

Project Management

(Code : ILO8021) (Institute Level Optional Course)

Semester VIII—Common To All Branches

(Mumbai University)

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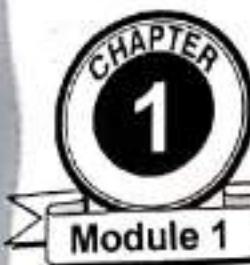
Syllabus : Introduction to project leadership, ethics in projects, Multicultural and virtual projects.

Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.

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Project Management Foundation

Syllabus

Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI).

1.1 Introduction

Project Management for long has been an important functional area of large no. of organizations. Today, large no. of organizations execute 50% of their work activities in the form of projects. There are large no. of project organizations whose main activity is to undertake and develop projects for other organizations. The projects executed are of all kinds be it infrastructure, IT, industrial setup or services. The successful execution of a project requires an effective use of management tools & techniques in order to achieve the objectives. Thus, Project management as a subject of study has become important for management personnel and students.

1.2 Project

- A project is a temporary work done with a definite start and end. It is generally unique in nature unlike a regular operation. It is planned and executed keeping a specific problem or opportunity in mind. The aim is always to achieve a specific goal that helps solve the problem or avail the opportunity present.
- For example : Building a bridge or a building, Developing a software, Launching a product, Conducting an event, Doing a market survey etc. Almost everyday around the world large no. of projects are initiated.

1.2.1 Project Management

The success of any project is measured by the objectives achieved at the end. Some of the important objectives to be achieved are the set standard of the output, its timely completion and meeting budget limits. In order to achieve the objectives, the role of management becomes very important. Project Management is the application of management knowledge, skills, tools and techniques to project activities in order to meet the project requirements.

1.3 Operations

- Operation is a vital organizational function. It includes production of goods as well as services. The process of operations turns raw materials into goods. The quality of products to a great extent depends on the operational efficiency and effectiveness.
- Operations include a three step process- Input, Process and Output. It is a routine function within an organization and is performed as long as the business of the organization exists.
- For effective and efficient operations its proper management is of utmost importance. Operation management is the administration of business practices to create the highest level of efficiency possible within an organization.



Operations management teams attempt to balance costs with revenue to achieve the highest net operating profit possible.

- Operations management involves utilizing resources from staff, materials, equipment, and technology. Operations managers acquire, develop, and deliver goods to clients based on client needs and the abilities of the company.
- Operations management handles various strategic issues, including determining the size of manufacturing plants and project management methods and implementing the structure of information technology networks. Other operational issues include the management of inventory levels, including work-in-process levels and raw materials acquisition, quality control, materials handling, and maintenance policies.
- Another large facet of operations management involves the delivery of goods to customers. This includes ensuring products are delivered within the agreed time commitment. Operations management also typically follows up with customers to ensure the products meet quality and functionality needs. Finally, operations management takes the feedback received and distributes the relevant information to each department to use in process improvement.
- Operations management focuses carefully on managing the processes to produce and distribute products and services. A great deal of focus is on efficiency and effectiveness of processes. Therefore, operations management often includes substantial measurement and analysis of internal processes.
- Ultimately, the nature of how operations management is carried out in an organization depends very much on the nature of the products or services in the organization, for example, agriculture, mining, construction or general services. Here are some additional perspectives on the field.

1.3.1 The Difference between Projects and Operations

There are many differences between projects and operations. Some differences are as follows :

- (i) Projects are unique and temporary, while operations are ongoing and permanent with a repetitive output.
- (ii) Projects have a fixed budget, while operations have to earn a profit to run the business.
- (iii) Projects are executed to start a new business objective and terminated when it is achieved, while operational work does not produce anything new and is ongoing.
- (iv) Projects create a unique product, service, or result, while operations produce the same product, aim to earn a profit and keep the system running.
- (v) There are more risks in projects as they are usually done for the first time, while in operations there are fewer risks as they are repeated many times.
- (vi) Projects are performance intensive while operations are efficiency intensive.
- (vii) Projects are managed through project management and operations require business process management.

Understand this difference through an example : Assume you were given a project to build a car manufacturing facility. You build the facility and deliver it to the client. Your job is completed, and the client has started manufacturing cars. In this example, building the facility is an example of a project, because here you constructed a car manufacturing facility and handed it over to the client and signed off.

However, once the facility starts working and the car manufacturing process begins, this is an example of operations, because here the facility is producing a repetitive output, cars. Therefore, this is an example of an operation.

1.4 Objectives/Necessity of Project Management

- **Successful development and implementation of project's phases :** A project generally involves different phases such as Initiation, Planning and Design, Construction and Execution, Monitoring and Control, Completion. The smooth and uninterrupted development and execution of all the phases ensures the success of a project.
- **Productive guidance, efficient communication and supervision :** The success or failure of a project is highly dependent on teamwork which requires collaboration among its members. Proper guidance, Good communication and regular supervision are of major importance as information needs to be articulated in a clear, unambiguous and complete way so everything is comprehended fully
- **Achievement of the project's main goal :** Project management has the responsibility of achieving the set goals of a project even with the presence of all constraints.
- **Optimization of the allocated resources :** The success of the project also depends on the optimum utilization of all the resources. This is a major objective of Project management. The Identification and proper utilization of the resources are to be done to achieve the goals.
- **Completion of project as per the client's exclusive needs and objectives :** This might mean that you need to shape and reform the client's vision or to negotiate with them as regards the project's objectives, to modify them into feasible goals. Once the client's aims are clearly defined they usually impact on all decisions made by the project's stakeholders.

1.5 Importance of Project Management

Clearly defines the plan of the project before it begins : The importance of planning in project management cannot be ignored. The more complex project, the more scope there is for chaos. One of project management's primary functions is to tame the chaos by mapping out a clear plan of the project from beginning to end.

Establishes an agreed schedule and plan : Schedules help to eliminate delays or overruns and provide a plan to be followed for all those involved with the project.

Create a base for teamwork : People are required to work in a team on a project. This is due to team synergy benefits through the sharing and support of knowledge and skills. Bringing people together in this way inspires team members to collaborate on a successful project.

Maximization of Resources : Both human and financial resources tend to be expensive. Project tracking and project risk management ensure that all resources are used efficiently and are accounted for economically.

Facilitates Integration : Projects that are completed within an organisation are generally integrated with wider business processes and systems. Integration forms the value aspect of projects and their management.

Keeps control of the cost : Depending on the scope of the project, some projects can incur organisations significant costs. It is important therefore to keep on budget and to control spending. Project management greatly reduces the risk of budget overruns.

Manages Change : Today, more than ever, change is something which all organisations face. Projects, during their running, also face changes and must be prepared to face such deviations from the original plan. Project management allows for effective change management and makes it less of a complex task.

Ensures Quality : More so than ever, it is important to produce quality results. Project management helps to identify, manage and control quality. Quality results make clients happy, which is a win-win situation for all involved.



1.6 Project Scope

Project scope management involves managing the extent of the project. The concept here is to ensure that all the work to be done is included. Scope management also involves ensuring that the work that was agreed to be done is the work that has been done before the project is certified as completed.

Project Scope Management processes

- (i) Collect Requirements
 - (ii) Define Scope
 - (iii) Create Work Breakdown Structure
 - (iv) Verify Scope
 - (v) Control Scope
- (i) Requirements Collection phase involves gathering all the requirements from the stakeholders. A stakeholder is anyone who has an impact on the project.
The stakeholders are usually documented in a stakeholder register and the high level documentation of the project is usually contained in the project charter.
The project charter also appoints and authorizes the project manager to take charge of the project. These two documents (project charter and stakeholder register) serve as inputs for the process of requirements collection.
- (ii) Scope Definition typically involves creating the project scope statement from the high level information (in the project charter) and the requirements you have gathered during the requirements collection process. Close attention should be paid to the eventual goal of the project and alternatives should also be explored. The output of this process is the scope statement.
- (iii) Work Breakdown Structure Creation involves dividing the entire project work into smaller bits until you have reached manageable units of work that can be easily controlled as individual entities. The small unit of work is called a work package. The goal here is that the units must be clear, measurable, assignable and easy to control. The output of this process is a Work breakdown structure, which is a chart that shows the decomposed project.
- (iv) Scope Verification happens after we have started receiving deliverables on the project. It involves formally accepting the deliverables of a project. It is important to note that the goal of this process is not validating the deliverables. This process focuses on inspecting the validated deliverables to ensure they meet the original requirements of the project as defined in the requirements documents.
- (v) Controlling the scope is one of the most critical aspects of the project scope management. This involves monitoring the project to ensure that there are no changes to the cost baseline which is not controlled. It is important to ensure that if changes are to occur, the correct integrated change control process is followed.

1.7 Project Environment

Business functions or projects are not performed in closed environment. There are a lot of uncertainties that surround a project. These are called environmental factors and they play a vital role in the success or failure of a project. They may be internal as well as external to the organization and often many of them are beyond the control. Therefore it becomes apparent to identify all of them in time so that pro-active measures can be planned to minimize the damage or interference in case such a situation arises.

1. Internal Environment : It comprises all those factors that are present within the organization and that may impact the success of the project. They are generally within organization's control. Some of them are

- | | |
|---|--|
| (i) Organizational Structure
(iii) Skill Availability
(v) Governance Approach | (ii) Infrastructure
(iv) Risk taking Attitude
(vi) Management (Plan/Processes/Policies/Procedures/Knowledge) |
|---|--|
2. **External Environment :** It comprises all those factors that are present outside the organization. They are often beyond the organization's control and therefore their understanding is of utmost importance. Some of them are:-
- (i) Political Climate
 - (ii) Economic Condition
 - (iii) Market Condition

1.8 Triple Constraint

- It is a model of the constraints inherent in managing a project. Those constraints are threefold. They are
 - o Cost : It is the financial constraints of a project also known as the project budget.
 - o Scope : It is the tasks required to fulfil the project's goals
 - o Time : It is the schedule for the project to reach completion
- The Triple Constraint states that the success of the project is impacted by its cost, scope and time. As a manager of the project, you can trade between these three constraints. However, changing the constraints of one means that the other two will suffer to some extent which should give you an idea of how important the Triple Constraint is when managing a project.
- If you are managing a project you are working with the Triple Constraint too. Therefore, it can be easily argued that the Triple Constraint becomes a vital concept in project management.
- While it's true that the Triple Constraint is an important part of any successful project, it doesn't determine success. Projects are made from many parts, more than the three that make up the Triple Constraint but these factors are always at play in the project.

1.8.1 Importance of Triple Constraint

- Triple Constraints are like the boundaries in which you have to work. Just as restrictions enhance creativity, the Triple Constraint provides a framework that everyone in the project can agree on. These metrics drive the project forward while allowing for adjustments as needed when issues arise.
- Managing a project is often a series of trade-offs and compromises to keep things moving towards a successful completion. The Triple Constraint is a model that helps managers know what trade-offs are going to work and what impact they'll have on other aspects of the project.
- By using a project management dashboard, a manager can keep sight of the project as it progresses. Metrics such as the schedule, cost and scope of the project are easy to track. With this information, a manager can identify issues and adjust the Triple Constraint to prevent those issues from developing into problems.

Let us now learn the three constraints in details

1. Cost

- Cost is the first financial constraint that affects a project. It is the financial commitment that is made to the project. Cost of a project is dependent on several components ranging from the materials to people. Apart from that there are outside forces also that impact a project and therefore they too are considered as the cost of the work.
- Costs are divided into fixed and variable cost. Both of them are associated with a project. Costs vary depending on various factors such as the use of contract workers or outsourcing.



- Cost of a project needs to be processed. There are various costs processes associated with a project. Cost estimating is used to figure out the financial commitment needed for all the resources necessary to complete the project.
- Cost budgeting is another process used to create a cost baseline. Cost control is third process which works to manage the fluctuation of costs throughout the project.
- Cost has always been a complicated area on the Triple Constraint triangle. To ensure that your estimates are accurate, it's advisable to use project management tools to calculate the cost variances.

2. Scope

- The scope of a project is the second constraint. It outlines the specific requirements or tasks which are necessary to complete the project. Managing the scope is vital in any project, whether they are agile software projects or well-planned waterfall projects. Failing to control the scope of the project will not help in delivering it on time or within budget.
- Managing scope is critical. It is important to prioritize the tasks so that resources are planned and assigned effectively.
- Project management has a specific feature called task management that help a project easily assign, sort and prioritize the tasks. This way all the critical project tasks can be delegated to the right people. It prevents the scope to be compromised. Additionally, by offering file sharing and task comments, collaboration on the task level is encouraged.
- Managing and establishing scope also requires effective handling of stakeholder expectations. Stakeholders often have new demands that keep coming up during the progress of a project and that need to be fulfilled. This can especially be the case in long term projects where new stakeholders might be introduced in the middle of the project.
- In order to fulfill the requests and new demands of stakeholders that come with the progress of the projects, it is important to manage change. At the same time care should be taken to accommodate only those change requests that are necessary to achieve project goals and deliverables.
- The steps used under scope management are essential as the amount of time each task required is critical to assure the quality of the project. This can have a great impact on schedule and cost particularly for a project which is large.

3. Time

- Time is a very important project constraint. The amount of time required to complete a project or produce the deliverables must be estimated well for a good schedule. Usually, this is done by first identifying all the tasks that are going to be performed during the entire life cycle of the project.
- For estimating time, first of all a Work Breakdown Structure (WBS) is used generally to convert the large project goal into a series of manageable tasks. These tasks are then prioritized and placed on a timeline.
- A useful tool in the form of Gantt Charts can also be used to prepare the project schedule, with each task given a place on that timeline, with task dependencies linked, and durations determined. Data from previous projects can also help make more accurate estimates.
- For estimating time, various project management software features such as an online Gantt chart are available. Here, time gets updated automatically as your team completes their project tasks, so data is always accurate.

According to the Project Management Body of Knowledge (PMBOK), the schedule can be managed through a process of time management. Those steps are as follows.

- (i) **Planning Schedule** : Before beginning with a project, necessary policies, procedures and documentation with regard to planning, executing and monitoring of the project schedule should be prepared.
 - (ii) **Defining Activities** : It is very important to identify and record all the actions that can be taken to produce the project deliverables.
 - (iii) **Sequencing Activities**: Next step is to identify and record the order of the work activities in the right logical way.
 - (iv) **Estimating Resources Required** : A project requires various resources in various quantities. Therefore, it is important to estimate what type of and how many materials, people, equipment, supplies, etc. will be required to perform each activity.
 - (v) **Estimating Activity Durations** : In this step, you calculate the time required to complete each activity with the required resources.
 - (vi) **Developing Schedule** : In this step, you analyze activity, duration, resources and timeline to develop a proper schedule.
 - (vii) **Controlling Schedule** : This is done by comparing the planned schedule to the actual progress. It tells whether the project is on track or not. Necessary actions can be taken based on the analysis.
- Thus, as we can see, the triple constraint should be balanced to reach a successful conclusion.

1.9 Project Management Life Cycle

The project management life cycle is a process that is followed by nearly all the project managers. It provides a framework within which any project can be well managed. Leaders around the world have found that following a project life cycle is critical for the success of a project.

A project cycle can be of two types

- 1. **Typical** : It is also called a standard Project life cycle because it follows a set of steps that are predictable and prove successful in most of the cases.
- 2. **Atypical** : It is also called Adaptive Project life cycle. It deviates from the set steps and is used mostly for projects where rapid changes are expected and scope is not possible to define upfront.

1.9.1 Typical Project Management Phases

In project management there are five phases: initiating, planning, executing, controlling and closing. The five phases of project constitute the project management life cycle.

Let's take a closer look at the five phases of a project.

Initiation

This is the phase where all projects begin. In this phase, the value as well as the feasibility of the project is determined. The project is approved or rejected on the basis of these two documents. They are created to convince the stakeholders or sponsors:

- (i) **Business Case** : A business case is a document prepared to justify the need of the project. It analyzes the benefits to be offered by the project both in terms of financial gain and problem solving.
- (ii) **Feasibility Study** : This is an important report. It analyzes whether it is feasible to start the project and complete on the given time. You need to evaluate the project's goals, the timeline to completion and the total cost to be incurred. You also require to identify the resources to be required to complete the project.



2. Planning

Once the project is approved, the next step is to build a project team and start working on project planning. Planning helps to achieve the goals within budget and allotted time.

The project plan identifies the resources, financing and materials needs. The plan also gives your team direction and the following :

- (i) **Scope** : A Scope statement reiterates the need for the project and identifies its deliverables and objectives.
- (ii) **Definition** : It is a process used to break down the larger deliverables into smaller ones that help manage them better.
- (iii) **Tasks** : Tasks are performed to produce the deliverables. Thus their identification and dependence on other tasks must be figured out.
- (iv) **Schedule** : This refers to the duration of the tasks and their completion date and time.
- (v) **Cost** : Costs are the financial commitments involved across the project and it helps formulate a budget.
- (vi) **Quality** : Quality objectives are important to be defined and met throughout the project.
- (vii) **Organization** : Project organization must be clearly described with a good structure including reporting on progress.
- (viii) **Staff** : Determining roles and responsibilities of the project team is another vital aspect of project planning.
- (ix) **Communications** : Decide how information will be disseminated, to whom and with what frequency.
- (x) **Risk** : Project plan also includes assessment of possible risks that are likely, and their impact on the project and how to resolve them.
- (xi) **Procurement** : Decide what work or materials will be contracted. Define those contracts and who they'll go to

3. Execution

After planning is done, it's time to start the project execution. This phase is made up of the following detailed processes:

- (i) **Executing the Plan** : You begin by following the plan you created. Assign the tasks to team members and manage and monitor their progress with project management tools
- (ii) **Administrative** : This is done by managing the contracts secured in the project.

4. Monitor and Control

This is another crucial phase of project management life cycle. Here, you ensure that the project plan is being executed as described by monitoring and adjusting all the aspects of the project as and when required. To do this, follow these processes :

- (i) **Reporting** : You should develop a metric to measure project progress and an instrument to deliver this information.
- (ii) **Scope** : It is important to monitor the scope and control changes.
- (iii) **Quality** : Develop ways to measure the quality of deliverables and make sure that the planned quality is being met. If not, evaluate how to improve the quality.
- (iv) **Schedule** : Keep track of delays or blocks that impact the timeline of the project and adjust to stay on track.
- (v) **Cost** : Monitor expenses and control cost changes.
- (vi) **Risk** : Note changes in risk throughout the project and respond accordingly.

5. Close

This is the last phase of the cycle. A project isn't over till the project goals and objectives have been met. The last phase of the project is all about meeting the goals. This involves the following set of processes:

- (I) Scope : Make sure the project deliverables have been completed as planned.
- (II) Administration : Close out all outstanding contracts and administrative matters, archive the paperwork and disseminate to proper parties.

1.9.2 Atypical (Adaptive) Project Life Cycle

- The life cycle of a particular project is composed of different phases, around which the project management scheme is organized. There are different types of project life cycle depending on the organizations involved as well as the phases. One of the project life cycles important in project management is the adaptive or atypical project life cycle.
- An atypical project life cycle is change-driven. It is an agile way of doing things as it is intended to the high level of changes. It needs on-going stakeholder's involvement. In this life cycle, the overall scope of a project is broken down into different sets of requirements or sub-projects that will be undertaken individually. During the iteration, the functionalities of the cycle is discussed, implemented and, finally, reviewed by the client.
- Here iterations are very rapid usually with a duration of 2 to 4 weeks and are fixed in time and cost. This life cycle is used for projects where rapid changes are expected and scope is not possible to define upfront. So, a change during the project is naturally handled in rapid iterations.
- Also, the end result is delivered at the end of 2 to 4 week iteration. Like, a yearlong project will have multiple 2-4 week iteration and each iteration will execute Planning, Analysis, Design, Code, testing phases and deliver the result at the end of the iteration.
- The advantage of atypical life cycle is that it is appropriate for projects that involve higher levels of complexity and uncertainties such that each iteration of this particular project life cycle should address issues for every task and each task should be completed before another task is undertaken. The risk is minimized for this particular project life cycle.

Atypical Project Lifecycle exists within five stages

1. Constant Change
 2. Urgency
 3. Need to Learn
 4. Small Team Ability
 5. Deliver in Small Increments
- When we work in adaptive, there's a sense of urgency, we've to move quickly. We also recognize before we get underway that there will be constant change. There will always be change on projects. It's constant change after change and decision after decision. You need a different framework for an adaptive project than you do for predictive, incremental or iterative projects.
 - Unlike a predictive lifecycle or incremental iterative where you could have one factor suggest that this is a predicted, or this is incremental because we can do phases or stages. In an Adaptive project you need constant change as a definition. There will be a sense of urgency to learn because you don't know the goal because it's unclear.
 - For this methodology, or sometimes referred to as the Agile Manifesto, it is a small team ability. Small teams set out to work to figure out where to go.

 Project Management (MU)

- For example, Israelites trying to find the Promised Land or the frontier wagon trains exploring but unsure which way they're headed will send a small team of scouts or explorers to try to find the route to get through the mountain pass, to cross the river, to find food, etc.
- You've got all of these little scouts going out and coming back to the wagon train and going out and coming back until they established stopping points along the way. You might have to backtrack and try again.
- It's all these lessons we're learned as we're going. There's a need to learn, typically at either delivered in small teams or small increments. We are going to call it incremental. Its small parts as we're learning.
- The ability to deliver in small increments or small deliverables, small components, small parts is the requirement of the project following this life cycle. you may have an output that doesn't meet or lead to another step, therefore you set it aside or throw it away entirely.

1.9.2.1 The Core Values of Atypical Project Life Cycle

In Atypical project life cycle, the focus is on the clients. They are given the opportunity to control the direction of the project. It centers around six core values :

- Focus on Clients : Here, the focus is on the need of the client. But they must be within the scope of ethical business practices
- Client-driven : Being client-centric encourages you to include and involve the clients in your project by having project co-managers incremental
- Early Results : It makes it possible to deliver a solution to the client's problems at the earliest and also keep the clients engaged in the project
- Continuous Questioning and Introspection : Openness and honesty must exist between client and the project team to make the best possible decisions and deliver positive results
- Change for a better solution : The client and the project team work on the deliverables from the early stages of the project to understand the project better. This also helps them think of the better changes that can be brought.
- Future not speculated : APLC focuses on the work activities that bring benefits to the client. Work that doesn't give value is removed. Project teams resist the temptation of getting the best rather they focus on the planned processes.

1.10 Stage Gate Process

The State Gate process is a patented trademark of Dr. Robert Cooper. The center of this model is on developing innovative processes. It is also called the Waterfall process. This model offers a project management technique which a project is divided into several stages. The stages are separated by 'gates' where decisions are taken to decide whether or not to proceed to the next stage. This model is generally useful while developing new products or bringing change or improvements in a.

1.10.1 Gates

Gates in state gate process are decision points in a project. They help take a decision whether to continue the next stage or not. The decision is based on the availability of information on the project progress till that moment. The decision is taken by a manager or a committee.

At each gate, the quality and repercussions of an idea are assessed. The areas of assessment are the quality of the execution, business motivation to continue financially and the action plan showing the things that need to be done to make the project successful. After each gate, one of the following decisions is to be taken :

- Go : This decision considers the project good enough to move on to the next stage.

- Kill : This decision is taken when the project is not good enough and cannot be developed further and terminating it is better.
- Hold : This decision is taken project is not found good enough to continue at that moment, but there is possibility for the situation to improve and therefore rather than terminating it should be put on hold for resumption at a later date.
- Recycle : This decision is taken when the project is found good enough to develop further with some changes.

1.10.2 Stages

The Stage Gate process has five stages. They are connected to each other by gates. Each stage is designed to collect specific information :

- Stage 0 : Discovery
- Stage 1 : Scoping
- Stage 2 : Business Plan Concept
- Stage 3 : Development
- Stage 4 : Testing and Validation
- Stage 5 : Launch and Implementation

Not all of the Following stages are used in all the projects. For example, stages 2, 3 or all 5 are followed depending on the size of the project. A project focusing on major product innovation goes through all 5 stages. A project with less risk requires to go through just stage 1, 2 and 4. A project that requires very small or simple adjustments needs to go through only stage 3 and 4.

Stage 0 : Discovery

This is the initial preparatory stage. It identifies the project a company wants to undertake. For that, Ideas are generated in brainstorming sessions. Everyone from Employees, Customers to the suppliers are involved in the session. They provide useful information for idea generation. An idea is first selected and then proposed. If the idea is not found good enough the gate closes here.

Stage 1 : Scoping

In this stage, the product and the existing market for it are assessed. Product's strengths and weaknesses and the benefits it brings to the user/consumer are evaluated. All the possible threats from competitors are also taken into account. The assessment of the threats helps decide whether project will not continue. If the threats are big the chances are that the gate will be closed.

Stage 2 : Business Plan Development

This is the last stage of concept development. Here, business plan is developed considering all kinds of opportunities, threats, competitions, etc. It is crucial before starting the actual project implementation. This stage includes the following sub-stages :

(i) Product Analysis

Here, the value a customer is going to get is determined by analyzing the benefits offered by the product. This information can be collected by interviews and surveys of the prospective customers and the project development team. The environmental factors such as the competition are also analyzed.

(ii) Creating the business plan

Here, a document of the project is prepared to describe and define the project requirements including the legal health and safety requirements.

**(iii) Creating the project plan**

This plan contains a list of all tasks that are to be executed during the entire project development cycle. It also outlines the roles and responsibilities of the people involved in the execution. The expected launch date can also be mentioned in this plan.

(iv) Feasibility review

Here, a feasibility study is done in which different departments assess the plan's chances of succeeding. Even at this stage if it appears that the business concept is not having sufficient potential the gate is closed.

Stage 3 : Development

- At this stage, the plans are executed and simple tests are conducted. For example, at this stage customers can be asked for their feedback of the product. A timeline with specific milestones that have to be achieved are created by the development team.
- This timeline can be revised and updated regularly. It also takes help of multi-functional teamwork. Different departments provide input with expert advice. This stage results into a product prototype, which is then extensively tested during the next stage. The gate remains closed if the prototype of the product has not been sufficiently developed.

Stage 4 : Testing and Validation

In this stage, product testing and validation are done. The manufacturing process and the product acceptance by customers and the market are assessed. There are some sub-stages that are completed during this stage :

(i) Near testing

This test is done to identify all possible production errors or any other problem area. At this stage, the product is almost ready to be sold. The groups that carry out this test include staff, regular customers and suppliers and are closely tied to the organization.

(ii) Field testing

In this part, the product is tested in the field by various participants who can make a valuable contribution. This is usually done with the help of specific customers. Whether this target group is interested in the product is evaluated. The characteristics they consider important and the context in which the product will be used are also assessed.

(iii) Market testing

This is an optional test as the product is offered in the market only when it has passed through the previous test stages. This test is just to assess to see whether the product sufficiently matches the needs and wishes of the consumer after a period. The product is usually pretty much in its final form after testing. However, a good marketing plan is equally important at the time of launching the product. If not, the gate to the next stage will remain closed.

Stage 5 : Launching and Implementation

In this stage, the marketing strategy comes into play. The product is ready to be launched and that requires attention by means of an advertising campaign, free publicity and interviews or other promotional activities. An estimate is made about the quantity that will be sold. Policies regarding production, inventory and distribution are prepared. In this stage, the sales team is predominantly responsible for ensuring a smooth process.

1.11 Role and Responsibilities of the Project Manager

- The project manager is the most important person in a project. He has the following role and responsibilities :
- He designs the appropriate project management standards and then implements that. He also has to manage the production of the required deliverables at different stages of the Project development.
 - He has a crucial role of preparing project plans and ways to monitor the project. He also prepares and maintains project stages and exception plans as and when required.
 - He has to identify and managing project risks including the development of contingency plans.
 - Another very important role is to liaison with program management and related projects to ensure that work is neither overlooked nor duplicated.
 - He monitors the overall progress and usage of resources, initiates corrective action where-ever necessary and applies change control and configuration management processes.
 - He has to reporting to the top management on project progress through reports and end stage assessments.
 - He has to liaison with appointed project assurance representatives to assure the overall direction and integrity of the project is maintained. He must maintain an awareness of potential interdependencies with other projects and their relative impact.
 - He identifies and obtains support and advice required for the management, planning and control of the project, managing project administration
 - He has to regularly conducting a project evaluation review to assess how well the project is being managed and then he prepares any follow-on action on the received recommendations

1.12 Negotiation

- Negotiation is a process used to resolve disputes of different kinds between different people or group. It is done by conducting consultations between the involved parties to reach a consensus.
- Negotiation involves a discussion between two or more parties involved. It aims at reaching an agreement or settlement. It can take place at any time in a project, program or portfolio and it may be formal or informal in nature.
- Formal negotiations are held on issues such as contract agreements while Informal negotiations include discussions to resolve conflict, or discussions to obtain internal resources.
- The skill of negotiation is used in many areas of Project Management. They could be managing conflict, contract, requirements management and stakeholder management. Negotiations can take place at any time within the project management life cycle. Depending on the issues, it can be either formal or non-formal. Negotiations are generally initiated by the project manager and therefore he should have excellent negotiation skills.
- Negotiation is done through a process which can be categorized into phases. These include planning, discussing, proposing and reviewing.
- Planning is the first phase. It helps a manager in preparing all the relevant information needed for the discussion. The second phase is discussing. It refers to setting up the scene for discussion. In this phase, the conflicting issues are explored and discussed.
- The proposing stage involves creating the solution to solve the problem. This may also include bargaining before arriving at an agreement. Once the agreement is done, the information in this regard is disseminated all throughout the organization. Finally, the last phase reviewing is carried out to see whether it resulted into a win-win situation for both the parties or not.

Good Negotiation Skills Include

- An ability to set goals and limits;
- Excellent listening skills;
- Excellent verbal communication skills;
- Accommodative not rigid
- Knowledge of when and how to close the negotiation.

1.12.1 Negotiation Falls Within Two Categories

1. Competitive negotiation
 2. Collaborative negotiation
1. **Competitive negotiation** : Here, the focus is on getting the best deal regardless of the needs and interests of the other party. This form of negotiation can easily become a battle where the winner takes all. While competitive negotiation should be avoided, it may not always be possible.
 2. **Collaborative negotiation** : It seeks to create a 'win-win' scenario where all parties involved get benefitted from the negotiation. This approach tends to produce the best results and helps build long-term relationships. It also minimizes the further opportunity for conflict at any other stage.

1.12.2 Process of Negotiation

- **Planning** : This is the first step where the focus of the negotiating party is to gather as much information as possible. That helps in preparing better plans. A plan is prepared by setting goals that could be agreed upon.
- **Discussing** : Project managers are often required to open the negotiations by giving the details of the conflict. Then they explore and discuss the key issues. The involved parties must listen to, probe and question and regularly check their understanding of the discussion.
- **Proposing** : At this step, the discussion is over and based on that a proposal is made and communicated clearly and openly to all.
- **Bargaining** : In this step, the negotiation begins for trade-offs. The parties involve try to accommodate each other's demands.
- **Agreement** : At this step, an agreement is reached and based on that an agreement is done, prepared on paper and signed as there is no substitute for a written record;
- **Review** : Here, the outcome is communicated to all parties and the consequences incorporated within the Project management plan.

Common mistakes in negotiations

- Ill-preparedness of the negotiator
- Opening and showing rigidity in negotiations with an unreasonable offer;
- Rushing through negotiations without paying close attention in order to secure a quick agreement;
- Failing to walk away if an agreement is not possible without breaching tolerances;
- Not showing a cool and calm attitude.

Negotiation in Project Management

- Project managers often face a situation where negotiation becomes necessary. Therefore they need to be prepared and apply negotiation skills throughout the project life cycle. Early on in a project, as requirements are being assessed and initial plans produced, the project manager needs to balance the time, cost, quality and scope requirements of the project and negotiate with stakeholders.
- As resources are mobilized and procured, internal negotiation with line managers who 'own' the resources and conduct more formal contract negotiations with potential providers become necessary.
- As the project progresses, conflicts may arise. Therefore the project manager will be required to negotiate the issues of conflicts.
- In some environments, there may be specialist support available. It is important for project managers to know when to ask for help from, for example, the HR or legal departments within the host organization.

1.13 Conflicts

- Conflicts are nothing new. We all experience it in our daily lives. It ranges from minor disagreement to a major problem. But they have the potential to disrupt organizational activities and progress. Being a project manager or a team leader, these conflicts are especially rampant and thus damaging in project environment.
- Since project activities are executed by human resources there is a possibility of conflict. Everyone tries to execute activities in order to achieve project objectives as per the expectations of the stakeholders. While managing human resources, conflicts are natural but they become serious when they lead to quarrels, fights and even a breakup of the project team. According to the PMBOK Guide, "conflict is inevitable in a project environment."

In the project environment, conflicts are

- Inevitable
- Can build the team
- Can destroy the team
- Must be managed

1.13.1 Causes of Conflict

Wherever people work, sooner or later, smaller or bigger, conflicts are bound to arise because of various causes. Some of the causes may be

- Scheduling problems
- Different Project Priorities
- Competitions for gaining access to resources
- Cultural differences
- Differences on team formation
- Differences on technical issues
- Personality Conflict
- Poor Planning



1.13.2 Ways to Resolve Conflicts

After defining the problem, the PMBOK Guide suggests five techniques for project management. Let's review these techniques and consider when to use them in managing conflicts.

1. Withdraw/Avoid Conflict

- This is a good technique where people involved retreat from an actual or potential conflict situation. They postpone the issue to be better prepared or to be better resolved by others. Suppose you are short-tempered, withdrawing can be an excellent technique. By withdrawing, you have the opportunity to come up with better ideas to address the conflict.
- Temporarily avoiding the conflict allows you to take time and rethink over the issues. It also means you have the chance to think through the other person's perspective. While withdrawing and avoiding is valuable in the short term, it can be over used. If you retreat from a conflict situation and fail to follow up, the conflict is likely to become worse over time.

2. Smooth/Accommodate Conflict

- In this technique, emphasis is given on areas of agreement rather than areas of difference. One concedes his position to accommodate the needs of others in order to maintain harmony in relationships. This approach maintains professional relationships which are critical to project success. On long term projects, anything over a few weeks, persevering and strengthening the project team becomes very important. Project team members constantly emphasize differences making progress on the project becomes very difficult.
- Areas of agreement to emphasize may vary depending on the context. You can look at how disagreement impacts others on the team.

