The project is a work plan devised to achieve a specific objective within a certain set time frame.
- It can be considered as a proposal involving capital investment for the purpose of developing facilities to provide goods and services.
- A project is a blueprint for action-oriented activities of an organization. A project reflects the plan for actions put in a sequential manner.
- Like a movie film it is rejection- oriented process. The project has beginning, middle and an end.

For example, manufacturing projects,

Power projects, Refinery Projects, Health Projects, Educational projects, Social projects, Construction Projects, Information Technology Projects etc.

Definition

"A project is a temporary endeavour undertaken to create a unique product,service, or result." - Project Management Institute, U.S.A

"The project is a specific activity with a specific starting point and a specific ending point, intended to accomplish a specific objective."

Features of a Project (Project Characteristics)

1. Every project is unique in nature.
2. A project has a fixed set of objectives(goals) to achieve.
3. Once the objectives have been achieved, the project comes to an end.
4. Have a specific time frame for completion with a definite start and finish.
5. Requires set of resources.
6. Every project has risk and uncertainty associated with it.
7. Project is developed by a dedicated team of work force.
8. Project has a life cycle reflected by growth, maturity and decline.
9. Change is an inherent feature in any project throughout it's life.
10. Project is based on systematic procedure and it is difficult to learn fully the endresults at any stage.
11. A project works for a specific set of goals with the complex set of differentactivities.
12. High level of sub-contraction of work can be done in a project.
13. Well qualified professionals efficiently execute the complex mega project.

Types of Projects

Projects are categorized in terms of their need and speed of implementation asfollows:

1. Normal Projects

- Adequate time is allowed for implementation.
- All the phases in a project can take their normal time, as measuredpreviously.
- Minimum requirement of capital cost.
- No sacrifice in terms of quality.

2. Crash Projects

- Requires additional costs to gain time.
- Maximum overlapping of phases is encouraged. Simultaneous work, by subcontracting is preferred.

3. Disaster Projects

- These are projects, undertaken, due to unexpected nature's calamities or furylike floods results in rehabilitation of dwelling houses for affected people. Anythingneeded to gain time is allowed in these projects.
- Round the clock work is done at the construction site.
- Capital cost will go up very high.
- Project time will get drastically reduced.

Project Management

What is Project Management?

- Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements.
- Project management enables organizations to execute projects effectively and efficiently.

Definition: "A controlled process of initiating, planning, executing, and closing down a project."

Benefits of Project Management

Project Management helps to avail the following benefits:

1. Meet the business objectives.
2. Satisfy stakeholder expectations.
3. Be more predictable.
4. Increase the chances of success.
5. Deliver the right products at the right time.
6. Resolve problems and issues.
7. Respond to risks in a timely manner.
8. Optimize the use of organizational resources.
9. Identify, recover, or terminate failing projects.
10. Manage constraints (e.g., scope, quality, schedule, costs, and resources).

11. Balance the influence of constraints on the project.
12. Manage change in a better manner.

Obstacles in Project Management

To enjoy the various benefits of project management given above following obstacles should be overcome carefully.

1. Project complexities.
2. Execution of customer's special requirement might result in time delay.
3. Co-ordination with many agencies.
4. Organization restructuring is a typical task.
5. Project risks.
6. Statutory changes.
7. Changes in technology needs highly qualified team.
8. Forward planning and pricing.

Project Manager

1. Project Manager is a pivot where the entire team performs its activities.
2. Project Manager is a person who has the overall control of the project and responsible for its execution and performance.
3. Project Manager is thoroughly involved in planning the work and monitoring, directing and leading the participants and seeks to reach the project goal in time-cost-quality puzzle.
4. The Project Manager is either a specialist or a person having predominantly technical background with sufficient experience, exposure expertise on multifaceted, multi-dimensional and multi-disciplinary projects.
5. A project manager is always found learning the newest facts from external world around him.

Qualities of Project Manager

- He should be flexible and adaptable to certain circumstances.
- He should give preference for significant initiatives to evolve as a best leader.
- He should show aggressiveness, confidence, persuasiveness, verbal fluency.

- He should be ambitious and active.
- He should be effective as integrator of project personnel.
- He should be a multi-faceted person having diverse interest.
- He should have enthusiasm, excitement and spontaneity.
- He should be able or willing to devote most of his time to planning and controlling.
- He should be able to identify problems ahead.
- He should be willing to make decisions that are acceptable to the team.
- He should be able to maintain a proper balance in the use of time.
- He should have physical fitness to undertake tasks with feeling of positivestress.

Project Consultants

- Project consultant who is an embodiment of knowledge is an asset to every organization.
- Consultants provide guidance as well as direction to the projects. From the formulation state to the completion and post project evaluation state, consultant's services are essential and are also available in different manner.
- In fact, the consultant is a part of the project management team, though as a paid member on contractual terms and conditions.

Need of Consultants

Need on Consultants arises:

- When a project with new technology is undertaken.
- When the in-house consultant is incapable of meeting the requirement of the project.
- When there is no in-house facility available in the organisation.
- When the project is executed based on imported technology.
- To avail the advantages of expertise available with the outside consultants.

Types of consultants:

Consultants may be of,

- (a)In-house consultants
- (b)Outside consultants

1. Local consultants
2. Foreign consultants

- As regards 'in-house consultant', it may be stated that in many organizations a separate department is maintained.
- This department looks after the work of detailed engineering, drawings and preparation of technical specifications, etc.
- An office order shall be issued assigning the jobs along with scope of work, time schedule and job responsibilities to be carried out.
- When the jobs cannot be done by the in-house consultants, the appointmentof outside consultants would become unavoidable.
- While assigning jobs to the outside consultants the following steps should be carried out effectively:
  - Approval from the competent authority to get the specialist's service.
  - Decide about local or foreign consultant, depending on the scope of theproject.
  - Preparation of list of consultants.
  - Scope of services of consultants.
  - Preparation of tender documents.
  - Inviting offers from leading consultants.
  - Evaluation of offers.
  - Award of contract to the consultant.

While selecting outside consultants the various factors to be considered are job requirements, facilities available in their organizations, experience, performance, their organization structure, fees, the terms and conditions pre and post commissioning services etc.

Functions of Consultant

The functions of a project management consultant have been identified as

(1) Assisting the agency in suitable site investigation and sourcing of materials.

(2) Assisting the agency in selecting the suitable contractor.

(3) Checking the quality of work, supervision control, testing monitoring and progress reporting, checking measurements and of bills.

(4) The project management consultant must give periodic reports to the client on the progress, trend and completion date, likely slippage in time, adequacy of resources with the contractor.

Main jobs of the consultants are:

(i) Preparation of feasibility report.

(ii) Techno-economic report.

(iii) Preparation of detailed project report

(iv) Detailed engineering and consultancy services

(v) Detailed commercial viability

(vi) Project monitoring and control

(vii) Supervision of erection and commissioning of report

(viii) Provide pre and post commissioning services

Objectives of Project Management

- Project management aims to plan, co-ordinate and control the complex and diverse activities of the modern industrial and commercial projects.
- The objectives in project management must be specific, instead of being ambiguous.
- Such specific objectives will enhance the timely achieving the desired outcome of the project.

1. Performance and quality: Performance done properly, speaks volumes of the project. The result of a project must fit the purpose for which it was intended. The concept of total quality management is the responsibility of quality shared by all staffstarting from top management to the staff at operational level.

2. Budget: The project must be completed without exceeding the budgetedexpenditure.

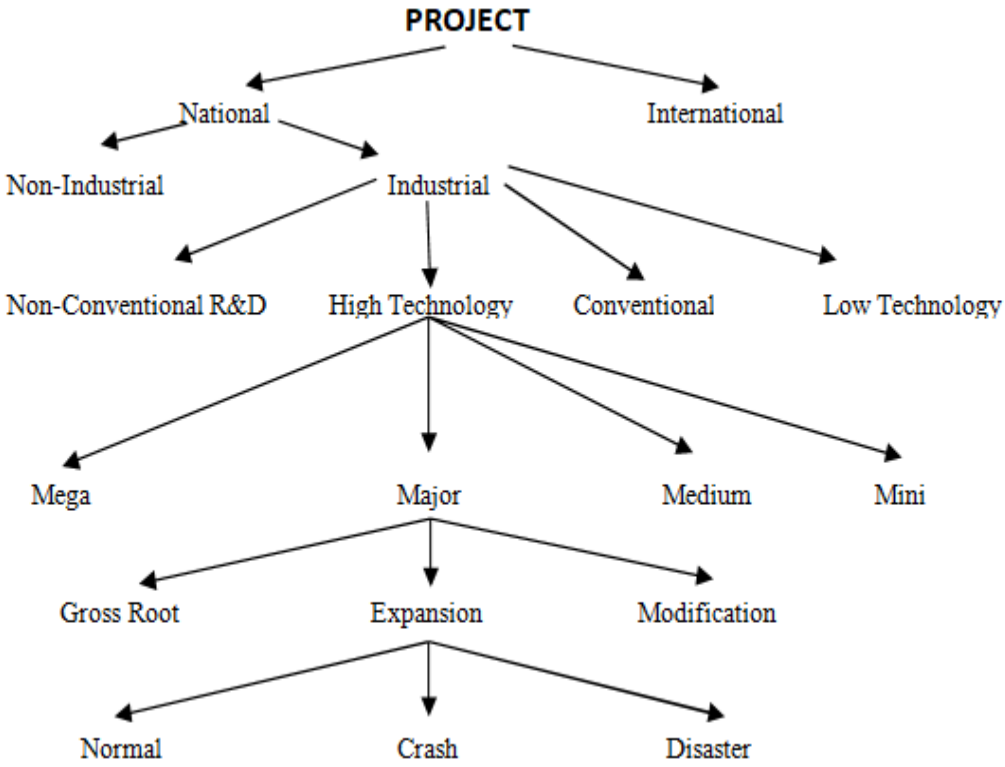
- Financial sources are not always inexhaustible and a project might be abandoned altogether if the funds run out before completion.
- If it happens, the time money and effort invested in the project would be

forfeited and written off.

- In the extreme cases, the project contactor could face enormous financial loss.
- Hence, proper attention is to be paid to the cost budgets and financial management.

3. Time of completion: Actual progress must match the planned progress. All the significant stages of the project must take place on or before the specified dates and completion on or before their respective latest completion times so that the entire project is completed on or before the planned finish date.

Categories of Projects



Classification of Project

The project can be classified on several basis. Major classifications of the projects are given below:

Based on Expansion

- Project expanding the capacity.
- Project expanding the supply of knowledge.

Based on Magnitude of the resources to be invested.

- Giant projects affecting total economy
- Big projects affecting any one sector of the economy
- Medium size projects
- Small size projects (depending on size, investment & impact)

Based on Sector:

- Industrial project
- Agricultural project
- Educational project
- Health project
- Social project

Based on Objective:

- Social objective project
- Economic objective project

Based on nature of benefits:

- Quantifiable project
- Non-quantifiable project

Based on government priorities:

- Project without specific priorities
- Project with specific priorities

Based on dependency:

- Independent project
- Dependent project

Based on ownership:

- Public sector project
- Private sector project

- Joint sector project

Based on location:

- Project with determined location
- Project where location is open

Based on social time value of the project:

- Project with present impact
- Project with future impact

Based on National policy:

- Project determined by inward looking policy
- Project determined by outward looking policy

Based on risk involved in the project:

- High risks project
- Normal risk project
- Low risk project

Based on economic life of the project:

- Long term project
- Medium term project
- Short term project

Based on technology involved in the project:

- High sophisticated technology project
- Advanced technology project
- Foreign technology project
- Indigenous technology project

Based on resources required by the projects:

- Project with domestic resources
- Project with foreign resources

Based on employment opportunities available in the project:

- Capital intensive project
- Labour intensive project

Based on management of project:

- High degree of decision-making attitude

- Normal degree of decision-making attitude
- Low degree of decision-making attitude

Based on sources of finance:

- Project with domestic financing
- Project with foreign financing
- Project with mixed financing

Based on legal entity:

- Project with their own legal entity
- Project without their own legal entity

Based on role played by the project:

- Pilot project
- Demonstration project

Based on speed required for execution of the project:

- Normal project
- Crash project
- Disaster project

What is Operation?

- Operation is an ongoing work effort.
- The objective of an ongoing operation is to sustain the project.
- It is repetitive. Once objective is reached adopt a new set of objectives andcontinue the work.

Difference between Project and Operation

SL#	PROJECT	OPERATION
1	Unique and temporary	Ongoing and permanent with a repetitive output
2	Fixed budget	Earn a profit to run the business.
3	Executed to start a new business Objective and terminated when it isachieved.	Does not produce anything new and is ongoing.
4	Create a unique product, service, or result.	Produce the same product, aim to earn a profit and keep the System running.
5	More risks in projects as they are Usually done for the first time.	Fewer risks as they are repeated Many times.
6	Performance intensive.	Efficiency intensive
7	Managed through project Management.	Require business process Management.