3. Compromise/Reconcile Conflict

- In this technique, the focus is on searching for solutions that bring at least some degree of satisfaction to all parties and the conflict is resolved either temporarily or partially. This technique recognizes that some conflicts cannot be fully solved.
- But, this technique has some drawbacks too. The project manager needs to understand the needs of the person or stakeholder for successful negotiation. The project manager also has to be willing to make changes to his project. For compromise to be successful, each party needs to benefit and sacrifice part of their objectives.
- Project managers can also compromise across time. For example, you may respond to a stakeholder's request for additional functionality by deferring their request to phase two of a multi-phase project. Though, this type of change is best handled through a change request.

4. Force Conflict

- This technique creates more problems than solutions. Here, the focus is on pushing one's viewpoint at the expense of others thus offering only win-lose solutions. It is usually enforced through a power position to resolve an emergency. From time to time, project managers have to take a stand and apply their power.
- As the PMBOK definition suggests, applying force to resolve conflicts comes at a cost. The project manager is likely to harm relationships with the project team by using this method. Abuse or overuse of this technique tends to cause more conflict in the long term. One should use this technique only when absolutely required.

5. Collaborate Conflict

- This technique focuses on incorporating multiple viewpoints and insights from differing perspectives. It requires a cooperative attitude and open dialogue that typically leads to consensus and commitment.
- This technique is the most productive technique. It has two major benefits; one, the conflict itself is solved and second, the project team is strengthened as a by-product of working to solve the problem. This technique is most likely to be successful in situations where the project team already has a high level of trust.

1.14 Organization Structure

- The process of organizing leads to the creation of the structure of an organization. The term organization structure may be defined as a system of job positions, the roles assigned to them and the authority relationships among the various positions. The structure provides a basis for a framework for managers and employees for performing their various functions.
- Organisation structure can be viewed as established pattern of relationships among the components of the organization. Because strategies and environmental circumstances differ from one organization to the other there are varieties of possible organization structures. Generally, the organizational structure looks like a pyramid with a narrow top and a broad bottom.
- In large and complex organizations the structure is set forth initially by the design of the major components or subsystems and then by establishing relationships among these subsystems. It is the patterning of these relationships with some degree of permanency which is preferred to an organizational structure.
- According to Henry Fayol, "Organization is of two kinds, i.e. Organization of the human factor and organization of material factor. Organization of the human factor covers the distribution of work to those who are best suitable along with authority and responsibility. Organization of the material factor covers utilization of raw materials, plant and machinery etc."

1.14.1 Roles of Organization Structure

Organization structure is the mechanism through which management directs, coordinates and controls the organizational activities. It is needed for the foundation of management. Following are the roles of organization structure :

- **Facilitating Management Action :** When a large number of people work together, some sort of formal structuring is required to place them according to the needs of the organization. All of them perform various functions which are interdependent and interrelated. Therefore, there must be a plan for systematic completion of the work of each specialized job so that total activities accomplish common objectives.
- **Encouraging Efficiency :** Organisation structure is the framework within which an organization functions. In this functioning, efficiency is the major criterion. Organizational members using the framework try to maximize the output of goods and services using a given input of resources.
- **Communication :** Organization structure provides the pathways for communication among organizational members as well as between the organization and its environment. Organization structure establishes reporting relationships which involve communication. Similarly, when the organization interacts with its environment, a communication process is involved. Thus structure serves the purpose of communication.
- **Optimum Use of Organizational Resources :** Organization structure tries to make optimum use of organization resources by ensuring their allocation to points where there are needed. Organization structure gives a higher place to activities which are more important to the achievement of organizational objectives. Thus placing of activities according to their importance provides guidelines for resource allocation.



- **Job Satisfaction** : Organization is a source of satisfaction to people. Since organization provides relationship among tasks, responsibilities and people, those who work for an organization sooner or later come to evaluate the nature of those relationships and of their own relationships to the organization and to their jobs. The organization structure provides for each person a place of status which confers a certain standing among his fellows.

1.14.2 Importance of Organizational Structure

The functions of Organizing and organization are important in the following ways :

- **Specialization** : In the process of creating a suitable structure, care is taken to see that the activities are divided and subdivided into compact and convenient jobs. An organizational structure thus promotes specialization, speedy performance of tasks and efficiency.
- **Well-Defined Jobs** : The organization structure clearly defines and differentiates the jobs of managers and non-managers. This helps the process of looking for and selecting the employees and fitting the right person to the right job.
- **Clarifies authority and Power** : A clear-cut definition of authority enjoyed by each manager and his jurisdiction of activity minimizes conflict and confusion about the respective powers and privileges of managers. A good organization structure clarifies authority and power.
- **Avoids Duplication of Work** : The organization structure helps in avoiding duplication of work and overlapping in responsibilities among various employees and work units. This is because specific jobs are assigned to individuals and work groups.
- **Coordination** : The organization structure serves as a mechanism for coordination and unification of efforts of people. Harmony of work is brought about by higher level managers exercising their authority over interconnected activities of lower-level managers.

1.14.3 Some of the Most Common Organization Structures are

(a) Line Organization

- Line organization is the simplest form of organization and is most common among small companies. Here, authority is embedded in the hierarchical structure and it flows from the top of the managerial hierarchy down to different levels of managers and subordinates and further down to the operative levels of workers. It clearly identifies authority, responsibility and accountability at each level.
- These relationships in the hierarchy connect the position and tasks of each level with those above and below it. There is clear unity of command so that the person at each level is reasonably independent of any other person at the same level and is responsible only to the person above him. The line personnel are directly involved in achieving the objectives of the company.
- Because of the small size of the company, the line structure is simple and the authority and responsibility are clear-cut, easily assignable and traceable. It is easy to develop a sense of belonging to the organization. Communication is fast and easy and feedback from the employees can be acted upon faster.

(b) Line and Staff Organization

In this type of organization, the functional specialists are added to the line, thus giving the line the advantages of specialists. This type of organization is most common in our business world and especially among large enterprises. Staffs are basically advisory in nature and do not possess and command authority over line managers. The staffs consist of two types :

General Staff : This group has a general background usually similar to executives and serves as assistants to top management. They are not specialists and generally have no authority or responsibility of their own. They may be known as special assistants, assistant managers or in a college setting as deputy chairpersons.

Specialized Staff : Unlike the general staffs who generally assist only one line executive, the specialized staffs provide expert advice and service to all employees on a company wide basis. This group has a specialized background in some functional area and it could serve in any of the following capacities :

- Advisory Capacity :** The primary purpose of this group is to render specialized advice and assistance to management when needed. Some typical areas covered by advisory staff are legal, public relations and economic development.
- Service Capacity :** This group provides a service that is useful to the organization as a whole and not just to any specific division or function. An example would be the personnel department serving the enterprise by procuring the needed personnel for all departments. Other areas of service include research and development, purchasing, statistical analysis, insurance problems and so on.
- Control Capacity :** This group includes quality control staffs who may have the authority to control the quality and enforce standards.

The line and staff type of organization uses the expertise of specialists without diluting the unity of command. With the advice of these specialists, the line managers also become more effective and develop a sense of objective analysis of business problems.

The line and staff type of organization is widely used and is advantageous as the specialized advice improves the quality of decisions resulting in operational effectiveness. Staff specialists are conceptually oriented towards looking ahead and have the time to do strategic planning and analyze the possible effects of expected future events.

Its main disadvantages are the confusion and conflict that arises between line and staff, the high cost that is associated with hiring specialists and the tendency of staff personnel to build their own image that is sometimes at the cost of undermining the authority and responsibility of line executives.

Functional Organization

- One of the disadvantages of the line organization is that the line executives lack specialization. Additionally, a line manager cannot be a specialist in all areas. In the line and staff type of organization, the staff specialist does not have the authority to enforce his recommendations. The functional organizational concept, originated with F W Taylor permits a specialist in a given area to enforce his directive within the clearly defined scope of his authority.

The following Fig. 1.14.1 is an example of functional organization :

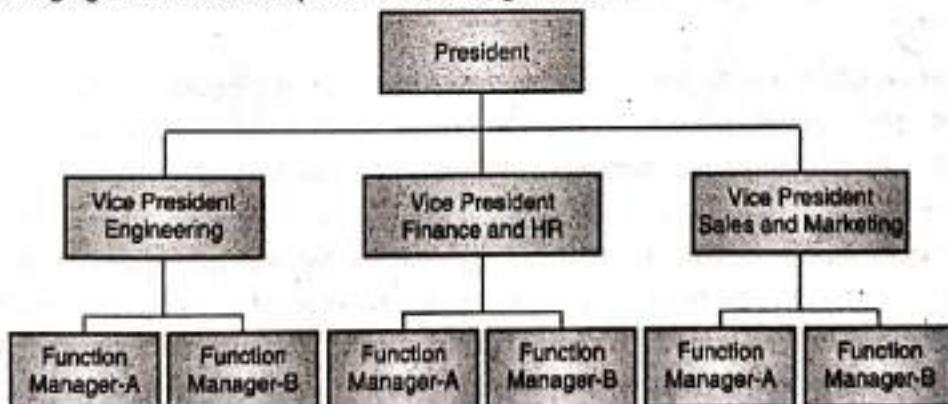


Fig. 1.14.1 : Functional Organization Structure



- A functional manager can make decisions and issue orders to the persons in divisions other than his own, with a right to enforce his advice. Some good examples of specialists who have been given functional authority in some organizations are in the areas of quality control, safety and labour relations.
- The functional organization creates a separate hierarchy for each function creating a larger scale version of functional departments. Functional departmentalization is the basis for grouping together jobs that relate to a single organizational function or specialized skill such as marketing, finance, production, and so on. The chain of command in each function leads to a functional head who in turn reports to the top manager.
- The functional design enhances operational efficiency as well as improvement in the quality of the product because of specialists being involved in each functional area and also because resources are allocated by function rather than being duplicated or diffused throughout the organization.
- One of the main disadvantages of the functional design is that it encourages narrow specialization rather than general management skills so that the functional managers are not well prepared for top executive positions. Also, functional units may be so concerned with their own areas that they may be less responsive to overall organizational needs.

(d) Divisional Organization

- The divisional or departmental organization involves grouping of people or activities with similar characteristics into a single department or unit. These departments operate like small organizations under a large organizational umbrella meeting divisional goals as prescribed by organizational policies and plans.
- The decisions are generally decentralized so that the departments guide their own activities. This facilitates communication, coordination and control, which contributes to the organizational success. As the divisional units are independent and semi-autonomous, they provide satisfaction to the managers. It further improves efficiency and effectiveness.

This division and concentration of related activities into integrated units is categorized on the following basis :

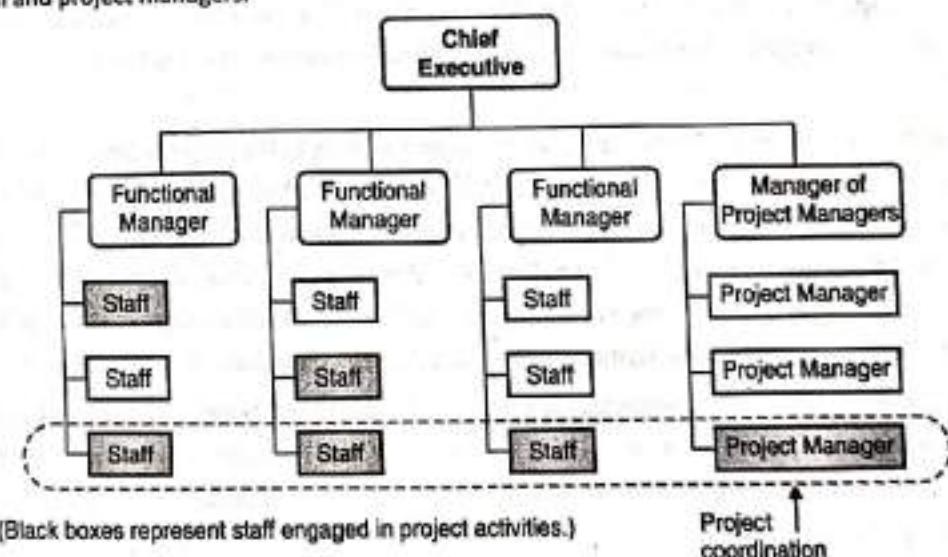
- (i) **Departmentalization by Product** : In this case, the units are formed according to the type of products and are more useful in multi-line corporations where product expansion and diversification of the products are primary concern. The general policies are decided upon by the top management within the philosophical guidelines of the organization.
- (ii) **Departmentalization by Customers** : Departmentalization is used by those organizations that deal differently with different types of customers. Thus, the customers are the key to the way the activities are grouped. Many banks have priority services for customers who deposit a given amount of money with the bank for a given period of time. Similarly, business customers get better attention in the banks than other individuals.
- (iii) **Departmentalization by Region** : If an organization serves different geographical regions, the division may be based upon geographical basis. Such divisions are especially useful for large scale enterprises that are geographically spread out such as banking, insurance, chain department stores or a product that is nationally distributed.
- (iv) **Departmentalization by Time** : Hospitals and other public utility companies such as telecom companies that work around the clock are generally departmentalized on the basis of time shifts. For example, the telephone company may have a day shift, an evening shift and a night shift, and for each shift a different department may exist, even though they are all alike in terms of objectives.

(e) Project Organization

- These are temporary organizational structures formed for specific projects for a specific period of time and once the goal is achieved, these are dismantled. For example, the goal of an organization may be to develop a new automobile. For this project, the specialists from different functional departments will be drawn to work together.
- These functional departments are production, engineering, quality control, marketing research, etc. When the project is completed, these specialists go back to their respective duties. These specialists are basically selected on the basis of their skills and technical expertise rather than decision-making experience or planning ability.
- These structures are very useful when :
 - o The project is clearly defined in terms of objectives to be achieved and the target date for the completion of the project is set. An example would be the project of building a new airport.
 - o The project is separate and unique and not a part of the daily work routine of the organization.
 - o There must be different types of activities that require skills and specialization and these must be coordinated to achieve the desired goal.
 - o The project must be temporary in nature and not extend into other related projects.

(f) Matrix Organization

- A matrix structure can be said to be a combination of project and functional structures and is created to overcome the problems associated with project and functional structures. The key features of a matrix structure are that the functional and project lines of authority are super-imposed with each other and are shared by both functional and project managers.

**Fig. 1.14.2 : Matrix Organization Structure**

- The project managers are generally responsible for overall direction and integration of activities and resources related to the project. They are responsible for accomplishing work on schedule and within the prescribed budget.
- They are also responsible for integrating the efforts of all functional managers to accomplish the project and directing and evaluating project activity. The functional managers are concerned with the operational aspects of the project.

The functional structure is primarily responsible for :

- Providing technical guidance for the project.
- Providing functional staffs that are skilled and specialized.
- Completing the project within prescribed technical specifications.
- In a matrix organization cross-functional teams are used, as a response to growing complexity associated with the organizational growth. These complexities, both internal (size, technology) as well as external (markets, competitors), create problems of information processing and communication that are best dealt by matrix type of organization.
- Matrix organizational design is most useful when there is pressure for shared resources. For example, a company may need eight product groups, yet have the resources only to hire four marketing specialists. The matrix provides a convenient way for the eight groups to share the skills of the four specialists.
Each matrix contains three unique sets of role relationships :
 - The top manager or Chief Executive Officer who is the head and balances the dual chains of command
 - The managers of functional and project (or product) departments who share subordinates
 - The specialists who report to both the respective functional manager and project manager.

1.15 Project Management Institute (PMI)

- PMI stands for the Project Management Institute. It is a not-for-profit volunteer professional membership association for project managers and program managers. It supports and drives our industry forward.
- PMI was started in 1969, and with over 250 project chapters and a membership of more than 2.9 million professionals around the globe, PMI today is the largest project management membership group.
- The Project Management Institute is the organization that gives out the PMP (Project Management Professional) credential, a globally recognized certificate that assures employers that a person is trained and qualified to manage projects.
- PMI, in conjunction with its volunteer membership, developed A Guide to the Project Management Body of Knowledge (PMBOK® Guide), which is the agreed upon book of standard language, terminology and principles governing project management. In the past, there was no formal degree in project management for project managers. PMI has been instrumental in creating the Project Management Professional (PMP) certification, which professionalized the career of project management. Now, project managers worldwide have been studying the agreed upon principles and passing the PMP exam. The PMP certification is formalizing and validating the profession.
- Project Management Institute, Inc. (PMI) found that 52% of all project teams are a mix of professional project managers and non-project managers. In the past, experienced project managers had a couple of choices. Invest in a high end software solution that takes a lot of training to implement, or purchase a low end tool that lacks features. Now, Project Insight bridges the gap.
- Project Insight is the only mid-range project software that respects and conforms to PMI's PMBOK Guide or standards body. This is important for teams that are of mixed levels of expertise.
- Most experienced project managers have been using Microsoft Project desktop to manage projects. More and more of these savvy project managers find that they need to collaborate on projects with dispersed project teams. Yet, they still need robust scheduling functionality. On the other end of the spectrum, the team members, vendors, contractors and other third parties they collaborate with want something that is simple to use.

1.16 PM Knowledge Areas

- **Integration :** This is covered first in the PMBOK Guide, but it's about bringing together everything you know so that you are managing your project holistically and not in individual process chunks.
- **Scope :** It is the way to define what your project will deliver. Scope management is all about making sure that everyone is clear about what the project is for and what it includes. It covers collecting requirements and preparing the work breakdown structure.
- **Time :** It relates to how you manage the time people are spending on their project tasks, and how long the project takes overall. This knowledge area helps you understand the activities in the project, the sequence of those activities, and how long they are going to take.
- **Cost :** It is all about handling the project's finances. The big activity in this knowledge area is preparing your budget which includes working out how much each task is going to cost and then determining your project's overall budget forecast.
- **Quality :** This area is where you will learn about how to set up the quality control and quality management activities on your project so that you can be confident the result will meet your customers' expectations.
- **Procurement :** It supports all your procurement and supplier work from planning what you need to buy, to going through the tendering and purchasing process to managing the work of the supplier and closing the contract when the project is finished.
- **Human resources :** Human resources are vital to complete your project so you need to put your team together. After that, it's all about managing the people on the team including giving them extra skills to do their jobs.
- **Communications :** Given that a project manager's job is often said to be about 80% communication, in there, the PM writes communications plan for the project and monitor all the incoming and outgoing communications.
- **Risk management :** It involves identifying risks and understanding how to assess risks on your project that includes how you perform quantitative and qualitative risk assessments. Risk management isn't a one-off activity, it covers controlling your project risks going forward through the project life cycle.
- **Stakeholder management :** It is one of the most important groups which take you through the journey of identifying stakeholders, understanding their role and needs in the project and ensuring that you can deliver those. I think we'll see this area develop further in the next edition of the standard.

If you can grasp all these knowledge areas, you will have everything you need to know as a project manager.

1.17 Certified Project Management Professional (PMP)

In a highly competitive management-oriented world, management skills underline and equip project managers with the arsenal to meet the demands of global projects. PMI provides comprehensive certification programs for project managers across various levels of skill and education. You can opt Project Management Professional (PMP) Certification Prep, Certified Associate in Project Management (CAPM) Certification Prep.

The certified Project Management Professional Course must be attended by :

- Project Managers
- Functional Managers
- Team Leads
- Project Executives

1.17.1 The Demand for Project Management Professionals

- The demand for Project Management Professionals is at an all-time high. Whether one works in Information Technology, healthcare, manufacturing, sales, construction or energy – all sectors require experts in project management.
- It is believed that job opportunities for Project Management Professionals are continuously growing at a rate of 1.5 million new opportunities every year. According to a report by the Project Management Institute, by 2027, project management employees in seven project-oriented sectors is estimated to increase by 33 percent, which is equal to nearly 22 million new job opportunities.
- Also, nearly 88 million project management employees will be required by employers, by the year 2027. This report is a clear eye opener and showcases the need for PMPs in the coming years, along with demonstrating their contribution to productivity.

1.17.2 Careers in Project Management

- A career in Project Management is highly engaging, beneficial and lucrative because of the reasons mentioned as follows :
- **Increased demand** – There is a huge demand for Project Management Professionals. As mentioned earlier, the PMI foresee approximately 22 million project management job openings through 2027.
 - **High pay cheques** – Project Management Professionals take home a higher pay cheque than their uncertified peers. The salaries are no doubt highly competitive.
 - **Required by almost all industries** – Project Management is one of the top skill sets that the employers are seeking today. Almost every industry is in constant need of proficient project managers. Industries such as manufacturing, construction, IT, utilities, finance, business and oil and gas, among others, offer the highest level project management work to PMPs.
 - **Offers good career** – As Project Management Professionals are in huge demand across industries, the opportunities never cease and good decisions provide a soaring career.
 - **Constant learning** – Project managers are always learning and enhancing their skills. This is a great career move for individuals who wish to regularly update and refresh their knowledge.

1.18 Project Management Book of Knowledge (PMBOK)

- PMBOK has been used as the standard by which Project management Professional Certification is obtained. PMP Certification is based upon a survey of many companies' best practices. The advantages of using PMP Certified Project Managers and Team members are that resources have already been trained. PMBOK is valuable for both companies and employees. PMBOK is valuable for many reasons. Here are three :
- The first reason PMBOK is valuable is that it allows companies to standardize practices across departments. This means that the people in development manage projects in the same manner as those in distribution.
 - Second, PMBOK can help project managers to work with a standardized system across companies. Someone working for company x who then moves onto company y can use the same practices.
 - Third, PMBOK discusses what works. The methods documented within the project management community can assist those who are uncertain of how to undertake risk management. PMBOK also discusses what doesn't work. This prevents failure of projects.

Finally, project managers who are familiar with PMBOK standards can custom tailor their project management process to best fit their company's needs. There's an old saying, "To break the rules, first you have to know the rules." When project managers invest time into learning the rules, they also are investing time in learning how and where rules can be broken.

1.18.1 PMBOK Structure

Project management as a practice is rapidly growing and spreading worldwide, and is now seen globally as a recognized and strategic competency, a career path and a subject for training and education. The PMBOK framework consists of five process groups and ten domain areas.

The 5 PMBOK Process Groups

1. Initiating

The initiating process group involves the processes, activities, and skills needed to effectively define the beginning of a project. Setting all permits, authorizations, and initial work orders in place to secure an effective and logical progression of initial project activities sets the stage for subsequent success throughout all project phases. Setting clear phases for work to be completed, initializing teams, and having the budget in place before work begins are vital for a strong start to any project across industry.

2. Planning

The Planning Process Group sets forth the processes needed to define the scope of the project, set strategic plans in place to maximize workflow, and begin to assemble priority lists and plan team needs. This process group also addresses a more narrow clarification of all project goals and expectations and puts in place the project infrastructure necessary to achieve those goals according to the timeline and budgetary constraints.

3. Executing

The executing process group involves managing teams effectively while orchestrating timeline expectations and reaching benchmark goals. Project managers utilizing this set of skills will demonstrate a high degree of organization and communication skills while addressing team concerns or other complex situations associated with getting the work done on time and within budget.

4. Monitoring and Controlling

Processing change orders, addressing on-going budget considerations, and mitigating unforeseen circumstances that may affect a team's ability to meet initial project expectations are all part of the core skills and competencies involved in the Monitoring Process Group. Seasoned managers keep the momentum moving forward and guard the project against stalling by actively monitoring progress and using foresight and quick response to address project challenges. Monitoring and Controlling hover over the whole project. According to PMBOK GUIDE, these are "processes required to track, review and regulate the progress and performance of the project."

5. Closing

The biggest challenge of this process group is to bring the project to a successful close which means completing it on time and within the budget allotted. The bottom line is that while these process groups are not necessarily easy to implement, not doing so means the team may never realize the full benefits of their highly strategic projects.

**Review Questions**

- Q. 1 What is Project management? State its importance. (Refer Sections 1.2 and 1.5)
- Q. 2 What do you mean by Operations? Differentiate Project & Operations. (Refer Sections 1.3 and 1.3.1)
- Q. 3 Explain the scope of Project Management. (Refer Section 1.6)
- Q. 4 Describe Project Environment. (Refer Section 1.7)
- Q. 5 What are Triple Constraints? How are they significant in Project Management? (Refer Section 1.8)
- Q. 6 Explain Project Management Life cycle. Describe the typical Project life cycle phases. (Refer Section 1.9)
- Q. 7 Describe the atypical project life cycle along with its phases. (Refer Section 1.9.2)
- Q. 8 What is Stage Gate Process? Describe its stages. (Refer Sections 1.10 and 1.10.2)
- Q. 9 Describe the role and responsibility of a project manager. (Refer Section 1.11)
- Q. 10 What is Negotiations? What is its importance in Project Management? How should a project manager prepare for it? (Refer Section 1.12)
- Q. 11 Describe Conflict and its causes. Explain ways to handle conflict. (Refer Sections 1.13 and 1.13.2)
- Q. 12 What is Organizational Structure? Describe its importance for a project. (Refer Sections 1.14 and 1.14.2)
- Q. 13 Explain Functional & Project Structure. (Refer Sections 1.14.3 (c) and 1.14.3 (e))
- Q. 14 Explain Matrix Structure. (Refer Section 1.14.3 (f))
- Q. 15 Write a short note on PMI. (Refer Section 1.15)
- Q. 16 Describe the knowledge areas as recommended by PMI. (Refer Section 1.16)



Initiating Project

Module 2

Syllabus

How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter, Project proposal, Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.

2.1 Introduction

A project work demands a lot of planning and effort from all those who are involved in it. The basic understanding of the project life cycle is vital for every project manager specially. As it is said, well begun is half done, the successful initiation of a project plays a very important role in its ultimate success. If you begin by putting the right foot forward you are in a good chance of making it to the end as desirable. Thus project initiation becomes a very important part of a project work. This chapter deals with everything that helps you develop a good understanding of project initiation.

2.2 Project Initiation

The most critical phase of a project is its initiation. It involves estimating, scoping, assigning resources, defining requirements, briefing in your team, etc. There are a series of tasks so critical in giving a concrete shape to your project.

A project comprises five steps. They are :

- Initiating, Planning, Executing, Monitoring & Controlling and Closing. Project initiation is the first phase of a project life cycle.
- This phase describes the opportunity or reason for the project initiation. Objectives are defined to avail the opportunities lying ahead. During this phase of the project some of the important tasks are like assembling a team and defining a business case to define the project in detail.
- In this phase all sorts of information such as client proposal or the research of any research done earlier is accumulated to set and define the project's scope, timings and cost. This becomes the most basic set up for your project through which you identify the stakeholders, the team, goals and objectives and deliverables.
- The project initiation phase generally describes a project in details in terms of three important elements. They are people (Input), Processes and Products (Output). This is considered a good way to outline your project requirements and all the activities to be performed later. These are critical to a project.

2.2.1(a) People

Following are the people generally associated with a project. Let us understand their roles.

1. Team

(i) Describe your Team

In the Project Initiation phase, it is important to define and form a team on the basis of the project requirements and deliverables. You have to plan on what shape your team must be given. The following points help when you form your core team :



- Skills required (in the area of the project)
- Relevant Experience (Experience of working on the similar projects)
- Stakeholders (their role)
- Availability
- Budget required to get them onboard

(ii) Start with your Team

It's important to begin the work by arranging a starting meeting with your team members. This helps them to understand, clarify the requirements and other details and get their involvement in the project right from the beginning. The team members must be involved while setting the project requirements, team member's roles and responsibilities and the objectives to achieve. Managing the expectations of the people is the best way to initiate a project in the right way. When you get your team involved right from the beginning they will feel more included and involved in the decision making and therefore have a much more positive impression of the project as a whole.

2. Stakeholders

(i) Identifying and defining their roles

During project initiation process, it is equally important to outline and define the stakeholder involvement whether the stakeholders are the client or the internal ones. You must define the role and responsibilities of each one in terms of reviewing the deliverables and giving feedback.

(ii) Initiating Communication

Communication with the stakeholders is always important. It is very important to define the contents and timing of communication that will take place with different stakeholders. Timely communication with and updating of the stakeholders is a good approach. The communication and updating of project details should also be extended to others in the team involved.

(iii) Meeting with the stakeholder

Right from the project initiation phase, the role of stakeholders becomes important. So, knowing them well and getting along and creating a positive environment is quite helpful. Therefore an initial meeting with the client or stakeholders involved should be organized. The meeting should discuss everything related with the project including all the people, their roles and responsibilities. A meeting like this breaks the ice and gets all of them onboard.

2.2.1(b) Process

Following are the elements of a project process to explore before initiating a project.

1. Methodology

For your process to be effective you must begin by outlining your project activities, deliverables and the team. The process often comprises a blended mix of different methodologies. Efforts should be made to identify the methodologies that are suitable to give the desired outcome. You should refrain from forcing a certain methodology. Following are useful when considering the methodology :

- Size of your project.
- Scope, timeline and budget.
- Right team (Dedicated or shared).



- Role of your clients and stakeholders.
- Requirements and deliverables.

Clarity on the Following will give you a better idea of what type of project it is and how it should proceed.

2. Tools

- During the project execution you are going to require a lot of tools and therefore, it is important to identify them in the beginning so that they are available and you can plan their utilization at the right time. Some areas to consider when selecting what tools you need are :
- Resource planning and management
- Project Planning and timescales
- Stakeholders collaborations
- Communication with your team and stakeholders
- Management of Project internal tasks

Always get your internal team and stakeholder's agreement while selecting the right tools. It is also important to know how to use them effectively. Later changes can always be made depending on the requirements.

3. Managing Risks

There is no project that is without any risk. Risk is an integral part of a project. Thinking and planning all the possible risks ahead is vital in the project Initiation phase. To do this, highlight all possible Risks and then identify ways to reduce their impacts incase that happens. You should also involve your team hold a pre-mortem session with your team members where you discuss areas of risk, as they are often unexpected.

2.2.1(c) Product

1. Requirement Analysis

Right product is the outcome of a project work. Therefore, you should try to understand the requirements of your project as clearly as possible in the initial phase. It's important to begin by outlining things that you know already such as the needs of the business, client and users. This helps you to have a clear understanding of the background and context for the project.

2. Identifying Scope and Deliverables

During the project initiation phase, you must have a clear idea of the scope and deliverables that are required. You must write them in details so that every aspect of them is included and agreed upon. This will avoid any confusion at later stages. Needless to say, the involvement of your team members and the stakeholders is of utmost importance.

3. Setting Deliverables

On the basis of the information you collect, the deliverables must be finalized in order to avoid later confusions. Therefore you must organize an internal meeting with your team members and stakeholders to go through the deliverables. Make sure to get the feedback and suggestions from everyone. During the meeting while reviewing the deliverables with your team, keep these areas in mind :

- The deliverables
- Their format, shape, size and specifications

- Changes required from the initial understanding
- Timeline
- Dependencies on any other deliverables

4. Budgets and Timings

After you decide upon your list of deliverables, you establish a fair project scope and deliverables. Next is to decide on the timings to deliver and roles to be played by each team member. Therefore, you should work with the team to set the right perimeters on estimating timings and shaping the right team. Again, you shouldn't force a process onto a project rather make sure the process suits the requirements of the project. After this, the next step is to create a budget as it is important to put costs against each and every item that you have agreed upon. At this stage, you don't need a detailed breakdown of timings but more an overview of phases of time.

5. Setting Measures of Success

The success of a project should regularly be measured so that you can know and understand the progress and bottleneck, if any to be worked out. An on the track project gives the necessary confidence to the team and the stakeholders which is possible only through regular review. Therefore, you should create some measurement criteria to review. Consider areas such as :

- Meeting the core deliverables
- Client satisfaction
- Team satisfaction
- Adherence to the set timings
- Adherence to the budgetary constraints

2.2.2 The Process of Initiating a Project

1. Business Case

- The first step is establishing a business case in which focus is given on explaining the reasons for starting a project. The business case describes the availability of financial and other resources to support the business need. A business case considers the requirements of the project and justifies how it fits the size and risk of the proposal. The structure of a business case remains the same irrespective of the project types. A business case basically outlines the project relevance comprehensively describing its need and the likely impact. It does not reveal the technical aspect of the proposed project.
- While describing the business case care should be taken to make it easy to understand, clear, logical and relevant. The key aspects need to be identified, measured and justified. There also must be accountability and commitment for the delivery of the project outcomes and costs involved in the project
- Following should be the contents of a business case :
 - o Preface
 - o Table of contents
 - o Executive contents of the project
 - o Business drivers, scope of the project and financials aspect
 - o Business analysis such as the costs and benefits, risk
 - o Conclusion

2. Feasibility Study

- After the business case is prepared and approved the next step is to do a feasibility study. It describes whether it is feasible to undertake this project and what are the potential solutions to the opportunity or business problem that the project is proposed to address. It guides you and helps you take a decision on what should be the approach while undertaking the project.
- Through a feasibility study you can not only define the opportunity but also prepare the supporting documents and tell what is required to complete this project successfully. It also identifies other possible solutions. Probable risks and issues are also identified. The study also gives the proposed solution to each problem.

3. Project Charter

- The next step is to prepare a project charter. It describes the purpose for the project and its proposed structures and execution. A project charter also sets the vision, objectives, scope and deliverables of the project in details. It identifies and describes the responsibilities of the project team and the stakeholders.
- At this stage, the project charter is able to present the project in structurally organized, well documented form which mentions the project plan and list all risks, issues and assumptions.

4. Building Team

- The next step is building of a team as a project cannot be initiated without an effective team. Therefore, this step first prepares job descriptions for the people who will play their role in implementing the project plan. This includes their role and responsibilities.
- A project team is built by first by defining the roles for each member as clearly as possible to keep the work flowing smoothly. Next comes the responsibilities that come with the role. Authority associated with each role is also clearly described.
- Sometimes a detailed organizational chart is built by listing the skills and experience needed for each position. It is also helpful in defining different qualifications required for each position. The chart also includes the performance criteria, salary and working conditions.

5. Project Office

- A project office is a place in the office or work site where the project manager and support staff sit and work together during the project. It is generally equipped with the communications infrastructure and other technology needed for the project.
- The location of the project office must be near to the actual project work site. It should be large enough to house all the people associated with the project.

6. Periodical review

- Periodical review of each step that was identified during the initiation phase must be done to ensure that there is nothing that goes against the project as it is always possible to make mistakes and this is especially true with the project initiation phase as it is so critical to the success of the project. Project periodic review is an essential part of the project management.
- Periodical review also looks at the risks that were earlier identified and see if any have occurred, and if so how they were controlled and resolved. At times, changes are made to a project. A review evaluates if these changes were done correctly and whether they have kept the project on track.