Characteristics that are shared by Project & Operations

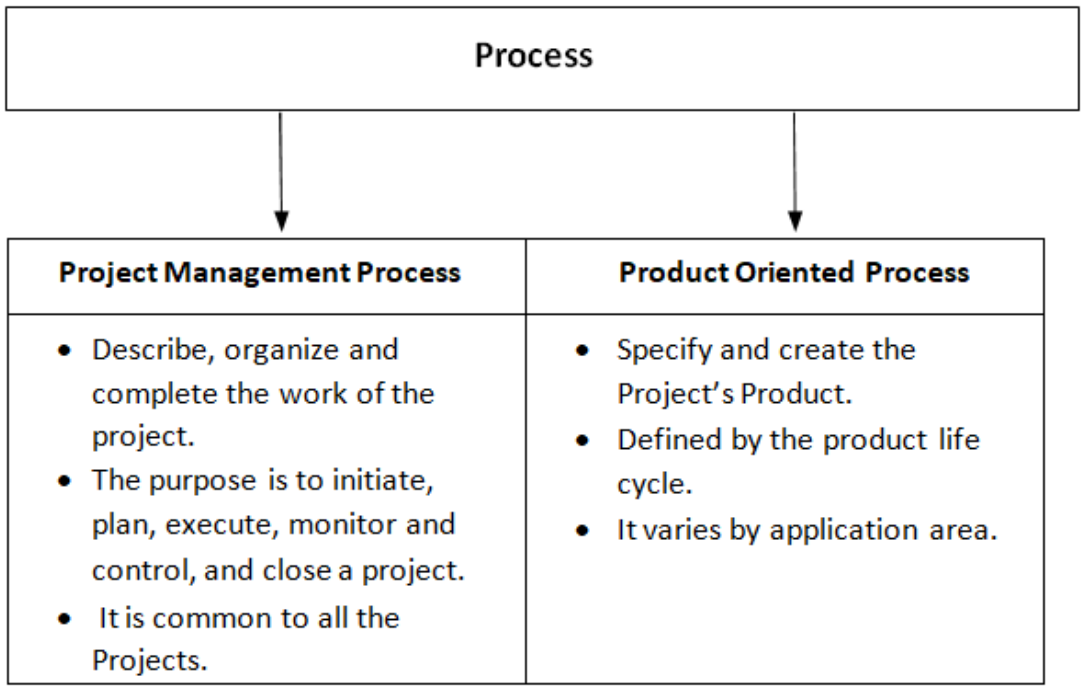
- Planned, Executed and Controlled.
- Constrained by limited resources. (ex: people, material, equipment, financial etc)
- Performed by people.

Projects are authorized because of one or more of the following strategicconsiderations:

- A market demands
- An organizational need
- A customer requests
- A technological advance
- A legal requirement

What is Process in Project Management and Process Groups?

The process a series of actions bringing about a result.



- Process is the application of knowledge, skills, tools and techniques to project activities to meet the project objectives.
- This is accomplished through the application and integration of the five project management processes groups (initiating, planning, executing, monitoring and controlling and closing).

Process groups:

A process group is a logical grouping of processes. There are Five Process Groups.

1. **Initiating Process Group:** Processes required to launch a new project or a newproject phase.

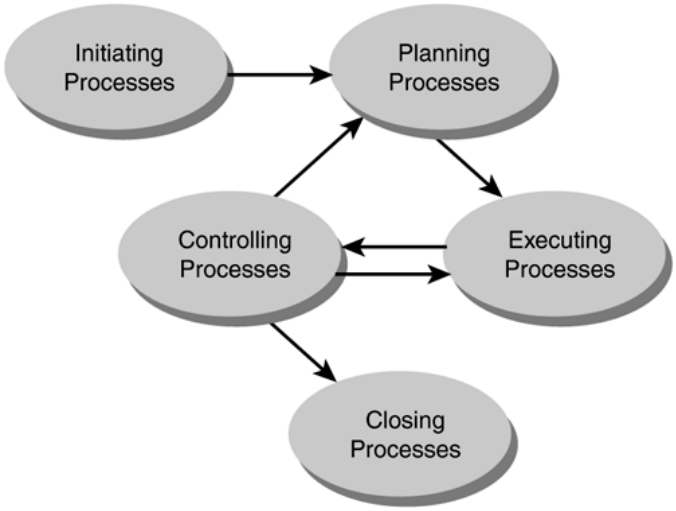
2. **Planning Process Group:** Processes related to defining and planning the extent ofthe project, as well as planning how it will be executed.

3. **Executing Process Group:** Processes related to the actual

completion of projectactivities and tasks.

4. **Monitoring & Controlling Process Group:** Processes covering everything relatedto tracking, monitoring, reporting on, and controlling project performance and progress.

5. **Closing Process Group:** Processes required finalizing and completing a project orproject phase.



Project Objectives vs. Project Scope

Project Objectives

Refers to a detailed description of the expected/desired outcome of theproject.

Ex: Build a new website.

Project Scope

Refers to the amount of effort required to complete a project. Ex: Build the website using ASP & NET products and Flash media.

Difference between Product Scope and Project Scope

Product Scope	Project Scope
• The features and functions that characterize a product/ Service/ result. • Completion of the product scope is measured against product requirements.	• The work that must be done to achieve Product Scope. • Completion of the project scope is measured against The Project management plan.

UNIT-2

PROJECT ADMINISTRATION

Essentials of Project Administration

- Project Administration focuses on two objectives. One is relieving the project team from the burden of project management's administrative responsibilities.
- The second objective is achieving schedule control. It views project management as a process control system.
- Once plans are ready and the project is executing, a feedback loop is provided in the form of clear, easy to understand status reports.

Project Team

A project team plays the vital role of designing and implementing a project. A project team consists of a specific group of individuals.

The following are different types of a project teams.

1. Initial project team.
2. Core project team.
3. Full project team.
4. Project advisors.
5. Project stakeholders.
6. Process facilitators.

1. Initial project team:

- The initial project team consists of specific people who initially conceive the ideaof starting a project.
- The team members are responsible for the planning andexecution of the project. One of the team members will be designated as the projectmanager.
- The project manager will be responsible for coordinating the activities amongst the team members.

2. Core project team:

- The core project team is a small group of people, typically 3 to 8 people who areultimately responsible for designing and managing a project.
- This team consists of sponsor, client leader, expert and internal auditor.

3. Full project team:

- This team consists of complete group of people involved in designing, implementing, monitoring and controlling a project.
- This team includes managers, stakeholders, researchers and other key implementers of the project.

4. Project advisors:

- Project advisors are the people who are not in the project team, but finally to whom the team members can depend for honest feedback and counseling.
- Project advisor is a person who anchors the cause of the project.

5. Project stakeholders:

- Project stakeholders are the individuals, groups or institutions who have a special interest in the natural resources of the project area.

6. Process facilitators:

- A process facilitator is a person who can help the project team through the planning process.
- The process facilitator understands the key elements of the process and has good facilitation skills.

The advantages of effective team are listed below,

1. Clear objective of the project from the initiation to completion.
2. Good decision-making process, which speed up the activities.
3. Clear roles, responsibilities and leadership, without overlapping, ensure smooth progress.
4. Trust, co-operation, support and constructive conflict or feedback.
5. Individual and mutual accountability for performance results.

Team formation:

- Proper care is to be taken while forming a team. The appointment of team leader should be done after an in-depth analysis.
- While selecting project team members, the following items may be kept in mind.

1. Knowledge of political, social and economic factors.
2. Knowledge/experience of stakeholders and their concerns.
3. Experience in developing strategies.
4. Experience in implementing strategies.
5. Experience in communications and fund raising.
6. Experience in budgeting and risk assessment.
7. Should understand the psychology of the team.

Project design

- Project design is the first stage in the execution of the project.
- Project design is concerned with developing project scheduling techniques and implementation of theproject.
- It includes finding of location, construction of buildings, procuring plant and machinery and finally execution the project.

Significance of Project design (Advantages):

1. It gives a comprehensive idea about the entire project.
2. It is a diagrammatic representation of the work plan designed to execute theproject.
3. The various activities of the project are explained in sequence to highlight thevarious phases of the project.
4. It helps entrepreneurs in coordinating project activities.
5. It serves as an effective tool of planning and implementation of a project.
6. It helps managers to plan the project economically.

Work Breakdown Structure (WBS)

- Work breakdown structure, WBS in short, is a technique which breaks down a work into its components and at the same time establishes the connections between the components.
- It is constructed by dividing the project into its major parts, with each of thesebeing further divided into sub-parts.
- This is continued till a breakdown is done in terms of manageable units of work for which responsibility can be defined.
- The work breakdown structure defines what work is to be done in a detailed manner.

- To assign responsibility for the tasks to be done, the work breakdown structure has to be integrated with the project organization structure.
- Work breakdown through the hardware approach is the only natural and permanent way of breaking work.
- Performance target, schedule, budget and accountability can similarly be fixed for any hardware element.

Advantages of the work breakdown structure:

1. Effective planning by dividing the work into manageable elements which can be planned, budgeted, and controlled.
2. Assignment of responsibility for work elements to project personnel and outside agencies.
3. Development of control and information system.

Project Execution Plan (PEP)

- The Project Execution Plan is the governing document that establishes the means to execute, monitor, and control projects.
- Project execution plan includes four sub-plans. These are:
  1. Contracting Plan
  2. Work packing Plan
  3. Organization Plan
  4. Systems and Procedure Plan

Contracting Plan

- This is the first step in the preparation of a project execution plan.
- To develop self- regulating systems, it is necessary to contract out those areas where the owner's company does not have inherent competence.
- Which type of contract to choose, which type of reimbursement to make, what conditions of contracts to stipulate, and what payment terms to offer, are the issues that must be examined during this phase of the project.

Work Packing Plan

- A work package is a group of related tasks within a project. Because they look like projects themselves, they are often thought of as sub-projects within a largerproject.

- Work packages are the smallest unit of work that a project can be broken down into when creating the Work Breakdown Structure (WBS).

Organization Plan

An Organization Plan is basically a "to do" list for an organization. It lists out the plan of work, programs, and organizational growth over a period of time, the tasks involved, who is responsible for them, and when they'll be done.

Systems and Procedure Plan

- More importance has to be given to routine systems and procedure so that nointervention is required in the day-to-day operation of a system.
- There are at leastseven routine sub-systems of project management for which appropriate procedures can be designed right at the start of the project implementation.

These sub-systems are:

1. Contract management
2. Configuration management
3. Time management
4. Cost management
5. Fund management
6. Materials management
7. Communication management

Project Procedure Manual

- A project procedure manual is to be prepared in such a way that the interacting agencies are able to see their roles and mutual relationships in achieving the commongoal.
- Preparation of a project procedure manual should start with each project management sub system.
- A system break-up has to be carried out on each sub-systemto identify the need for procedure write-ups.
- While carrying out system break-up thequestion to be asked is what the system must achieve and what contributes to the effective functioning of each of the elements.
- The project procedure manual gives acomplete picture about the system.

Project Diary

- The Project Diary is a summation of all of the daily activities on a project.
- This diary should be written so that it will represent the status of the project each day toanyone reviewing it in future years.
- A project manager would be holding several meetings with vendors, contractors etc, and many decisions are taken in these meetings and many commitments are made.
- Information derived on these meetings; decisions taken have to be properly recordedin the project diary.
- Information noted in the diary will help to justify the decisions atlater date.
- All project managers have to maintain project diaries, for efficient management of project.

Project Execution System

- The Project Execution System consists of the processes performed to complete the work defined in the project management plan to satisfy the project specifications.
- The successful execution and administration of project requires, direction, organization, co-ordination, communication and control all at the same time but in varying proportion.

Project Direction

Project Direction is the process of implementing and carrying out of thoseapproved plans that are necessary to achieve objectives.

Project Direction involves steps as follows.

1. **Staffing** – Seeing that a professional person is chosen for every position.
2. **Training** – Training individuals and groups on how to fulfill their duties andresponsibilities.
3. **Supervising** – Giving day-to-day instructions, guidance and discipline as required so that they can fulfill their duties and responsibilities.
4. **Delegating** – Assigning work, responsibility, and authority so that others can make maximum utilization of their abilities.
5. **Motivating** – Encouraging others to put more effort into the successful completion of the projects.

6. **Counseling** – Solve the personal problems and holding private discussions about how he might do better work.
7. **Coordinating** – Bring synchronization between different activities.

Communication in a Project

For a successful direction a two-way communications system is essential. For that matter, the entire process of direction, co-ordination and control in a project revolves around communication.

Communications has two dimensions physical and mental.

Physical communication: Passing a memo, drawing, data, instruction, information, etc. are the physical aspects of communication, which can be easily achieved.

Mental communication: Understanding the role expectation, empathy, language barriers, listening skills etc., are the mental aspects of communication which may create barriers in communication.

- Effective communication is often the foundation of successful projects. Good communication can unite team members and stakeholders to a project's strategy, objectives and budget.
- It can also enable everyone involved in the project to understand his or her roles, which may make them more likely to support the project.
- Without effective communication, projects can incur more risk and fail to meet desiredoutcomes.

Steps to be taken for effective communication:

1. Make communication a priority
2. Don't assume you know everything
3. Keep things positive
4. Switch up the communication channels
5. Keep updates timely and concise

Project Co-ordination

- Project coordination is the day-to-day management of tasks within thedepartment. The purpose of coordinating projects is to streamline the workflow of the tasks.
- A project manager informs employees about who is responsible for each sectionof a project and its deadlines.

- Co-ordination in a project is important because of the need for simultaneous working of number of activities. Therefore, one cannot proceed simply, with theexecution of a project without proper co-ordination.

Project Co-ordination Procedure:

Co-ordination basically addresses itself to two aspects of work.

1. **Physical aspect** would refer to what work is to be done, how much work is to be done and who will do the work.
2. **Timing aspect** would refer to when the work will be done.

Pre-requisites for Successful Project Implementation

- In order to minimize time and cost over-runs during the implementation of a project it is necessary to study about the prerequisites for successful project implementation.
- Keeping checks on these prerequisites help to improve prospects of successful completion of projects.

Pre-requisites for Successful Project Implementation are...

1. Adequate formulation.
2. Sound project organization.
3. Proper implementation planning.
4. Advance action.
5. Timely availability of funds.
6. Effective monitoring.

1) Adequate Formulation:

Often project formulation is deficient because of one or more of the following shortcomings.

1. Poor assessments of input requirements.
2. Improper field investigation.
3. Careless assessment of input requirements.
4. Improper methods used for estimating costs and benefits.
5. Omission of the project linkages.
6. Flawed judgments because of lack of experience and expertise.
7. Undue hurry to get started.

2) Sound Project Organization:

A sound organization for implementing the project is critical to its success. The characteristics of such an organization are:

1. It is led by a competent leader who is accountable for the project performance.
2. The authority of the project leader and his team is corresponding with their responsibility.
3. Adequate attention is paid to the human side of the project.
4. Systems and methods are clearly defined.
5. Rewards and penalties to individuals are related to performance.

3) Proper Implementation Planning:

Once the investment decision is taken, and during the formulation and appraisal process, it is necessary to do the detailed implementation planning before commencing the actual implementation. Such planning should involve following steps:

1. Develop a comprehensive time plan for various activities.
2. Estimate meticulously the resource requirements (manpower, materials, money, methods etc.) for each period to realize the time plan.
3. Define properly the inter-linkages between various activities of the project.
4. Specify cost standards.

4) Advance Action:

When the project appears to be operational, advance action on thefollowing activities may be initiated:

1. Acquisition of land,
2. Securing essential clearances,
3. Identifying technical consultants,
4. Arranging for infrastructure facilities,
5. Preliminary design and engineering,
6. Calling of tenders.

5) Timely Availability of Funds:

Once a project is approved, adequate funds must be made available to meetits requirements as per the plan of implementation.

6) Effective Monitoring:

To keep a track on the progress of the project, a system of monitoring must be

established. This helps in:

1. Anticipating deviations from the implementation plan.
2. Analyzing emerging problems and resolving it at the earliest.
3. Taking corrective action.

Questions:

1. List the advantages of project design.
2. What are the objectives of project administration?
3. List the types of project team.
4. What are the advantages of effective team?
5. What are the advantages of the work breakdown structure?
6. What is Project Execution Plan?
7. What is Project Diary? Why it is essential?
8. List the steps involved in Project Direction.
9. List the pre-requisites for Successful Project Implementation.
10. What is work breakdown structure?
11. What do you mean by project execution plan?
12. List the steps to be taken for effective communication

Understanding:

13. Explain Work Breakdown Structure.
14. Explain the significance of Project design.
15. Explain the importance of project procedure manual.
16. Describe the prerequisites for successful project implementation.
17. Explain the different types of a project teams.
18. Explain Project Execution Plan.

UNIT-3

PROJECT LIFECYCLE

Introduction

Every project has a beginning, a middle period (during which activities move the project toward completion) and an ending (either successful or unsuccessful).

This different phase of development in a project is called project life cycle. A clear understanding of these phases helps entrepreneurs and project managers to have better control over existing resources to achieve the desired goals.

Phases of Project Life Cycle

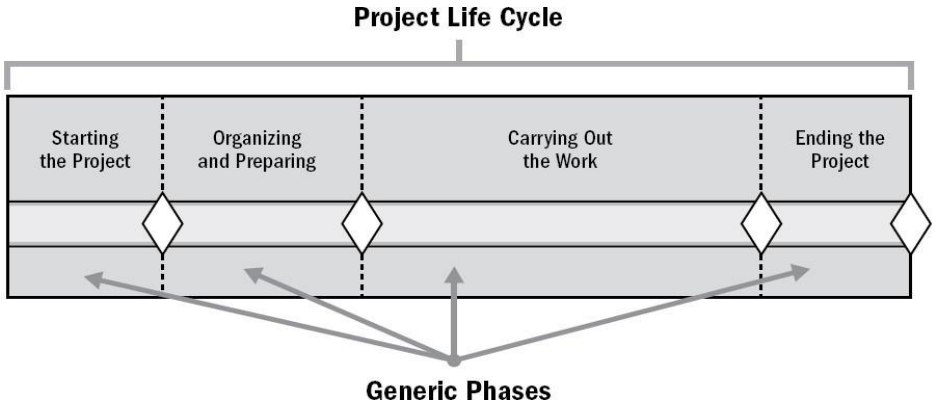
- Project life cycle is a complex process consisting of different steps arranged in asequential order.
- By definition, a project has a beginning and an end and passes through several phases of development known as life cycle phases.
- The number of phases and sequence of the cycle are determined by the management and various other factors like, needs of the organization involved in the project, the nature of the project, and its area of application.
- The phases have a definite start, end, and control point and are constrained by time.
- The project lifecycle can be defined and modified as per the needs of the organization.
- The lifecycle provides the basic foundation of the actions that has to be performed in the project, irrespective of the specific work involved.

Definition: A project life cycle is the series of phases that a project passes through from its start to its completion.

General Project Life Cycle:

1. **Starting of the project** - The Initiation Phase.
2. **Organizing and Preparing** - The Planning Phase.
3. **Carrying out the project** - The Execution Phase.

4. **Closing the project** - The Termination Phase.



1. Starting of the project: (The Initiation Phase)

- In this phase the project objectives are defined and the conceptual aspects of the project are agreed.
- In this phase a problem is identified and potential solutions suggested. The project manager takes the given information and creates a Project Charter.
- A project charter is a short document that explains the project in clear, concisewording for high level management.

The Project Charter includes information such as:

1. Project's purpose, vision, and mission
2. Measurable objectives and success criteria
3. Elaborated project description, conditions, and risks
4. Name and authority of the project sponsor
5. Concerned stakeholders like project managers, investors, company owners etc.

2. Organizing and Preparing: **(The Planning Phase)**

- The purpose of planning phase is to lay down a detailed strategy of how the project has to be performed and how to make it a success.
- The planning phase is where the project solution is further developed in as much detail as possible and the steps necessary to meet the project's objective are planned.
- In this step, the team identifies all of the work to be done.

- This phase is where the project is broken down into manageable areas of work and planned in terms of time, cost and resources.

- This is a continuous process and will extend throughout the execution phase of the project.

3. Closing the project: (The Termination Phase)

- The Termination Phase: This is the last phase of any project, and it marks the official closure of the project.

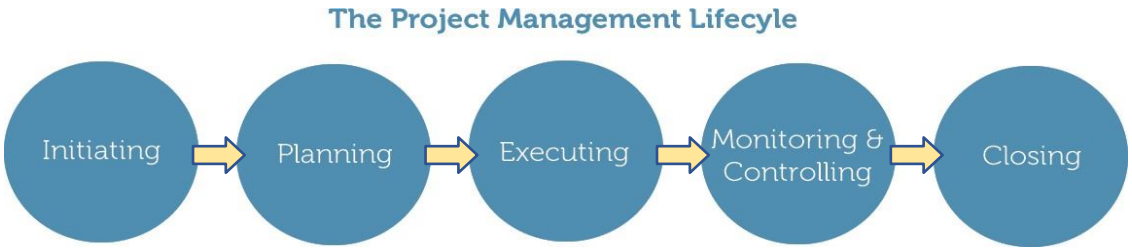
- The project is handed over to the customer and the post-project review is carried out.

Project Management Life Cycle General

The project management life cycle describes high-level processes for deliveringa successful project.

A project management life cycle as defined in the PMBOK (Project Management Body of Knowledge) by Project Management Institute (PMI) consists of 5 phases:

1. Project Initiation
2. Project Planning
3. Project Execution
4. Project Monitoring and control
5. Project Closure



1. Project Initiation: (Defining what needs to be done)

In this phase the initial work necessary to create and authorize the project are defined.

Key project management steps for initiating a project:

1. **Make a Project Charter** – What is the vision, objective, and goals of this project?
2. **Identify the High-level Scope and Deliverables** – What is the product or servicethat needs to be provided?
3. **Conduct a Feasibility Study** – What is the primary problem and its possiblesolutions?
4. **Estimate the overall Cost and create a Business Case** – What are the costs andbenefits of the solution?
5. **Identify Stakeholders** – Who are the people this project affects, how, and whatare their needs?

2. Project Planning: (Defining how to do, what needs to be done)

It involves creating the planning documents to guide the team throughout theproject delivery.

Key project management steps for planning a project:

1. **Create a Project Plan** – Identify the phases, activities, constraints and schedule and create a project timeline with a Work Breakdown Schedule and Gantt chart.
2. **Create a Financial Plan** – Create a project budget and cost estimate and a plan to meet the maximum cost, complete with allocations across resources and departments.
3. **Create a Resource Plan** – Build a great team, recruit and schedule the resourcesand materials needed to deliver the project.
4. **Create a Quality Plan** – Set project quality targets and measures.
5. **Create a Risk Plan** – Identify the possible risks, assumptions, issues and dependencies, assign an owner, and develop a mitigation plan for how toavoid/overcome them.
6. **Create an Acceptance Plan** – Assign criteria for what constitutes ‘done’ and ‘delivered’.
7. **Create a Communication Plan** – List your stakeholders, and plan the frequencyof communication between stakeholders.
8. **Create a Procurement Plan** – Find any 3rd party suppliers required and agree terms.

3.Project Execution: (Making a project happen)

In the execution phase project plan is executed and planning gets

turned into action. The project manager directs and manages project work, and the project team carries out the work. The project deliverables are produced and delivered.

Key project management steps for executing a project:

1. **Team Leadership** – Set a vision for success and enable the team to deliver on it.
2. **Creating Tasks** – Clearly define what needs to be done and the criteria for thetask.
3. **Task Briefing** – Ensuring the team is clear about what they need to do, by when.
4. **Client Management** – Working with the client to ensure deliverables areacceptable.
5. **Communications** – Ensure you are informing and updating the right people atthe right time through the right channel.

4. Project Monitoring and control: (Keeping a project on track)

In this phase, the monitoring of the project life is done to ensure the project is going according to plan, and if it isn't, controlling it by working out solutions to get it back on track.

In reality, a project manager is monitoring and controlling a project in some way throughout the phases.

Key project management steps for monitoring and controlling a project:

1. **Cost & Time Management** – Review timesheets and expenses to record, control and track against the project's budget, timeline and tasks.
2. **Quality Management** – Reviewing deliverables and ensuring they meet the defined acceptance criteria.
3. **Risk Management** – Monitor, control, manage and reduce potential risks and issues.
4. **Acceptance Management** – Conduct user acceptance testing and create a reviewing system, ensuring that all deliverables meet the needs of the client.
5. **Change Management** – When the project doesn't go as per the plan, managingthe process of acceptable changes with the client to ensure they're happy with necessary changes.

5. Project Closure: (Ending a project)

Project closure is the last phase of the project life cycle, which formally closes the project and reports the overall achievements of the project in terms of defined performance measures.

Key project management steps for closing a project:

1. **Project Performance Analysis** – This is an overall look at how well the projectwas managed.
2. **Team Analysis** – Did everyone do, what they were assigned to do?
3. **Project Closure** – Document the tasks needed to bring the project life to anofficial end.
4. **Post-Implementation Review** – Write down a formal analysis of successes andfailure, and resulting lessons learned and suggestions for the future.

Project Risks

Definition of Risk:

Risk is defined as the possibility of an outcome being different from the expectedoutcome.

It refers to the possibility of adverse results flowing from the uncertainty involved in carrying out the activities.

Project Risks:

- The element of risk is inherent in every activity of a project. All projects are exposed to various types of risks.
- Since all risks cannot be eliminated or avoided, it is the job of the project manager to ensure that risks do not have adverse consequences.

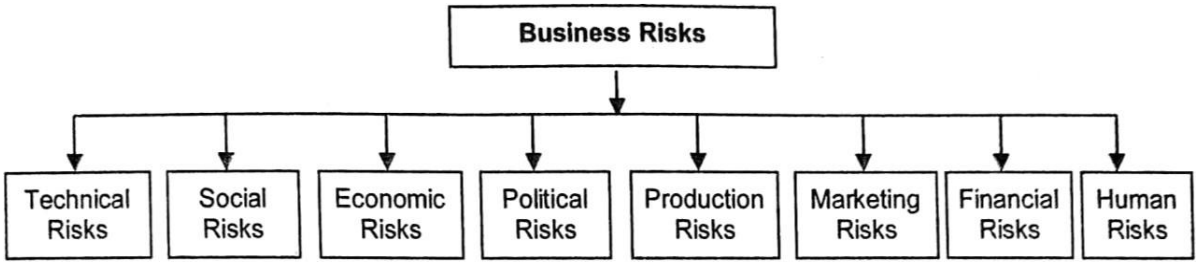
- Every project manager follows a specialized risk management methodology thatnormally consists of four processes:
  - Risk identification
  - Risk quantification
  - Risk response
  - Risk control

Types of Risks:

Risks can be classified as technical risks, social risks, economic risks,

politicalrisks, production risks, marketing risks, financial risks and human risks.