2.3 Strategic Project Selection

- Every organization has limited resources. Time, financing, human resources, material, and skills are just a few of the top items on a long list of constrained organizational resources. The constraints of the organization force choices in all areas of operation, including project selection. There simply isn't enough of what is needed to go around and undertake every potential project.
- Moreover, not every project is a good idea. In the best of cases, we might have several good projects to select from. By applying a structured approach to project selection, project managers can increase the chances of selecting potentially successful projects with the most positive organizational impacts.
- Therefore, the goal should always be to select projects with the maximum benefits to the organization. By having a number of different selection tools and techniques at our disposal, we will be in a better position to select the best projects to undertake.

2.3.1 Techniques used for Strategic Project Selection

There are lots of ways to decide on which projects to select. Following are some basic techniques used for picking projects to undertake. All of the methods listed here can be used alone, or in combination with other techniques.

2.3.1(a) Financial Analysis

- On many occasions, the project selection decision is taken on the basis of just one factor i.e. financial benefits. In such situations, projects are selected on the basis of the project opportunity that gives the maximum financial benefit to the organization.
- Such decisions are never easy. Fortunately these days, several financial analysis tools are used to determine the financial benefits a project can provide. Two of the most frequently used tools are Returns on Investment (ROI) and Payback Period.
- ROI measures the returns produced by a project with respect to the amount of capital invested. ROI is calculated with the following equation :
$$\text{ROI} = (\text{Gain from Investment} - \text{Investment Cost}) / \text{Investment Cost}$$
- Therefore, the project that provides the highest returns on investment is selected.
- The payback period of a project is a tool that calculates the time period a project will take in order to recover the amount of capital invested. The calculation for payback period is done by dividing the amount of capital invested in the project by the income generated by the project per period of time (months, years, etc.). Using payback period, the project with the shortest time to recover invested capital can be selected.
- In many cases, the selection of a project is also done by the measurement of the opportunity cost. Opportunity cost is the measurement of the cost that an organization pays for not selecting the other projects. A decision on which project is to be selected is based on financial analysis alone. It provides the best possible outcome based on the specific financial needs and objectives of the organization.

2.3.1(b) Strategic Objectives Analysis

- Projects generally play a very important role in achieving the strategic objectives of an organization. Therefore if an organization has clearly defined strategic objectives, projects are then selected in such a way that they help further the organization achieve the strategic objectives.

- During the project selection care should be taken to see how well a project can support organizational strategy. For example, if a service based organization sets its mission to provide superior customer service, then the projects selected should be such that it enhances customer service. For an organization that focuses solely on innovation to gain competitive advantage, projects that support research and development should be picked as a better option.

2.3.1(c) Problem Solving Nature

Organizations, at times, have specific problematic conditions which require to be improved. In such situations, particular projects that solves the problem and improves the conditions could be chosen. This concept of using projects is used by many organizations to solve internal problems. In such cases, the reasons for selecting a specific project is to remove hindrance and impediments for smooth and efficient, organizational operations.

2.3.1(d) Opportunity Analysis

New opportunities are found in plenty all the time. It is up to the organizational and their management to lookout for them to take advantage of. Opportunities are required to be identified to achieve different organizational goals which could be increasing profits, entering new markets or developing new products and services. Though, it is easier said than done as identified opportunities rarely take advantage of themselves. In many cases, projects are designed, selected, and implemented specifically to take advantage of opportunities identified by organizational leadership.

2.3.1(e) Requirements Analysis

Business environment, today, is ever changing. Industrial, regulatory, and market conditions keep changing resulting in the creation of new requirements. Organizations must keep a close eye on the changing requirements and fulfill them with the right projects. People should be assigned with the specific job of tracking all the changes and looking for an opportunity for the organization to come up with a solution.

2.3.1(f) Time Frame Analysis

- While selecting a project we must look at the time frame as it is an important point of consideration in the selection of a project. It is done in two ways; analyzing the time of implementation and total project life cycle time.
- Time required in the implementation of the project components is important to analyze particularly when significant portions of the project are to be implemented in a time bound manner. Analysis should be done to find out whether the organizational resources required for a project are available at the time of project planning. Project life cycle time is the total time involved in the completion of the project starting from selection and initiation to final closing and shut-down. Time frame becomes more important if there is a limited period of time available for the undertaking of a project.

2.3.1(g) Weighted Scoring Model

- Weighted scoring models are project selection analysis tools. They are useful when the decision on project selection is taken on the basis of not one, but several factors. In such a case, a weighted scoring model (Also called Decision Matrix) is considered one of the best tools to examine, rate, and select a project among multiple available options.
- A weighted scoring model is developed by determining the factors which are considered important to an organization in project selection. Those factors are then assigned a relative level of importance or value (weight). The factors are then examined and rated for each available project option under consideration with the rating multiplied by the relative weight of the factor. The project with the highest total score is the one that should be selected.



2.4 Project Selection Models

Project selection is an important function of business organizations. A wrong selection of project may generate losses which is undesirable. Therefore, having a thorough understanding of project selection models becomes very important. Following are the two important types of project selection models.

1. Non-Numeric
2. Numeric Project Selection Models

2.4.1 Non-Numeric Project Selection Models

Non - Numeric project selection models are described as follows :

1. The Sacred Cow
2. The Operating Necessity
3. The Competitive Necessity
4. The Product Line Extension
5. Comparative Benefit Model
6. Q-Sort Model

1. The Sacred Cow

This is a commonly used method in which the senior members of the organization suggest a project out of their own understanding and expertise. Most of the projects using this method are those that are initiated out of an apparent opportunity available or taking chance of an un-established idea for a new product. The project is created as an immediate result of this approach in which about whatever the boss proposes becomes the project.

The sacredness of such project reflects the fact that it generally continues till it finishes or until the senior declares its failure of the idea & ends it.

2. The Operating Necessity

Sometimes, the necessity of a project arises simply because it is capable of either enhancing the operating efficiency of the organization or solving a serious problem that's troubling the organization. For example, if a plant is threatened by the flood then it is not much complex and effortful to start a project for developing a protective desk. Many potential projects are evaluated for selection using this criterion of project selection. Questions such as the estimated cost and its comparative effectiveness come in for analysis in front of the organization. The project cost is generally analyzed to find out whether these could be maintained as minimum and compatible with the success of the project.

3. The Competitive Necessity

Organization always like to stay ahead in competition and this desire becomes the basis for making decision to carry out a project. Although, preference is generally given to the project whose needs is felt by the operating necessity & competitive necessity with regard to Investment. Generally, both types of project selection models are considered quite useful & effective as compared to others.

4. The Product Line Extension

In this selection model called the product line extension, a project is initiated for the development & distribution of new products and is evaluated on the basis of how much it suits the company's current product lines, how much it fortifies a weak line, fills a gap, or enhance the line..

On many occasions, evaluation of profitability is not done as the decision makers take decisions on the basis of their belief about the probable influence of the addition of the new product to the line over the entire performance of system.

5. Comparative Benefit Model

- This model is used when there are several projects up for consideration by the organization. The selection is done on the basis of their comparative studies and only that project is selected which can provide the maximum benefits to the company. Though, comparing various projects is not an easy task as there are chances of committing mistakes.
- Sometimes, this comparison is done just on the basis the perception of the selection committee members that certain projects will benefit the company more than the others even when they fail to suitably specify or measure the proposed benefit.
- For all such projects, instead of a formal model, the concept of comparative benefits is considered beneficial for the selection decisions. All the considered projects with positive recommendations are examined by the senior management of the funding organization. Efforts are then made to develop a plan that can effectively suit the objectives & budgets of the organization.

6. Q-Sort Model

- This is the one of the most simple and straightforward techniques used for selecting projects. In this model, the available project for undertaking are first divided into three groups according to their relative merits. They are Good, Fair and Poor.
- The main group is further subdivided into the two types - fair-minus and fair-plus. The projects within each type are ranked from best to worst. Again relative merit of the respective projects provides the basis for determining this order. Specific criterion is used by the rater to rank each project. Sometimes, he just uses his general entire judgment.
- At times, one person holds the responsibility for carrying out the evaluation & selection process of the project. Sometimes, a selection committee is formed to perform the selection process. The ranking of the projects differ only to some degree from rater to rater. Finally the projects are selected on the order of preference, though financial basis becomes the most important criterion before final selection.

2.4.2 Numeric Project Selection Models

These models use profitability as the sole measurement criterion for selection of a project. Majority of the organizations use different numeric types of project selection models. Following are some of numeric models for project selection.

1. Payback Period
2. Accounting Rate of Return
3. Break Even Analysis
4. Cost benefit Analysis
5. Net Present Value (NPV)
6. Internal Rate of Return (IRR)

1. Payback Period Method

- This method is a simple non-discounted factor method. It calculates the time period that will be required for the project to generate enough returns to recover the initial investment. It focuses on measuring the cash inflows.



economic life of the project and the investment made in the project without looking at the time value of money. This method is used to select a project proposal based on its earning capacity within a fixed time period. With simple calculations, selection or rejection of the project can be done. The results also help identify the risks involved. As the method doesn't consider the time value of money, the accuracy of selection at times becomes difficult to ascertain.

- The payback period is the time period expected to be taken by the project before the investment will be returned in the form of income. When comparing two or more investments, business managers and investors typically compare the projects to see which one has the shorter PBP. Projects with longer PBP are usually associated with higher risk.

2. Accounting Rate of Return Method (ARR)

- This method is a better method as it overcomes the disadvantages of the payback period method. Here, the rate of return is expressed as a percentage of the earnings of the investment in a particular project. This method helps in selecting a project by using the criteria that a project that has higher Accounting rate of return than the minimum rate of returns set by the management will be considered and those below the predetermined rate of returns are rejected.
- ARR takes into account the whole economic life of a project which helps in getting a better means of comparison. However, even this method ignores time value of money and doesn't consider the length of life of the projects.

3. Break-Even Analysis

- Break-even analysis is another numeric financial tool used frequently for project selection. It is used to determine the stage at which your project, a new service or a product, will be profitable.
- In other words, it's a financial calculation done to determine the number of products or services a company should sell to cover its costs. Break-even is defined as a situation where your income and expenses match and thus you are neither making money nor losing money. You have enough income to recover all your costs.
- This method is useful in understanding the relationship between the variable cost, fixed cost and revenue. As per this analysis it has been observed that an organization with low fixed costs will have a low break-even point of sale. For an example, a company has a fixed cost of Rs.0 (zero) will automatically have broken even upon the first sale of its product.

Usage of Break-even Analysis

- (i) Starting a new project : For selecting every new project it is advisable to conduct a break-even analysis. Not only it helps you in deciding whether the project idea is viable, but it will force you to be realistic about the costs. It will also guide you on the pricing strategy.
- (ii) Launching a new product : An existing business planning to launch a new product should do a break-even analysis particularly if such a product is going to add a significant expenditure.
- (iii) Changing the business model : It is also useful to an organization which plans to change its business model like switching from wholesale business to retail business. As the cost incurred to the business could change considerably this method helps to figure out how much the selling prices need to change too.

4. Cost benefit analysis

- Cost benefit analysis is another numeric method used to determine the viability of a new project. Through this method organizations analyze the profitability of projects. It is also used to determine the value for intangible assets. This model was built by identifying the benefits of an action as well as the associated costs, and

- subtracting the costs from benefits. When completed, a cost benefit analysis gives concrete results that can be used to develop reasonable conclusions around the feasibility and/or advisability of a decision or situation.
- Cost benefit analysis in project management is one more tool in your toolbox. This has been devised to evaluate the cost versus the benefits in your project proposal. It begins with a list.
- The list of project expense is prepared on one side and the benefits to be received after successfully executing the project is listed on the other side. Based on this you can calculate the returns on investment (ROI), internal rate of return (IRR), net present value (NPV) and the payback period.
- The difference between the cost and the benefits determines whether action is required to be taken or not. In most cases, if the cost is 50 percent of the benefits and the payback period is not more than a year the action is worth taking.

Uses of Cost-Benefit Analysis

- (i) To determine the feasibility of a project : This analysis helps the management of an organization in determining whether undertaking the project will give benefits or not as nobody wants to incur losses in business. When a huge sum of money is invested in a project or initiative, it should at least break even or recover the cost. The costs and benefits are identified and discounted to present value to ascertain the viability.
- (ii) To help compare projects : As you have today so many choices for investment there must be a basis for selecting the best alternative. Cost-benefit analysis is quite useful to pick through the available options. This model helps businesses to rank the projects according to their order of merit and choose the one that is the most profitable.
- (iii) Evaluating Opportunity Cost : Cost-benefit analysis is a useful tool for comparing and selecting the projects and selecting best option particularly when the resources are finite but investment opportunities are many. However, while choosing the most viable project, it is also important to know the Opportunity Cost which is the cost of the next best alternative foregone. It helps businesses to identify the benefits that could have arisen if the other option was chosen.
- (iv) Sensitivity Analysis : Sensitivity analysis is a useful tool for improving the results of Cost-benefit analysis and is mainly used when there is no clarity over the discount rate. In this condition, the discount rate and the horizon value are changed to test the sensitivity of the Cost-Benefit Analysis model.

5. Net Present Value (NPV) Method

- This is another widely used method for evaluating the returns that you can get out of an investment in a project. In this technique the cash inflow that is expected at different periods of time is discounted at a particular rate. The present values of the cash inflow are compared to the original investment. If the difference between them is positive then it is accepted or otherwise rejected. This method considers the time value of money and is consistent with the objective of maximizing profits for the owners.
- Net Present Value is calculated by subtracting the present value of cash outflows from the present value of cash inflows. The present value defines what will be the worth of the future sum of money as of today.
- While investing in certain investments or projects if it produces positive NPV then you can accept the project as this will show the additional value to your wealth.
- And in case of negative NPV you should not accept the project.

6. Internal Rate of Return (IRR)

- The internal rate of return (IRR) is a discounting cash flow technique. It gives a rate of return as expected to be earned by a project. It gives a discounted rate where the total of initial cash outlay and discounted cash inflows are equal to zero. In other words, it is the discounting rate at which the net present value (NPV) is equal to zero.

 Project Management (MU)

- For the computation of the internal rate of return, we use the same formula as in NPV. Software like Microsoft Excel is also available to calculate IRR. In Excel, there is a financial function that uses cash flows at regular intervals for calculation.

$$\text{IRR} = \frac{\text{(Cash Flows)}}{(1+r)^t} - \text{Initial Investment}$$

Where

Cash Flows = Cash flows in the time period

r = Discount rate

t = Time period

- An ideal rate of return is the rate at which the cost of investment and the present value of future cash flows match. A project that can achieve the ideal return is a profitable project. In other words, at this rate the cash outflows and the present value of inflows are equal, making the project attractive.

2.5 Project Portfolio Process

- The project portfolio process is a method which is used to maximize the output potential of all projects undertaken by an organization at a given time, subject to limited resource constraints.
- Before beginning the project portfolio management efforts, it is important to establish an environment of understanding and cooperation among key decision makers in your organization.
- The project portfolio process may include terminating current projects that may be successful and timely in favor of projects that have a larger economic or strategic impact on your operations.
- During the project portfolio management process, resources such as time, money, employee productivity, and technology are allocated to those projects that contribute the most to the company's profitability. Before considering any specific projects, a list of priorities is developed by which each one is judged.
- The organization continually monitors the priority list and adapts it to the changing strategic goals and evolving business climates. Items by which to prioritize the projects can include cost, contribution to revenue, marketing impact, time frames, and achievement of specific goals.
- Project portfolio process has become a key component in organizations as they look to enhance their ability to manage multiple projects in an efficient and effective way. Project portfolio management process is the key to success because it defines how an organization approaches project prioritization, resource allocation, budgeting, scheduling, and other major project components.
- The goal of Project Portfolio Process is to find the best possible combination of resources to help an enterprise achieve its objectives, and it takes into account such factors as external market conditions, customer demands, competitive environment, and government regulations.
- The need for Project Portfolio Process is driven by the fact that all projects require funding, time, and staff to be completed successfully. But often the resources needed are in limited supply. At the same time, it's clear that not all projects are of equal value to an organization. As a result, stakeholders need a way to manage projects and resources to ensure that the most strategically important projects will receive the attention and resources to ensure success.
- To ensure success with a Project Portfolio Process, organizations can follow the following steps :

1. Identify Business Goals and Strategy

- The first step toward effective Project Portfolio Process is to identify organizational goals and clearly define a business strategy to achieve those goals. This will help companies develop an action plan. Each of the projects in a portfolio should align with the organization's strategic vision.

- A common pitfall occurs when organizations identify their business strategies but lose sight of the individual projects. To avoid this, organizations should take the time to identify the business strategy as well as evaluate where projects stand in relation to business objectives.
- This involves taking an inventory of all current projects and resources, including evaluating the current projects in the pipeline for redundancies, stalled projects and other potential areas for cost savings, and identifying skilled employees and their current and future availability to find out who's available to work on high-value projects.

2. Establish a Project Management Office (PMO)

- Companies should create a business unit to oversee Project Portfolio Process and coordinate efforts across the whole organization. In many cases this unit is referred to as a PMO.
- Many organizations might already have informal teams that support managers and projects. But for Project Portfolio Process efforts to be successful, a team needs to be given recognition and support from senior executives. Without this, the system of checks and balances will not work.

3. Develop Project Evaluation Criteria

The PMO can work with business leaders to create project evaluation criteria, which will help the organization review, evaluate, and authorize projects to ensure that they align with strategic objectives of the enterprise.

Among the questions to ask when evaluating new project initiatives are :

- Whether the project drives business goals
- What the expected tangible outcomes will be
- Whether the outcomes can be achieved by a project already underway
- What the project's risk-return profile is
- What resources are needed to complete the projects

4. Develop a Risk Management Strategy

- Evaluating the risk-return profiles for projects is a key step in the review phase. But developing an organizational risk management strategy is included as a best practice by itself because it's so vital to Project Portfolio Process success.
- Companies need to evaluate each project's inherent and potential risks to the overall portfolio, rather than just comparing project initiatives side-by-side. It's important to conduct risk assessments several times over the course of a project's lifecycle, because this enables project managers to keep the PMO and stakeholders up-to-date on any changes. Stakeholders, in turn, can weigh new initiatives against the overall portfolio more accurately.

5. Invest in a Project Portfolio Process Solution

- Finally, companies need to deploy a Project Portfolio Process solution that can increase cohesion and visibility into their processes.
- These tools can help create a historical project archive, which business leaders can draw upon when they make future investment decisions. Organizations should thoroughly evaluate products before buying them, including reading reviews of Project Portfolio Process platforms and scheduling product demonstrations.
- Project Portfolio Process platforms can identify projects that do not warrant investment and provide clarity into projects at every level, from objectives to cost. They can provide strategic insight and visibility into the most important projects that make sense for an organization, prioritize the most valuable work, and help deliver project initiatives on time and on budget.



2.6 Project Sponsor

- A Project sponsor is a person or group that provides resources and support for the project, program or portfolio and is accountable for enabling its success.
- The project sponsor is a very important part of the project management organizational chart. In fact, every project has a sponsor. The project sponsor is one level above the project manager.
- They do not manage the day to day operations of the project but ensure the resources are in place, promote the project and hold overall responsibility for the project's success.
- They represent the business side of the project. They are generally involved since the time the project is conceived and advocate for its inception even before a project manager was assigned.

Here are some examples :

- (i) For a highway construction project, the project sponsor is employed by the state. In contrast, the project manager is employed by the construction company and submits project updates and requests funding changes to the project sponsor.
- (ii) For a house construction project, the project sponsor is likely employed by the house building company. They are responsible for multiple house building projects, or for the success of the company on some level. In contrast, the project manager is responsible for the day to day operations and scheduling of a house building project.
- (iii) For an IT project, the project sponsor might be the Chief Information Officer of the company. They receive updates and approve project changes from and to the project manager who is responsible for the immediate day to day project work.

2.6.1 Roles and Responsibilities

The project sponsor generally has the following roles

- **Promotion** : They attempt to keep the project at the highest priority within the organization by promoting them.
- **Authorization** : They authorize the project and assign work to the project manager.
- **Funding** : They are responsible for ensuring that funding is in place and approve changes to the project budget.
- **Approving** : They approve the project management plan and are kept aware of how the project is managed.
- **Scoping** : They are generally responsible for determining the initial project scope although the project manager is ultimately responsible for the official project scope within the project management plan.
- **Project Charter** : This document officially creates the project and assigns the project manager. It falls directly within the project sponsor's responsibility.
- **Informing** : They receive project status updates from the project manager and disseminate the information to the relevant executives.
- **Receiving** : The project sponsor receives the project deliverables from the project manager, approves them, and integrates them into the owner organization.

It is important for every project to have a sponsor to :

- Ensure separation of decision-making responsibilities between project manager and project sponsor
- Ensure accountability for the realization of project benefits
- Ensure oversight of the project management function
- Carry out senior stakeholder management

2.6.2 Functions of Project Sponsor

1. **Project promotion** : One of the foremost functions of a project sponsor is to support and promote the importance of the project to relevant stakeholders. This is necessary to give the project visibility at higher levels and to provide a human face to answer questions about why the project needs to happen.
2. **Putting forward the business case** : Someone who is a project sponsor needs to be a believer in the necessity of the project to sincerely make the case for it. They will assist the PM and team leaders in forming the business case so that it makes a powerful argument for why it should go ahead.
3. **Ensuring funding and resources** : The project sponsor also assists in making sure that the project has everything it needs.
4. **Determining project scope** : During the initial exploration and project planning stage, the project sponsor is often called upon to contribute their experience of the possibilities and limitations for previous projects they have worked on.
5. **Approval and authorization for project steps** : In order to streamline the reporting structures for a project, the project sponsor will often be handed responsibility for reviewing and approving project activities, which means that a PM can get a quicker response than having to address executives or stakeholders.
6. **Overseeing project health** : Although they may not have daily interactions with the project, project sponsors receive regular project reports so that they have an understanding of the overall level of project health. They assist the PM in following up on budget proposals and maintaining the funding of the project. They also assist with the hiring of human resources and implementation of new technologies.
7. **Informing stakeholders of progress** : A very important function of the project sponsor is to receive information about the project and then transfer this to relevant stakeholders. This is done to ensure continued support for the project and to make sure all stakeholders are kept in the information loop.
8. **Assessing final deliverables** : At the final stage of the project the person who is a project sponsor should review the final deliverables to sign off on them before being handed over to the client. This is a final checking process performed by someone who has enough distance from the project to be able to judge it fairly.

2.7 Project Charter

- Project Charter is a statement that describes the objectives of a project. This statement also sets out detailed project goals, roles and responsibilities, identifies the main stakeholders, and the level of authority of a project manager. It also acts as a guideline for future projects.
- It defines the roles and responsibilities of the participants and outlines the objectives and goals of the project. The charter also identifies the main stakeholders and defines the authority of the project manager.

2.7.1 Roles of Project Charter

Following are the roles of a Project Charter :

- It documents the reasons for undertaking the project.
- It outlines the objectives and the constraints faced by the project.
- It provides solutions to the problem in hand.
- It identifies the main stakeholders of the project.



2.7.2 Benefits of Project Charter

Following are the prominent benefits of Project Charter for a project :

- It improves and paves way for good customer relationships.
- Project Charter also works as a tool that improves project management processes.
- Regional and headquarter communications can also be improved to a greater extent.
- By having a project charter, project sponsorship can also be gained.
- Project Charter recognizes senior management roles.
- Allows progression, which is aimed at attaining industry best practices.

2.7.3 Contents of Project Charter

Following are the contents of Project Charter :

- It describes the reasons for undertaking the project so that everyone is clear about the purpose of the project.
- It describes the objectives and constraints of the project. If you don't have a clear target your project is going to miss the mark.
- It outlines the proposed solution to the constraints to the project.
- It also gives the details of the main stakeholders in the project. It's always crucial to note the stakeholders in any project for they're the ones who you will be reporting to and, in a sense, managing their expectation.
- It gives the details of the in-scope and out-of-scope items. Scope is the boundaries of your project, such as its start date and when its finish dates. The in-scope items lay out the step-by-step process of the project.
- It also analyzes and describes the potential risks in the project. It is important to identify all risks that could arise in the project so you're not taken by surprise. This should be followed up by a risk register and risk management plan in your project plan, where you detail how you will resolve those risks.
- It outlines the project benefits. A good way to sell the project is to have a sense of what good the project will bring to sponsors and stakeholders. Project Charter figures out what those benefits are and list them.
- It determines the project costs. While you will go into greater detail when you create the project budget, you get a rough figure on what you expect the budget for the project to be and who will have spending authority.

2.7.4 Usage of Project Charter

The following are three main uses of the document :

1. You need it to authorize your project. This is the document that sells the project to your stakeholders and define broadly what their return in investment will be. It's like elevator pitch, so it has to sell the project.
2. It serves as a primary sales document. When you present this to the stakeholders they now have a summary to distribute or present when approached about other projects, so they can focus their resources where they're needed.
3. This is a document that stays with you throughout the life cycle of the project. You refer to it throughout, whether in meetings or to assist with scope management. The charter acts like a roadmap.

Tips on Writing a Project Management Charter

Writing a project charter is a process which also requires good experience and expertise. Here are some tips which may help you in preparing a good project charter.

Vision

Once you have the vision clear, then you can break it down into more practical bits. It must be supported by the following :

- **Objective** : List three to five objectives of the project - specific, measurable, achievable, realistic and time bound.
- **Scope** : Outline the formal boundaries of the project by describing how the business may change or alter by delivery of your project, also note what's relevant to the project and what is not. This is how you maintain better control of the project.
- **Deliverables** : Describe each of the deliverables the project is tasked to produce. Once you've got all of them down, you've got a foothold on your charter and are ready to move on.

Organize

When you're building a structure for your charter there are four subsets you need to identify. This is done by listing the following :

- **Customers/End Users** : To complete this list, ask yourself: Who is a customer and/or end user in the context of this project? Is there a specific individual or entity responsible for accepting the deliverables of the project?
- **Stakeholders** : As noted earlier, identifying the stakeholders of the project is crucial. They are the person or entity within or outside of the project with a specific key interest in that project. It might be a financial controller overseeing costs or the CEO, but whoever it is they'll have a slightly different focus depending on their role.
- **Roles** : You need to assign the key roles and responsibilities to those involved in delivering the project, from the project sponsor, project board and project manager. After each entry write a short summary defining their role and what their responsibilities are in the project.
- **Structure** : Now you need to define the lines of reporting between these various roles in the project. Use a project organization chart to do this. It diagrams the structure of an organization and the relationships and roles of those involved in the project.

Implementation

You have a vision and have organized the various parts of your project. Now you have to develop a plan to implement them. There are four parts to this :

- **Plan** : To implement your project as stated you need an implementation plan. This is a way to develop an atmosphere of confidence for your customers and stakeholders by listing the phases, activities and timeframes of the project's life cycle. Gantt charts are the traditional planning tool for projects. They turn your tasks and deadlines into visual timelines.
- **Milestones** : Milestones mark major phases in the project and collect smaller tasks into bigger chunks of work. The project should only have a few of them, that's why they're milestones, but they are an important way to acknowledge the completion of a key deliverable.
- **Dependencies** : List all key dependencies and what their importance is to the project. These are tasks or activities that are linked to one another, as they will impact the project during its life cycle.
- **Resource Plan** : What resources are involved in the project? Break down this list into labor, equipment and materials. This is how you will know what you need before you need it, and you will be able to estimate your budget more accurately. As the project progresses, and changes are introduced, you will need to adapt your resource plan. ProjectManager.com features workload and resource management tools that let you quickly see everyone's workload, so you can reassign tasks as necessary. This keeps everyone from being over or under worked.

4. Risk, Issues & Budget

- No charter is complete without collecting the potential risks and issues that can derail a project. This includes assumptions and constraints related to the project.
- A risk is a potential issue that may or may not happen in a project. Risk is not always negative, as there is such a thing as positive risk, and you should prepare for that as well.
- An issue is something that has already occurred in the project. Basically, a risk is a future threat while an issue is a present threat, but you have to be prepared for any and all eventualities when creating a project management charter.
- Finally, with all the following information, you can sketch out a rough figure on how much it will cost to deliver the project within the timeframe you're allowed. Then you present your charter, and once it's approved and signed, the real work begins.

2.8 Project Proposal

A project proposal is a document used by business organizations where the aim is to persuade a sponsor to agree to the proposal of investing money into producing a particular product or service.. You do this by identifying pain points and providing your sponsor the right solution to alleviate those pain points.

2.8.1 Purpose of a Project Proposal

- Essentially, a project proposal aims to streamline the business process between you as a solution provider and a sponsor by serving the dual purpose of acting as a source of information as well as a sales pitch aimed at convincing your sponsor why they should invest in what you have to offer.
- There are two types of project proposals: solicited and unsolicited.
- Solicited project proposals are requested by a prospective client. While with unsolicited project proposals, you approach a potential sponsor with a proposal, even if they don't request one, to gain their business.
- It's a common misconception that project proposals and business proposal are the same. The project proposal's aim is to initiate a project in order to solve an existing problem or offer a unique product while a business proposal aims to sell product or service. Instead of assisting your search for investors to fund your business, a proposal helps you seek new customers.

2.8.1(a) How to Write a Project Proposal ?

- **Title page :** Use the title page to introduce yourself and your project. Be sure to include your name, your company name, the date you submitted the proposal, and the name of the sponsor or individual you're submitting the proposal to.
- **Table of contents :** A table of contents will let your sponsor know exactly what will be covered in the project proposal. If you're sending your proposal electronically, include a clickable table of contents that will jump to the different sections of your proposal for easy reading and navigation.
- **Executive summary :** The executive summary details exactly why you're sending the proposal and why your solution is the best for a specific problem or situation. Similar to a value proposition, it outlines the benefits of your products or services, and how they can solve the specific problems. After reading your executive summary, even if they don't read the full proposal, the prospect should have a clear idea of how you can help them.

- **Statement of the problem or need :** This is where you provide a summary of the issue impacting the organization. It provides you with the opportunity to show them you have a clear understanding of the needs and the problem needs help in solving.
- **Proposed solution :** Here's where you offer up a strategy for solving the problem. Make sure your proposed solution is customized to the needs so the sponsors know you've created this proposal specifically for them. Let them know which deliverables you will provide, the methods you will use, and a timeframe for when they should expect them.
- **Qualifications :** Are you qualified to solve this problem? Why should they trust you? Use this section to communicate why you're best for the job. Include case studies of client success stories; mention any relevant awards or accreditations to boost your authority.
- **Cost & Budget :** This is where things can get a bit tricky, as you don't want to under or over budget your product. If you like to provide the prospect a few cost options for their budget, include an option table. Some proposal software offer responsive budgeting tables which allow a sponsor to check the products or services they're interested in, and the cost will automatically adjust.
- **Terms and conditions :** This is where you go into details about the project timeline, pricing, and payment schedules. It's essentially a summary of what you and the sponsors are agreeing to if they accept your proposal. Make sure you clear the terms and conditions with your own legal team before sending the proposal to the client.

2.8.1(b) Project Proposal Tips

There's a lot to keep in mind when writing a project proposal. Here are a few tips to help you out :

- **Keep it simple :** While there's no ideal project proposal length, focus on quality over quantity. Keep sentences short and simple, and avoid the use of business jargon.
- **Stay on brand :** Don't be afraid to let your company's personality to shine through in your proposal. Stay true to your brand and show the sponsor what sets you apart from your competitors.
- **Include data and visuals :** Don't forget to include compelling, quantitative data. When applicable, use visuals such as charts and graphs to enhance the proposal.
- **Quality control :** Before you send the proposal out, make sure to read and re-read it for any typos or grammatical errors.

2.9 Effective Project Team

- A Project Team is an organized group of people who are involved in performing shared/individual tasks of the project as well as achieving shared/individual goals and objectives for the purpose of accomplishing the project and producing its results.
- The team consists of the full-time and part-time human resources supposed to collaboratively work on producing the deliverables and moving the project towards successful completion.
- Successful projects are usually the result of careful planning and the talent and collaboration of a project's team members. Projects can't move forward without each of its key team members.
- The project team is a group of people who have a role in the project. Team members can be grouped but each individual has a certain role and function and thus can be assigned certain tasks.
- The project team fulfills these roles and functions within the time frame of the project and is usually dismantled after the project completion. During that time, the project team works towards the common goal of delivering the project's scope within time and budget/costs. Each team member has certain responsibilities based on their role, functions and assigned tasks.

- Project teams are multi-disciplinary. Team members are brought together from different departments and may include experts from external companies or suppliers. For an effective team, project team organization structure is vital and the Project Manager must have sufficient seniority and authority to lead the project team.
- For the duration of the project the team should report to the project manager and the organization structure of the project team should reflect the ownership of the project manager.
- An example project organization structure is shown Fig. 2.9.1. The Project Manager heads the team with a direct reporting line to senior management.