Figure below shows the types of risks in a project.



1.Technical Risks:

Technical risks refer to changes in technical specifications of the product results in loss.

2. Social Risks:

Social risks refer to risks arising from changes in the needs and preferences of customers.

Lack of necessary natural resources, labor unrest, agitations and social movements against the project also constitute social risks.

3. Economic Risks:

Economic risks refer to an increase in the rate of inflation, changes in the economic policies of governments.

4. Political Risks:

Nationalizations or privatization of a particular industry, political instability, and trade restriction are some examples of political risks.

The project manager should ensure that the project does not go against the political interests of the country.

5. Production Risks:

Production risks refer to the shortage of necessary raw materials, sudden breakdown of key machinery and huge rise in installation and maintenance costs.

6. Marketing Risks:

Marketing risks refer to failure of the developed product or service in the market dueto changes in market demand, errors in forecasting of demand, or difficulties in distribution.

7. Financial Risks:

Financial risks refer to bad debts, change in the interest rate, wrong choice ofinvestments and mistakes in the accounting procedures.

8. Human Risks:

Human risks refer to the sudden demise of key employee, limited availability of skilledemployees, inter-group politics, etc.

Risk Analysis:

It is defined as "A process of identifying and quantifying the risk involved in a project and developing measures to avoid and manage such risks".

Activities involved in Risk Analysis:

1. Risk Assessment
2. Risk Management

Risk Assessment is the process of identifying and quantifying risks. Identifying means to find out the reason or source of risk and quantification means to know the probability of occurrence of risk.

Risk Management is the process of avoiding or minimizing the impact of assessed risk. Efforts are made to avoid the risk by any meansand if it is not possible minimize the impact of such risks.

Project risk management:

Project risk management is the process of identifying, analyzing and respondingto any risk that arises over the life cycle of a project.

This is to help the project remainon track and meet its goal.

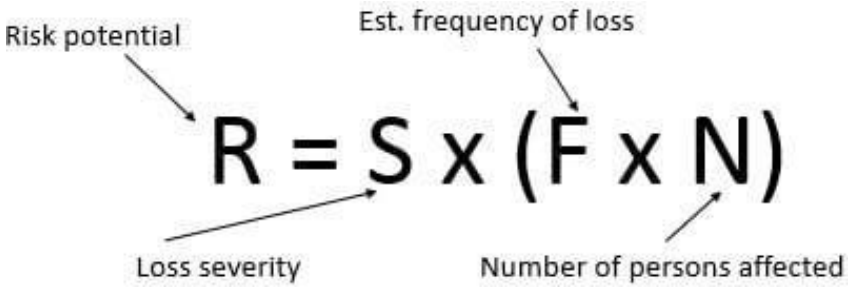
Risk Assessment Techniques with Illustrations

There are two Risk Assessment Techniques. They are,

1. Severity x frequency x number of people affected.

"Rodney Turner" suggests a method for prioritizing risk which assesses the loss severity of a risk with the frequency at which it could occur and the number of personswho could be affected.

The result is the Risk Potential which can be used to priorities risks and guide decisions on mitigating actions and contingency plans.



1. The Risk Assessment Matrix:

Severity \ Likelihood	1	2	3
1	Low	Low	Medium
2	Low	Medium	High
3	Medium	High	High

"Cooke" and "Williams" describe a simpler risk assessment calculation: Severity × Likelihood. Both severity and likelihood can be rated on a scale of 1 to 3 giving a priority.

Methods of risk analysis:

(a) Sensitivity Analysis:

Sensitivity Analysis is a method that measures how the impact of uncertainties of one or more input variables can affect the output. This analysis improves the prediction of the model, by improving the response of model to change in input variables. In sensitivity analysis, typically one variable is changed at a time.

(b) Scenario Analysis:

Scenario analysis is a process of analyzing future events by considering alternative possible outcomes. Scenario analysis is conducted, to analyze the impacts of possible future events on the system performance.

(c) Best-case and Worst-Case Analysis:

The objective of best-case and worst-case scenario analysis is

to get a feel of what happens under the most favorable or the most adverse configuration of key variables, without bothering much about the internal consistency of such configurations.

Best Scenario	High demand, high selling price, low variable cost, and so on.
Normal Scenario	Average demand, average selling price, average variable cost, and so on.
Worst Scenario	Low demand, low selling price, high variable cost, and so on.

(a) Simulation Analysis:

The Simulation Analysis is a method, wherein the infinite calculations are made to obtain the possible outcomes and probabilities for any choice of action.

The role of simulation analysis is to summarize and analyze the results, in a way that will yield maximum insight and help with decision-making.

Project Cost Risk Analysis

Future estimates are not facts but statements of probabilities about how things will turn out. Hence, actual costs may be higher or lower than estimates made by evenexperts.

Cost risk analysis considers the different costs associated with a project (labour, materials, equipment, administration, etc) and focuses on the uncertainties and risks that may affect these costs.

Estimating Time and Cost Overrun Risks

Time and cost overrun are the most common and most serious risks in project completion in especially the complex and big projects.

Over estimating the time requirements or providing contingencies are the remedies commonly used to take careof the situation.

However, statistical tools are available to simulate the project time more accurately.

A cost overrun is the amount by which actual expenditures exceed the plannedamount.

It is the sum of unpredicted expenses that exceeds initial budget estimates at any point throughout the course of project realization.

Reasons for Project Cost Overruns:

1. Unplanned expansion of the project scope.
2. Inaccurate initial cost estimation.
3. Failures in project performance.
4. Errors in project design.
5. Improper risk management.
6. Improper project team building.
7. Wrong choice of equipment.
8. Incompetent material suppliers.

Time Overruns

Poor planning and failure to meet time schedules result in time overruns.

The project manager prepares a "**time overruns analysis sheet**" to understand where delays have occurred and the reasons for delays.

The Chart given below shows a timeanalysis sheet.

	Event Name	Scheduled Time	Actual Time	Time Overrun	% of time Overrun	Reasons for Time Overrun
1						
2						
3						
4						
5						
6						
7						

Time overruns occur due to,

1. A change in the scope of the project.
2. Ineffective project time management.
3. Delays in starting and executing some of the project activities.
4. A delay in one project, results in delays in subsequent projects.
5. Use of outdated technology.
6. Political interference.
7. Poor administration.

Questions:

1. List the phases of project management life cycle.
2. List the phases of project life cycle.
3. Define risk.
4. What is project risk?
5. List the types of risk.
6. What is project initiation?
7. What is project planning?
8. What is resource plan?
9. What is communication plan?

Understanding:

1. Explain the phases of project management life cycle.
2. Explain the phases of project life cycle.
3. Explain the types of risk.
4. Explain the Risk Assessment Techniques.
5. Explain the risk analysis methods.
6. Explain the reasons for Project Cost Overruns.
7. Explain the reasons for Project time Overruns.
8. Explain financial plan.
9. Explain Quality plan.
10. Explain the processes of project execution phase.

UNIT-4

PROJECT PLANNING, SCHEDULING AND MONITORING

Introduction

Planning is answering questions like, what must be done, by whom, for how much, how, when, and so on.

What is a Project Plan?

The project plan decides what, where, who, why, how and when to do the project. The purpose of a project plan is to guide the execution and control the project phases.

A project plan is a series of formal documents that define the execution and control stages of a project.

Nature of Project Planning

The project planning helps in streamlining the process of the Project. Planning helps in the smooth running of the project as every aspect of the project is taken into consideration, and the required solution.

The Project plan consists of three related parts.

1. Scope
2. Schedule
3. Cost

Scope: It states the methods and procedures of each work and the name of the person or organization unit, responsible for the work.

Schedule: It states the estimated time required to complete each work and the interrelationships among the work.

Cost: It is stated in the project budget, usually called the control budget.

Need for Project Planning

One of the objectives of project planning is to completely define all the work required so that it will be readily identifiable to each project participant.

There are four basic reasons for project planning.

1. To eliminate or reduce uncertainty.
2. To improve efficiency of the operation.
3. To obtain a better understanding of the objectives.
4. To provide a basis for monitoring and controlling the work.

Functions of Project Planning

The functions of the Project Planning are;

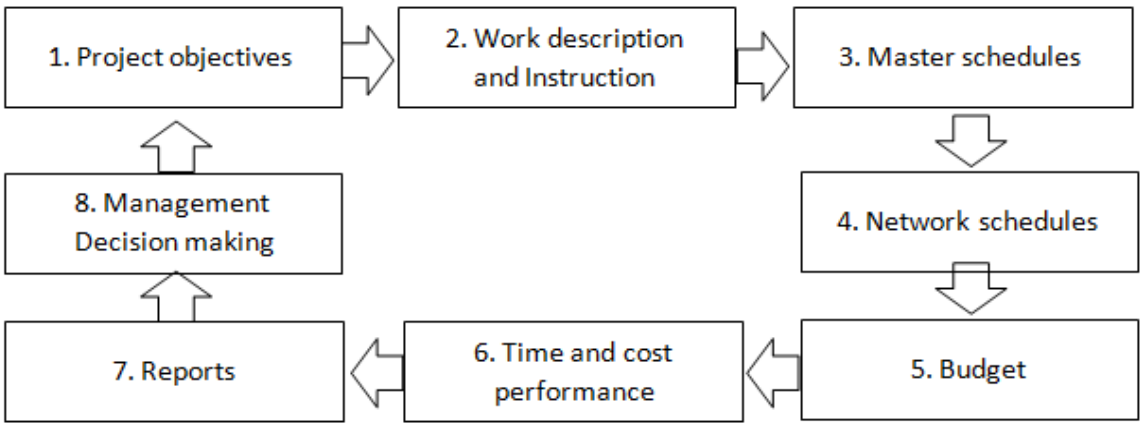
1. It should provide a basis for organizing the work on the project and allocating responsibilities to individuals.

2. It is a means of communication and coordination between all those involved in the project.
3. It inspires the people to look ahead.
4. It induces a sense of urgency and time consciousness.
5. It establishes the basis for monitoring and control.

Steps in Project Planning

1. Define the problem to be solved by the project.
2. Develop a mission statement, followed by statements of major objectives.
3. Develop a project strategy that will meet all project objectives.
4. Write a scope statement to define project boundaries (what will and will notbe done).
5. Develop a work breakdown structure (WBS).
6. Using the WBS, estimate activity durations, resource requirements, and costs.
7. Prepare the project master schedule and budget.
8. Decide on the project organization structure.
9. Create the project plan.
10. Get all project stakeholders to sign off on the plan.

Project Planning Structure



Types of Project Plan:

Single use plans: It includes programmers schedules and special ways of operating under particular circumstances. It can also be known as short term plans to deal with the specific problem for specific place with prescribed time limit.

Standing plans: Standing plans are those plans which include policies, standard methods and standard operation, procedures. They are designed to deal with recurring problems. It may be treated as standard document to be used in

different plans to deal with a set of problems.

Project Objectives and Policies

Project objectives are what we plan to achieve by the end of the project. It includes deliverables and assets, increasing productivity or motivation. Project objectives should be attainable, time-bound, measurable specific goals of the project.

An effective project goal has the following characteristics. These characteristics are captured in the term **SMART**, an acronym for the aspects of a goal commitment. These characteristics of a project goals are, **S**pecific – Clear about what, where, when and how.

Measurable - Are we able to measure the problem, establish a baseline, and set targets for improvement?

Achievable – Is the objectives are attainable?

Realistic – Is the project objectives and schedules are realistic?

Time Bound – Have we set the time for completion?

The objectives of a project may be

1. Technical objectives.
2. Performance objectives.
3. Time and cost objectives.

Project Policies:

Policies are the general guide for decision making on individual actions. Some of the policies of a project are,

1. Extent of work given to outside contractors.
2. Number of contracts to be employed.
3. Terms of the contract etc.

Project policies must be formulated on the basis of following principles:

1. It must be based upon the known principles in the operating areas.
2. It should be complementary for co-ordination.
3. It should be definite, understandable and preferably in writing.
4. It should be flexible and stable.
5. It should be reasonably comprehensive in scope.

Tools of Project Planning

The tools for project planning may be grouped into two categories. Traditional tools and network analysis tools.