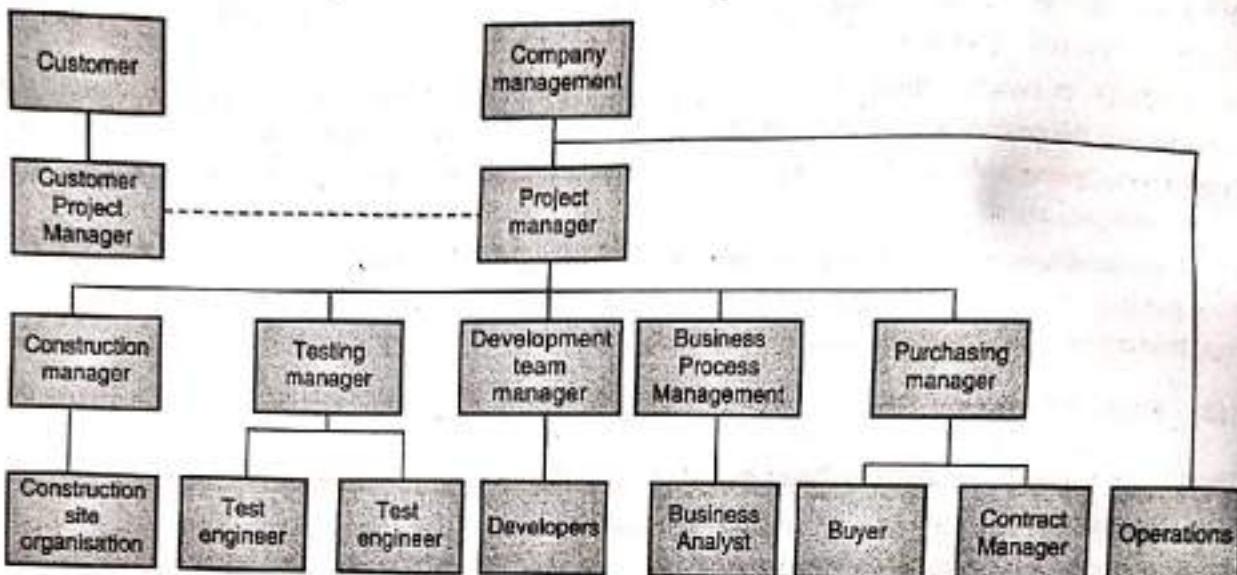


Fig. 2.9.1 : Project Organization Structure

- Organization of the project team is the responsibility of the project manager who is committed to building a productive team of professionals in order to guarantee that the project deliverables will be produced on schedule, under budget and as per specification.
- Successful implementation of this task requires the manager to acquire, develop and lead a group of people who are supposed to do the project. A group of people turns into a team when every person of the group is capable of meeting the following conditions :
 - o Understanding the work to be done within the endeavor
 - o Planning for completing the assigned activities
 - o Performing tasks within the budget, timeline, and quality expectations
 - o Reporting on issues, changes, risks, and quality concerns to the leader
 - o Communicating status of tasks
 - o Being a person who can jointly work with others

2.9.1 Conventional Roles

- Every team, regardless of the project type, size and nature, has three roles defined as conventional. These roles are :
1. **Leader** : A project team leader is a person who provides leadership and guidance to the team and takes responsibility for the results of teamwork. The team leader role involves the development and encouragement of the team through training, leading, motivation, recognition, rewarding and other activities that stimulate or force team members to do

2. Member : A project team member is a person who is involved in doing assigned tasks. Team members directly access the project and actively evolve its processes. They're subordinated to the team leader.
3. Contributor : A project team contributor is a person or an organization that participates in teamwork but is not actually involved in performing tasks and carrying out project team responsibilities. Contributors help improve the project through giving valued suggestions, expert judgment and consultation. They have an interest in the project, so they facilitate its successful completion.

2.9.2 Responsibilities and Duties

A team can be responsible for a variety of duties and responsibilities, depending on the project they're involved in. Here're several common responsibilities and duties of a project team :

- Gaining the right understanding of the amount and scope of assigned work
- Following the planned assignments
- Increasing the details level per task and activities, if needed
- Completing the assigned tasks within the constraints of scope, quality, time and cost
- Informing the leader of any issues arisen
- Proactively communicate and collaborate with other team members

2.9.3 Key Team Members and their Roles

Roles, responsibilities, approaches and practices significantly depend on the particular project, its goals, environment, and requirements. While this is true, there are several typical roles that work for literally any project team.

1. Sponsor

Sponsor is the most senior member of a project team who has crucial responsibilities and is accountable for the project performance. He is the key person in communication of the team with the company's management and key stakeholders. This is also the person who provides necessary resources for project performance and approves or rejects the outcome.

Key responsibilities of a sponsor are :

- Defining project's goals and expected outcome;
- Providing necessary resources;
- Managing communication between project team and key stakeholders;
- Translating company's strategy and vision to the team;
- Approving or rejecting the outcome.
- Some project teams have a project steering committee that consists of the sponsor and key stakeholders. It represents the interests of parties involved in project implementation, provides leadership in the work process, and resolves issues escalated by project managers and team leads.

2. Project Manager

Project manager is the team member who defines the framework and course of the project, sets estimates and milestones, defines required resources, and manages project activities. The responsibilities of a project manager can include a wide range of activities that depend on specific project. In general, the key activities are :



- Defining project milestones and estimating upcoming work scope;
- Identifying resources necessary for successful project implementation;
- Scheduling project activities and coordinating team members' work;
- Solving problems and issues that appear in the course of the project implementation;
- Managing change;
- Monitoring work progress and results.

3. Team Leader

In smaller projects, this role is merged with the project manager's one. In larger ones, team leader takes on team management responsibilities that mostly require soft skills such as :

- Initiating work processes;
- Identifying and handling possible issues in work and team environment;
- Providing and receiving feedback;
- Coaching team members and maximizing their potential;
- Leading by example by performing their share of work.

4. Team Members

A team member is the heart of any project. By participating in project activities and performing their work assignments, regular team members contribute to the expected outcome of the project. Alongside with that, their project responsibilities include :

- Clearly understanding project goals and contributing to their achievements;
- Following project plan and meeting deadlines;
- Escalating issues related to their responsibilities to the team lead.

2.9.4 Qualities of Project Team Members

An effective project team is one which possesses both professional and soft skills. They ensure better communication, teamwork, and outcome of the project work. Following are the key parameters to pay attention to when hiring and building a project team.

- (i) **Skills and experience** : This is a very important criterion for most positions. Relevant previous experience and related skills are critical for a smooth start of a project work.
- (ii) **Willingness to learn new skills** : Some hiring expert advice that it might be useful to look beyond the skills needed for the role. Employees need to be willing to get out of their comfort zone to help the team and learn something new.
- (iii) **Personal traits** : Personal traits are often a reason why a team of professionals turns out to be dysfunctional. They are nearly as important as professional skills, experience and expertise. Unwillingness to help, arrogance and other types of toxic behaviour impair teamwork. So it's better to prevent this on the first step of building a project team.
- (iv) **Cultural fit** : It's a matter of fact that professional cultures are very different and depend on industry, region and many other factors. Making sure all your employees fit in your office culture not only simplifies their on-boarding process but also prevents work environment issues in the future.

5 Building Effective Project Team

The following five steps will lead to an effective project team.

Establish the Team

- The first step is to establish the project management team. The best project teams include stakeholders at all levels, from executives to those individuals at the front line. These individuals have the inside knowledge that will be critical to the success of the project.
- The most important element about team composition is having a team that is effective working together. Collaboration and communication skills are two of the most critical personal skills demanded of all members.

Facilitate Effective Communication

Accurate, useful, timely and credible communication is crucial to maintaining a cohesive team environment and achieving project success. All project information should be communicated consistently throughout each stage of the process so all team members are equally informed.

- Open sharing of information should be encouraged and a variety of communication mediums should also be used. Team members respond differently to written and verbal methods of communication.
- Busy schedules and multiple projects can become obstacles to effective communication. Recurrent face to face meetings must be scheduled to encourage ongoing discussions and ensure that deliverables are completed within project time frames.

Encourage Collaboration

- Groups that plan together are typically more successful, therefore project leaders must realize the importance of collaborative planning and goal setting. This collaborative goal setting allows team members to achieve individual successes, while contributing to the overall project goals. Collaboration is the vehicle which:
 - o Generates the most creative solutions
 - o Gets the greatest membership support
 - o Produces the greatest amount of personal growth
- By matching each team member's incentive to the overall goals, the entire team is motivated further to achieve success. It is also the project manager's responsibility to manage the team's development to ensure a cohesive integrated team is founded.

Accept and Manage Problems

- Bringing a group of people together does not necessarily constitute a team, especially not an effective working team. One of the biggest mistakes made by project managers is not recognizing this as a fact and then expecting their project team to do well from day one.
- Project leaders facilitate relationships among people of very different backgrounds. However, they all share the common goal of the project. Conflict within projects can manifest itself in many different ways but a good project manager will intercept and take action when conflict occurs.

Recognition and Reward

- A recognition and reward scheme will help reinforce the importance of the key project deliverables and focus the team on the important aspects of the project. Completion of a project and the steps along the way can be very rewarding for team members.



- Celebrating these successes is quite motivating for the team. When project milestones are reached, they should be communicated to the project team members and stakeholders.
- Rewards can come in various forms. They should be established and communicated at the start of the project, as they may impact on other areas to the project, such as cost and time.

2.9.6 How to Efficiently Manage a Project Team ?

Creating an efficient team is essential but bringing it to success requires a wise management approach. From the perspective and experience of many project managers, in order to get the best from your team you must :

1. Be a decisive leader

If you are the project leader you be a decisive leader. Make decisions on the basis of the information you have at the time and make sure to involve your team. Team members, being a part of that process and seeing you as a leader who is focused on the success of the project, will be motivated to focus on their work, identify and point out possible issues, suggest improvements, and perform better.

2. Involve everyone in planning processes

When planning strategy or the early phases of a project, involve the entire team. Make sure you receive each team member's feedback on the process and their particular part of work. They might help you identify weak points and suggest great process optimization ideas that will help you plan better.

3. Get contributions and accountability from everyone

Being a project leader, you should get productivity from everyone. Assign tough tasks to all project team members and expect weekly accountability from each team member for their respective tasks. One of the best practices for monitoring team members input into the project is to use some project management software.

4. Acquire right team members

- Teamwork and communication are the keys to productivity of the team. That's why just finding great professionals for your team is not enough; it's not uncommon that the best ones come with big egos. Arrogance and unwillingness to communicate are extremely detrimental for productivity of an otherwise great team – and for overall results too. It's not always easy to identify that during hiring processes or team selection processes, so be careful to ask tough questions and not just take the best talent with blinders on.
- The project management team needs to clearly understand the requirements and deliverables of the project as well as being aware of the organizational overall strategy, objectives and drivers. It is also essential for the project management team to understand the organization's professional and ethical requirements and subscribe to them and ensure that the project complies with them.

2.10 Stages of Team Development & Growth

This process of learning to work together effectively is known as team development. Research has shown that teams go through definitive stages during development. Bruce Tuckman, an educational psychologist, identified a five-stage development process that most teams follow to become high performing. He called the stages forming, storming, norming, performing, and adjourning. Team progress through the stages is shown in the following diagram.

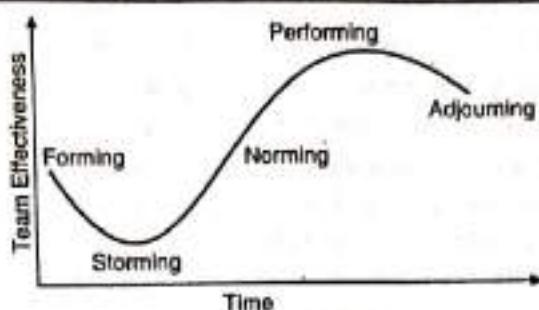


Fig. 2.10.1 : Stages of Team Progress

1. Forming Stage

The forming stage involves a period of orientation and acquaintance. There is a high level of uncertainty during this stage, and people look for leadership and authority. A member who asserts authority or is knowledgeable may be looked to take control. In this stage team members ask for their role and benefits. Most interactions are social as members get to know each other.

2. Storming Stage

- The storming stage is the most difficult and critical stage to pass through. It is a period marked by conflict and competition as individual personalities emerge. Team performance may actually decrease in this stage because energy is put into unproductive activities.
- Members may disagree on team goals, and subgroups and cliques may form around strong personalities or areas of agreement. To get through this stage, members must work to overcome obstacles, to accept individual differences, and to work through conflicting ideas on team tasks and goals.
- Teams can get bogged down in this stage. Failure to address conflicts may result in long-term problems.

3. Norming Stage

- By getting through the storming stage, conflict is resolved and some degree of unity emerges. In the norming stage, consensus develops around who the leader or leaders are, and individual member's roles. Interpersonal differences begin to resolve and a sense of cohesion and unity emerges.
- Team performance increases during this stage as members learn to cooperate and begin to focus on team goals. However, the harmony is precarious, and if disagreements re-emerge the team can slide back into storming.

4. Performing Stage

In this stage, consensus and cooperation are well-established and the team is mature, organized, and well-functioning. There is a clear and stable structure, and members are committed to the team's mission. Problems and conflicts still emerge, but they are dealt with constructively. The team is focused on problem solving and meeting team goals.

5. Adjourning Stage

- In the adjourning stage, most of the team's goals have been accomplished. The emphasis is on wrapping up final tasks and documenting the effort and results. As the work load is diminished, individual members may be reassigned to other teams, and the team disbands.
- There may be regret as the team ends, so a ceremonial acknowledgement of the work and success of the team can be helpful. If the team is a standing committee with ongoing responsibility, members may be replaced by new people and the team can go back to a forming or storming stage and repeat the development process.



2.11 Team Dynamics

- Team dynamics is a broad concept and represents the way in which team members behave. It also includes the psychological processes underlying the interactions within the team.
- When team members engage in a project work, their behaviour is interdependent and from these interactions there is an emergence of attitude, motivation, and cognition within the team that influence how team members feel about each other, their team, and the projects. This constellation of effect, attitude and behaviour represent team dynamics and is the foundation for team work

2.11.1 Important Dimensions of Team Dynamics

1. Open Communication

- Consider this scenario: A young manager-to-be accompanied his mentor, an experienced manager, to observe a high-performing team in operation at a manufacturing company. When he first walked into the room, he said to his mentor, "Oh boy, this is a dysfunctional team! Listen to the way they're arguing with each other." The older man replied, "Pay attention, you're witnessing a great team."
- It took the younger man several minutes to understand what the manager meant. This team was in conflict. The members were strongly disagreeing with one another on the best way to improve their product. It is often a good sign when this kind of friction exists. A team that cares passionately about its task is very positive. It has open honest communication. That is a team dynamic!

2. Empowerment

- You get a strong team dynamic when you empower your team members by giving them the right to make decisions concerning the work they are doing. Of course, you set boundaries of time, money, choices, and so forth.
- But once you give the team the final power of decision making, you will notice a confidence and a feeling of strength.
- Whatever you do, make sure you do not empower teams that are not ready for it. That can be disastrous, and many new managers make this big mistake. They probably do it because they want to get into the good graces of the team. Make sure the team is ready for empowerment or you and the organization will suffer from the consequences of its poor decisions.

3. Clear Roles and Responsibilities

- Can you walk up to any one of your team members and have this person clearly define his role and responsibilities on the team? Can you walk up to any one of your team members and have this person clearly define the roles and responsibilities of every other team member, including you as the leader?
- When team members can do this, they know what is expected of them and what is expected of every other team member. They also know on whom they can count for helping them with their work. All of this leads to an effective team dynamic.

4. Goal Clarity

- Does everyone you manage know the goals of both your team and the entire organization? Make sure they do. Keep it simple—ideally down to one sentence for each. Your team's goal statement could be something like, "Our goal is to provide our internal customers with accurate, timely, and valuable market data at the lowest cost." This is perfect—it covers it all.

- Once you have worked with your team to develop your simple goal statement, make sure everyone knows it and has it memorized. You may want to post it in a prominent location, always include it at the top of meeting agendas, or include it below the signature on your internal emails.

Organizational goal clarity keeps everyone moving in the same direction. Goal clarity facilitates a number of valuable outcomes :

- o It allows your people to make more of their own decisions
- o Fewer issues will need to be escalated to you to resolve
- o Decisions will be made more quickly
- o Your organization will be more agile, making it better able to adapt quickly to changes
- o Your organization will be more efficient.

5. Effective Leadership

When you are able to check off all the necessary items, you are doing your part in building an effective team dynamic.

As leader, you should do the following :

- Set clear goals for each team member and the team. Give clear directions for those who need it
- Share examples and experiences of your personal successes and mistakes in order to relate to the team. Emphasize the positive rather than the negative in your talks with your team
- Give continual feedback to each team member and to the team—both positive and constructive and express your and the organization's appreciation through rewards, if available
- Use small successes to build team cohesiveness. Develop a constructive relationship.
- Make change happen for the better by encouraging creativity and innovation. Encourage self-reliance and self-development
- Encourage team members to express their views during conflict and share yours with them
- Help your team see its connection to the larger organization, customers, and the community

6. Reward and Accountability System

- This last factor for building a strong team dynamic is the responsibility of the organization and the managers working together. Many organizations preach teamwork. You walk around the building and see posters with happy groups of people working and playing together. You read company mission statements and they say something about being the best team. People are assigned to teams, yet teamwork is lacking. Why is this? It is because the organization and its managers do not hold people accountable for working in teams or reward them for it.
- If we truly expect people to cooperate with each other for the common good of the organization, we cannot just evaluate them, rate them, or give them performance appraisals just for their individual contribution.
- We have to do all of that for their team contribution as well. When team members understand that you are holding them accountable based on how well they perform as team players, they quickly get the message that teams count. You have to do the same thing with the reward system; that is, reward people for both their individual and team contributions.

**Review Questions**

- Q. 1** State the importance of Project Initiation phase. (Refer Section 2.2)
- Q. 2** Describe Project Initiation Process. (Refer Section 2.2.2)
- Q. 3** Describe some of the techniques used for strategic selection of project. (Refer Section 2.3.1)
- Q. 4** Describe any four non-numerical Project Selection Models. (Refer Section 2.4.1)
- Q. 5** Write notes on (i) Payback period (ii) Break even analysis. (Refer Section 2.4.2)
- Q. 6** What is cost benefit analysis? What is its usage? (Refer Section 2.4.2)
- Q. 7** Describe Project Portfolio Process. (Refer Section 2.5)
- Q. 8** What is a project sponsor? Describe its functions. (Refer Sections 2.6 and 2.6.2)
- Q. 9** What is Project Charter? Describe its benefits and use. (Refer Sections 2.7, 2.7.2 and 2.7.4)
- Q. 10** What is Project Proposal? How do we write a Project Proposal? (Refer Sections 2.8 and 2.8.1(a))
- Q. 11** What is a project team? State its key members and their roles. (Refer Sections 2.9 and 2.9.3)
- Q. 12** Describe the role and responsibilities of a project team. (Refer Sections 2.9, 2.9.1 and 2.9.2)
- Q. 13** Describe the technique of building an effective project team. (Refer Section 2.9.5)
- Q. 14** Describe the stages of Project team development. (Refer Section 2.10)
- Q. 15** Describe the importance of team dynamics. What are its important dimensions? (Refer Sections 2.11 and 2.11.1)



Project Planning and Scheduling

Syllabus

Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques, PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).

3.1 Project Planning

- Project planning is the most important part of the project life cycle. It tells what is to be achieved and how. The planning phase is when the project plans are documented, the project objectives and requirements are defined, and the project schedule is created.
- It involves creating a set of plans to help guide you through the implementation and closure phases of the project. The plans created during this phase helps manage time, cost, quality, changes, risk, and related issues. They also help control staff and external suppliers to ensure that the project is delivered on time, within budget, and within schedule.
- The project planning phase is often the most challenging phase of project management as you need to plan the staff, resources, and equipment needed to complete your project. You may also need to plan your communications and procurement activities.

3.1.1 Purpose of the Project Planning

- To clearly identify and describe business requirements
- To establish cost, schedule, list of deliverables, and delivery dates
- Resources planning for their effective utilization
- Obtaining management approval and proceeding to the next phase

3.1.2 Basic Processes of Project Planning

- **Scope planning :** It specifies the scope requirements for the project to help in creating the work breakdown structure
- **Preparation of the work breakdown structure :** Here, the entire project is divided into tasks and sub-tasks for better handling and execution.
- **Project schedule development :** Here, the entire schedule of the activities of the project is prepared detailing their sequence of implementation.
- **Resource planning :** This process identifies and then plans the effective utilization of all the resources required during the project implementation.
- **Budget planning :** It specifies the budgeted cost to be incurred at the completion of the project
- **Procurement planning :** It plans to identify the right vendors outside the company for procurement of materials and resources.



- **Risk management** : In this process, planning is done to prepare against all possible risks by devising optional contingency plans and mitigation strategies
- **Quality planning** : In this process, quality criteria to be used for the project are assessed and finalized.
- **Communication planning** : Here, communication strategy with all project stakeholders is designed for smooth implementation of the project plan.

3.1.3 Important Areas of Project Planning

- **Scope, schedule and cost** : Project Planning needs to outline the scope and size of the project, the scheduling of the tasks and activities, which means planning them out along a timeline. The plan also needs to include how the costs are going to be spread out and covered.
- **Quality, human resources, communications and risk** : The quality of the outcomes needs to be established in the plan so that they can be measured throughout the project progress. Team members need to be allocated tasks before the project begins so that they are aware of what is expected of them. The way in which communications will be held also needs to be outlined along with the potential risks and bottlenecks of the project.
- **Requirements plan** : In the project plan format, a project may have several requirements such as infrastructure, location, space etc. It is important to plan and organise for the availability of these requirements before the project begins.
- **Change management plan** : Any project can face changes and uncertainty. Planning for these changes and creating a way in which they will be dealt with reduces their negative impact on the project. So it is important to manage change correctly and establish a plan for its management.
- **Process improvement plan** : Improvement and learning is essential in project management. It is important to strive for quality results. Lessons can be learned from previous projects and applied to future ones, heightening the potential for increased success.

3.2 Project Scheduling

- Project scheduling is a mechanism to communicate what tasks are to be done and which organizational resources will be allocated to complete those tasks. Thus project scheduling is a document collecting all the work needed to be done to deliver the project on time.
- A project is made up of many tasks, and each task has a start and end time to ensure timely finish. People in the past had printed calendars on a shared wall in the water-cooler room, or shared spreadsheets via email, today most teams use online project scheduling tools.
- Typically, project scheduling is just one feature within a larger project management software solution, and there are many different places in the software where scheduling takes place.

3.2.1 Project Scheduling Process

Before going deeper into project scheduling, let's review the fundamentals to project scheduling. Project scheduling occurs during the planning phase of the project. You have to ask yourself three questions to start :

- What needs to be done?
- When will it be done?
- Who will do it?

Once you have got answers to these questions you can begin to plan dates, link activities, set the duration, milestones and resources. The following are the steps needed to schedule a project :

1. Defining Activities

Identify and define the activities that you have to do in the project. By using a Work Breakdown Structure (WBS) and a deliverables diagram, you can begin to take these activities and organize them by mapping out the tasks necessary to complete them in an order that makes sense.

2. Preparing Estimates

After you have the activities defined and broken down into tasks, the next step is to determine the time and effort it will take to complete them. This is an essential piece of the equation in order to calculate the correct schedule.

3. Determining Dependencies

Tasks are not an island, and often one cannot be started until the other is completed. That's called a task dependency, and your schedule is going to have to reflect these linked tasks. One way to do this is by putting a bit of slack in your schedule to accommodate these related tasks.

4. Assigning Resources

The last step to finalizing your planned schedule is to decide what resources are going to be required to get those tasks done on time. For example assembling a team and scheduling their time just like the tasks.

3.2.2 Scheduling Techniques

The first two techniques used by project managers are Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT). You can use these methods to calculate the assumed start and finish dates, based on the known scope of the project.

1. Critical Path Method (CPM)

- The Critical Path Method helps you uncover the longest possible timeline for the project, as well as the shortest one. With the CPM you will also be able to mark critical tasks and the ones that may float. Changes in the latter's delivery won't affect the schedule.
- To use the CPM, you need to know your project's scope and list all of the tasks necessary for its completion. Next, estimate how long each task may take. After that, you should also note all dependencies between the tasks. This way you know which ones can be done separately, and which ones require previous tasks to be completed. Lastly, add milestones and deliverables to your project.
- A critical path helps to visualize the project flow and calculate its duration when all dependencies and deliverables are known. This technique may not be so handy if there are many uncertainties in the project.

2. Program Evaluation and Review Technique (PERT)

- Similar to a critical path, PERT is a way to visualize tasks' flow in the project and estimate the timeline based on their assumed duration. This technique also illustrates dependencies between tasks.
- To schedule a project using PERT, just like in CPM you will need to define tasks and their order first, based on your project's milestones. Using a network framework similar to CPM, consisting of these tasks, you can estimate different timelines for a project depending on the level of confidence :
 - (i) Optimistic timing
 - (ii) Most-likely timing
 - (iii) Pessimistic timing



- Although it looks very similar to CPM, PERT uses weighted average duration rather than estimates to calculate possible timeframes.
- A disadvantage of this approach is also a need to know the tasks and dependencies between them in order to fully benefit from this technique.

3.3 Work Breakdown Structure (WBS)

- The WBS is a method for getting a complex, multi-step project done in an easy and effective way by dividing it into smaller units so that you can get things done faster and more efficiently.
- Work breakdown structure (or WBS) is a hierarchical tree structure that outlines your project and breaks it down into smaller and more manageable units. Today, software is also available which you can use to build a WBS by creating folders and subfolders, and can even go further to divide individual tasks into subtasks.
- The goal of a WBS is to make a large project more manageable by breaking it down into smaller chunks so that separate but interconnected units can be done simultaneously by different team members leading to better team productivity and easier project management overall.

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

- o It creates an accurate and readable project organization.
- o It creates accurate assignment of responsibilities to the project team.
- o It clearly lays down the project milestones and control points.
- o It helps the project team to estimate the cost, time and risk.
- o It clearly illustrates the project scope, so the stakeholders can have a better understanding of the same.

3.3.1 Characteristics of a Work Breakdown Structures

A well-designed WBS facilitates planned outcomes instead of planned actions. Outcomes are the desired ends of the project, such as a product, result, or service, and should be predicted accurately. Actions, on the other hand, may be difficult to predict accurately. A well-designed WBS makes it easy to assign elements of the WBS to any project activity. A good WBS should exhibit the following characteristics :

1. **Definable** : It is easily described and well understood by project participants.
2. **Manageable** : It is a meaningful project planning method where specific responsibility and authority are assigned to responsible individuals.
3. **Estimated** : Using WBS, duration of the whole project and separate units can be estimated in terms of the time required to complete, and the cost likely to be incurred in resources required to complete the project.
4. **Independent** : It allows minimum interface with or dependence on other ongoing elements (i.e., assignable to a single control account, and clearly distinguishable from other work packages).
5. **Integration** : It facilitates integration with other project work elements and with higher level cost estimates and schedules to include the entire project.
6. **Measurable** : WBS can be used to measure progress; has start and completion dates and measurable interim milestones.
7. **Adaptable** : It is sufficiently flexible so the addition/elimination of work scope can be readily accommodated in the WBS framework.

3.3.2 Advantages of WBS

Now that you have the complete work breakdown structure, it's time to review why you should use this approach to project management. Using a work breakdown structure delivers numerous benefits including :

- **Improved planning :** Large, complex projects can be difficult to wrap to execute let alone plan from start to finish. Using work breakdown structure helps improve planning by making it easy to visualize the scope of the project and break it down into more manageable milestones. As a result, work breakdown structure allows you to set clear timelines earlier on. It makes sure no work gets duplicated or overlooked and it understands the level of output at any point in the project timeline.
- **Smarter budget and resource allocation :** By improving project planning, work breakdown structure allows for smarter budget and resource allocation. Specifically, it ensures that all budget and time requirements get accounted for at the very beginning of a project. Additionally, the mutually exclusive rule guarantees that no duplicate work will take place, which eliminates wasted budget and time.
- **Simplified risk identification :** The visual nature of work breakdown structure makes it easier to identify areas of risk so that you can get ahead of problems and remedy them faster.
- **Improved accountability :** The clear work assignments, timelines, and budgets identified by work breakdown structure improve accountability among team members. That's because everyone involved should have a clear understanding of what they are responsible for and the time they have to complete that work.
- **Enhanced visibility :** Finally, work breakdown structure provides a high level of visibility into every project. This visibility makes it easy to communicate expectations to stakeholders and team members and track progress throughout the project.

A work breakdown structure is a helpful method for managing the challenges that accompany large-scale enterprise projects and enjoying successful outcomes.

3.3.3 Work Breakdown Structure Rules

There are several ways you can create a work breakdown structure. The lowest tech options are a whiteboard or a wall with sticky notes, but that clearly won't work for a geographically dispersed team. Go digital with project management software that drives agility across teams, whether in the same room or distributed across the globe.

As you get started with work breakdown structure, there are several rules to keep in mind, many of which are covered in the work breakdown structure definition. These rules include :

1. 100% Rule

- Both the work and budget allotment for all deliverables must always add up to 100% and they must do so in a hierarchical manner. For example, at all level two deliverables must add up to 100% of work and budget for the entire project as outlined at level one of the hierarchy.
- Below that, at all level three deliverables must add up to 100% of their parent deliverable. So, if the parent deliverable is 40% of work for the project and Rs. 60,000, the sum of all its sub-deliverables must equal 40% of work and Rs. 60,000.

2. Mutually Exclusive

Every deliverable and sub-deliverable must be mutually exclusive, which means that no milestone can appear within the work breakdown structure twice. This mutual exclusivity helps eliminate duplicate work, excessive costs, and communication issues since it means that only one team or person is responsible for each deliverable.



3. Focus on Outcomes

Once again, it's important that every deliverable mapped out in the work breakdown structure defines an outcome, not an action. This rule makes it easier to manage project scope and gives team members working on the project flexibility to complete each outcome as they see fit.

4. The 8/80 Rule

The 8/80 rule states that the work required to complete each deliverable should not take fewer than eight hours or more than 80 hours (10 days of full-time work) to complete. If the work package takes fewer than eight hours to complete, you should combine it with another deliverable. If the work package takes more than 80 hours to complete, you need to break up the deliverable into separate components.

3.3.4 Work Breakdown Structure Diagram

- The Work Breakdown Structure (WBS) is developed to establish a common understanding of project scope. It is a hierarchical description of the work that must be done to complete the deliverables of a project. Each descending level in the WBS represents an increasingly detailed description of the project deliverables.
- The first two levels of the WBS (the root node and Level 2) define a set of planned outcomes that collectively and exclusively represent 100% of the project scope. At each subsequent level, the children of a parent node collectively and exclusively represent 100% of the scope of their parent node. Here is a Work Breakdown Structure example :

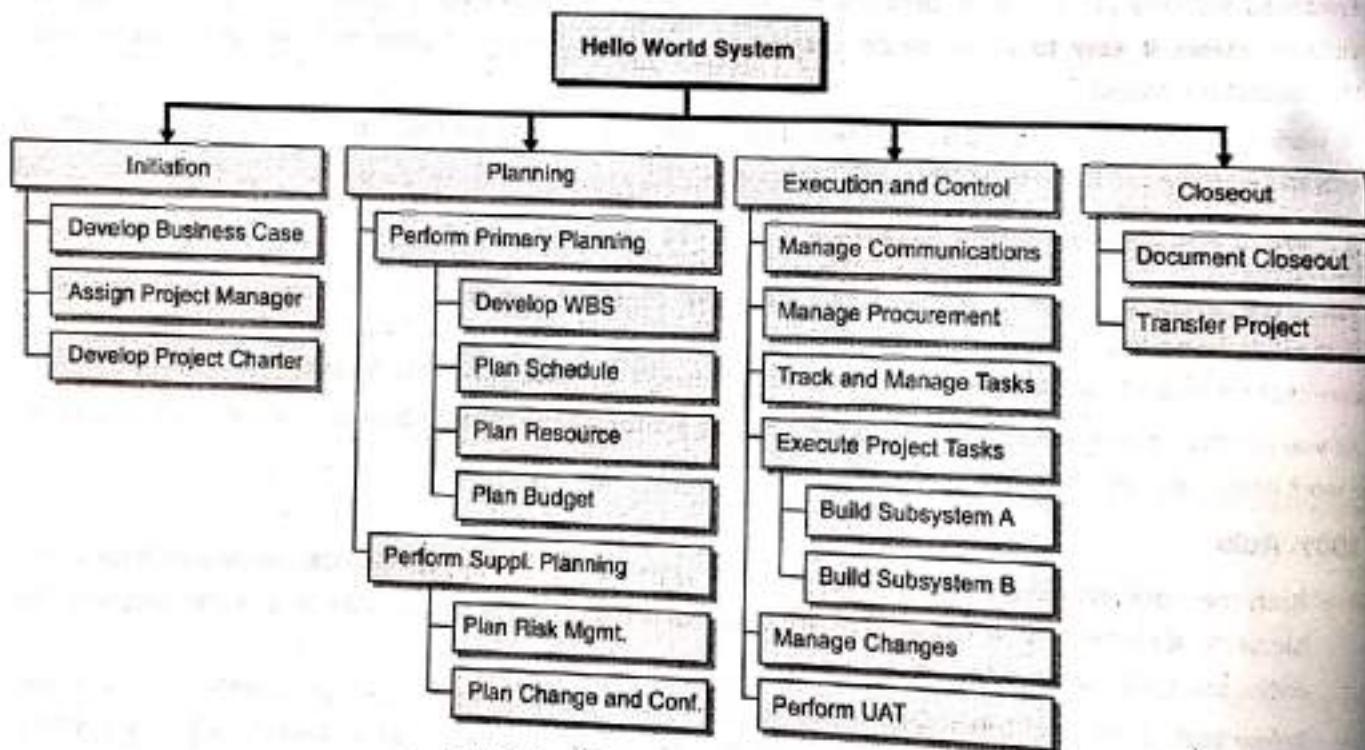


Fig. 3.3.1 : Work Breakdown Structure

- This following example includes three levels, which is the most common setup. The structure can be extended to four or five levels if needed. Each deliverable should be a project milestone not a specific task. The tasks required to meet each deliverable are known as a "work package." Finally, each deliverable must have a work and budget allocation. You can also choose to include team assignments and start and end dates for each deliverable.

3.3.5 Different Forms of Work Breakdown Structure

Generally speaking, there are three typical ways in structuring works with a Work Breakdown Structure (WBS). They include phase-based structures, deliverable-based structures and responsibility-based structures.

1. Phase-based structures

It defines and structures project activities based on the project phases.