Project Planning tools are,

1. Gantt Chart
2. Network Diagrams

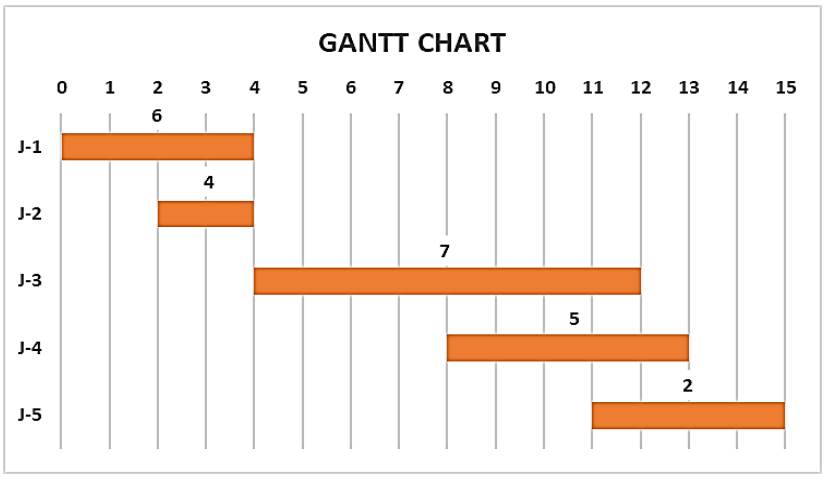
3. Critical Path Methods (CPM)
4. Work Breakdown Structure (WBS)
5. PERT chart

Gantt chart:

- It is the oldest formal planning tool designed by Henry Gantt in 1993. Under this, the activities of project are broken down into a series of well-defined jobs of short duration whose cost and time can be estimated.
- It is a pictorial device in which the activities, jobs are represented by horizontal bars in the time axis. The length of the bar indicates the estimated time for the job.
- The left-hand end of the bar shows the beginning time, the right-hand end shows the ending time.
- The manpower required for the activity is shown by a number on the bar.
  An illustrative Gantt chart is shown as follows.

PROJECT DETAILS

JOBS	START DAY	DURATION	MANPOWER
J-1	0	4	6
J-2	2	2	4
J-3	4	8	7
J-4	8	5	5
J-5	11	4	2



The merits and demerits of Gantt chart are below:

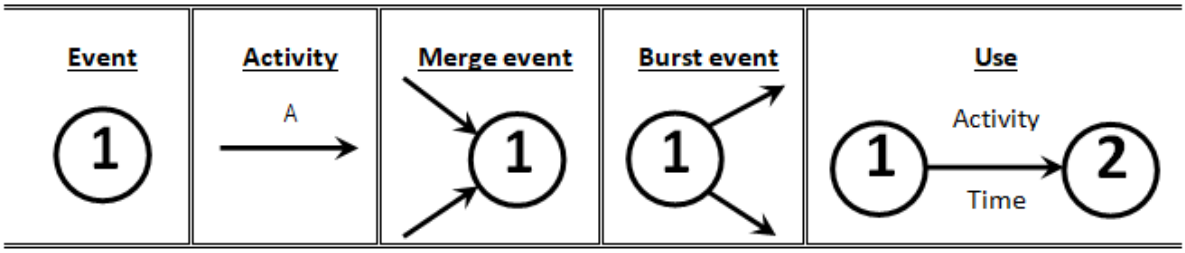
MERITS:

1. It is simple to understand.
2. It can be used to show progress.

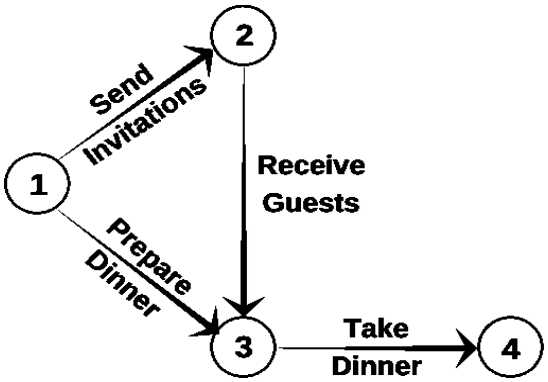
3. It can be used for manpower planning.

DEMERITS:

1. It cannot show inter-relationship among activities on large, complete projects.
2. There may be physical limit to the size of the bar chart.
3. It cannot easily cope with frequent changes or updating.



In the network techniques, the activities, events and their inter relationships are represented by a network diagram which is also called an arrow diagram.
Example:



EVENT	ACTIVITY
Invitation (1-2)	Sending
Dinner (1-3)	Preparing
Guests' arrival (2-3)	Receiving
Dinner (3-4)	Taking

The advantages of network diagram are:

1. They can effectively handle inter relationships among project activities.
2. They identify the activities which are critical to them.
3. Completion of the project on time indicate the float (spare time) for other activities.
4. They can handle very large and complex projects.

The disadvantages of network diagram are:

1. They are not easily understood by the project personnel.
2. They do not define an operational schedule which tells who does what and when.

Project Scheduling

- It is one of the key components in the project control system. It refers to when it is to be done and how much is to be done.
- The purpose of scheduling is to obtain commitment, communicate the commitments to concerned project team and ensurecoordination among them.
- The scheduling is helpful to link the summary of activities and review the lapses.

Purpose: The ongoing scheduling and monitoring process enables us to:

1. Successively detail out the schedule to provide physical equivalence with reality.
2. Adopt the schedule to the changed realities.
3. Provide intervention when stability of the work system is being threatened and re-energize the system.

Time Monitoring Efforts

Monitoring is an action inducing efforts to ensure that, commitments made by various agencies are followed by action for seamless execution.

For monitoring the time aspects of the project, the below efforts should be taken.

1. Development of project execution plan and overall project implementation schedule.
2. Preparation of special condition of contract for scheduling and monitoring.
3. Evaluation of bids in relation to scheduling and monitoring.
4. Review the detailed schedules and progress reports submitted by vendorsand contractors.
5. Reviews with owner, consultants, contractors and vendors.
6. Project audit and corporate review.
7. Monthly progress report to the owners.
8. Installation and operation of an on-line information system.
9. On job training for on-going schedule and monitoring.

Bounding Schedules

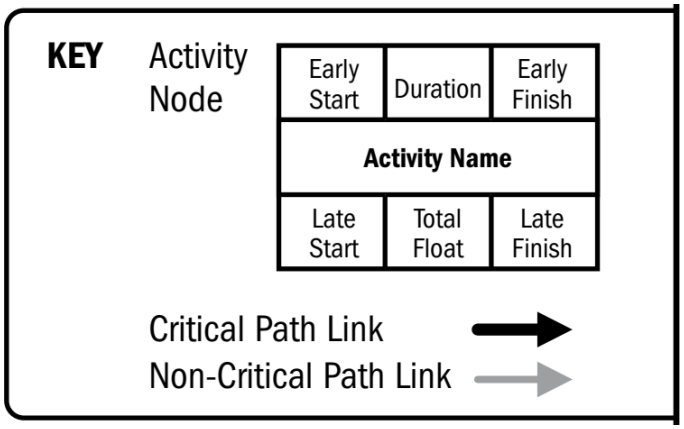
Scheduling of non-critical activities can be done by two methods.

- Early start schedule
- Late start schedule

Early start schedule:

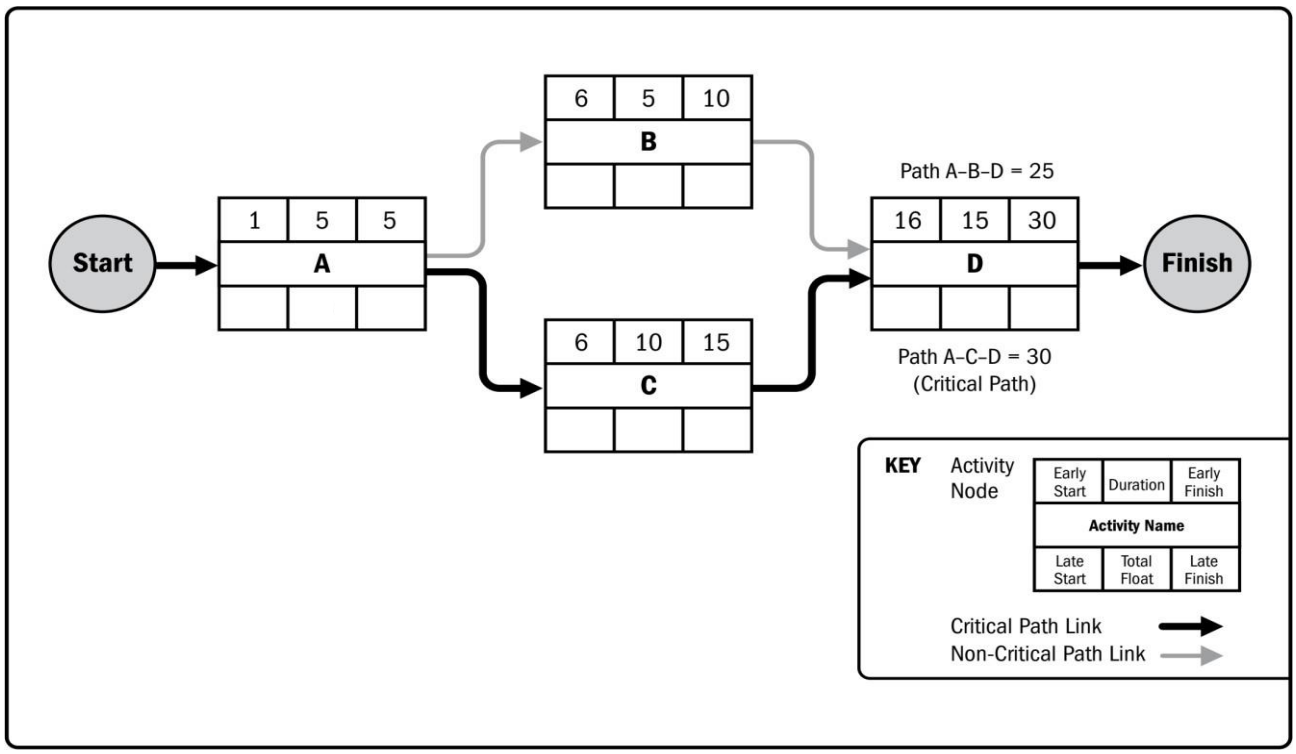
- The early start schedule indicates a cautious attitude towards the project and a desire to minimize the possibility of delay.
- It provides a greater measure of protection against uncertainties and adverse circumstances.
- Early start schedule refers to the schedule in which all activities start as early as possible. In this schedule,

1. All events occur at their earliest because all activities start at their earliest starting time and finish at their earliest finishing time.
2. There may be time lags between the completion of certain activities.
3. All activities emerging from an event begin at the same time.



A model for early start schedule is given below:

ACTIVITY	PREDECESSOR	DURATION
A	--	5
B	A	5
C	A	10
D	B, C	15



The late start schedule:

It refers to the schedule arrived at when all activities are started as late as possible. Inthis schedule,

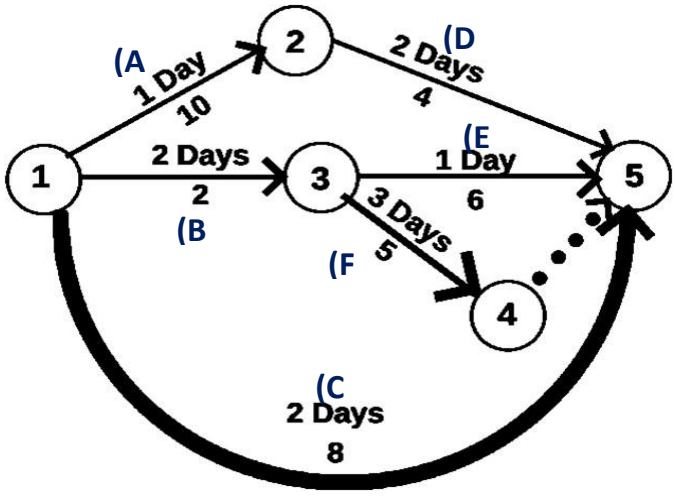
1. All events occur at their latest because all activities start at their latest starting time and finish at their latest finishing time.
2. Some activities may start after a time lag subsequent to the occurrence of the proceeding events.
3. All activities leading to an event are completed at the same time.

- The late start schedule reflects a desire to commit resources as late as possible.
- However, such a schedule provides no elbow room in the wake of adverse developments.

- Any unanticipated delay results in increased project duration.
- A model for late start schedule is given below:

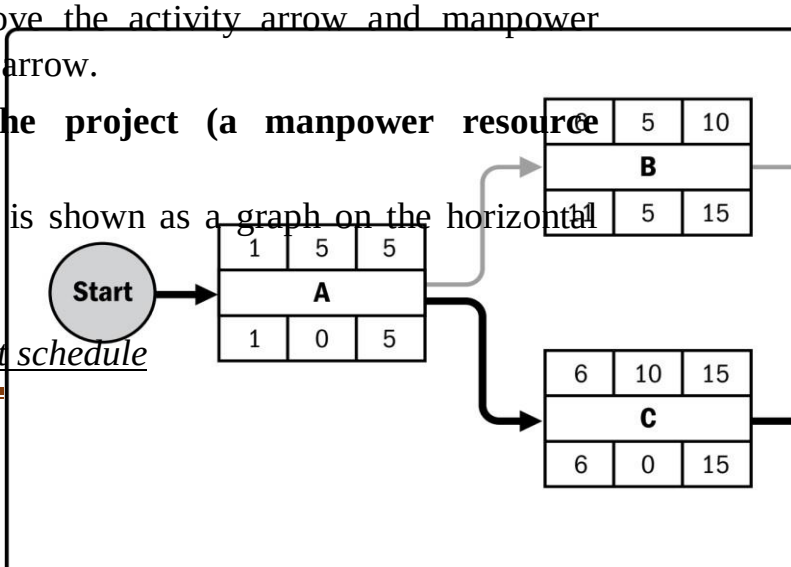
Scheduling to Match Availability of Manpower

Let us consider a small project for which the network diagram is shown in fig.



ACTIVITY	URATION (DAY)	ANPOWER (MEN)
A (1-2)	1	10
B (1-3)	2	2
C (1-5)	2	8
D (2-5)	2	4
E (3-5)	1	6
F (3-4)	3	5

- In fig. activity duration is shown above the activity arrow and manpower requirement is shown below the activity arrow.
- **Only 12 men are available for the project (a manpower resource constraint).**
- The early start schedule of this project is shown as a graph on the horizontal time scale in fig.



Early start schedule

DAYS ->	**1**	**2**	**3**	**4**	**5**
	A	**D**			
	10	**4**	**4**		
	B		**F**		
	2	**2**	**5**	**5**	**5**
	C				
	8	**8**			
			E		
			6		
TOTAL MEN ->	**20**	**14**	**15**	**5**	**5**

- Looking at the manpower requirement for the early start schedule we find it is as follows:
- **20** men for the first day, **14** men for the second day, **15** men for the third day, **6** men for the fourth day and **6** for the fifth day.

- Obviously, this schedule is unacceptable in view of the manpower constraint.
- So, we explore the possibility of shifting activities. Our efforts at shifting activities, keeping the project duration at **five** days soon reveals that no schedule is feasible with only **12** men, so we extend.
- The duration of the project by one day and try various schedules to whether we can find a feasible schedule.
- A little juggling of activities shows that a schedule like the one shown in fig. is feasible - this is the best we can do.

A feasible schedule

DAYS ->	1	2	3	4	5	6
	A		D			
	10		4	4		
	B			F		
	2	2		5	5	5
		C				
		8	8			
						E
						6
TOTAL MEN ->	12	10	12	9	5	11

Scheduling to Match Release of Funds

The cost estimates for various activities of a simple project are given in the table.

Cost Estimates:

Activity	Duration (months)	Cost per month	Cost per activity
A (1-2)	13	2,00,000	26,00,000
B (1-3)	12	5,00,000	60,00,000
C (2-4)	2	10,00,000	20,00,000
D (3-4)	8	2,50,000	20,00,000
E (2-5)	15	1,00,000	15,00,000
F (4-5)	2	7,50,000	15,00,000
		Total	**₹ 1,56,00,000**

The government has decided to release **₹ 1, 56, 00,000** required for the project inthe following manner.

- **₹ 69, 00,000** in the first year **₹ 68, 00,000** in the second year, and **₹ 19, 00,000** in thethird year.

- It has also stipulated that the unspent amount would lapse and hence cannot be carried forward.
- Before we develop the project schedule, a preliminary question may be asked: it is possible prima facie to schedule this project without extending its duration beyond 28months?
- Which is the minimum time required for the given project to complete its activities.
- To answer this question let us look at the fund's requirement for the early start schedule and late schedule.
- This is shown in Fig.

Gantt chart: Cumulative funds release scheduling

EARLY START SCHEDULE

	YEAR -1												YEAR-2												YEAR-3											
Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A (1-2)	A (13)																																			
Cost / Month	2	2	2	2	2	2	2	2	2	2	2	2	2																							
B (1-3)	B (12)																																			
Cost / Month	5	5	5	5	5	5	5	5	5	5	5	5																								
C (2-4)														C (2)																						
Cost / Month														10	10																					
D (3-4)													D (8)																							
Cost / Month													2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5																
E (2-5)														E (15)																						
Cost / Month														1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								
F (4-5)																					F (2)														
Cost / Month																					7.5	7.5														
	28 months																																			
Total cost / Month	7	7	7	7	7	7	7	7	7	7	7	7	4.5	14	14	3.5	3.5	3.5	3.5	3.5	8.5	8.5	1	1	1	1	1	1								
Cost / Year	84												68												4											

LATE START SCHEDULE

	YEAR -1												YEAR-2												YEAR-3											
Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A (1-2)	A (13)																																			
Cost / Month	2	2	2	2	2	2	2	2	2	2	2	2	2																							
B (1-3)							B (12)																													
Cost / Month							5	5	5	5	5	5	5	5	5	5	5	5																		
C (2-4)																									C (2)											
Cost / Month																									10	10										
D (3-4)																			D (8)																	
Cost / Month																			2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5										
E (2-5)														E (15)																						
Cost / Month														1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								
F (4-5)																											F (2)									
Cost / Month																											7.5	7.5								
	28 months																																			
Total cost / Month	2	2	2	2	2	2	7	7	7	7	7	7	7	6	6	6	6	6	3.5	3.5	3.5	3.5	3.5	3.5	14	14	8.5	8.5								
Cost / Year	54												58												44											

From the Early start and late start schedules we find that:

1. The rate of expenditure is relatively higher for the earlier stages in the early start schedule and is relatively higher for the later stages in the late start schedule.
2. A rate of spending greater than that of the early start schedule is not possible (This is because in the early start schedule all activities start as early as possible). Any release of funds above the early start — schedule is beyond the capacity of the project to spend.
3. The rate of spending corresponding to the late start schedule is the absolute minimum necessary to complete the project on time. If the rate of spending is less, than that corresponding to the late start schedule the project duration will have to be necessarily extended.
4. A pattern of funds release lying between the two bounds, early start and late start schedule requirements, prima facie suggests that a schedule can be worked out without extending project duration.

- Let us now look at the cumulative funds release pattern for our illustrative project.
- This lies between the early start and late start schedule requirement. So, prima facie it suggests that a feasible schedule without extending the project duration can be developed.
- Let us proceed further and consider scheduling year by year.
- The activities thus begin in year 1 according to the early start schedule are **A (1-2)** and **B (1-3)**. If both these activities are commenced as early as possible, the fund requirement for year I would be 84 lakhs.
- Since this amount exceeds 69 lakhs, the amount to be released in year 1, the

expenditure in year 1 has to be reduced by 15 lakhs. For this we consider the possibility of shifting activities to subsequent periods.

- Looking at activities **A (1-2)** and **B (1-3)** we find that **A (1-2)** is on the critical path, hence it cannot be shifted.
- Activity **B (1-3)**, however, can be shifted as it is not on thecritical path.
- Since activity **B (1-3)** requires 5 lakhs per month it has to be shifted by three months so that the amount spent in year 1 is equal to the amount released in that year.
- Since there is free float of six months for activity **B (1-3)**, we shift it by three months.
- In the year 2 the effects of shifting activity **B (1-3)** by three months are as follows:
  - The funds requirement for year 2 increases by 15 lakhs.
  - The earliest starting time for activity **D (3-4)** moves to 15 months from 12 months and the earliest finishing time moves to 23 months from 20 months.
  - Since this shift occurs within year 2, there is no change in funds requirement on account of activity **D (3-4)**.
- The earliest starting time for activity **F (4-5)** moves to 23 months from 20 months.
- This decreases the funds requirement for year 2 by 7.5 lakhs.
- Since the fundsbudgeted for year 2 is only 68 lakhs, we consider the possibility of shifting some activities to year 3.
- We find that by shifting activity **F (4-5)** to year 3 the expenditure in year 2 can be reduced to 68 lakhs.
- As a result of this shifting the expenditure for year 3 (first four months of it) equals the budgeted funds release for that year.

Gantt chart: Scheduling to match release of funds

	YEAR -1												YEAR-2												YEAR-3											
Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A (1-2)	A (13)																																			
Cost / Month	2	2	2	2	2	2	2	2	2	2	2	2	2																							
B (1-3)				B (12)																																
Cost / Month				5	5	5	5	5	5	5	5	5	5	5	5																					
C (2-4)														C (2)																						
Cost / Month														10	10																					
D (3-4)																D (8)																				
Cost / Month																2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5													
E (2-5)														E (15)																						
Cost / Month														1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								
F (4-5)																									F (2)											
Cost / Month																									7.5	7.5										
	28 months																																			
Total cost / Month	2	2	2	7	7	7	7	7	7	7	7	7	7	16	16	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	1	8.5	8.5	1	1								
Cost / Year	69												68												19											

Problems in scheduling Real-Life projects

- In real life projects there may be hundreds of activities and there may be several constraints.
- The problem of scheduling in such cases tends to become very complex.
- For solving such problems, the technique of linear programming can be used.
- However, when a problem has numerous activities, the technique of linear programming becomes computationally unwise and expensive, even with the aid of the fastest computers available.

Project Monitoring and Implementation

Introduction

- Monitoring is an integral part of every project, from start to finish.
- A project is a series of activities (investments) that aim at solving particular problems within a given time frame and in a particular location.
- The investments include time, money, human and material resources. Before achieving the objectives, a project goes through several stages.
- Monitoring should take place at allstages of the project cycle.

The three basic stages of monitoring are:

1. Project planning
2. Project implementation
3. Project evaluation.

- Monitoring should be executed by all individuals and institutions which have an interest (stake holders) in the project.

- To efficiently implement a project, the people who are planning and implementing, should plan for all the interrelated stages.

Situation Analysis and Problem Definition

- Situation analysis is a process through which the general characteristics and problems of the community are identified.
- It involves the identification and definition of the characteristics and problems specific to particular categories of people in the community.
- These could be people with disabilities, women, youth, farmer and artisans.
- Information necessary to understand the community includes,

1. Population characteristics (e.g., sex, age, tribe, religion and family sizes);
2. Political and administrative structures (e.g., community committees and local councils);
3. Economic activities (including agriculture, trade and fishing);
4. On-going projects related to city, district, Central Government, non-Government organizations(NGO's), and community-based organizations (CBOs);
5. Socio-economic infrastructure (e.g., schools, hospitals, roads etc.);
6. Community organizations (e.g., savings and credit groups, women groups, self-help groups), their functions and activities.

- Information for situation analysis and problem definition should be collected withthe involvement of the community members using several techniques.
- This ensures valid, reliable and comprehensive information about the community and its problems.

Some of the following techniques could be used:

1. Document's review;
2. Surveys;
3. Discussions with individuals, specific groups and the community as a whole;
4. Interviews;
5. Observations;
6. Listening to people;
7. Brainstorming;
8. Informal conversations;
9. Making an inventory of community social resources, services and opportunities.

Situation analysis is very important before any attempts to solve the problem because:

1. It provides an opportunity to understand the dynamics of the community.
2. It helps to clarify social, economic, cultural and political conditions.
3. It provides an initial opportunity for people's participation in all projectactivities.
4. It enables the definition of community problems and solutions.
5. It provides information needed to determine objectives, plan and implement.

Setting Goals and Objectives

- Goal setting is to ask the question, "Where do we want to go?" (What do wewant?).
- Before any attempts to implement a project, the planners, implementers and beneficiaries should set up goals and objectives.
- A goal is a general statement of what should be done to solve a problem.
- It definesbroadly, what is expected out of a project. A goal emerges from the problem that
- Needs to be addressed and signals the final destination of a project.
- Objectives are finite sub-sets of a goal and should be specific, in order to be achievable. The objectivesshould be "SMART."
- To achieve the objectives of a project, it is essential to assess the resources available within the community and from external sources.
- The goals and objectives provide the basis for monitoring and evaluating a project.
- They are the yardsticks uponwhich project success or failure is measured.

Generating Structures and Strategies

- This aspect is to ask the question, "How do we get there?" (How do we get what we want with what we have?).
- The planners and implementers should decide on how they are going to implement a project, which is the strategy.
- Agreeing on the strategy involves determining all items (inputs) that are needed to carry out the project.
- Generating the structures and strategies involves:

1. Discussing and agreeing on the activities to be undertaken during implementation.
2. Defining the different roles and role players, inside and outside the community.
3. Defining and distributing costs and materials necessary to implement the project.

- After establishing the appropriateness of the decisions, the executive should

discuss and agree with all role players on how the project will be implemented. This iscalled designing a work plan.

- A work plan is a description of the necessary activities set out in different stages, with rough indication of the timing.
- The work plan is a guide to project implementation and a basis for project monitoring. It helps to:

1. Finish the project in time.
2. Do the right things in the right order.
3. Identify responsible person/ team for all activities.
4. Determine when to start project implementation.

Implementation

- Monitoring implantation is to ask the question "What happens when we do?"
- Implementation is the stage where all the planned activities are put into action.
- Before the implementation of a project, the implementers should identify their strength and weakness, opportunities and threats (SWOT).
- The strength and opportunities are positive forces that should be exploited to efficiently implement a project. The weakness and threats are obstacles that can hamper project implantation.
- The implementers should ensure that they devise a means of overcoming them.
- The monitoring activities should appear on the work plan and should involve all stake holders.
- If activities are not going on well, arrangements should be made to identify the problems so that they can be corrected.

What is Project Evaluation?

- Project Evaluation is a step-by-step process of collecting, recording and organizinginformation about project results.
- The project results may include short-term outputs (immediate results of activities, or project deliverables), and long-term project outputs (changes in behavior, practice or policy resulting from the project).
- Need for conducting evaluations are:

1. Response to demands of the project for accountability.
2. Demonstration of effective, efficient and equitable use of financial and other resources.
3. Recognition of actual changes and progress made.
4. Identification of success factors, need for improvement where expected outcomes are unrealistic.
5. Validation for project staff and partners when desired outcomes are achieved.

Why is Project Evaluation Important?

Evaluating project results is helpful in providing answers to questions like;

1. What progress has been made?
2. Weather the desired outcome is achieved? If not why?
3. Are there ways that project activities can be refined to achieve betteroutcomes?
4. Do the project results justify the project inputs?