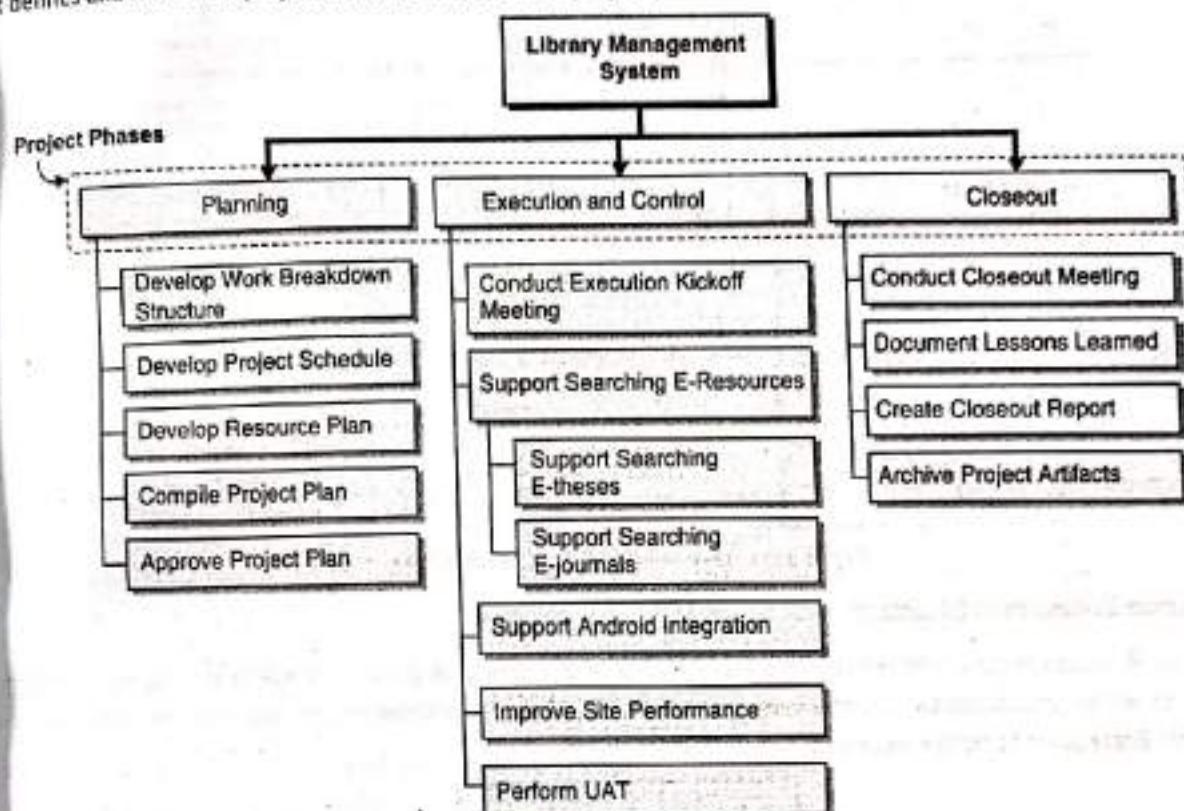


Fig. 3.3.2 : Phase based structure

2. Deliverable-based structures

It defines and structures project activities based on the deliverables agreed to deliver.

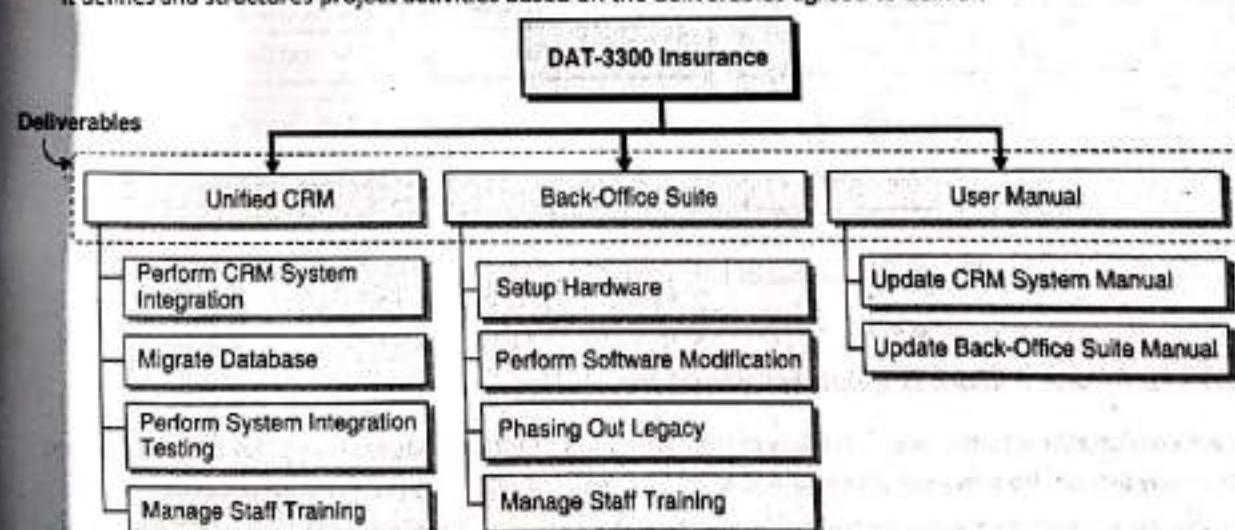


Fig. 3.3.3 : Deliverable-based Structure



3. Responsibility-based structure

It defines and structures project activities based on the organization units that will work on the project.

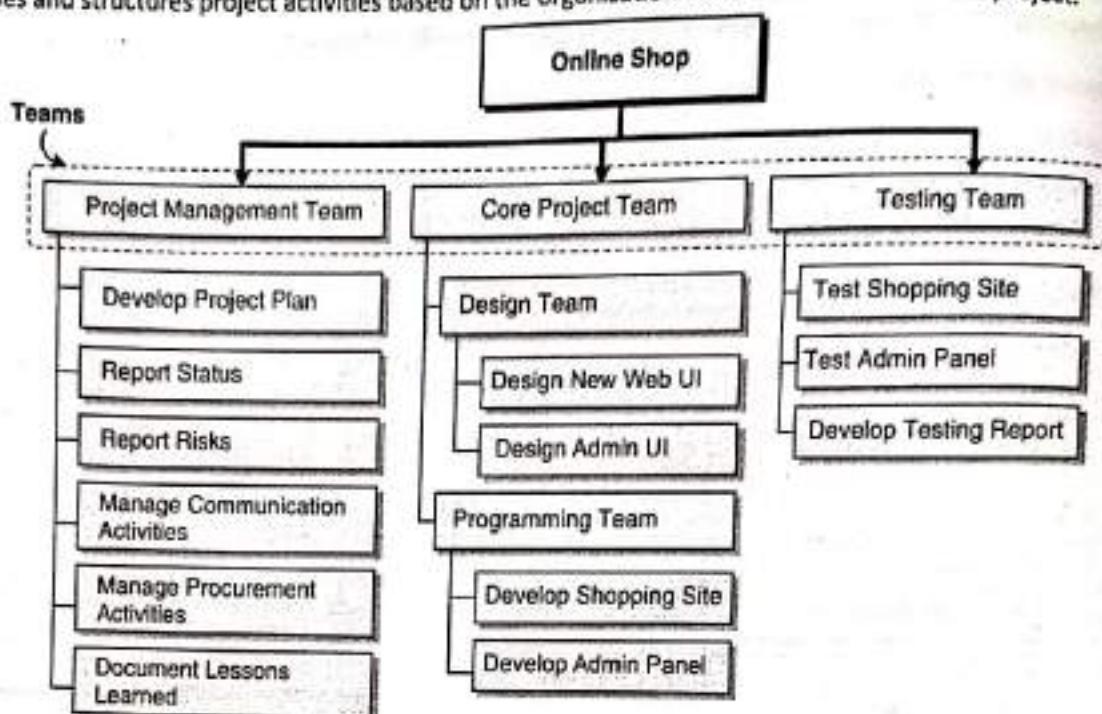


Fig. 3.3.4 : Responsibility-based Structure

4. Resource Breakdown Structure

Resource Breakdown Structure (RBS) is a project management tool that provides a hierarchical decomposition of resources, either structured by resource category, types or by IT/business function that has resource needs. Here is a Resource Breakdown Structure example:

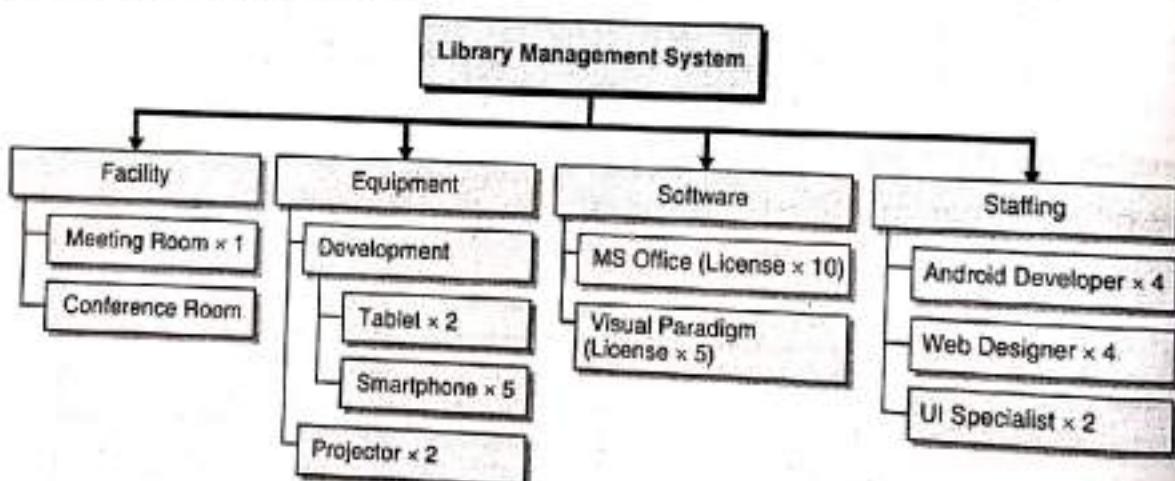


Fig. 3.3.5 : Resource Breakdown Structure

3.3.6 Process to Create a Work Breakdown Structure

- When you are comfortable with the overall process of creating a work breakdown structure, you will be able to apply the practice to any project, from moving your house to building a complex database with 75 offshore teams.
- But before you go off and start creating these documents and on-point estimates, you should walk through the following process that will help ensure a solid, workable estimate.

Step 1 : List high-level deliverables

- If you have got a project scope, getting started on your work breakdown structure should be easy. Starting any project without a scope is dangerous because it sets the stage for what will be delivered and when.
- First, sit down with your team, and list out what you will need to deliver to meet your project's end goal. For instance, if you are building a new website, your deliverables might include :
 - o Sitemap
 - o Wireframes
 - o Page designs
 - o Front-end code
 - o Back-end code
- Be sure to include all tasks and that you are not leaving anything out. For instance, if you are working on a website redesign project, have you accounted for content? If you miss a deliverable now, you will regret it later.
- That's why listing things out as a team is so helpful. A team conversation not only ensures all your bases are covered. It also helps you set expectations for who will be responsible for deliverables and tasks, all while engaging the team on the overall process of the project.

Step 2 : Think about tasks

- Once you have identified the high-level deliverables for your project, it's time to take a deeper look into what actually needs to be done within each individual deliverable.
- This isn't just a simple exercise where you just identify the right person and time period for completion. It goes much deeper than that and that's a good thing because that's how you will be able to create a better estimate.
- Therefore, as you dig into each high-level deliverable, ask your team :
 - o What needs to be done to create this deliverable?
 - o What other related project tasks will contribute to successfully completing this deliverable?
 - o What are the task requirements?
- As you conduct this exercise, keep in mind that you truly want to list every possible task that could go into a high-level deliverable. Remember, the point here is to account for all time so you can create a reasonable estimate. You won't be able to do that if you are not thinking it through properly.
- Using the website redesign as an example, here's how you might break up the "Sitemap" deliverable :
 - o Review current site
 - o Test the current structure with 5 site users
 - o Review test findings
 - o Organize the sitemap in a spreadsheet
 - o Review the first low-fidelity version with the team
 - o Revise the structure using the team's input
 - o Create a visual version of the sitemap
 - o Annotate sections
 - o Write description of the new sitemap
 - o Present the sitemap to clients
 - o Review client feedback
 - o Implement feedback

Project Management (MU)

- o Deliver v2
- o Conduct meeting with clients
- o Finalize sitemap
- This list of tasks is an estimate for all of the work that will need to be done in order to get to a finalized sitemap.
- This might not be the way you'd do it, and that's just fine. When you sit down with your team to discuss these tasks, just be sure you are operating with a common understanding of how things are done. Listing out every single detail will help you spell out the effort it will take to complete the deliverable.

Step 3 : Prepare Minute Details

- You should make your work breakdown structure as detailed as possible. The only way to do that is to examine every task you have identified and list out subtasks. It's all about elaborating effort and determining the work that will need to be done to successfully complete the deliverable.
- It's a process that takes time and thought, but if you make an investment to do this, you will find less room for missed expectations and budget overages in the long term. So, take the next step and detail out what will go into each task.
- Using the website redesign as an example, here's how you might break down the "Test the current structure with site users" deliverable even further :
 - o Recruit users
 - o Schedule sessions
 - o Write test script
 - o Conduct 5 sessions
 - o Compensate users for time
- Write up findings and recommendations. This one task is proof that any single line item in a scope can be an expensive one! Not only did this example include subtasks it also included a line item that requires payment to a party outside of the project.
- You are going to want to know about any expenses before scoping your project, and your clients will too. Be sure to account for them early on so nothing comes as a surprise when you are knee-deep in your project.

Step 4 : Format and Estimate

- Traditionally, you will find work breakdown structures presented in flowcharts that resemble website sitemaps. This format works well because it shows a hierarchy of tasks and is easily numbered and referred back to.
- But, some people like to list them out on whiteboards or put them in spreadsheets. The format isn't what matters here; it's the completeness and accuracy of the tasks included. You can create your work breakdown structure in any format that makes you comfortable.
- When you have listed all of your tasks and subtasks in a format that makes sense, you will want to review it again and make sure you have included all of the possible tasks and subtasks.
- Once that's confirmed, go through the list and discuss each task in terms of level of effort. This could be in minutes, hours, days, weeks. It really depends on how granular you need to get and how your organization estimates projects. Assigning an increment of time to each task will help you add up a total estimate of time (and possible cost) and set you up to create a project plan when you are ready for that step in your project.
- When you are done, you will know if you are in scope, out of scope. You might run this exercise and find you have articulated too much time or effort to do everything within the scope of the project. The good thing is, you have set the baseline for what's needed, and as a group, you can scale back on tasks to fit the scope or the timeline.

3.4 Linear Responsibility Chart

- Linear Responsibility Chart (LRC) is the chart of responsibility which identifies the project participants and shows authority and responsibility relationship among them. The participants may be general manager, manager of projects, project manager and functional managers. It clearly specifies the authority and responsibility relationships of project participants to avoid confusion and conflicts.
- The LRC is specially used in matrix organization structure in order to minimize the confusion and conflicts between project manager and functional managers. It explains what and who of project work. It links the project activities or task to the responsible person which ensures effective implementation of project to achieve defined objectives within constraints.
- The LRC promotes communication and coordination of responsibilities within a project. It decides who are the participants, and to what degree, when an activity is performed or a decision is made. It shows the extent or type of authority exercised by each position in performing an activity in which two or more positions have overlapping involvement.
- It clarifies the authority relationships that arise when people share common work. In the absence of a LRC within a project plan, some required communications or tasks may face troubles as no one will take responsibility for completing these communications or tasks assuming they were someone else's responsibility.
- Linear Responsibility Chart is also known as linear chart (LC), Matrix Responsibility Chart (MRC), Responsibility Interface Matrix (RIM), Responsibility and Accountability (RAM).

Example

- As a contribution to Building Practice Guidelines, these Linear Responsibility Chart templates list the typical tasks involved in a building project according to its phase or stage. Each entry recommends who should take the lead and who else should be providing significant support for each task. The tasks should be modified or augmented to suit the particular construction project and the needs of its participants.
- In a well developed team, all will participate to some degree. Nevertheless, on a project it is essential for the project manager to identify who will be accountable for initiating, conducting and concluding each and every task.

The charts illustrate how

- Every task can be identified and assigned to a single point responsibility
- The project can and should be divided into phases and stages, each separated by a financial 'control gate' or decision point for control purposes
- This process builds on the standard project management generic life cycle, and
- Project management can and should be distinguished from the management of the project's technology.

3.4.1 Preparation of LRC

- LRC is prepared to find out responsibility centre of all key activities in the project and for that purpose, LRC is divided into rows and columns and numbers. The rows of LRC indicate activities, responsibilities and authorities. The columns identify the position of the project participants and numbers indicate the degree of authority and responsibility existed between rows and columns of LRC, the numbers can be symbol.
- The Linear Responsibility chart is divided into :
 - o Rows : They indicate activities, responsibilities, authority.
 - o Columns : They Identify position of project participants.
 - o Numbers : They indicate the degree of authority-responsibility existing between the rows and columns. They can be symbols.



Activity/Responsibility	General Manager	Manager of Project	Project Manager	Functional manager
Establish Objectives & Policies	1	3	3	3
Integration of Projects	2	1	3	3
Project Direction	4	2	1	3
Project Planning	4	2	1	3
Functional planning	2	4	5	1
Project Budget	4	6	1	3
Project Control	4	2	1	3

Table 3.4.1 : Linear Responsibility Chart

Symbols

- 1 = Actual Responsibility
- 2 = General Responsibility
- 3 = Most be consulted
- 4 = May be consulted
- 5 = Must be notified
- 6 = Must Approve

3.4.2 Advantages of Linear Responsibility Chart

- It describes the role of project participants in project matters. Authority, responsibility and accountability for project activities are delineated among various project participants. Problem-solving becomes easier.
- Communication is facilitated. It cuts red tape. It is a useful tool for supervising of authority and responsibilities. This is delegation of authority.
- It postures coordination because it clarifies rules and responsibility, authority and responsibility relationships for project activities among the participants.
- It reduces confusion and conflict between project manager and functional managers which helps to monitor responsibility of project participants.
- It combines organizational structure with work breakdown structure which makes easy to fix responsibility to project participants.

3.4.3 Disadvantages of Linear Responsibility Chart

- It does not describe the people interactions in the project. It is a mechanical aid.
- All relationships may be difficult to delineate.
- Customer-imposed requirements may limit its usefulness.
- It acts as mechanical tools for fixing responsibility only but not defines the relationship between project participants.
- It tries to express authority-responsibility relationship in specific terms. But situation and degree of all relationships may be difficult to express.

3.5 Interface Coordination

- Interface coordination is a process that facilitates agreements with other stakeholders regarding roles & responsibilities, timing for providing interface information and identification of critical interfaces early in the project through a structured process.
- The overall goal is the early identification of issues with potential to impact the cost or schedule, to minimize or remove their impact and promote clear, accurate, timely, and consistent communication with other organizations for exchanging interface information.
- Interface Information is a requirement that associates two distinct entities, either internal or external, that is necessary for an entity to generate its own deliverables.
- Interface Agreements result in exchange of any project information generated by one party and that is required by another party so that the other party can continue with its scheduled project tasks. This can include the engineering drawings, specifications, design reports and calculations, equipment details and project schedule information.
- Information requests on an Interface Agreement have two basic rules :
 - o They should be specific and primitive in nature and should not be capable of further breakdown into more items.
 - o They should have a specific requirement date

Interfaces

- An interface is defined as a point of connect between entities working on a common project. This point can be :
 - o Physical : Physical interaction between components
 - o Functional : Functional Requirements between systems
 - o Contractual : Interactions between subcontractors/suppliers
 - o Organizational : Information exchanged between disciplines
 - o Knowledge : General information exchanged between parties
 - o Resource : Points of dependencies between equipment, material, and labour suppliers
- Internal Interface : An internal interface is one where the complete responsibility lies within contractor's scope of work.
- External Interfaces : These are part of the Scope of Work under the responsibility of contractor which may influence, or be influenced by, the scope of work covered by any other contract related to the project.

3.5.1 Objectives

- Identify the appropriate personnel who will be responsible for each interface request and for resolution of the interface request.
- Provide a system which will facilitate the identification of interfaces, and address the specific interface request requirements.
- Establish a procedure that promotes efficient management of interface issues from initiation to close out.
- Define methods for communication and coordination of interface requests between various parties.
- Facilitate clear and frequent communications amongst parties.
- Facilitate the agreement of a schedule for interface request resolution and close-out.
- Define a means for the control, expediting, and reporting of progress on the transfer of interface requests.
- Define processes of assurance that interface requests are effectively identified and managed.

3.5.2 Process

The interface coordination process is designed to provide a method to formally document and track the exchange of information between project participants and to monitor the performance of all participants in making available the required information.

The Process Involves

- Identification and recording an interface
- Creating an interface agreement
- Agreeing / Resolving Conflict
- Monitoring the status
- Reporting the status
- Closing the interface agreement

3.5.3 Functions of Interface Coordination

- Internal interface issues are identified, catalogued, assessed for impact, assigned and managed throughout the duration of the project.
- Internal interface issues are resolved at the appropriate working level within the Project organization to minimize rework (for example, engineers responsible for the design and design verification);
- Regularly advise company on the status of resolution of internal interface issues;
- Internal interface activities are coordinated with other contractor work groups and process such as Management Change, HES, QMS, and Risk Management to improve process efficiencies and avoid duplication of efforts.

3.5.4 Roles and Responsibilities of Interface Coordinators

- Participate in Interface Meetings with affected/involved parties as required to manage interfaces.
- Review outgoing interface requests and serve as interface request approver
- Ensure resolution of inbound interface requests
- Actively monitor interface request register to expediting requests and open/update/close requests on behalf of the team
- Provide collaborative interface resolution support
- Serve as PMT liaison between contractor and operating plant point of contact.
- Inform Interface Manager of potential impacts due to unsatisfactory resolution response.

3.6 Concurrent Engineering

- As time has become a competitive weapon, time pressures have become central to the project-based organization. The pressure has made project managers understand that time compression is a driver of project and its subsequent business performance.
- As a consequence, methods, techniques, and organizational approaches have been designed and developed in such a way that time compression needs be handled in a proper manner.
- All these approaches have one common principle is that: they try to maximize the number of major design development tasks that can be performed concurrently. This has given the concept of concurrent engineering.

- Concurrent engineering, also known as simultaneous engineering, is a method of designing and developing products, in which the different stages run simultaneously, rather than consecutively. It decreases product development time and also the time to market, leading to improved productivity and reduced costs.
- Concurrent Engineering (CE) is a systematic approach to integrated product development that emphasises the response to customer expectations. It embodies team values of co-operation, trust and sharing in such a manner that decision making is by consensus, involving all perspectives in parallel, from the beginning of the product life-cycle.*
- Concurrent Engineering is a long term business strategy which gives a long term competitive benefits to business though the initial implementation can be challenging. It removes the need to have multiple design reworks by creating an environment for designing a product right the first time round.
- In a concurrent engineering environment, even if certain tasks cannot be completely executed at the same time, designers and developers are encouraged to achieve maximum overlap between otherwise sequential activities.
- In other words, concurrent engineering aims at achieving throughput time reductions by planning and executing design and development activities in parallel, or by striving for maximum overlap between activities that cannot be completely executed in parallel. Concurrent engineering also called integrated product development (IPD) or simultaneous engineering was introduced a few decades ago to eliminate the delays arising from sequential engineering. This systematic approach is intended to force all the stakeholders to be involved and consider the full engineering product cycle from concept to after sale support.
- The use of concurrent engineering has been growing of late because of the ever-increasing demand for quality products at affordable prices and reduced time to market.
- Although managing a concurrent engineering process is very challenging, the techniques and practices followed as part of concurrent engineering give several competitive advantages to the company and to the final engineering product.
- In a concurrent engineering environment, teams of experts from different disciplines are encouraged to work together to ensure that design progresses smoothly and that all participants share the same information. The project and problem-solving methods and the technologies utilized make up the essential elements through which parallelism in new product design and development can be achieved.

Following methods describes the concurrent engineering implementation.

(I) Project Methods

- Project methods are based on team-work, milestone management, target-oriented work definition and follow-up. These methods are supported by senior management commitment and incentive programs. Each team is granted a large degree of autonomy to solve design problems without much hierarchical intervention.
- However management must ensure that the transfer of information between different activities or tasks is smooth and transparent. Also, the means of experimentation must allow the experts involved to rule out differences in interpretation on the functional and technical design parameters.
- In other words, for concurrent engineering to be successful, information and interpretation asymmetries between the experts involved must be avoided whenever possible.

(II) Problem Solving Methods

- During design and development projects, methods that foster and support smooth interdisciplinary problem definition and problem solving methodologies such as brainstorming are utilized to open the boundaries of the team to allow for wider ranges of alternative design definitions and solutions to be considered.
- The use of methodologies like Quality Function Deployment (QFD) further helps experts from different disciplinary backgrounds to jointly define a product's functional and technical requirements.


Project Management (MU)

- Activity flow chart methods such as IDEF3 allow for detailed planning and monitoring of the different parallel and overlapping activities involved in project execution. Failure Mode and Effects Analysis (FMEA) allows for systematic investigation of the occurrence and impact of possible flaws in the new product design.
- The use of Design of Experiments (DOE) enables the systematic identification of critical product/process parameters that influence performance.
- These are just a few of the many supportive methods that can be used in a concurrent engineering environment.

3.6.1 Benefits of Concurrent Engineering

- **Competitive Advantage** : Reduction in time of launching products in the market results in businesses gain an edge over their competitors.
- **Enhanced Productivity** : Quick discovery of design problems helps in correcting the potential problems early than at a later stage in the development process.
- **Decreased Design and Development Time** : It makes products which match their customer's needs in less time and at a reduced cost.

The concurrent engineering approach is based on five key elements :

- o A process
- o A multidisciplinary team
- o An integrated design model
- o A facility
- o A software infrastructure

3.6.2 Advantages of Concurrent Engineering

- It encourages multi-disciplinary collaboration
- Reduces product cycle time
- Reduces cost
- Increases quality by supporting the entire project cycle – enhanced quality
- Increases productivity by stopping mistakes in their tracks
- It gives you the competitive edge advantage

3.6.3 Disadvantages of Concurrent Engineering

- Complex to manage
- Relies on everyone working together hence communication is critical
- Room for mistakes are small as it impacts all the departments or discipline ie electrical, mechanical or software

3.7 Project Cost Estimation and Budgeting

- Project Cost Estimation is defined as the process of determining the total expenditure of the project. The accuracy of the cost estimation depends on the accuracy and details of the project scope. The scope will also define the constraints like date, resources or budget. The risk register will help to calculate types of costs, the expenses made behind the contingent action and the expenses made to cope up with risks.
- A well-researched and planned cost estimation and budget is necessary for the successful completion of any project. Project managers need to thoroughly scope the project in order to secure sufficient funding. Scoping involves estimating labour hours, materials, supplies and other miscellaneous expenses. Cost estimations and budgets should work in progress and should contain room for change.

3.7.1 Characteristics

1. Unbiased

- A good cost estimate is unbiased. It should not be made by someone who would over or under-state the numbers. The cost estimate should clearly define the purpose of the project, what it will accomplish, what assumptions are made, how long the estimate is valid, and how much the project will cost.
- It should show all interested parties, everything relevant without holding back information. The estimate should be flexible, adaptable and provide a range of the costs involved. Cost estimates start out broad, and as various stages are completed, they are more accurately defined.

2. Accuracy

Management needs to assess the accuracy of cost estimates and budgets. Unanticipated expenses can result in the project being abandoned. Cost estimates that are overstated also have negative consequences. If they are too liberal they can kill an otherwise viable project by making it look unaffordable.

3. Considerations

- At times not scoping the project thoroughly enough, not understanding technical difficulties and making changes are the most common reasons why projects do not adhere to cost estimates and budgets. Cost estimates can never be too detailed.
- Every change should be documented thoroughly. Management should consider how changes affect other phases of the project. A simple, yet effective tool is to use a spreadsheet to prepare the cost estimate, and keep all of the important data visible in cells, instead of hidden in formulas.

4. Project Management Software

An effective and simple way to estimate costs and prepare a project budget is to use project management software. Most software has features that identify the types, quantities, and phasing of different types of labour. It also has capabilities for estimating the costs for individual project pieces and adding them together to reach a project total. The pieces can differ in size and number from a few large phases of a project with known costs to hundreds or thousands of small tasks.

3.7.2 Key Components of a Cost Estimate

A cost estimate is the sum of all the costs involved in successfully finishing a project from initiation to completion. These project costs can be categorized in a number of ways but the simplest classification divides costs into two main categories :

1. Direct costs

They are broadly classified as the costs that are directly associated with a single area such as a department or a project. In project management, direct costs are expenses billed exclusively to a specific project. They can include project team wages, the costs of resources to produce physical products, fuel for equipment, and money spent to address any project-specific risks.

2. Indirect costs

They are not associated with a specific cost and are instead incurred by a number of projects simultaneously sometimes in varying amounts. In project management, quality control, security costs, and utilities are usually

classified as indirect costs since they are shared across a number of projects and are not directly billable to a project.

Beyond the broad classifications of direct and indirect costs, project expenses fall into more specific categories.

- (i) Labour : The cost of human effort expended towards project objectives.
- (ii) Materials : The cost of resources needed to create products.
- (iii) Equipment : The cost of buying and maintaining equipment used in project work.
- (iv) Services : The cost of external work that a company seeks for any given project (vendors, contractors, etc.).
- (v) Software : Non-physical computer resources.
- (vi) Hardware : Physical computer resources.
- (vii) Facilities : The cost of renting or using specialized equipment, services, or locations.
- (viii) Contingency costs : Costs added to the project budget to address specific risks.

3.7.3 Project Cost Estimation Techniques

Many factors affect project cost estimation making it difficult to come up with precise estimates. Luckily, there are techniques that can help in preparing more accurate cost estimation.

1. Analogous Estimating

Here, experts who have experience in similar projects are approached for help. They use your own historical data. If you have access to relevant historical data, try analogous estimating, which can show precedents that help define what your future costs will be in the early stages of the project.

2. Statistical Modeling

- Statistical modeling, or parametric estimating also uses historical data of key cost drivers and then calculates what those cost would be if the duration or another aspect of the project is changed.
- Three Point Estimate: Another approach is the three-point estimate, which comes up with three scenarios: most likely, optimistic and pessimistic ranges. These are then put into an equation to develop cost estimation.

3. Reserve analysis

This technique determines how much contingency reserve must be allocated. This approach tries to wrangle uncertainty.

4. Cost of quality

This technique uses money spent during the project to avoid failures and money applied after the project to address failures. This can help fine-tune your overall project cost estimation. And comparing bids from vendors can also help figure out costs.

5. Bottom-up Analysis

This technique supports the idea that the individual cost of each activity or entire work package is of prime importance. By using the method, individual scheduled activities or a work package can be estimated to the smallest detail. All estimates are grouped and sorted by categories and then gathered into a summary table that is used for tracking, control and reporting purposes.

6. Top-down Analysis

- This technique is opposite to the Bottom-up Analysis. It assumes that the overall budget is determined at the project's beginning and the expert team needs to identify the costs of each work item.
- The technique allows determining the number of required activities and tasks referring to the WBS (Work Breakdown Structure) which reflects the necessary work items and work packages.
- By using the WBS, the expert team can determine the quantity of the work items that can be delivered within the fixed budget. They may decide to add or remove certain items in the WBS in order to fit the fixed budget.

3.7.4 Cost Estimating Process

1. Determine Estimate Basis

- This step focuses on obtaining project information including all previously developed project scope and schedule details and data from which a project cost estimate can be prepared.
- The level of scope detail varies depending on the project phase, project type, and project complexity but would include the design matrix and criteria, all assumptions and pertinent scope details.
- The estimate basis should be clearly documented and forms the beginning of the estimate file that should be prepared for each estimate. Each of the following steps will add information to this file with the end result being a complete traceable history for each estimate.

2. Prepare Base Estimate

- This step develops the estimated costs for all components of a project, excluding future escalation. These components may be estimated using different techniques depending on the level of scope definition and the size and complexity of the project.
- The number and detail of components estimated may vary depending on the project development phase. Key inputs to this step include project scope details, Historical Databases and other cost databases, knowledge of Market Conditions, and use of Inflation Rates.
- A required component of the base estimate step is the preparation of a Basis of Estimate document that describes the project in words and includes underlying assumptions, cautionary notes, and exclusions.

3. Review Base Estimate

This step is necessary to ensure that

- (i) Assumptions and basis are appropriate for the project
- (ii) The base cost estimate is an accurate reflection of the project's scope of work
- (iii) Scope, schedule and cost items are calculated properly and required components are not missing or double counted
- (iv) Historical data, the cost based estimate data, or other data that was used reasonably reflects project scope and site conditions.

4. Determine Risks and Set Contingency

- This step is part of developing a risk management plan for a project, and is an integral component of project management planning. Risk management is an active and ongoing process of maximizing the probability and consequences of positive risk events (opportunities) and minimizing the probability and consequences of negative risk events (threats) to the project objectives.
- In the context of cost estimating, the cost impact of project risks must be included to derive a total project cost.

5. Determine Estimate Communication Approach

- Cost estimate data is communicated to both internal and external constituencies. The communication approach determines what estimate information should be communicated, who should receive this information, how the information should be communicated, and when the information should be communicated.
- Cost estimate information should be included when the communication plan is developed as part of the project management process. Often the words are as important as the numbers. The Basis of Estimate document can be used effectively as a communication tool to convey key information about the project to others.

6. Conduct Independent Review and Obtain Management Endorsement

- Estimates are key products of the project management process and are fundamental documents upon which key management decisions are based. Given their importance, all estimates should receive an independent review and then be reconciled and revised as needed to respond to independent reviewer comments.
- Once independent review comments have been satisfactorily incorporated, estimates should be presented to management staff for approval. Management approval of estimates developed for initial budgeting or baseline definition is a defined step in the project management process.
- Revised estimates, typically developed if project requirements change, or as design is developed, should also be reviewed by management staff, revised as necessary to reflect management comments, and then approved.

3.7.5 Advantages of Cost Management

- It helps in controlling the project specific cost, in turn also the overall business cost.
- One can predict the future expenses and costs and accordingly work towards the expected revenues.
- Predefined costs can be maintained as records for the business.
- It helps in taking those actions that are necessary to assure that the resources and business operations aim at attaining the chalked objectives and goals.
- It helps in analysing the long term trends of the business.
- The actual cost incurred can be compared to the budgeted to see if any component of the business is spending more than expected.
- It helps in analysing the business positioning in terms of making an acquisition factoring the cost component involved.

3.8 Bottom-Up Estimating

- Bottom-up estimating is a project management technique in which the people who are going to perform the work take part in the estimating process. Typically those people are the employees, vendors and other project team members.
- They work with the project manager to develop estimates for tasks in the work breakdown structure (WBS). Setting the estimates of the amount of work, duration and cost at the task level lets you combine them into estimates of higher-level deliverables and the project as a whole.
- Bottom-up estimating is the most accurate approach to estimating the cost and duration of project tasks. It also requires the most time. This estimating technique gives the entire project team the opportunity to take part in developing the estimates used to measure their work.
- As a result, bottom-up estimating tends to develop a higher level of project team commitment than other types of techniques. Another problem is that you must wait to know who will be on your team before you can do the bottom-up estimating.

- Bottom-up estimating is a way to estimate an overall value by approximating values for smaller components and using the sum total of these values as the overall value. In project management, this type of estimating is used to create a schedule or budget.
- Typically, the project work is broken down into smaller components and an estimate of duration and cost is assigned to each component. The schedule is determined by aggregating the individual duration estimates, while the budget is determined by aggregating the individual cost estimates.
- The advantage of bottom-up estimating is that it leads to greater accuracy because it takes into consideration each component of the project work. Accuracy is also achieved because the estimates for each component are given by the individuals responsible for these components: the ones who know the work well.
- The primary disadvantage of bottom-up estimating is the time it takes to complete. In order to take into consideration each component of the project work, these components must first be identified, through decomposition. This process is long, and can be even more so when a large amount of work or complex work is involved.
- Another disadvantage of bottom-up estimating is that it can be costly. The time spent decomposing project work is not free. Additionally, the estimation done for each component is given by the individuals responsible for completing the components.
- In general, bottom-up estimating is not the best choice for projects that do not allow for long periods of planning or projects that have contracted resources that typically do not start on the project much earlier than when the work is going to be completed.

3.9 Top-Down Estimating

- Top Down estimating is a project estimating technique in which the overall project is estimated first, and individual tasks are apportioned from it. You start from the top of the pyramid and work downwards.
- This type of project budgeting usually occurs when there is a fixed budget and/or the scope of the project must fit within a predetermined funding level, particularly when projects aren't blessed with rich resources.
- Top Down is the opposite of Bottom Up Estimating, whereby individual tasks are estimated first and "rolled up" into the overall project estimate.
- In top down estimating, individual task estimates are only as accurate as the overall project estimate they are derived from. If the overall estimate is incorrect, nothing will make the individual task estimates accurate.
- And because projects are normally tracked via individual tasks, this could lead to issues during the project when individual tasks are incorrectly apportioned, even though the overall estimate is correct.

3.9.1 Advantages

- Top-down estimating can be very useful when cost estimates are needed in the very early phases of a project. This is typically when not much is known about the project and very little information, if any, is available.
- Since this technique is based on high level information, the estimated cost can be calculated faster and with fewer resources and effort. Therefore, it's a less expensive quick method for establishing the project budget than other cost estimating techniques that require more detailed information, involving more time and resources.
- Another good advantage is that top-down estimating gets greater commitment for the project from upper-level management, while relaying to the lower management staff expectations for the budget.

3.9.2 Most used Top-Down Methods

At the strategic level top down estimates are used to evaluate the project proposal. Sometimes much of the information needed to derive accurate time and cost estimates is not available in the initial phase of the project.

1. Consensus Methods

This method simply uses the pooled experience of senior and/or middle managers to estimate the total project duration and cost. This typically involves a meeting where experts discuss, argue, and ultimately reach a decision as to their best guess estimate.

2. Ratio Methods

Top Down estimates usually use ratios to estimate project times or costs. Top Down estimates are often used in the concept or "need" phase of a project to get an initial duration and cost estimate for the project.

3. Apportion Methods

- This method is an extension to the ratio method. Apportionment is used when projects closely follow past projects in features and costs. Given good historical data, estimates can be made quickly with little effort and reasonable accuracy.

- This method is very common in projects that are relatively standard but have some small variation or customization. Anyone who has borrowed money from a bank to build a house has been exposed to this process.

3.10 Network Planning

- Network Planning is a technique used in Project Management. It is used to plan, schedule and control the projects that consist of many interrelated activities. There are many techniques used in Network Planning. The techniques separate planning and scheduling functions.
- Network Planning uses a network diagram to show various activities of a project. The diagram shows various sequences of the activities to be done using different techniques.
- In other words, we can say that the network planning is the categorisation of the activities involved in project implementation in a sequential order followed by a schematic presentation of the activities necessary for the entire project.

3.10.1 Steps used in Network Planning

- A. Identify and list the category of activities involved from the start to the completion of the project. The activities are grouped in categories which are different from each other.
 - B. Arrange the list of activities in sequential order of their performance. There may be activity which can be started only after the completion of some other activity, whereas there may also be some other independent activity which can be started simultaneously.
- In network planning, such independent and inter-dependent activities are laid down along with their estimated time schedule, i.e. the duration estimated from the start to the completion of the activity.
- C. With the details of following A and B, draw the diagram of the network of the activities so that the operational planning of the execution of the entire project can be visualised.
- This whole procedure is the network planning of the project schedule which makes the monitoring and controlling of the project easier than to look around the list of activities and locate lapses, if any.

The network planning as detailed here is a tool available to the project management for a systematic project scheduling. Under such method the inter-relationship of the various activities involved in the project schedule will be visible in the total plan and, as such, steps can be taken to economise the consumption of resources, wherever possible.

3.11 Network Diagram

- A network diagram is a graphical representation of all the tasks, responsibilities and work-flow for a project. It often looks like a chart with a series of boxes and arrows. It is used to map out the schedule and work sequence for the project and track its progress through each stage, up to and including completion. Since it encompasses every single action and outcome associated with the project, a network diagram also illustrates the scope of the project.
- A network diagram not only allows a project manager to track each element of a project and quickly share its status with others, but also improves comprehension and enhances retention. As research shows depicting data in a visual way can also boost performance and productivity while reducing stress among your team members.
- The project network diagram displays the duration of activities in the project, their chronological order and logical dependencies between the activities graphically or in tabular form. Unlike the work breakdown structure (WBS), a network diagram also takes into account the chronological order of activities according to their dependencies, and not just the logical order of the project activities. Bar charts such as Gantt Charts are a special form of the network diagram.

3.11.1 Main Functions of a Network Diagram are

- Determination of the total duration of the project
- Representation of the logical and chronological order in the project
- Identifying Risk by identifying the critical path and the potential bottlenecks in the project process
- Identifying opportunities where the project process can be streamlined

The network diagram is the foundation for the project scheduling. In modern project management, hardly any network plans are calculated "manually" anymore. Project Managers use a project management software to do so. However, understanding the basics of the method enable you to better understand your own project plan.

Tasks

- Prior to the construction of the network diagram, the project needs to have been broken down into its constituent tasks. Tasks should not be too small or they become prone to micromanagement. Neither should they be too large to lose the benefit of project control. So, a large task is no different than a whole project.

For an example, a simple task list for a small convention could be :

- o Finalize Attendees
 - o Book Venue
 - o Order Catering
 - o Write Speech
 - o Travel & Set up
- Interestingly, several of these tasks can be done in parallel. If you force yourself to perform each task one after the other, you might be taking too long. That's where task dependencies come in.

Dependencies

- Prior to the network diagram, the project manager must have determined the dependencies of each task. In theory, every task must be dependent on at least one other (except the first task) else it would not be part of the project. Hence, if you are in a project management class, make sure they are all dependent upon one another.
- There are four types of dependencies :
 - (i) **Finish to Start (FS)** : Task B cannot start until Task A completes. This is the most common.
 - (ii) **Finish to Finish (FF)** : Task B cannot finish until Task A completes.
 - (iii) **Start to Start (SS)** : Task B cannot start until Task A starts.
 - (iv) **Start to Finish (SF)** : Task B cannot start until Task A starts (this one is rare).
- Also, the tasks do not have to line up exactly. A lead time means that Task B doesn't start until a period of time has elapsed, and a lag time means that Task B starts before Task A finishes. In project management software, there's usually only a lag time specified, and a lead time is simply entered as negative lag.
- It sounds complicated, but suffice it to say that Finish to Start (FS) relationship is by far the most common and if you stick to that, you won't get into much trouble.
- In project management, the network diagram is a graphical depiction of a project schedule which uses boxes to represent each task. It is used to determine the critical path, as well as the float of each task.
 - (i) **Critical Path** : These are the tasks which define the completion date of the project. They cannot finish late, or be moved, or the overall project completion date will change by the same amount.
 - (ii) **Float** : It is the amount by which a task can move without affecting the completion date of the project. Critical path tasks have a float of zero. It is also called Slack.

3.11.2 How to Create a Network Diagram ?

- Creating a network diagram can be an involved process that begins after you have determined predecessors to your activity. Here's a simple example that can help you learn how network diagrams can be useful in any project you manage.
- You find out how to draw the network diagram for a sample project from the information in the table shown here :

Predecessor Relationships for Your Picnic

Activity Identifier Code	Activity Description	Immediate Predecessors
1	Load car	3, 6
2	Get money from bank	5
3	Make egg sandwiches	7
4	Drive to lake	1
5	Decide which lake	None
6	Buy gasoline	2
7	Boil eggs (for egg sandwiches)	5

Table 3.11.1

1. Begin your project with a single milestone and label it Start.
2. Find all activities in the table that have no immediate predecessors. They can all start as soon as you begin your project. In this case, only Activity 5 has no immediate predecessors.
3. So, Begin your diagram by drawing the relationship between the Start of your project and the beginning of Activity 5.

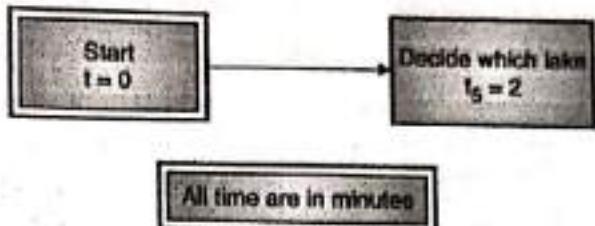


Fig. 3.11.1

4. Find all activities that have your first activity as an immediate predecessor. Activities 2 and 7 have Activity 5 as an immediate predecessor. Draw boxes to represent these two activities, and draw arrows from Activity 5 to Activities 2 and 7.
5. Continue in the same way with the remaining activities.

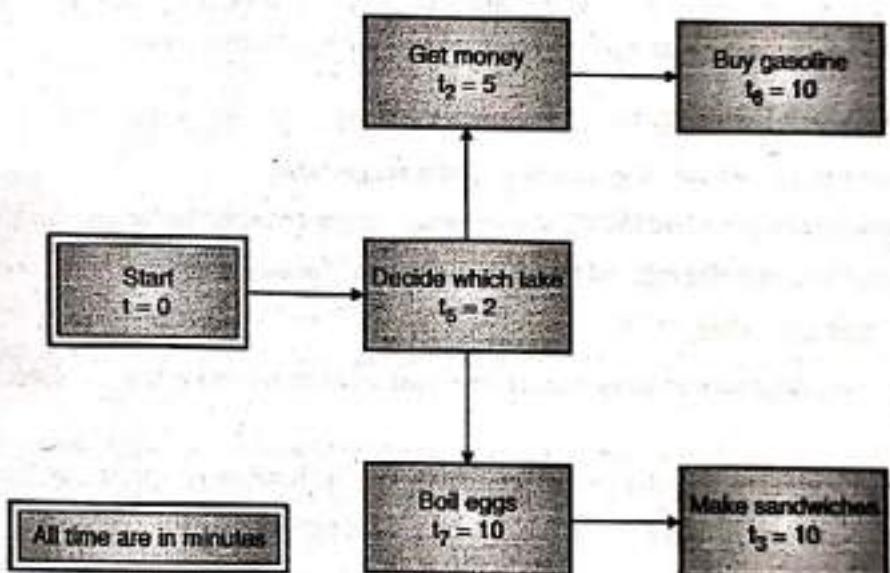


Fig. 3.11.2

- Draw a box to represent Activity 6 and draw an arrow from Activity 2 to that box. Only Activity 3 has Activity 7 as an immediate predecessor. So draw a box to represent Activity 3, and draw an arrow from Activity 7 to Activity 3. Now realize that Activity 1 has both Activities 3 and 6 as immediate predecessors. Therefore, draw a box representing Activity 1 and draw arrows from Activities 3 and 6 to this box.
 - The rest is pretty straightforward. Because only Activity 4 has Activity 1 as its immediate predecessor, draw a box representing Activity 4 and draw an arrow from Activity 1 to Activity 4.
6. After adding all the activities to the diagram, draw a box to represent End, and draw an arrow from Activity 4 (the last activity you have to complete) to that box.

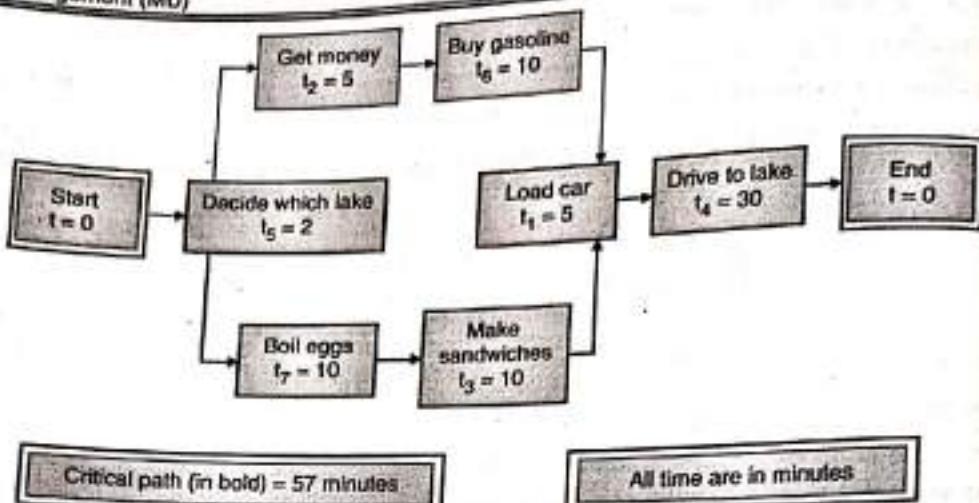


Fig. 3.11.3

Now for an important timing-related question. How long will you and your friend take to get to the lake for picnic? The upper path (Start, Activities 5, 2, 6, 1, 4, and End) takes 52 minutes to complete, and the lower path (Start, Activities 5, 7, 3, 1, 4, and End) takes 57 minutes to complete. Thus, it will take 57 minutes from the time you start until you arrive at the lake for your picnic, and the lower path is the critical path.

3.11.3 Types of Network Diagrams

There are two main types of network diagrams in project management :

1. **The Arrow diagramming method (ADM)**, also known as "arrow network" or "activity on arrow"; and
2. **The Precedence diagramming method (PDM)**, also known as "node network" or "activity on node."

1. Arrow Diagram Method (ADM)

The arrow diagramming method uses arrows to represent activities associated with the project.

In ADM :

- The tail of the arrow represents the start of the activity and the head represents the finish.
- The length of the arrow typically denotes the duration of the activity.
- Each arrow connects two boxes, known as "nodes." The nodes are used to represent the start or end of an activity in a sequence. The starting node of an activity is sometimes called the "i-node," with the final node in the sequence sometimes called the "j-node."
- The only relationship between the nodes and activity in an ADM chart can represent is that of "finish to Start."

Occasionally, "dummy activities" arrows that do not represent a direct relationship need to be included in ADM network diagrams. An ADM chart also does not have a way to encapsulate lead and lag times without introducing dummy nodes and activities, and it's important to note ADM is not widely used anymore due to its representational limitations.

2. Precedence Diagram Method (PDM)

In the precedence diagramming method for creating network diagrams, each box, or node represents an activity and the arrows representing relationships between the different activities. The arrows can therefore represent all possible relationships :



- (i) "Finish to Start" (FS) : This is used when an activity cannot start before another activity finishes.
- (ii) "Start to Start" (SS) : This is used to illustrate when two activities are able to start simultaneously.
- (iii) "Finish to Finish" (FF) : This is used when two tasks need to finish together
- (iv) "Start to Finish" (SF) : This is an uncommon dependency and only used when one activity cannot finish until another activity starts.

In PDM, lead times and lag times can be written alongside the arrows. If a particular activity is going to require 10 days to elapse until the next activity can occur, for example, you can simply write "10 days" over the arrow representing the relationship between the connected nodes.

PDM network diagrams are frequently used in project management today.

Before starting to draw the network, following measures should be taken serially

- Prepare a list of the activities included in the project and their dependence on other activities.
- Draft the network roughly, usually by soft pencil and an eraser on a large piece of paper.
- The estimate of time required for each activity is made considering manpower and equipment's available and in certain cases assumptions are based on statistical approach and experience.
- These time estimates are then written on each activity.
- Then scheduling computations are done to get earliest and latest allowable start and finish times for each activity, to identify critical path and to indicate the amount of slack on non-critical paths.
- Now this is prepared in final form for use in the field. Project is controlled by checking the progress against the schedule.

3.12 Network Analysis

- Network analysis has played an important role in field of engineering. Application of network analysis has been made in information theory, study of transportation problem and planning and control of research and development projects.
- In transportation problem, there are many routes to reach a terminal, but we like to choose a route for which the cost or time is minimum. There is a problem to select the shortest route through a network. Thus the problem of network analysis is to find a course of action, which minimizes some measure of performance.
- A project consists of no. of interrelated activities which must be executed in specific order to complete the project. The activities are interrelated in a logical sequence in such a way that some activities cannot start until some others are completed.
- These activities require time and consumption of resources like labor, money, material and machine etc. The main objective before starting any project is to schedule the required activities in an efficient manner so as to complete it-on or before a specified time limit at minimum cost of its completion.
- The techniques which are used for planning, scheduling and controlling large and complex projects are termed as network analysis or network techniques. These techniques are based on the representation of the project as a network of activities.
- A network is essentially a graphical plan consisting of a certain configuration of arrows and nodes for showing the logical sequence of various activities to be performed to complete the project.

3.12.1 Basic Concepts of Network Analysis

1. Activity

- All projects may be viewed as being composed of operations or tasks called activities, which require the expenditure of time and resources for their accomplishments. An activity is depicted by a single arrow (\rightarrow) on the project network. The activity arrows are called arcs. The activity arrow is not scaled; the length of the arc is only a matter of convenience and clarity and does not represent importance of time.
- The head of the arrow shows the sequence or flow of activities. An activity cannot begin until the completion of the preceding activities. It is important that activities be defined so that beginning and end of each activity can be identified clearly.



3.12.1

- Generally, there are three types of activities found in a network, which are :
- Predecessor Activity :** It is an activity which must be completed before one or more other activities start.
 - Successor Activity :** This is an activity that cannot be started until one or more of the other activities complete but immediately succeeds them.
 - Concurrent Activity :** These are the activities which can be accomplished concurrently are known as concurrent activities.
 - Dummy activity :** This is an activity which does not consume any kind of resource or time is known as dummy activity. A dummy activity is added in a network only to establish the given precedence relationship among other activities of project in following two situations:
 - When two or more parallel activities in a project have same starting and finishing points.
 - When two or more activities have some (but not all) of their immediate predecessor activities in common.

A dummy activity is generally shown by a dotted line in network diagrams :

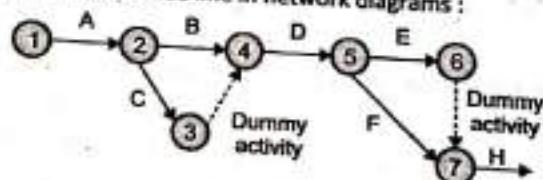


Fig. 3.12.1

2. Event

An event in a network diagram is a specific instant of time which marks the start, or the end of an activity. Event consumes neither time nor resources. It is represented by a circle and the event number is written within the circle. The event circles are called nodes. Therefore, the major difference between activities and events is that activities represent the passage of time whereas events are points in time.

All activity arrows must begin and end with event nodes as shown as follows



Fig. 3.12.3

The events can be further classified into following three categories :

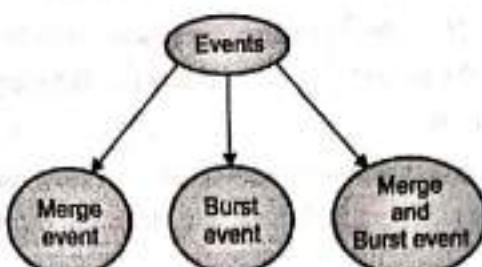


Fig. 3.12.4

- (i) **Merge Event** : An event which represents the joint completion of more than one activity is known as merge event.
- (ii) **Burst Event** : An event which represents the beginning of more than one activity is known as burst event.
- (iii) **Merge and Burst Event** : An event may be merged for some activities and burst for some other activities simultaneously.

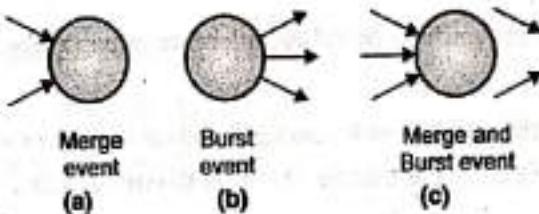


Fig. 3.12.5

12.2 Advantages of Network Analysis

Sequence of Activities : Schedule network analysis specifies the logical sequence of activities required to achieve project goals. It uses sequencing and dependencies to establish activity relationships.

Critical Path : Schedule network analysis uses techniques like CPM and PERT to identify the critical path of a project. The critical path is the longest path of a schedule network diagram. Refer to paragraph "Critical Path Method (CPM) Scheduling" to understand other features of critical path.

Project Duration : It analytically estimates the minimum duration before which the project cannot complete.

Critical Activities : Not all activities can start and finish at the same time. Activities on critical path are critical activities. Hence schedule network analysis indicates exactly which activities need maximum attention of project team.

Schedule flexibility : It is permissible delay in activities that are not on critical path. It uses mathematical calculations to establish early start, early finish, late start, and late finish of each activity.

Schedule Model : It is the output of analysis process. The schedule model helps to conduct risk and scenario analysis of project schedule.

- **Schedule Analysis** : The schedule model allows further analysis like What-if analysis, scenario analysis and schedule compression techniques.

3.12.3 Techniques in Network Analysis

The most commonly used network techniques are :

1. Critical Path Method (CPM)
2. Programme Evaluation and Review Technique (PERT)

3.13 Critical Path Method (CPM)

- CPM method developed was by E.I. du Pont de Nemours Company (USA) in 1958 and named as critical path method (CPM) to schedule and control the project. CPM is applicable to both large and small projects, taking from space programs to wedding or horse shows.
 - It is widely recognized and is the most versatile and potent management planning techniques. The objective of critical path analysis is to estimate the total project duration and to assign starting and finishing times to all activities involved in the project.
1. Break down the project into various activities systematically. Label all activities. Arrange all the activities in logical sequence. Construct the network diagram.
 2. Number all the nodes (events) and activities. Find the time for each activity considering it to be deterministic. Indicate the activity times on the arrow diagram.
 3. Calculate earliest start time, earliest finish time, latest start time and latest finish time. Tabulate activity normal times, earliest times and latest times.
 4. Determine the total float for each activity by taking difference between the earliest time and latest time for each node.
 5. Identify the critical activities (the activities with zero float) and connect them with the beginning node and the ending node in the network diagram by double line arrow. This gives the critical path.
 6. Calculate the total project duration.
 7. It is intended to reduce the total project duration, crash the critical activities of the network.
 8. Optimize the cost.
 9. Update the network and smooth the network resource.

3.13.1 Time Estimate in CPM

The basic objective of the time analysis is to get a planned schedule of the project for which the following factors should be known :

- Total completion time of the project.
- Earliest time when each activity can begin.
- Latest time when each activity can be started without delaying the total project.
- Float for each activity i.e., amount of time by which the completion of an activity can be delayed without delaying the total project completion time.
- Identification of critical activities and critical path.

The basic scheduling computations can be grouped into the following heads :

1. Forward Pass Method (For Earliest event time)

Based on fixed occurrence time of the initial network event, the forward pass computation yields the earliest start and earliest finish times for each activity and indirectly the earliest expected occurrence time for each event.

This consists of the following steps :

- (i) The computation begins from the start node and move to the 'end' node. To accomplish this, the forward pass computations start with an assumed earliest occurrence time of zero for the initial project event. i.e. $E_1 = 0$; $i = 1$
- (ii) Calculate earliest start time for each activity which begins at event i . This is equal to the earliest occurrence time of event i (Tail event) i.e., $ES_{ij} = E_i$ for all activity (i, j) starting from event i .
- (iii) Calculate earliest finish time of each activity (i, j) which is the earliest start time of the activity plus the duration of the activity, i.e.
- $$EF_{ij} = ES_{ij} + t_{ij}$$
- $$= E_i + t_{ij}$$
- (iv) Calculate earliest occurrence time for event j ($j > i$) which is the maximum of the earliest finish times of all activities ending into that event, i.e.
- $$E_j = \text{Maximum } (ES_{ij} + t_{ij})$$
- $$= \text{Max } [E_i + t_{ij}]$$

The computed values are put into the lower left portion of each event.

2. Backward Pass Method (For latest allowable time)

In this method calculation begin from last event L .

The various steps are as follows :

- (i) Set the latest occurrence time of last event L which is equal to the earliest occurrence time of that event obtained from forward pass method.
i.e., Assume $L = E$ for ending event.
- (ii) Latest finish time for activity (i, j) equal to the latest event time of event j , i.e., $LF_{ij} = L_j$
- (iii) Latest starting time of activity (i, j) is the latest completion time of (i, j) minus the activity time i.e.
- $$LS_{ij} = LF_{ij} - t_{ij}$$
- $$= L_j - t_{ij}$$
- (iv) Latest event time for event i is the minimum of the latest start time of all activities originating from that event.

Thus

$$L_i = \text{Minimum } (LS_{ij})$$

$$= \text{Min } (LF_{ij} - t_{ij})$$

$$= \text{Min } (L_j - t_{ij})$$

The computed values are put into the lower right portion of each event.

3.13.2 CPM Systems

1. Activity-On-Arrow (AOA) Network

In this type of network representation activity is represented by an arrow. The tail of the arrow represents the start and the head of the arrow represents the end of the activity. The description of activity is written above the arrow. Events are represented by circles or nodes at the start and the end of an activity arrow.

These diagrams have a single starting node from which all activities with no predecessors may start. The diagram then move from left to right, ending with a single ending node, where all activities come together with no successor.



Advantages of AOA Network

- Many computer programs are based on AOA network.
- AOA diagrams give a better sense of the flow of time throughout a project.
- AOA diagrams can be superimposed on a time scale with the arrow diagram, the correct length indicate the time requirement.

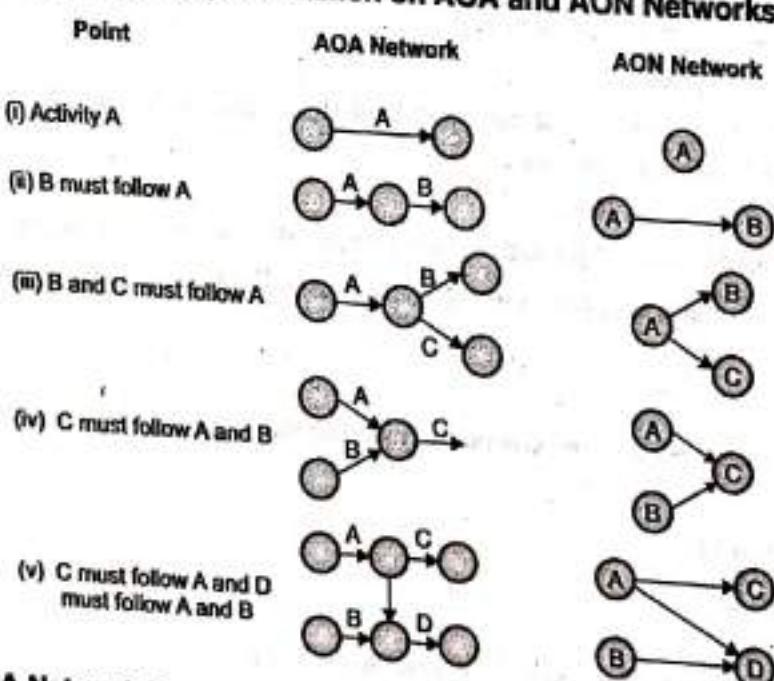
2. Activity-On-Node (AON) Network

In AON networks, activities are represented by circles or nodes and arrows are used only to show the dependency relationship between the activity nodes. Generally these diagrams have no particular starting or ending node for the whole project. The lack of dummy activities in diagrams makes them easier to draw and understand.

Advantages of AON networks

- AON diagram does not require dummy activities.
- They are easier to draw and understand.
- They are easier to revise and update.

3.13.3 Comparison Between the Representation on AOA and AON Networks



3.13.4 Rules of AOA Network Construction

Following rules have to be followed while constructing a network :

- In network diagram arrow represents activities and circles the events. The length of arrow has no significance.
- Each activity should be represented by only one arrow and must start and end in a circle called event. The tail of an arrow represents the start and head the completion of work.
- The direction of arrow indicates the direction of work flow. The normal convention is to go from left to right.
- All networks are constructed logically on the basis of principle of dependency.

- An event cannot occur until all the incoming activities into it have been completed.
- An activity cannot start until all the preceding activities have been completed.
- No set of activities cannot form a circular loop.

3.13.5 Numbering the Events (Fulkerson's Rule)

- After the network is drawn in a logical sequence, every event is assigned a number. The number sequence must be such so as to reflect the flow of the network. A number is placed inside the circle. The rule devised by D.R. Fulkerson is used for numbering.
- The procedure for applying this rule consists of identifying the initial event and then gradually converting the succeeding event by deleting the arrows from the previous preceding events. A number is assigned only when by such deletions a node is converted into initial event. It involves the following steps :
 - Event numbers should be unique.
 - Event numbering should be carried out on a sequential basis from left to right,
 - The initial event which has all outgoing arrows with no incoming arrow is numbered as 1.
 - Delete all arrows emerging from all the numbered events. This will create at least one new start event out of the proceeding events.
 - Number all new start events 2, 3 and so on. Repeat this process until all terminal event without any successor activity is reached. Number the terminal node suitably.

Example : Construct a network for the project whose activities and their precedence relationship are as given as follows :

Activities	A	B	C	D	E	F	G	H	I
Immediate predecessor	-	A	A	-	D	B,C,E	F	D	G,H

Solution :

From the given constraint, it is clear that A, D are the starting activity and I the terminal activity. B and C are starting with the same event and are both the predecessors of the activity F. Also E has to be the predecessor of both F and H, hence, we have to introduce a dummy activity.

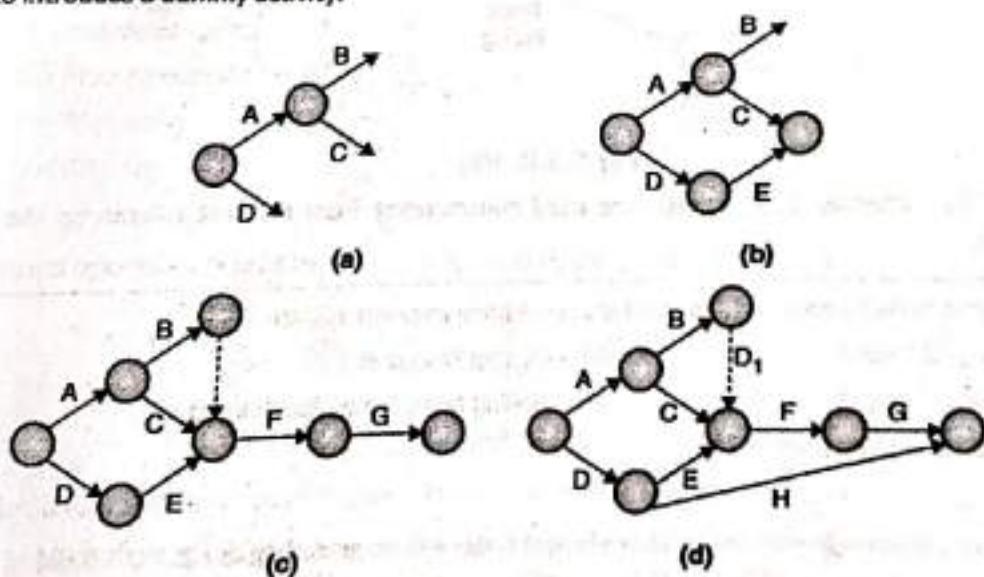


Fig. 3.13.1

ID_1 is the dummy activity.



Finally we have the following network

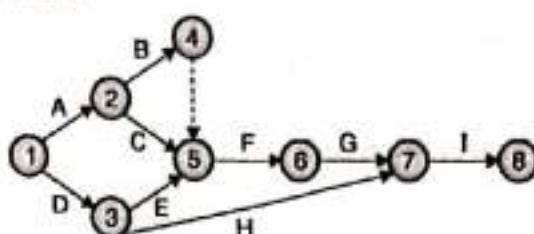


Fig. 3.13.1 (e)

The construction of C.P.M. diagram can be explained by the following examples :

Example 3.13.1 : For the construction of wall the complete process can be broken into the following operations :

- | | |
|----------------------------|--------------------------------|
| (i) Brick laying A | (ii) Preparing mortar B |
| (iii) Digging foundation C | (iv) Planning the foundation D |

Solution :

These following operation have not been written in a logical sequence. These operations can be denoted by the symbols ABCD.

The C.P.M. diagram can be drawn as shown in Fig. P.3.13.1(a).

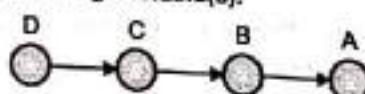


Fig. P.3.13.1(a)

The operations D, C, B and A have now been shown in the logical sequence. From the study of these operations, it is found that preparing mortar is independent of digging foundation and planning operations. Therefore a modified C.P.M. diagram is drawn in Fig. P.3.13.1(b).

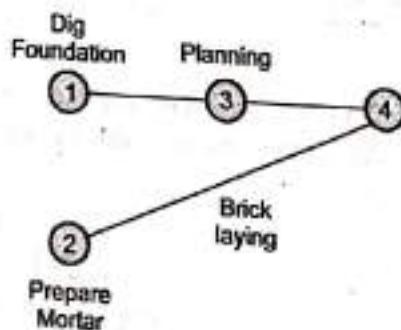


Fig. P.3.13.1(b)

In this Fig. P.3.13.1(b) numerals (1, 2, 3, etc.) are used commencing from the first column on the left and then proceeding towards right.