What are the Challenges in Monitoring and Evaluation?

1. Getting the commitment to do it.
2. Establishing base lines at the beginning of the project; identifying realistic, quantitative and qualitative indicators.
3. Finding the time to do it and sticking to it.
4. Getting feedback from your stakeholders.
5. Reporting back to your stakeholders.

Questions:

1. What is project planning?

2. What is the necessity of project planning?
3. List the steps in project planning.
4. What are functions of project planning?
5. Draw the project planning structure.
6. List the principle of project policies.
7. List the project planning tools.
8. What is network diagram?
9. What is project scheduling?
10. List the efforts to be taken for monitoring the time aspects of the project.
11. What is project monitoring?
12. List the information necessary to understand the community.
13. What is goal?
14. What is Project Evaluation?
15. Why is Project Evaluation Important?
16. What are the Challenges in Monitoring and Evaluation?

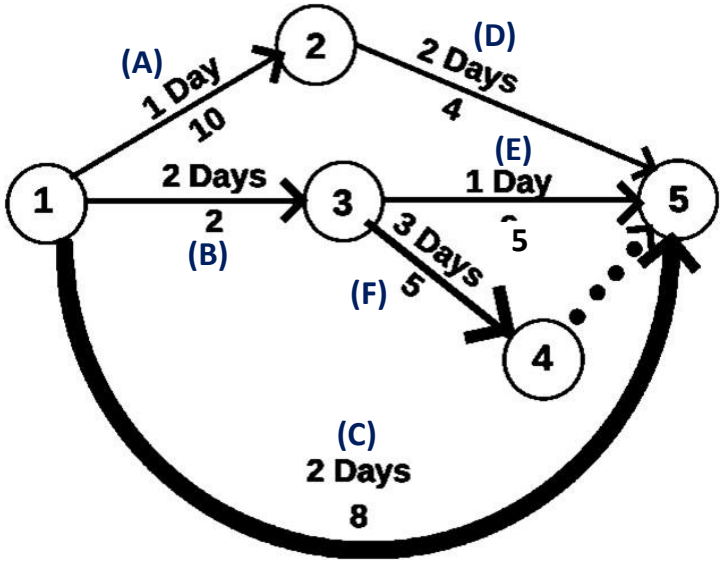
Understanding:

1. Explain the types of project plan.
2. Explain the term SMART with respect to project objectives.
3. Explain the project planning tools.
4. Explain the network diagram with example.
5. Explain early start and late start schedule.
6. Draw the Gantt chart for the given project.

PROJECT DETAILS

JOBS	START DAY	DURATION	MAN POWER
J-1	0	5	7
J-2	2	3	3
J-3	4	6	9
J-4	8	4	2
J-5	11	4	4

7. Design a project schedule for the given network diagram using Gantt chart. **Consider only 10 men are available for the project.**



8. Prepare an early start schedule network diagram for the given project.

9. Design a project plan to match the release of funds. The government has decided to release ₹ 1, 66, 00,000 required for the project in the following manner.

ACTIVITY	PREDECESSOR	DURATION
A	--	6
B	A	6
C	A	11
D	B, C	16

₹ 78, 00,000 in the first year ₹ 70, 00,000 in the second year, and ₹ 18, 00,000 in the third year.

It has also stipulated that the unspent amount would lapse and hence cannot be carried forward.

Cost estimates:

Activity	Duration (months)	Cost / month	Cost / activity
A (1-2)	10	3,00,000	30,00,000
B (1-3)	14	4,00,000	56,00,000
C (2-4)	3	8,00,000	24,00,000
D (3-4)	10	3,00,000	30,00,000

E (2-5)	10	1,00,000	10,00,000
F (4-5)	2	8,00,000	16,00,000
		Total	₹ 1,66,00,000

10. Explain the importance of situation analysis.
11. Explain the steps involved in generating the structures and strategies of a project.
12. Explain project implementation.

UNIT-6

Digital Project Management

Digital Technology Trends in Project Management

- Majority of traditional project management failures occurring due to the requirements miss management, scope creep, change request handling, adoption failures or sustained maintenance of all activities that are with the project management.
- Therefore, it is very important to understand the critical aspects of project management and its related challenges and it is very essential to introduce the digital technology for the management of modern projects to overcome the most of the shortcomings of the conventional project management and it is called as Digital Project Management.
- Project management aims to utilize resources across all technology tracks to achieve the intended goals within a predetermined schedule.
- Managing the projects using digital technologies involves managing various digital technologies such as content management systems, portals, search, analytics, etc., to achieve high quality deliverables.
- The project management uses the digital technologies such as experience platforms, enterprise portals, content systems, commerce platforms, user experience technologies, mobile technologies, search and collaboration.

Following are the key trends of digital projects:

- The digital project uses modern day technologies such as experience platforms, commerce products, API platforms, Big-data technologies, Al technologies, Cloud technologies, IOT platforms, AR and VR applications.
    - The digital projects are mainly executed through an Agile methodology orin iterations to attain faster time to market.
    - The primary success metrics are user engagement, performance, responsiveness, agility and user conversion.
    - The solutions are mainly supplied to internet users and provide Omni-channel capabilities.

A significant benefit of digital technology is the storage of information via a cloud. By keeping your critical resources in the cloud, team members can access documents, images and more with ease and without a never-ending email chain.

Some ways how these trending technologies are making positive changes in project management:

- **Project planning:** Uses the data from previous projects to plan better.
- **Scheduling and time tracking:** Keeps track of time spent on tasks andmanages scheduled events, meetings, milestones and deadlines.
- **Communication and collaboration:** Lets you share critical informationwith team members, clients and stakeholders.
- **Budgets and deadlines:** Helps you in delivering the projects within theallocated budgets.
- **Process tracking:** Keeps track of the ongoing projects whether they areon track or not, whether the resources need to be adjusted or not.

Recent Trends in Digital Technology in Project Management:

- **Location based analytics:** Using location-based services, organizations want to push personalized, relevant, and effective campaigns and services.
- **Social channel utilization and touch point optimization:** Organizations want toengage their customers at all touch points (web, offline, kiosk, mobile, social media, IVR, etc.). Due to increased popularity of social media platforms, organizations use them for the voice of customer channels, brand marketing, campaigns, etc.
- **Mobile-first and cloud-first strategies:** Digital plat forms are built with mobile devices as their primary delivery platforms. The applications are deployed increasingly on the cloud to realize the "software as service" model.
- **Intuitive user experiences:** Seamless and integrated cross channel enabled content with dashboard views, unified views, 360-degree activity views, and rich, real-time visualizations are becoming the norm in the user experience space.
- **Digital marketing:** Organizations are leveraging social media platforms to market their products and brands. Peer recommendations and peer approval play a major role in influencing customers.
- **Analytics:** Real-time analytics of user actions and analysis of historical data will be used for contextual recommendation and for personalizing the experience.

- **Domain specific trends:** Each functional vertical has its own set of digital transformation goals. The main digital transformation goals for some of the verticals are as follows.
    1. ***Banking:*** Digital banking, omni-channel experience, personalization, dashboard experience, virtual branch, self-service tools, social media engagement, analytics, mobile apps, digital payments, and digital wallets.
    2. ***Retail:*** Virtual assistant, Al-based smart recommendations, chat bot, augmented reality, mobile apps, Big Data, IOT, wearable's, cloud delivery (SaaS), social media marketing, social listening, user enablement,targeted marketing, loyalty management, digital marketing, customer segmentation, and voice of customers.
    3. ***Utilities:*** Dashboard experience, self-service, process automation, real- time monitoring, dashboard view and analytics.
    4. ***Life sciences:*** Business intelligence, mobile apps, CRM, ERP applications, wearable's, IOT and reporting.
    5. ***Automobile:*** IOT and telematics.
- **Other digital technologies:** Organizations are increasingly investing in Big Data,IOT and wearable for applicable use cases.
- **Personalized, unified, responsive and contextual user experiences:** Modern digital applications are user centric and the user experience is designed to provide a holistic view of all the user activities. Customers expect consistent cross-channel experiences due to proliferation of mobile apps and multiple digital channels. Digital applications provide a unified view through personalized dashboards and landing pages with aggregated information from various sources.

Platform philosophy: Normally, development of a digital platform for an enterprise requires implementation of multiple capabilities such as experience modules, personalization modules, content management system, digital marketing modules, mobile apps, services enablement, web analytics, search modules, and so on.

Business process optimization: Underlying business processes are optimized through process automation and simplification. Products such as BPM (Business Process Management), message-oriented middleware (such as Enterprise Service Bus-ESB, and API gateway), and rules engines are used to orchestrate the complex rules driven business processes.

- **Internet of things (IOT):** 10T and sensors are used to get real-time

information from various connected devices and report/predict the outcome. Connected and wearable devices are increasingly used in the health care domain.

- **Big data analytics:** Applying analytical techniques to a massive volume of data will reveal the hidden patterns and trends and provide vital insights into the data. Digital solutions can leverage big data analytics for predicting outcomes, providing relevant recommendations, understanding the data, creating data visualizations, and making faster decisions. Big data analytics is increasingly used in financial applications, digital e-commerce solutions, and in health care.
- **Touch and gesture-based inputs:** As native mobile apps are gaining momentum for implementing the mobile-first strategy, touch-based features and location- based services are replacing traditional keyword/text-based inputs.
- **Social integration:** Social and collaboration features (such as blogs, wiki, chat, community, forums, calendar, surveys and message boards) and integration with social media platforms (such as Twitter and Face book) are becoming a basic necessity in most modern digital applications. Enterprises are engaging their customers at various social touch points and carryout personalized and targeted marketing campaigns. Enterprises also use other advanced features such as social analytics, social listening, social media marketing, and sentiment analysis to gauge user sentiment about the organization's service and product.
- **Voice-enabled applications:** More and more B2C digital applications are becoming voice-enabled. Most of the digital applications, such as search, maps, mobile apps, and smart phone assistants, work based on voice commands.
- **Location-aware services:** As mobile devices are becoming primary access channels for users, more digital applications are exploiting the location-based services to push the notifications, offers, promotions, and services to actively engage with end users. Digital applications such as maps, games, navigation systems, and logistics systems use location-based services.
- **Gamification:** Gaming concepts such as point-based incentives, explorative themes, entertainment value, increasing complexity of challenges, using multimedia content, instant feedback, goal/task-based UI design, and collaborative problem solving are used in the context of digital solutions. Gamification is widely used for digital marketing, e-

learning, e-commerce applications, digital knowledge management, and question-answer systems.

- **Augmented reality (AR):** The AR based systems augment the real world with digital world, thereby enhancing the end user experience. Augmented reality creates a virtual world and is mainly used in retail domain, gaming/entertainment, and e-commerce domains.

Cloud Technology:

- Cloud technology or cloud computing is also popularly referred as a cloud.
- The cloud can be defined as a virtual storage space that exists on the internet.
- It is a storage space where the people can place their digital resources such as software, applications and files.
- Cloud technology allows the people to use the digital resources stored in the virtual space by the way of networks, often using satellite network.
- It allows the peopleto share information and applications across the internet without being the restrictionof their physical location.

Application of Cloud Technology in Project Management:

- It is very easy to apply the concept of cloud in management and it comprises a service of entrance to the background of the project as well as to use.
- For instance, the software distribution model is referred to us **S**oftware **a**s **a S**ervice (**SaaS**), wherebya customer is able to access the basic software applications located in the provider server and pays for each as he/she continues to use them.
- The benefit of using Cloud applications is that it allows information sharing between participants of a project as well as its capacity to protect inclusion of the customer to manage the project.
- The expertise of project management managers shows that the teething troubles that concerns a project manager relate to the so called "hard" features, for example, the choice of technology, adaptation of infrastructure as well as developing a single management, and there are more related to "soft" sections of management, such as organizing as

well as putting into practice of change process, resistance of network administration and education.

- The using of the service model is able to provide an organization implementingthe project similar advantages as the application of Cloud for the firm which includes:
- Secure storage of data associated with the project;
- The compatibility with the version of the application that supports the management of a project;
- Automation of some processes;
- Requires no special license for the software;
- It is not necessary to acquire
- an exceptional server for project management; easy and quick access to the project from any place, one just needs to have internet access; the ability to support remote working of project team members when need arises; offers the right to use hefty computing power required in the execution of giant as well as complex projects and; technical assistance of cloud providers.
- Project management is a complicated process that requires all project partnersto be involved to avoid project failures.
- For instance, project management calls for proper management of resources, scheduling of projects, monitoring, evaluation and project milestone mapping.
- With the cloud computing technology, it provides the platform(s) that will enable project managers to coordinate various project stakeholders from different remote areas with the sharing of cyberspace to implement the projects. However, there are project management software available, but the project managers need to learn how to use them.
- It is also recommendable that project managers and organizations should use the clouding services to implement their projects so as to improve their service delivery and timely completion of their projects hence customer satisfaction.
- However, cloud computing services has its limitations in internet and server reliability, by the failure of one of the systems (internet or server), the entire service will be down.

- Therefore, there will be no any accessibility of. Any information until the systems is restored.
- Nevertheless, cloud computing services are reliable and effective that project managers or organizations should consider to implement.

Internet of Things (IoT):

Internet of Things (IoT) refers to the process of connecting everyday physical objects to the internet from common household objects like light bulbs to health care assets like medical devices to wearable, smart devices and even smart cities.