Example 3.13.2 : A ladder is to be constructed. The various operations involved in it are :

- | | |
|---------------------------|--------------------------------------|
| (i) Fixing of Nails A | (ii) Cutting Wrings B |
| (iii) Drilling Wrings C | (iv) Drilling holes in two Bamboos D |
| (v) Cutting two Bamboos E | |

Solution :

The operations are not given in logical order. Their logical order will be according to Fig. P.3.13.2(a)

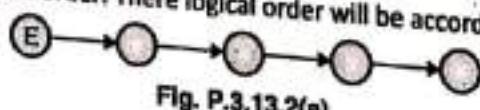


Fig. P.3.13.2(a)

The modified network of the Fig. P.3.13.2(a) is shown in Fig. P.3.13.2(b)

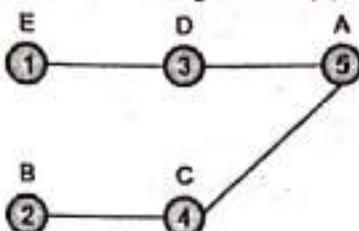


Fig. P.3.13.2(b)

The cutting and drilling of the bamboos and wrings are different operations, and these are independent of each other. Therefore cutting two bamboos and cutting wrings can be started concurrently. Thus after the end of operation E, operation D can begin and similarly after the end of operation B, operation C can start.

After the end of operation C and D, the last operation of fixing nails can begin. Thus the network is drawn from left to right and each circle representing an operation is numbered from left to right. All the circles in the extreme left are first numbered and so on.

It is clear from the Fig. P.3.13.2(b) that operation 5 can only begin when the operations 3 and 4 are over. Thus we can say that operation 1 immediately precedes operation 3, and operation 2 immediately precedes operation 4. Also the operations 3 and 4 must immediately precede the operation 5.

In the language of C.P.M., the operations 1 and 2 are called the pre-operations (or PRE-OPR) of 3 and 4 respectively. Similarly 3 and 4 both are the PRE-OPR of operation 5. Also 3 and 4 will be called post operations (POST-OPR) of operations 1 and 2 respectively, 5 is the POST-OPR of operation 3 and 4.

Example 3.13.3 : Suppose we want to start a small scale factory in a shed available in an industrial area in which workshop is to be prepared. First step is then to divide the project into operations.

The list of operations is given as follows, which is not in a logical order :

A = Machine foundation

B = Electric fitting

C = Repair of floor

D = Installation of machines

E = Procure workshop building

F = Whitewash

G = Clean up

Solution :

Its logical order of operations should be E, A, D, B, F, C and G. (Refer Fig. P.3.13.3(a)).

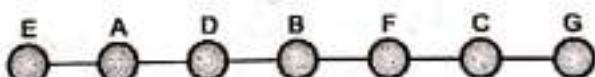


Fig. P.3.13.3(a)

- If each operation is represented by a circle then this work can be executed in a better way as follows :
- Sketch shown in Fig P. 3.13.3(b) is drawn as per circle and line method in which circles represents the operation or activity and the line shows the relationship between the two activities. The operation on the left of each line should be completed before the starting of the operations on the right of the line.

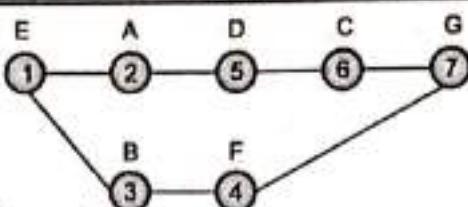


Fig. P.3.13.3(b)

- Network shows that operation 3 and 4 are not affected by operations 2, 5 and 6. Hence the operations 3 and 4 can be conducted at the same time, when 2, 5 and 6 operations are being conducted.
- This reduces the time to complete the project because after operation 1, operation 2 and 3 can be started simultaneously. Operations 6 and 4 should be completed before the beginning of the operation 7. In the final network, diagram operations should be represented by the numerals instead of alphabets.

Example 3.13.4 : Construct the network diagram for which operations and post operations are given as under:

Operation	Post-operation
1	2,3
2	4
3	4,5
4	6
5	6

Solution :

As no operation precedes operation 1, hence we shall start network from operation 1, keeping it in first vertical column. Operations 2 and 3 are post-operations of operation 1; hence these are kept in second vertical column as shown in Fig. P.3.13.4(a)

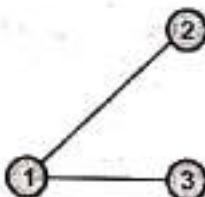


Fig. P.3.13.4(a)

As operation 4 can be started when operation 2 is completed therefore, it will be kept in third vertical column. Operations 4 and 5 are the post-operations of operation 3 and can be started simultaneously after completion of operation 3, hence operations 4 and 5 both can be kept in the same third column. As operation 6 is the post-operation of operations 4 and 5, hence will be connected by both 4 and 5 and will be placed in the next column, i.e., in the fourth column as shown in Fig. P.3.13.4(b)

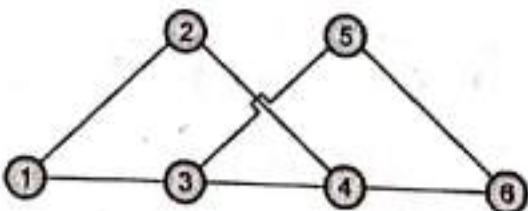


Fig. P.3.13.4(b)

In Fig P.3.13.4(b) , line connecting operations 3 and 5 crosses another line; hence it may be arranged in a better and clear form as shown in Fig. P.3.13.4(c).

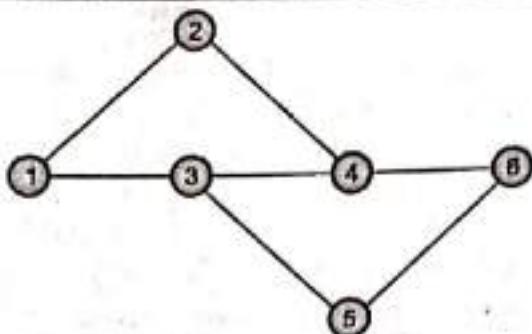


Fig. P.3.13.4(c)

Sometimes, it is not possible to avoid it then the lines may cross each other but care should be taken that such lines should be as minimum as possible and clear to understand.

Example 3.13.5 : Example illustrates a case in which, operations and pre-operations are as under :

Operation	Pre-operation
2	1
3	1 and 2

Solution :

As the operation 1 is the first operation, hence network will be started by operation 1 denoted by the circle in first column. Operation 2 is the post-operation of 1 and therefore will be kept in second column.

Operation 3 has pre-operations 1 and 2; therefore operation 3 cannot be started unless operations 1 and 2 are complete. Hence operation 3 can be kept in third column, i.e. after operation 2, and not in second column immediately after operation 1. It is shown in Fig. P.3.13.5(a).

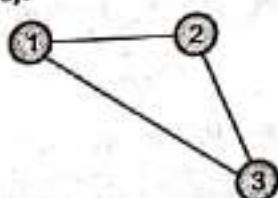


Fig. P.3.13.5(a)

Example 3.13.6 : Draw a network diagram for painting in a two storey building.

Solution :

After dividing the project into some operations, network can be drawn as per Fig. P.3.13.6(a).

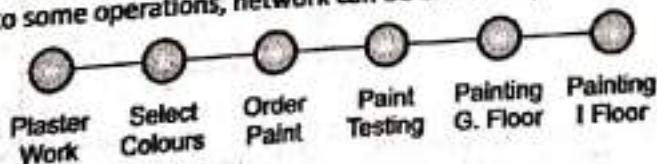


Fig. P.3.13.6(a)

If sufficient men, equipment's and materials are available the network would be better to draw in the form as shown in Fig. P.3.13.6(b) to reduce the timing required for selecting colors, ordering and testing paints and without waiting for plaster on first floor, painting can be done on ground floor and in the mean-time plaster work on first floor will be completed and the painting on the same can be done. Therefore network shown in Fig. P.3.13.6(b) is a better diagram in the point of view that it will save the time.

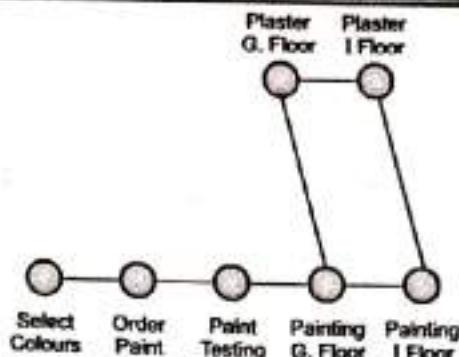


Fig. P. 3.13.6(b)

Example 3.13.7 : Draw the network diagrams for the project in which PRE-OPR or POST-OPR are given as :

Operation	PRE-OPR
A	None
B	A
C	B
D	B
E	B
F	C, D, E

Solution :

The CPM network will be as in Fig. P.3.13.7(a).

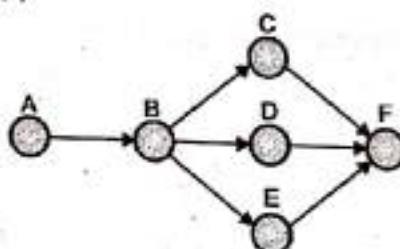


Fig. P.3.13.7(a)

Example 3.13.8 : The example 3.13.7 for the above network diagram can also be framed in terms of POST-OPR as given under :

Operation		POST-OPR
A	Precedes	B
B	"	C, D, E
C	Precedes	F
D	"	F
E	"	F

Solution : Refer example 3.13.7

Example 3.13.9 : Draw the network for the following in which POST-OPRs are given :

Operation		POST-OPR
A	Precedes	B
B	"	C, D
C	"	E, F
D	"	E
E	"	G
F	"	G

Solution :

Fig. P. 3.13.9(a) shows the sequence of operations A, B, C and D. Now the operation E is preceded by C and the operation F is also preceded by C. Hence, when the circles are drawn to show the operations E and F, the connecting lines of DE and CF intersect each other as shown in Fig. P.3.13.9 (b).

The intersection of lines DE and CF can be avoided by placing the operation F in the fourth sequence above the operation E, as shown in Fig. P.3.13.9(c). Now the numbers may be placed in the operation circles beginning from left to right as shown in Fig. P.3.13.9(d).

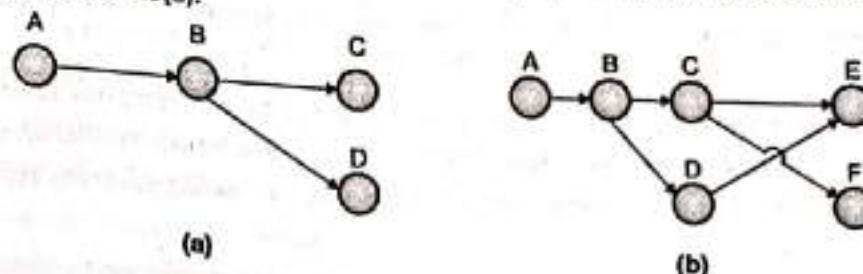


Fig. P.3.13.9

As far as possible, the crossing of lines should be avoided. This makes the diagram less confusing and easier to understand. However, sometimes it may not be possible or desirable to eliminate the occurrence of such crossing lines. The numbering should be done starting from left and moving towards right, the first vertical sequence of operation being numbered first and then the second and so on.

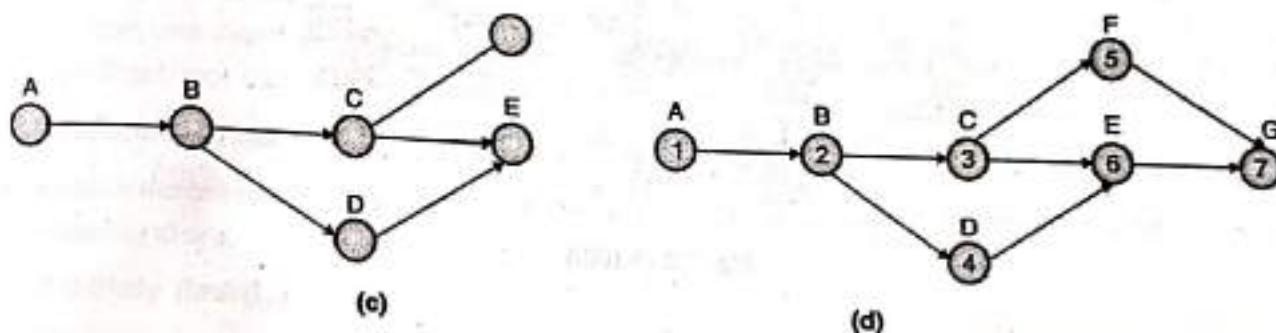


Fig. P.3.13.9

Example 3.13.10 : Following table shows the operation time in working days for different activities. Draw the critical path on the diagram.

Activity	Particular	Time in days
A	Macgube Foundation	10
B	Electric Fitting	15
C	Repair floor	20
D	Installation	12
E	Procure Workshop Building	15
F	Whitelash	5
G	Clean up	2

Solution :

The following activities are drawn in the network as shown in Fig. P.3.13.10(a). Each activity is represented by the numeral in the circle. Numbers of days are mentioned on the left corner of circle representing the operation.

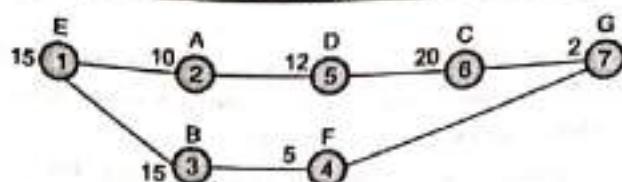


Fig. P.3.13.10(a)

- After drawing the network diagram, Earliest Finish for each operation is calculated and noted on the top right corner of the circle in the rectangles.
- For the last operation 7, Latest time = Earliest finish time, i.e. 59 days in this case. From this value, Latest Finish time for other operations is calculated and written on the right bottom corner of the circle and inscribed in a triangle. For operations 2, 3, 4, 5 and 6 latest finish time is calculated by subtracting the working days required from the latest of post operation.
- For operation 1, Latest Finish calculated by considering operation 2 is $59 - 10 = 49$ days and by considering operation 3 is $59 - 15 = 44$ days. In such case lower value is considered as the Latest Finish.
- Hence for operation 1, Latest Finish = 44 days.
- Operations which are having Earlier Finish = Latest Finish are joined with double line and represent the critical path as shown in Fig. P.3.13.10(b).



Fig. P.3.13.10(b)

3.14 PERT Computation

- PERT (Program Evaluation and Review Technique) was developed by a navy sponsored resource team composed of Messrs. D.G. Malcolm, J.R. Roseboom, C.E. Dark and W. Fazar in about 1950.
- This is essentially a management technique used with advantage for responsibility accounting in addition to attaining other well defined objectives. It is a method in which we try to exercise logical discipline in planning and controlling projects.
- PERT is designed for scheduling complex projects that involves many inter-related tasks. It improves the planning process because :
 - o It forms the planner to define the projects various component activities and events logically.
 - o It provides a basis for normal time estimates and yet allow for some measure of optimum or pessimism in estimating completion dates.
 - o It shows the effects of changes to the overall plan as they contemplated.
 - o It provides a built in means for on-going evaluation of the plan.
 - o It facilitates the process of communication between planners management by either adhering organisational lines or crossing over them. In essence, PERT makes the clear cut assignment of responsibility possible.

project :

1. It provides all parties involved a common basis of progress reporting, both, within organisation and outside of it.
2. It identifies likely trouble spots before they are encountered.
3. It provides data specially tailored to each level of management.
4. It focuses management attention on the critical path, where it is most needed, as well as on other no-critical activities that finish resources essential to the completion of activities of the critical path.
5. It permits the effects of various reallocation alternatives to be simulated such that the impact of any proposed changes in the overall project can be predicted. In other words PERT answers 'the what' if questions.

Because of these planning and controlling features, PERT is especially effective in projects with many distinct tasks in which the complex inter relationships between tasks and projects with respect to personnel scheduling and time constraints are of critical importance.

3.14.1 PERT System of Three Time Estimates

The main objective in the analysis through PERT is to find out the completion for a particular event within specified date. If yes, what are the chances of completing the job? The PERT approach takes into account the uncertainties. In this approach, three time values are associated with each activity of the optimistic value, the pessimistic value, and the most likely value. These three time values provide a measure of uncertainty associated with that activity.

1. The optimistic Time

This is the shortest possible time in which the activity can be finished. It assumes that everything goes very well. This is denoted by t_0 or a .

2. Most likely Time (t_m)

This is the most likely time as probably the actual time required to complete an activity. In this case it assumes that things go in the normal way, with a few delays or breakdown etc. this is denoted by t_m or m .

3. Pessimistic Time (t_p)

This time is based on the assumption that everything will go badly. Thus, it is the maximum possible time required to perform an activity. However, this does not include major catastrophes like labour strikes, acts of God, and unrest. It is denoted by t_p or b .

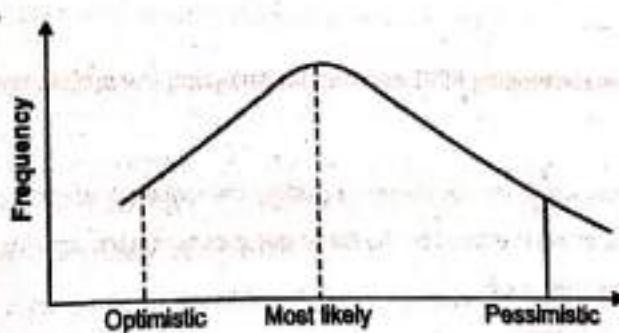


Fig. 3.14.1 : Time Distribution Curve

Expected Time or Average Time (t_e)

- In PERT activity duration is not a single time estimate, in fact a random variable which is characterized by some probability distribution usually β distribution. To estimate the parameters of β -distribution PERT uses three time estimates for each activity.
 - The optimistic time, most likely time and pessimistic time are combined statistically to develop the expected time (t_e) for an activity. The fundamental assumption in PERT is that the three time estimates form the end points and mode of Beta distribution.
 - According to β -distribution, we can get the expected time for an activity to complete by adding together 1/6th of the optimistic, 2/3rd of the most likely and 1/6th of the pessimistic time estimate.
- Mathematically,

$$t_e = \frac{1}{6} t_o + \frac{2}{3} t_m + \frac{1}{6} t_p$$

$$t_e = \frac{t_o + 4 t_m + t_p}{6}$$

Variance (σ^2)

- Variance for an activity is estimated on the basis of analogy to the normal distribution where 99% of the area under the normal curve lies within the $\pm 3\sigma$ from the mean or fall within the range approximately 6σ in length therefore, the interval ($t_u - t_l$) or range ($t_p - t_o$) is assumed to enclose about 6σ of a symmetric distribution. Thus, if denote the standard deviation, then

$$6\sigma \approx t_p - t_o$$

$$\text{or } \sigma = \frac{t_p - t_o}{6}$$

Variance of activity time,

$$\sigma^2 = \left(\frac{t_p - t_o}{6} \right)^2$$

$$6\sigma = t_p - t_o$$

$$\sigma = \left(\frac{t_p - t_o}{6} \right)$$

Variance of activity time,

$$\sigma^2 = \left(\frac{t_p - t_o}{6} \right)^2$$

3.14.2 PERT Algorithm

The various steps involved in developing PERT network for analyzing any project are summarized as follows :

Step 1 :

1. Develop a list of activities that made up the project including immediate predecessors.
2. A rough PERT network is drawn on the basis of the three questions for each activity.
 - (i) Which activities precede this one?
 - (ii) Which activities follow this one?
 - (iii) Which activities are concurrent with this one?

Obviously, the first activity would be preceded by none and the last activity would be followed by none. During rough

sketching such logical rules as insertion of dummies, activities should be straight, slanting or bent but not curved, etc., may be ignored.

3. The network is then suitably sketched to conform to rules and conventions.
4. Events are numbered in ascending order from left to right.
5. Time estimates for each activity are then obtained.

They are :

- (i) The most likely estimate, m
- (ii) Pessimistic estimate, a
- (iii) The optimistic estimate, b

6. Then upon the assumption of beta distribution for the activity duration, the expected time, t_e for each activity is computed from the following formula :

$$t_e = \frac{1}{6}(1 + 4m + b)$$

7. Using the expected activity time estimates, determine the earliest start time and the earliest finish time for each activity, the earliest finish time for the complete project corresponds to the earliest finish time for the last activity.
8. After determining the latest start time and the latest finish time for each activity, compute the float associated with each activity, the critical path activities are the activities with zero float. Determine now the critical path through the given network.
9. Using the values for b and a , which were determined in step 5.

Calculate the variance (σ^2) of each activities time estimates by :

$$\sigma^2 = \left[\frac{1}{6}(b - a) \right]^2$$

10. Use the variability in the activity times to estimate the variability of the project completion date, then using this estimate compute the probability of meeting a specified completion date by using the standard normal equation.

$$Z = \frac{\text{Due date} - \text{Expected date of completion}}{\sqrt{\text{Project Variance}}}$$

- Where Z = no of standard deviations the due date or target date lies from the mean or expected date.
- Crashing or compressing the project may have to be undertaken if the critical path duration is not acceptable to the management or resource allocation may have to be performed if resources are limited.

3.15 Gantt Bar Chart

- A Gantt bar Chart is a horizontal bar chart that visually represents a project plan over time. Modern Gantt charts typically show you the status of as well as who's responsible for each task in the project. In other words, a Gantt chart is a super-simple way to keep you out of project difficulties.
- Gantt chart was developed as a production control tool in 1917 by Henry L. Gantt, an American engineer and social scientist. Frequently used in project management, a Gantt chart provides a graphical illustration of a schedule that helps to plan, coordinate, and track specific tasks in a project.

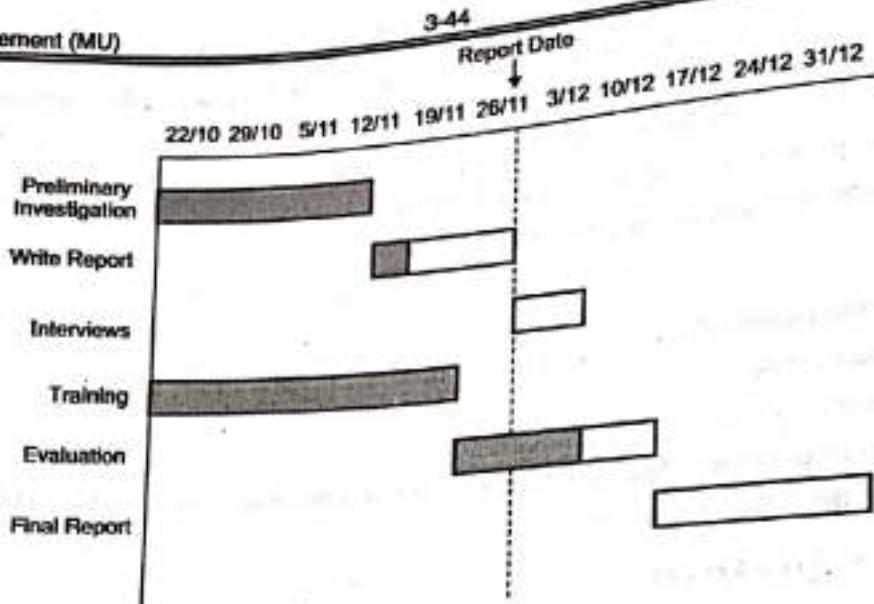


Fig. 3.15.1 : Gantt chart of Project Schedule

A Gantt chart shows graphical depiction of a project schedule. It's a type of bar chart that shows the start and finish dates of several elements of a project that include resources, milestones, tasks, and dependencies.

3.15.1 Key parts of a Gantt chart

A Gantt chart is made up of several different elements. So let's take a quick look at 8 key components so you know how to read a Gantt chart :

- Task list : Runs vertically down the left of the Gantt chart to describe project work and may be organized into groups and subgroups.
- Timeline : Runs horizontally across the top of the Gantt chart and shows months, weeks, days, and years.
- Dateline : A vertical line that highlights the current date on the Gantt chart.
- Bars : Horizontal markers on the right side of the Gantt chart that represent tasks and show progress, duration, and start and end dates.
- Milestones : Yellow diamonds that call out major events, dates, decisions, and deliverables.
- Dependencies : Light gray lines that connect tasks that need to happen in a certain order.
- Progress : Shows how far along work is and may be indicated by % Complete and/or bar shading.
- Resource assigned : Indicates the person or team responsible for completing a task.

The History of Gantt Charts

The first project management chart was invented by Karol Adamiecki in 1896. So why isn't it called an Adamiecki chart? Good question!

Here's a quick history of Gantt charts :

- 1896 : Karol Adamiecki creates the first project management chart: the Harmonogram, a precursor to the modern Gantt chart.
- 1931 : Adamiecki publishes the Harmonogram (but in Polish with limited exposure).
- 1910-1915 : Henry Gantt publishes his own project management system, the Gantt chart.
- Today : Gantt charts are the preferred tool for managing projects of all sizes and types.

3.15.2 How Gantt Charts works ?

A Gantt chart is a visual presentation used in project management to show overview of timeline for project activities and their inter-dependence. Each project task or activity is represented with a bar chart clearly displaying start and end date. Thus the length of the bar shows the duration required for a task to complete. This way multiple tasks when displayed as bar charts, shows work breakdown structure on a timeline. Essentially Gantt chart shows when an activity starts, completes, how long it will take to complete an activities and also overall project, which is a project schedule.

How to Use Gantt Charts ?

Gantt charts come in many forms, from good old-fashioned paper to desktop and even web-based software. Bringing these charts online transformed them from a static document that quickly becomes obsolete to a living, collaborative representation of a project's current state.

Gantt charts are useful in almost any industry. Here are just a few examples of the types of teams and companies that use Gantt charts to plan, schedule, and execute their projects :

- o Construction
- o Consulting Agencies
- o Marketing teams
- o Manufacturing
- o Human Resources
- o Software Development
- o Event Planning

3.15.3 Functions of Gantt Charts

The Gantt chart is the most widely used chart in Project Management.

- These charts are useful in planning a project and defining the sequence of tasks that require completion. In most instances, the chart is displayed as a horizontal bar chart.
- Horizontal bars of different lengths represent the project timeline, which can include task sequences, duration, and the start and end dates for each task. The horizontal bar also shows how much of a task requires completion.
- A Gantt chart helps in scheduling, managing, and monitoring specific tasks and resources in a project.
- The chart shows the project timeline, which includes scheduled and completed work over a period.
- The Gantt chart aids project managers in communicating project status or plans and also helps ensure the project remains on track.

3.15.4 Benefits of Gantt Charts

- The chart identifies tasks that may be executed in parallel and those that cannot be started or finished until other tasks are complete.
- A nicely presented Gantt chart produce with high level tasks properly organized and resources allocated to those tasks. It speaks volumes about whether you are on top of the needs of the project and whether the project will be successful.
- The Gantt chart can help detect potential bottlenecks and identify tasks that may have been excluded from the project timeline.

- The bars on the chart indicate in which period a particular task or set of tasks will be completed. This can help you to get things in perspective properly.
- The chart depicts task slack time or additional time for completion of a task that should not delay the project, noncritical activities that may be delayed and critical activities that must be executed on time.
- Gantt charts can be used in managing projects of all sizes and types. These charts are utilized in several industries and for a range of projects, such as building dams, bridges and highways, software development, and development of other goods and services.
- It can be useful to place the chart or a large version of it where everyone can see it. This helps to remind people of the objectives and when certain things are going to happen.

Project management tools, such as Microsoft Visio, Project, SharePoint, and Excel or specialized software, such as Gantto or Matchware, can help in designing Gantt charts.

3.15.5 Limitations of Gantt Charts

- **They can become extraordinarily complex :** Except for the simple projects, there will be large projects with large number of tasks undertaken and resources employed to complete the project. When the project gets to this level it must be managed by a small number of people who manages all of the details. Sometimes this does not work so well in a business that is not used to this type of management.
- Big businesses will frequently employ one or more project managers who are very skilled in this. For a range of reasons, this may not work so well in a smaller enterprise.
- **The size of the bar does not indicate the amount of work :** Each bar on the chart indicates the time period over which a particular set of tasks will be completed. However, by looking at the bar for a particular set of tasks, you cannot tell what level of resources are required to achieve those tasks.
- So, a short bar might take 500 man hours while a longer bar may only take 20 man hours. The longer bar may indicate to the uninformed that it is a bigger task, when in fact it is not.
- **They need to be constantly updated :** As you get into a project, things will change. If you are going to use a Gantt chart you must have the ability to change the chart easily and frequently. If you don't do this, it will be ignored. Again, you will probably need software to do this unless you are keeping your project management at a high level.
- **Difficult to see on one sheet of paper :** The software products that produce these charts need to be viewed on a computer screen, usually in segments, to be able to see the whole project. It then becomes difficult to show the details of the plan to an audience. Further, you can print out the chart, but this will normally entail quite a large "cut and paste" exercise. If you are going to do this frequently, it can be very time-consuming.

3.16 Project Management Information System (PMIS)

- A project management information system (PMIS) is a computer based information system that efficiently stores and organized information needed to run a project. It collects and uses project information through one or more software applications. It helps project managers to plan, execute and close their project.
- The Project Management Book of Knowledge (PMBOK) states that a PMIS is "an information system consisting of the tools and techniques used to gather, integrate, and disseminate the outputs of project management processes. It is used to support all aspects of the project from initiating through closing and can include both manual and automated systems."

There are different types of PMIS software, but most share features that include tools for scheduling, work authorization, information collection and distribution, etc. Some also have automated gathering and reporting on key performance indicators (KPIs). Others are simply a collection of files.

PMIS is made to support all aspects of project management by collecting and storing information. Some of those areas are integration management, project scope management, project cost management, project time management, project quality management, project communications management, project risk management, project procurement management and project stakeholder management.

In a project there is a lot of information to keep track of and while managing a project, it is crucial to receive information required at that moment. Therefore, a PMIS becomes important. It's the tool that gives you instant access to the required information. The information is also critical for future projects in terms of reducing risk, improving efficiencies and lowering costs.

A PMIS captures all project data and stores them in an organized way. It also makes them retrievable, searchable, categorized, shareable and analytic. To do all this, a typical PMIS uses a series of tools.

Schedule and Planning : Computes early and late schedule, slack times and the critical path

Resource Management : It includes resource loading, levelling, allocation, etc.

Budget: It associates cost with individual tasks for more accurate budget estimation and generation.

Control and Performance : It analyzes and controls cost and performance, updates existing plans as actual against planned data changes and provides what-if scenarios for the project manager.

Reporting and Communication : It facilitates creation of graphs and charts of collected and analyzed data that can be shared with stakeholders and team members.

Integration and Ease of Use : Some PMIS provide access to data from different projects for multi-project analysis, integrating with other systems, such as payroll, inventory, etc. The easier a PMIS is to use, the less time and money required to train.

3.16.1 Functions

A PMIS has different functions depending on the phase of the project.

- During the initiation phase, a project manager uses PMIS to help prepare a preliminary budget including cost estimates and resources.
- PMIS in conjunction with other tools helps with scheduling the project. In terms of approval, it helps define the scope of work, assists with preparing the bid and can be used when presenting the data to decision-makers.
- When planning, PMIS helps with detailing the scheduling including task and critical path analysis.
- It supports cost management planning including WBS analysis and integration of control processes. PMIS also proves beneficial to the project manager when resource planning in terms of availability and level. It can also help establish a baseline for project scope, schedule and cost.
- Once the project has been executed, the PMIS starts collecting, organizing and storing data as it comes in from the project team, which can then be compared to the baseline projections.
- The PMIS helps with cost and schedule forecasts to help if changes are required mid-project. Materials management, cost collect, performance measurement and, of course, reporting are all supported by PMIS.
- When closing out a project, PMIS is a great help. It helps review requirements to make sure the project has met all its goals and objectives. It also organizes all the information collected over the course of the project for performance review, productivity analysis, final reports and then keeps an archive with the historical data for future projects.

3.16.2 Advantages

- While there are manual project management information systems, the benefits of using an online or cloud-based system are numerous. With an online information system speed, capacity, efficiency, economy, accuracy and the ability to handle complex projects can all be improved. But of all these benefits, the most practical is speed.
- Once the data is collected, it can then be adjusted to reflect the results a project manager needs with great speed and accuracy. A manual program is never going to match that. Nor can it create and revise plans, schedules or budgets as quickly. What once took days or longer is now completed in seconds.
- Project managers and their organizations can store large amounts of data with a PMIS. That data is also easily accessed, prioritized and summarized as needed. And unlike a manual system, which is large and requires many support personnel, an online PMIS needs far less support and space.
- With these factors there is also a cost benefit. The cost advantage of a digital over a manual PMIS is usually significant, especially when considering storage and processing. And if inputs are correct, the chance of errors is greatly diminished with a cloud-based PMIS.

Review Questions

- Q. 1 Explain Project Planning & its purpose. (Refer Sections 3.1 and 3.1.1)
- Q. 2 Describe the important areas of Project Planning. (Refer Section 3.1.3)
- Q. 3 Explain Project Scheduling. Describe the process of Scheduling. (Refer Sections 3.2 and 3.2.1)
- Q. 4 Explain work breakdown structure. What are its advantages? (Refer Sections 3.3 and 3.3.2)
- Q. 5 Describe the process of creating a work breakdown structure. (Refer Section 3.3.3)
- Q. 6 Explain Linear Responsibility Chart. List its advantages & disadvantages. (Refer Sections 3.4, 3.4.2 and 3.4.3)
- Q. 7 Describe Interface Coordination. What are its functions? (Refer Sections 3.5 and 3.5.3)
- Q. 8 Describe concurrent engineering. List its advantages & disadvantages. (Refer Sections 3.6, 3.6.2 and 3.6.3)
- Q. 9 Explain Project cost estimating. What are its key components? (Refer Sections 3.7 and 3.7.2)
- Q. 10 Describe any four cost estimation techniques. (Refer Section 3.7.3)
- Q. 11 Describe and differentiate Bottom-up and Top-down Estimating techniques. (Refer Sections 3.8 and 3.9)
- Q. 12 Describe network Planning and the steps used in it. (Refer Sections 3.10 and 3.10.1)
- Q. 13 What is a Network Diagram? How we construct it? Explain (Refer Sections 3.11 and 3.11.2)
- Q. 14 Explain different methods of constructing network diagram. (Refer Section 3.11.3)
- Q. 15 What is Network Analysis? List its advantages. (Refer Sections 3.12 and 3.12.2)
- Q. 16 Describe Critical Path Method with its steps. (Refer Section 3.13)
- Q. 17 Describe and differentiate AOA & AON (Refer Section 3.13.3)
- Q. 18 Describe PERT. Explain the three time estimates system. (Refer Sections 3.14 and 3.14.1)
- Q. 19 Explain PERT algorithm. (Refer Section 3.14.2)
- Q. 20 Explain Gantt Charts. Describe its advantages and Limitations. (Refer Sections 3.15, 3.15.4 and 3.15.5)
- Q. 21 Explain Project Management Information System. List its advantages. (Refer Sections 3.16 and 3.16.2)



Planning Projects

Module 4

Syllabus

Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan.