Working of IoT:

- IoT refers to any system of physical devices that receive and transfer data over wireless networks with limited human intervention.
- This is made possible by integrating computing devices in all kinds of objects.
- For example: a smart thermostat can receive location data from your smart car while you are travelling between work place and home.
- The connected devices can adjust your home's temperature before you arrive. This is achieved without your intervention and produces a more desirable result than if you manually adjust the thermostat.
- It works by continuously sending and receiving and analysing the data in a feedback loop.
- Depending upon the kind of 10T technology, analysis can be conducted either by humans or artificial intelligence and machine learning (AI/ML) in a real-time or over a longer period.
- The IoT is essentially the global network of devices that can communicate with one another and end users through the internet.
- Many major technology firms are developing their own IoT platforms such as Amazon web services, Microsoft Azure and Google cloud etc.
- The IoT intersects with project management on everything from team collaboration to data collection and you can expect real time status reporting via IoT to user in a new era of dynamic planning and revolutionized project execution.
- Data collection will happen seamlessly and constantly, allowing leaders to make more informed decisions.

- Inventory and resources will be easily monitored at all times.
- Devices can automatically sense and respond to what is happening around them or in their network, reducing the need for human intervention, lowering operating costs increasing response times and minimizing errors and also the customers can expect to receive better and faster service.

Uses of 10T in Project Management:

- In project management, the IOT technology will fundamentally alter the speed of project execution.
- Organizations' that capitalize on the IOT will complete projects faster than those don't.
- The following things will change and which will require project managers to adopt both technically and systematically.

1. IOT enables the hyper speed reporting, and reduces the cost of communication; no more idle times are required in between activities and no more silos from support systems such as database, storage and IT operations.

2. IOT allows complete monitoring and process control: IOT allows project managers, management and stakeholders to monitor and control activities in real-time. Therefore, the overall system is monitored on a single screen, which allows the managers to attend immediately to any interruptions.

3. IOT creates an explosion of valuable project data: In the past, archiving historical data was a time and labor-intensive process, with the IOT, historical data will become available immediately, which is extremely helpful for current and future projects.

4.IOT allows super-deep data analytics: With the 10T comes advanced data analytics and advanced data analytics require advanced interpretations and management, and project manager must upgrade their skills related to data handling.

5. IOT users in stricter ethical and legal implications: Today's internet connected devices send data to each other extremely fast. We are not dealing with dial- up modems anymore one error could create a domino effect that could topple an entire project or in extreme cases, an entire career before you

can say 'Enron'.

6. IOT raises expectations for all stakeholders: Once companies adopt IOT, the market place will be transformed into a level playing field, only the strongest and effect will survive.

AR and VR Applications in Project Management:

Augmented Reality (AR):

- Augmented reality is the real time use of information in the form of text, graphics,audio and other virtual enhancements integrated with real world objects.
- AR is an enhanced version of the real physical world that is achieved through theuse of digital visual elements, sound, or other sensory stimuli delivered via technology.
- It is a growing trend among companies involved in mobile computing and business applications in the particular.
- AR's primary goals is to highlight specific features of the physical world, increaseunderstanding of those features, and derive smart and accessible insight that can beapplied to real world applications.
- Such big data can help the company’s decision making and gain insight into consumer spending habit, among others.

Virtual Reality (VR):

Augmented Reality	Virtual Reality
1. Combination of digital and real world.	1. Totally artificial digital world.
2. User experience is partially immersed.	2. Complete sense of immersion.
3. Camera-enabled devices such as smart phone, tablet or smart glasses are required. Desktop and lap-top are not suitable because of its fixed camera position, unless an external camera isused.	3. Special hardware equipment is required (Microsoft Hololense, HTC vive,oculus right, Google daydream, etc).
4. Latest versions of common operating systems are good enough (Android, IOS, Windows).	4. Special software is required.
5. Initial cost is lower than the VR.	5. Initial cost is higher than the AR.

Virtual reality refers to a computer-generated simulation in which person can interact within an artificial three-dimensional environment using electronic devices, such as special goggles with a screen or gloves fitted with sensors. Ex: 3D movie, videogames, virtual meetings.

In 3D movie, using special 3D glasses, one can gets the immersive experience ofbeing a part of the movie with on-spot presence.

AR and VR in Project Management:

AR and VR in project management are useful in decision making problems in complex projects.

This is particularly important for fields where prompt and accurate reactions are extremely important and also with the help of AR/VR, easier and much faster understanding of large amount of data is possible.

Benefits of AR and VR in Project Management (PM):

- Increase in competitive ability.
- Increase in efficiency and productivity.

- Reduces time and costs.
- Reduces errors and facilitates of work processes.
- Enables fast remote support for repairing systems weakness.
- Enable fast and remote collaboration.
- Involve innovation support.
- Facilitate to understand large amounts of data.
- Facilitate decision making problems solving.
- Facilitates monitoring of projects.
- Reduces the project t validation ricks.

Applications of AR and VR in Project Management:

1. **Architecture, civil engineering, construction and real estate:**

- Instead of standard 2D format of drawings and renderings, investors and customers can now experience realistic impression of their future buildings, flats, business places, both from the outside and from the inside.

- Application of AR/VR technologies in these kinds of projects significantly reduces costs and time expenditure, improves design, and facilitates construction planning.

- Also, there is research that synthesizes current VR/AR applications from the point of construction safety with the conclusion that AR/VR applications already achieved lot in that field, and there is more space for further improving theirapplications in construction safety.

2. **Marketing and sales*:***

- Many companies have recognized additional values for both marketers and customers.
- For instance, Ikea Place app helps customers in fast decision making when purchasing furniture, by using cameras of Smartphone's or tablets.
- It analyses customer's room and puts furniture in adequate position. For wider use, there is a tool that promotes commercial sales - Amazon's app which lets to place items inside customer places usingAR, to see how items will fit the space.

3. **Education:**

- AR/VR technologies offer great opportunities and diversity in education (remote learning, interactive learning, 'real' lessons, etc.). This also involves education of experts for PM, who should be both educated by using such technologies, and be educated to apply these technologies in theirwork.
- There are many examples of AR/VR projects for general use in education,for example: SCARLET Special Collections using Augmented Reality to Enhance Learning and Teaching (University Manchester), cARe-Creating Augmented Reality in Education (City, University of London), AR studio- Australian research project (the University of Camberra, the Australian National University and Macquarie University) etc.

4. **Visual industries*:*** There are many examples of using AR/VR and related projects in this field; game industry, fashion industry, entertainment industry-cinema, film, travelling exhibitions (e.g., landmarks, museums) etc.
5. **Automotive:** AR/VR solutions are used for test drives, car elements testing, car dealership experience, etc.

- For example, Volkswagen adopts VR and AR solutions with belief that they help the company to successfully deal with increasing demands that automotive industry has been facing on.
- The company systematically engage employees to use VR and AR solutions for training and collaboration to empower their brands and business departments. They developed smart infrastructure that enables training, collaboration and service integration worldwide.
- Employees and whole teams learn within an interactive 3D space. This solution increases training efficiency, reduces learning time and travel costs, and helps transfer of relevant knowledge in solving practical tasks.

6. **Manufacturing:** In complex manufacturing processes AR is useful in delivering the right information at the right moment to factory workers on assembly lines.

- This is efficient in reducing errors, reducing costs, time saving, and productivity improving.
- Any operator in Industry 4.0 with the help of AR could be smart operator

soon, while simulation and optimization will be supported by VR technologies.

7. **Healthcare:** Training of surgeons is one of the most important field of application of the AR/VR technologies in healthcare.
   There are examples of usage AR/VR technology in triage and urgent care, for example Red Cross Triage AR application using Google Glasses.
8. **Defense:** TARGET (Training Augmented Reality Generalized Environment Toolkit) is European project which started 2015 and planned to end in 2018.
   - The project develops AR and VR solutions for training the security critical agents (for example, policeman, fireman, emergency medical staff, anti- terrorist units, etc.).
   - The project uses different approaches allowing remote connection of AR and VR systems to geolocation and other tools, involving 3D modeling, photogrammetric, drones and many other state-of-the-art technologies.
   - Creates new-made mixed reality environment where trainings are provided in extreme under-pressured security situations. Improving andoptimization training is the aim of the project.
9. **Service support:** Remote technical and expert support, visualized instructions, remote repairing, knowledge, exchange, etc., with the AV/VR technologies, maintaining and repairing at remote locations is possible.
   - For example, industrial giant ABB uses AR to maintain and repair equipment at remote locations which they found particularly useful in dangerous and complex remote procedures.

Cloud Technology, IOT, AR and VR Applications in Smart Cities:

- A smart city is a framework, predominantly composed of information and communication technologies (ICT), to develop, deploy and promote sustainable development practices to address a growing urbanization challenge.
- A big part of this ICT framework is essentially an intelligent network of connected objects and machines (also called as digital city) that transmit data using wireless technology and the cloud technology Cloud based IOT applications receive, analyse and manage data in real-time to help

municipalities, enterprises, and citizens to make better decisions that improve quality of life.

- Citizens engage with smart city ecosystems in various ways using smart phones and mobile devices and connected cars and homes, pairing devices and data with a city's physical infrastructure and services can cut costs and improve sustainability.
- Communities can improve energy distribution, streamline fresh collection, decrease traffic congestion and even improve air quality with the help of IOT.
- Connected traffic lights receive data from sensors and cars adjusting light cadence and timing to respond to real-time traffic, reducing road congestion.
- Connected cars can communicate with parking meters and electric vehicle charging docks and direct drivers to the nearest available spots.
- Smart garbage can automatically send data to waste management companies and schedule the pick-up as needed versus on a preplanner schedule.
- Citizen’s Smartphone becomes their mobile driver’s license and ID card with the digital credentials, which speeds up and simplifies access to the city and local government services together, these smart city technologies are optimizing infrastructure, mobility, public services and utilities.

AR and VR Technologies:

- All the above technologies contribute to the quality of the life in a smart city. However, without the augmented reality, this picture is incomplete.
- The other technologies are considered to be back-end technologies that work in the background and remain hidden from view. AR can be the interface which provides access to all the benefits of a smart city.
- With AR it is possible to interact with the normal environment in a completely different way for example

- **AR navigation systems of smart cities:** Augmented layer with navigation can drastically improve the navigation experience and increase the safety of your journey.
- **AR as a search engine for physical places/objects:** AR will help you in an innovative way i.e., it involves physical interaction with the world, using gestures and body movements.
- **Social network for citizens:** AR can be used as a framework for a social platform, where citizens can interact with each other, share information and leave comments about real physical objects such as restaurants, hospitals, etc.
- AR improves sight-seeing experience of smart city.

- AR as an eliminator of language barrier etc.
- VR can help in emergency management, disaster, preparedness, real time information overlay etc.
- VR/AR can enable remote training and distance learning to create engaging classroom content which accomplishes the same objective' as in person schooling.
- VR/AR can help in design, prototyping, production, prevention of workplace hazards, inventory management, training and assembly etc.

Data Science and Analytics in Project Management:

Data Science:

- Data science is an umbrella that encompasses data analytics. The data science is a multidisciplinary field focused on finding actionable insights from large sets of raw and structured data.
- This field is primarily fixed on finding answers to the things we don't know we don't know.
- Data science experts use several different techniques to obtain answers, incorporating computer science, predictive analytics, statistics, and machine learning to resolve through massive datasets in an effort to find solutions toproblems that have not been thought of yet.
- Data science focuses on finding meaningful correlations between large datasets and it seeks to discover new and unique questions that can drive business innovation.
- Data scientists' main goal is to ask the questions and locate potential places of study, with less concern for specific answers and more emphasis on finding the right question to ask and finding the better way to analyse the information.

Data Analytics:

Data analytics is a branch of data science. Data analytics focuses on processing and performing statistical analysis of existing datasets. Analysts concentrates oncreating methods to capture, process and organize the data to find actionable insightsfor current problems and best way to present this data.

More simply, the field of data and analytics is directed toward solving problems for questions that data science brings forth.

More importantly, it is based on producing results that can lead to immediate improvements.

Data science seeks to discover new and unique questions that can drive businessinnovations on other hand, the data analytics aims to find the solutions to those questions and determine how they can be implemented within an organization to foster data driven innovation.

Steps in data science and data analytics in PM involves

a. Define the question
b. Define the ideal dataset
c. Determine what data you can access
d. Obtain the data and clean the data
e. Exploratory data analysis
f. Statistical prediction/modeling
g. Interpret results
h. Challenge results
i. Synthesis/write up results
j. Create reproduceable code.

Questions:

1. What is digital project management?
2. Explain the digital technology trends in project management.
3. What are the positive changes in project management due to the digital technologies?
4. What are the recent trends in digital technology in project management?
5. What is cloud technology?
6. List applications of cloud technology in project management.
7. What is IOT? And explain the working of IOT.
8. List the uses of IOT in project management.
9. What is AR and VR?
10. What are the differences between AR and VR?
11. What are the benefits of AR and VR?
12. What are the applications of AR and VR?
13. Explain the applications of cloud technology in smart cities.
14. What are the steps in data science and data analytics in PM?
15. What are the applications of cloud based IOT in smart cities?
16. Explain the data science in project management.
17. Explain the data analytics in project management.