Risk Management in projects : Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks.

4.1 Introduction

- Project planning is the most important part of the project life cycle. It tells what is to be achieved and how. The planning phase is when the project plans are documented, the project objectives and requirements are defined, and the project schedule is created.
- It involves creating a set of plans to help guide you through the implementation and closure phases of the project. The plans created during this phase help manage time, cost, quality, changes, risk, and related issues. They also help control staff and external suppliers to ensure that the project is delivered on time, within budget, and within schedule.
- Project scheduling is a mechanism to communicate what tasks are to be done and which organizational resources will be allocated to complete those tasks. Thus project scheduling is a document collecting all the work needed to be done to deliver the project on time.
- Project risk management is the area of project management that deals with the identification, analysis and mitigation of risks that can occur on projects. A project is a temporary endeavour undertaken to produce a unique product, service or result. This definition shows it is a risky endeavour. Since every project is unique, there are often many uncertainties surrounding it. The limited time and cost for each project also increases its risk.
- A project risk is an event that can have a positive or negative impact on the scope, cost, time and quality of the project. Risks usually have causes and if they occur, they can have multiple impacts.
- Therefore, it is important to plan for these risks, identify and prioritize them, and ensure that adequate responses are provided. The goal here is to minimize the effects of these risks so they do not negatively affect the time, scope, cost and performance of the project.

4.2 Project Resource Allocation

- Resources are essential for the initiation as well as completion of a project. But resources are always scarce. No one has abundant resources and therefore their judicious use becomes very important. Their judicious use depends on their judicious allocation.
- Thus, Resource allocation becomes a critical part of any project management. If you have a task, project or program to accomplish, you need to allocate the scarce resources to your project to help in its successful completion.
- Every project requires various resources such as skilled professionals (e.g. creative writers, developers, construction workers), tools (e.g., software, hardware, meeting rooms), and time to get everything done. In virtually every type of industry, effective resource allocation is key to delivering projects on time and on budget.

- We define resource allocation or resource management as the scheduling of activities and the resources required by project activities while taking into consideration both the resource availability and the project time.
- The basic types of resources you might need or encounter in managing a project :
1. **People** : People are the key to successful completion of any project. They may be writers, editors, user experience (UX) designers, art directors, account people, traffic managers, freelance or contract resources, developers, testers. You need people with varied skills to get your project done.
 2. **Time** : This is the total amount of time (days, weeks, months, years) you require to bring your project over the finish line. While the end date of the project may already be decided, you can divide increments of time in that period to ensure your project stays on track.
 3. **Tools and capital** : Tools and capital are essential to carry out any work. Access to specific equipment is always required to create special features or products. These will have to be planned for during the resource allocation phase of project management and allocated appropriately.
- For the planning and then allocation of the resources, a project or program manager is responsible. The project manager needs to assess what types of people, time, and tools will be needed throughout a project's schedule. Therefore, his role in the successful execution and completion of the project becomes quite vital.

4.2.1 Benefits of Resource Allocation

As you can see, following the right processes and using a complete resource management tool, you can make resource allocation easier and benefit from it in many ways :

- It improves visibility of all resources across the company
- You can avoid under and over utilization easier
- It helps to keep bookings more accurate
- It's easier to negotiate bookings with other PMs

4.3 Resource Optimization

- Resource optimization is the set of processes and methods to match the available resources (human, machinery, financial) with the needs of the organization in order to achieve the established goals. Optimization brings the desired results within a set timeframe and budget with minimum usage of the resources.. The need to optimize resources is particularly evident when the organization's demands tend to saturate and/or exceed the resources currently available.
- In Project Management, Resource Optimization Techniques are utilized to make adjustments in the implementation and completion dates of the projects, modify the organized resource used and resource accessibility. Used as a part of the Schedule Network Analysis to calculate the schedule compression of the project, Resource Optimization Techniques includes the scheduling of activities and the resources required by those activities while considering the accessibility of resources and the task time.

4.3.1 Benefits

- (i) Resource Optimization Techniques helps to evaluate how well your entire resource pool is utilized on a daily, weekly or monthly basis.
- (ii) It ensures that the revenue is utilized to maximum effect and balance the workload.
- (iii) By enhancing your resources management procedure, you will have the capacity to distinguish the shortage of skills and preparing prerequisites, reducing any future resourcing clashes and their unfriendly impacts.

- (v) Improving project delivery will help diminish expenses and increment edges. Research demonstrates that organizations that have executed a PMO have significantly reduced costs, and for Professional Services Organization, it is a typical component of the most astounding performers.
- (vi) With a breakthrough perspective of your whole resource pool, you will diminish the authoritative expenses related to keeping up these outdated frameworks. Also, you can enhance income, enhance the resources to achieve success and sustain customer relationships.

The resource optimization in project management is intended to ideally modify resources to report the principal issues affecting the activities in the task. It empowers organizations to gratify resource requests for an ideal design and allows you to accomplish the organization's objectives.

4.4 Network Crashing

- Project management is about optimizing time, cost, and quality performance on projects. These three variables are intrinsically linked. Changes in requirements of these variables frequently occur and the project manager has to re-plan the project accordingly and provide revised estimates for the linked variables.
- In practice the most common requirement for project re-planning calculations concern time and cost. Clients often ask for projects to be speeded up and need to know how much of an increase in speed is possible along with cost.
- The analysis and execution of change of time and its corresponding impact on cost is commonly known as **Network crashing**. In crash analysis, a project manager offers re-planning advice based on the functional relationship between time and cost.
- The objective is to look at that relationship for the process concerned and to generate an alternative cost and time scenarios. The client can see how much it will cost to meet a range of different time options.
- In network crash analysis, the project manager offers re-planning advice based on the relationships between time and cost. This of course assumes that performance or quality criteria are fixed, as is the case in most projects. In most cases the specified outcome is fixed.
- A Guide to the Project Management Body of Knowledge (PMBOK® Guide) - Fourth Edition defines network crashing as, "A schedule compression technique in which costs and schedule tradeoffs are analyzed to determine how to obtain the greatest amount of compression for the least incremental cost."
- As a compression technique, network crashing concentrates on the project schedule in an effort to accelerate the project's completion date. Plausible examples of crashing include the following :
 - o Over-time
 - o Allocating additional resources to specific activities
 - o Hiring additional resources
 - o Incentive payments for early completion
 - o Subsequently outsourcing portions of the project to be completed within a shorter time period than would have been possible if the same work was to be completed by internal resources.
- For any given activity a point reaches beyond which no further reduction in time will be possible irrespective of the resources spent on this activity. The time for the activity at which minimum cost is incurred is called **normal time** and the minimum time for the activity is called **crash time**. The cost associated with these times are called **normal cost** and **crash cost** respectively.
- The total direct cost of the project can be determined by adding the direct costs of each individual activity. Initially, for all activities, normal time estimates are assumed and the total project duration is computed using the computational procedure.

- If the project duration has to be reduced, then time of one or more activities has to be reduced. The activities selected should be such that the total project duration is reduced at the least cost. This process can be repeated till no further reduction in the project duration can be achieved.
- The reduction in the project duration can be achieved by reducing the time requirement of few selected activities from their normal time, the maximum reduction in time possible for any activity being up to its crash time. This process of reducing the total project duration by reducing activity timing is known as crashing project network.

4.4.1 Network Crashing Procedure

Crashing of a network can be done in following steps :

1. **Find Critical path**

Find the normal critical path and identify the critical activity.

2. **Calculate Cost slope**

- Calculate the cost slope for the different activities by using the formula,

$$\text{Cost slope} = \text{Crash cost-Normal cost}/\text{Crash time-Normal time}$$

- The cost slope indicates the extra cost required to expedite an activity per unit time.

3. **Ranking**

Rank the activities in the ascending order of cost slope. The activity having the minimum cost slope have to be crashed first, crash the selected activity to its minimum duration.

4. **Crashing**

Crash the activities in the critical path as per the ranking i.e., activity having lower cost slope would be crashed first to the maximum extent possible. Calculate the new direct cost by cumulative adding the cost of crashing to the normal cost.

5. **Parallel crashing**

As the critical path duration is reduced by the crashing in step 3, other paths also become critical, i.e., we get parallel critical path. This means that project duration can be reduced duly by simultaneous crashing of activity on the parallel critical path.

6. **Total cost**

Crashing as per steps 3 and 4, one reaches a point when further crashing is either not possible or does not result in the reduction or crashing or project duration. For the different project durations total cost is found up to total cost is got by adding corresponding fixed cost to the direct cost, and the direct cost is got by adding the expediting crashing cost commutative to the normal cost.

4.5 Resource Loading in Project Management

- In project management, the constraint is the longest chain of activities from the start of the project until the end of the project. Most projects involve many different resources at different times. The effective use of these resources defines the effectiveness of the project.
- A good project management organization must make effective use of its limited resources. This often puts pressure on managers to maximize the use of the resources so that key resources can be kept busy. But, the aim of good project

management is to complete the projects as early as possible without compromising on the deliverables. This can't happen when key resources are overloaded or distracted. Management often commits errors of overloading resources. Often it results into delayed projects with less than high quality content.

The fact is neither too little nor too much utilization of resources is desirable. It is better if we can somehow predict when our key resources will be used. Scheduling key resources to complete tasks in advance sounds like a good idea. However, key resources are often used many times in a project and frequently shared between projects. Even a small delay in a task can cause chaos in such a complicated and interrelated schedule.

While it may be possible to estimate the current workload on hand for a specific resource at any moment in time it is difficult to be accurate. Examining the workload of key resources in advance in a general way can yield leading indicators for managers to effectively use these resources.

Resource loading is basically allocating resources to the activities at the right time. Project managers with the help of resource loading can calculate the employees working hours and do the allocation of various tasks. Based on the prediction, the manager can also predict if he needs to add any employees to the project to complete it on time.

The Resource Loading technique looks forward in time for a finite period and estimates the workload of key resources during that period. It does not look at exact work schedules but the general backlog of work released for the resources.

It also assumes there is adequate work in the system to allow the resources to have work most of the time. It does not look at unique timing situations which may overload even the best planned schedule.

- Some projects are long and some are short. The Resource Loading examines all the active projects of an organization and takes a simple average of the planned length of the projects. The average is simply the sum total of the planned length of each project divided by the number of projects. The Look Ahead Period will change each time a project ends or another project starts.
- The Resource Loading examines the all uncompleted tasks remaining in each active project for Look Ahead Period. The technique looks at each resource type involved in the active projects and adds the estimated uncompleted task durations required during the Look Ahead Period.
- This total task load time for each resource type is divided by the number of resources of that type and again by the Look Ahead Period. The key resources are those that have more than a 50% workload.
- The Resource Loading can quickly identify the Key Resources of the organization. These resources determine the rate at which projects can be completed. If these resources are more than 100% loaded, the project organization has overloaded the resources and project progress is almost at a standstill.
- Keeping the key resource loading at about 75% generates fast, quality projects and optimizes the project resources. When key resource utilization falls below 75%, the key resources can be starved and the organization is not being efficient or effective.
- The Resource Loading technique is good for monitoring active work. It can also help plan ahead for the release of new work. The Resource Loading shows what impact releasing a project will have on the key resource workload. A temporary Look Ahead Period is calculated which includes all the active projects and the project that is being considered for release.
- Key resource loading is calculated considering the proposed project along with the active projects. Management can compare the different impact of starting different projects at some point in the future and make informed decisions.

4.6 Resource Leveling

- Resource Leveling is a technique in project management that overlooks resource allocation and resolves possible conflict arising from over-allocation. When project managers undertake a project, they need to plan their resources accordingly.
- This will benefit the organization without having to face conflicts and not being able to deliver on time. Resource Leveling is considered one of the key elements to resource management in the organization.
- An organization starts to face problems if resources are not allocated properly i.e., some resource may be over-allocated whilst others will be under-allocated. Both will bring about a financial risk to the organization.

Resource Leveling is used when

- A critical resource may not be available for a certain duration;
- A critical resource may not be available at a certain point of time;
- You have to share a resource with another project;
- The demand for a resource exceeds the supply.
- You also use this technique when you must keep some resource usage at a constant level. In resource leveling, you are asked to optimize the limited resources given to you. Here the schedule is not fixed. Resource Leveling answers the question of when you will be able to complete the project with the given resources.
- Resource Leveling is sometimes called Resource Constrained Scheduling (RCS). If resources are not available, the project duration may change.

4.6.1 Key Elements

- As the main aim of resource Leveling is to allocate resource efficiently, so that the project can be completed in the given time period. Hence, resource Leveling can be broken down into two main areas;
 - (1) Projects that can be completed by using up all resources, which are available
 - (2) Projects that can be completed with limited resources.
- Projects, which use limited resources, can be extended for over a period of time until the resources required are available. If then again, the number of projects that an organization undertakes exceeds the resources available, then it's wiser to postpone the project for a later date.

4.6.2 Need for Resource Leveling

- Resource Leveling helps an organization to make use of the available resources to the maximum. The idea behind resource Leveling is to reduce wastage of resources i.e., to stop over-allocation of resources.
- Project manager identify time that is unused by a resource and will take measures to prevent it or making an advantage out of it.
- By resource conflicts, there are numerous disadvantages suffered by the organization, such as:
 - o Delay in certain tasks being completed
 - o Difficulty in assigning a different resource
 - o Unable to change task dependencies
 - o To remove certain tasks
 - o To add more tasks
 - o Overall delays and budget overruns of projects

4.6.3 Structure of Resource Leveling

- Many organizations have a structured hierarchy of resource leveling. A work-based structure is as follows:
 - o Stage
 - o Phase
 - o Task/Deliverable
- All of the following mentioned layers will determine the scope of the project and find ways to organize tasks across the team. This will make it easier for the project team to complete the tasks.
- In addition, depending on the following three parameters, the level of the resources required may be different. Therefore, the resource requirement for a project is always a variable, which is corresponding to the structure.
- For resource leveling to take place, resources are delegated with tasks (deliverables), which needs execution. During the starting phase of a project, ideally the roles are assigned to resources (human resources) at which point the resources are not identified.
- Later, these roles are assigned to specific tasks, which require specialization.

4.6.4 Resource Leveling Techniques

- Critical path is a common type of technique used by project managers when it comes to resource leveling. The critical path represents for both the longest and shortest time duration paths in the network diagram to complete the project.
- However, apart from the widely used critical path concept, project managers use fast tracking and crashing if things get out of hand.
- Fast tracking : This performs critical path tasks. This buys time. The prominent feature of this technique is that although the work is completed for the moment, possibility of rework is higher.
- Crashing : This refers to assigning resources in addition to existing resources to get work done faster, associated with additional cost such as labour, equipment, etc.

4.7 Goldratt's Critical Chain Method

- Critical Chain is a schedule network analysis technique that takes into account task dependencies, limited resources availability (people, equipment, physical space), and buffers necessary to successfully complete the project. CCM allows a project manager to plan and manage project's schedule by concentrating on resources used in Critical Path (also known as the Critical Chain).
- This is a critical technique intended to speed up the process by improving the rate of meeting due dates. It focuses on planning and managing by paying attention to resources and resource management, risks, uncertainties.
- Putting a primary focus on the resources needed to complete the project's tasks, critical chain method begins by building a project schedule and identifying the most crucial tasks that need to be done and reserving resource for those high-priority tasks.
- Critical chain method does not rely primarily on estimates. This approach allows managers to eliminate uncertainties and use safety buffers to level down risks and ensure the stability of a plan. It comes into action after the preparation of the initial project schedule that includes the establishing task dependencies. The evolved critical path is reworked based on the Critical Chain Method.
- Using the Critical Chain Method, projects can be completed more quickly and with greater scheduling safety. It modifies the project schedule to account for limited resources by adding duration buffers that are non-work schedule activities. Critical chain is completed after fixing the critical path by entering resource availability, managing remaining buffer durations against the remaining duration of task chains.

4.7.1 Functions of Critical Chain Method

- Critical Chain Project Management was developed and publicized by Dr. Eliyahu M. Goldratt in 1997. According to Goldratt, delaying the work of the project to more closely follow the late schedule has the advantage of allowing the project team to learn from the experience and knowledge gained in doing other parts of the project.
- As per Goldratt's terminology, a project schedule has critical and noncritical chains of activities. The critical chain of activities is the traditional critical path but includes the effect of resources on the schedule. This means that the critical chain is the list of activities that have no float after any resource conflicts have been resolved.
- All the activities in the project that are not on the critical chain are by definition, noncritical activities and have some float associated with them. In real projects these activities tend to group themselves together to form subprojects within the project. Goldratt calls them "feeder chains." The characteristic is that the feeder chains are relatively independent of the critical chain until an activity on the critical chain depends on them. In Fig. 4.7.1, feeder chain A, B, C, D has quite a lot of independence until the time activity P on the critical chain depends on it. The same is true of other feeder chains.
- The other important point here is that the feeder chains in real projects frequently have large amounts of float as well. As projects grow, it becomes more likely that there will be groups of activities that can be brought under subprojects.
- If the feeder chains are scheduled to their early schedule dates, early starts, and early finishes, there is a disadvantage. The disadvantage is that if changes in requirements, risks, or other problems occur in the project, much of the work in the feeder chains will already be done and will have to be ripped out.
- This problem can be at least partially avoided by scheduling the feeder chains more toward their late schedule. Delaying the schedule of the feeder chains will also let us take advantage of lessons learned on the critical chain activities. These can be applied to the feeder chain activities.

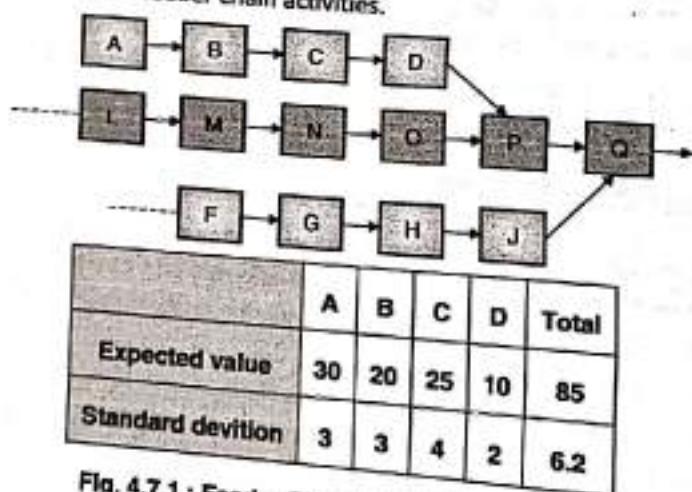


Fig. 4.7.1 : Feeder Chains and Critical Chains

4.7.2 Constraints in Critical Chain

- There is a certain amount of uncertainty in each task.
- Task durations are often overestimated by team members or task owners. This is typically done to add a safety margin to the task so as to be certain of its completion in the decided duration.
- In most cases, the tasks should not take the time estimated, which includes the safety margin, and should be completed earlier.
- If the safety margin assumed is not needed, it is actually wasted. If the task is finished sooner, it may not necessarily mean that the successor task can start earlier as the resources required for the successor task may not be available

until their scheduled time. In other words, the saved time cannot be passed on to finish the project early. On the other hand, if there are delays over and above the estimated schedules, these delays will most definitely get passed on, and, in most cases, will exponentially increase the project Schedule.

4.7.3 Critical Chain Project Management Process

1. Exploit the Constraint

Project management activities earlier were based on constraints that sometimes delayed the project. So extra reserve time is added to a project just to get it finished on time even after delays. So the first step is to let people know what you are trying to achieve. Of course, you want the average time in which an activity can be completed to make sure everything goes well. After you have got all the information, you can start constructing your critical chain using the average time, plus a buffer that's between the best and worst-case scenarios.

2. Eliminate Multitasking

Multitasking is the process of dropping a task before it is finished to start another and begin yet another. It is removed because you probably cannot do several things at once. Your projects expect 100 percent focus on the task in hand.

3. Limit your team's focus

When following the critical chain methodology for your projects, it's important to keep your team focused on individual tasks as it will lead to more productive, harmonious, collaborative behaviours. This will also add to timely task completion and efficiency.

4. Create 50/50 time estimates

The critical chain process avoids waste time and pushes the team members towards a more efficient timeline. Successful critical chain processes cut the estimated time needed for projects. Sometimes employees procrastinate. This practice will push them to finish their tasks on time.

5. Implement buffers for uncertainties

Buffers provide information on when and where recovery is needed, a buffer plan can inform you if the buffer can be removed. After you cut the estimated time needed by 50%, the remaining time can then be used as a buffer. It acts as a shock absorber for the project. Implementing project buffers with the CCPM process leads to finishing projects 25% faster.

4.7.4 Project Buffer in Critical Chain Management

- Buffers means extra time added considering the uncertainty associated with the critical chain. A buffer gives project managers time when unexpected events occur and affects the scheduling of project management. So, buffer in the project is used to protect the delivery date.
- A Project buffer added in the schedule helps in managing risk in CCM. It is put at the end in between the last task and the date of completion. It helps to keep the completion date the same despite any delays. Those delays consume buffer time what allows protecting the completion date.

There are four types of buffers :

1. **Project Buffer :** Protects the project from missing its scheduled end date and keeps the completion date unchanged. It is inserted at the end of the project network diagram, between the last task and the completion date. It protects project completion date, which might vary due to the changes in activity durations in the critical chain.

2. Feeding Buffer : It is inserted between the last task on a non-critical chain and the critical chain. These buffers are typically added to a non-critical chain so that any delays on a non-critical chain don't affect the critical chain.
3. Resource Buffer : These are added on the Critical Chain to ensure appropriate resources (people, equipment) are available throughout the project when needed. These resources are commonly known as Critical Resources.
4. Capacity Buffer : It is added on all resources necessary in case unforeseen budget issues arise.

4.7.5 Critical Chain Network Diagram

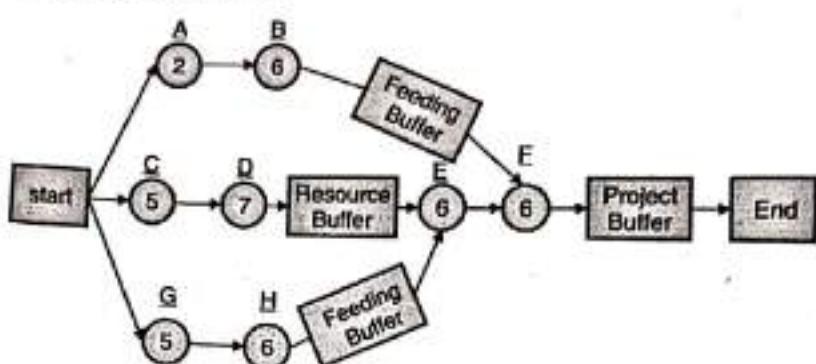


Fig. 4.7.2 : Critical Chain Network Diagram

Critical Chain is the longest path in the network diagram that takes into consideration task dependency and resource availability. (Path "Start->C->D->E->F->End" is the critical chain.) It's a modified form of Critical Path Method where project activities use aggressive time and have access to unlimited resources.

4.7.6 Benefits of Critical Control Process Management

- Although CCPM is mainly used in multi-project environments that require a lot of resources, you can apply it on your projects regardless of whether you are running a small company or a big corporation.
- CCPM is probably one of the most practical and the most important project management technique because of a number of benefits it offers:
 - (i) It allows people to become more focused on their tasks, thus increasing team productivity and efficiency.
 - (ii) It helps your team overcome the Student Syndrome phenomena (when people start working more as the deadline starts approaching).
 - (iii) It avoids mismanagement of floats.
 - (iv) It considers the minimal time needed to complete the project.
 - (v) It accelerates project completion.
 - (vi) It makes significant reduction in capital requirements.

4.7.7 Critical Chain Method of Scheduling

A Critical Chain is a resource constrained critical path. Scheduling in the new method is done by keeping the problems in mind and ensuring that we turn them into an advantage. In critical chain method,

1. The team members are encouraged to make optimistic estimates rather than traditional pessimistic estimates.
2. Buffers are not kept with individual activities, rather than the collective buffers are built at the end of each path, in this case known as a chain of activities.

- 3. Project Buffer is kept at the end of the Critical Chain (longest chain) and Feeding Buffers are kept at the end of Non-Critical Chains which are feeding into the Critical Chain thus reducing the impact of Path Convergence impacts.
- 4. Buffers are shown as activities which are under the control of the project manager.
- 5. This helps in effective use of buffers and eliminating their unnecessary wastage.
- 6. Resources are not punished if they miss a deadline of an activity, as there are buffer at the end of the chains
- 7. Late Start schedules are used rather than traditional Early Start schedules used in Critical Path Method
- 8. Resources are allocated 100% to avoid multitasking.

4.8 Stakeholders in Project Management

- A project is successful when it achieves its objectives and meets or exceeds the expectations of the stakeholders. But who are the stakeholders? Stakeholders are individuals who either care about or have a vested interest in your project.
- They are the people who are actively involved with the work of the project or have something to either gain or lose as a result of the project. They may be the members of a project team, project managers, executives, project sponsors, customers, and users. Stakeholders are people who are associated with the project and who are affected by the project at any point along the way and their input can directly impact the outcome.
- When you manage a project to add lanes to a highway, motorists are stakeholders who are positively affected. However, you negatively affect residents who live near the highway during your project (with construction noise) and after your project with far-reaching implications (increased traffic noise and pollution).
- It's a good idea to practice good stakeholder management and constantly communicate with them in order to collaborate on the project. After all, they have a stake in how it all turns out.

4.8.1 Project Stakeholders

1. Top Management

- Top management may include the president of the company, vice-presidents, directors, division managers, the corporate operating committee, and others. These people direct the strategy and development of the organization.
- The support of the top management makes it easier to recruit the best staff to carry out the project, and acquire needed material and resources; also visibility can enhance a project manager's professional standing in the company.

Some Suggestions in dealing with top management are :

- o Develop in-depth plans and major milestones that must be approved by top management during the planning and design phases of the project.
- o Ask top management associated with your project for their information reporting needs and frequency.
- o Develop a status reporting methodology to be distributed on a scheduled basis.
- o Keep them informed of project risks and potential impacts at all times.

2. The Project Team

- The project team is made up of those people who are dedicated to the project or borrowed on a part-time basis. As project manager, you need to provide leadership, direction, and follow all, the support to team members as they go about accomplishing their tasks.
- Working closely with the team to solve problems can help you learn from the team and build rapport. Showing your support for the project team and for each member will help you get their support and cooperation.

**Suggestions that can help**

- o Involve team members in project planning.
- o Arrange to meet privately and informally with each team member at several points in the project, perhaps for lunch or coffee.
- o Be available to hear team members' concerns at any time.
- o Encourage team members to pitch in and help others when needed.
- o Complete a project performance review for team members.

3. Manager

- Normally, the top management decides what the assignment is and who can work with the project manager on projects. Keeping your manager informed will help ensure that you get the necessary resources to complete your project.
- If things go wrong on a project, it is nice to have an understanding and supportive boss to go to bat for you if necessary. By supporting your manager, you will find your manager will support you more often.

Suggestions

- o Find out exactly how your performance will be measured.
- o When unclear about directions, ask for clarification.
- o Develop a reporting schedule that is acceptable to your boss.
- o Communicate frequently.

4. Peers

Peers are people who are at the same level in the organization as you and may or may not be on the project team. These people will also have a vested interest in the product. However, they will have neither the leadership responsibilities nor the accountability for the success or failure of the project that you have.

- Peer support is essential. To ensure you have cooperation and support from your peers :
- Get the support of your project sponsor or top management to empower you as the project manager with as much authority as possible. It's important that the sponsor makes it clear to the other team members that their cooperation on project activities is expected.
 - Confront your peer if you notice a behaviour that seems dysfunctional, such as bad-mouthing the project.
 - Be explicit in asking for full support from your peers. Arrange for frequent review meetings.
 - Establish goals and standards of performance for all team members.

5. Resource Managers

Because project managers borrowing resources from other managers who control those resources. So a good relationship with them is especially important. Project Managers may be able to consistently acquire the best staff and the best equipment for their projects. If relationship is not good, they may find themselves not able to get good people or equipment needed on the project.

6. Internal Customers

Internal customers are individuals within the organization who are customers for projects that meet the needs of internal demands. The customer holds the power to accept or reject your work. After the project begins, the project manager must stay tuned in to the internal customer's concerns and issues and keep the customer informed.

To meet the needs of the customer, client, or owner do the following :

- Learn the client organization's buzzwords, culture, and business.
- Clarify all project requirements and specifications in a written agreement.
- Specify a change procedure.
- Establish the project manager as the focal point of communications in the project organization.

7. External Customer

External customers are the outside customers to whom projects are marketed. In the case of Ford Motor Company, for example, the external customers would be the buyers of the automobiles. Also if you are managing a project at your company for Ford Motor Company, they will be your external customer.

8. Government

Project managers working in certain heavily regulated environments (e.g., pharmaceutical, banking, or military industries) will have to deal with government regulators and departments. These can include all or some levels of government from municipal, provincial, federal, to international.

9. Contractors, Subcontractors, and Suppliers

- There are times when organizations don't have the expertise or resources available in-house and work is farmed out to contractors or subcontractors. This can be a construction management foreman, network consultant, electrician, carpenter, architect, or anyone who is not an employee. Managing contractors or suppliers requires many of the skills needed to manage full-time project team members.
- Any number of problems can arise with contractors or subcontractors: Quality of the work, Cost overruns, Schedule slippage.
- Many projects depend on goods provided by outside suppliers. If the supplied goods are delivered late or are in short supply or of poor quality or if the price is greater than originally quoted, the project may suffer.
- Depending on the project, managing contractor and supplier relationships can consume more than half of the project manager's time. It is not purely intuitive; it involves a sophisticated skill set that includes managing conflicts, negotiating, and other interpersonal skills.

4.8.2 Culture of Stakeholders

- When project stakeholders do not share a common culture, project management must adapt its organizations and work processes to cope with cultural differences.

The following are three major aspects of cultural difference that can affect a project :

1. Communications
2. Negotiations
3. Decision making

Communication is perhaps the most visible manifestation of culture. Project managers encounter cultural differences in communication in language, context, and candour. Language is clearly the greatest barrier to communication. When project stakeholders do not share the same language, communication slows down and is often filtered to share only information that is deemed critical. The barrier to communication can influence project execution where quick and accurate exchange of ideas and information is critical.

The interpretation of information reflects the extent that context and candour influence cultural expressions of ideas and understanding of information. In some cultures, an affirmative answer to a question does not always mean yes. The cultural influence can create confusion on a project where project stakeholders represent more than one culture.

4.8.3 Managing Stakeholders

- Often there is more than one major stakeholder in the project. An increase in the number of stakeholders adds stress to the project and influences the project's complexity level. The business or emotional investment of the stakeholders in the project and the ability of the stakeholder to influence the project outcomes or execution approach also influences the stakeholder complexity of the project. In addition to the number of stakeholders and their level of investment, the degree to which the project stakeholders agree or disagree, influence the project's complexity.
- Therefore, take the time to identify all stakeholders before starting a new project. Include those who are impacted by the project, as well as groups with the ability to impact the project. Then, begin the process of building strong relationships with each one using the following method.
 1. **Analyze stakeholders** : Conduct a stakeholder analysis, or an assessment of a project's key participants, and how the project will affect their problems and needs. Identify their individual characteristics and interests. Find out what motivates them, as well as what provokes them. Define roles and level of participation, and determine if there are conflicts of interest among groups of stakeholders.
 2. **Assess influence** : Measure the degree to which stakeholders can influence the project. The more influential a stakeholder is the more a project manager will need their support. Knowing what each stakeholder needs or wants from the project will enable the project manager to gauge his or her level of support.
 3. **Understand their expectations** : Nail down stakeholders' specific expectations. Ask for clarification when needed to be sure they are completely understood.
 4. **Define "success"** : Every stakeholder may have a different idea of what project success looks like. Discovering this at the end of the project is a formula for failure. Gather definitions up front and include them in the objectives to help ensure that all stakeholders will be supportive of the final outcomes.
 5. **Keep stakeholders involved** : Don't just report to stakeholders. Ask for their input. Get to know them better by scheduling time for coffee, lunch, or quick meetings. Measure each stakeholder's capacity to participate and honour time constraints.
 6. **Keep stakeholders informed** : Send regular status updates. One update per week is usually about right. Hold project meetings as required but don't let too much time pass between meetings. Be sure to answer stakeholders' questions and emails promptly. Regular communication is always appreciated – and may even soften the blow when you have bad news to share.

4.9 Project Communication Plan

- A project communication plan is an important part of a project that helps a project manager to communicate effectively with his client, team, and other stakeholders of the project. It describes clear guidelines for information to be shared. It also defines who's responsible for and needs to be a part of project communication.
- A project communication plan is a critical part of any project. How well you communicate throughout the lifecycle of your project can make the difference between success and failure.
- During the planning phase of your project, you need to create a high level Communication Plan that defines the general communication requirements for your project. This plan should include:
 - o The plan's purpose and approach
 - o Communication goals and objectives
 - o Communication roles
 - o Communication tools and methods, and
 - o High level project communication messages

4.9.1 Communication Objectives

The plan begins by defining what you expect to achieve by communicating. This could be any number of things and is dependent on what your project will accomplish. Generally, these should be focused on educating and updating anyone impacted by the project. Here are a few ideas :

- Increase knowledge about the project and why it's important
- Create a dialogue among employees and key stakeholders to gain acceptance of the project.
- Provide opportunities for feedback from stakeholder groups

A communication plan plays an important role in every project by :

- o Creating written documentation everyone can turn to
- o Setting clear expectations for how and when updates will be shared
- o Increasing visibility of the project and status
- o Providing opportunities for feedback to be shared
- o Boosting the productivity of team meetings
- o Ensuring the project continues to align with goals

4.9.2 Creating Your Project Communication Plan

A communication plan must be created for the project. To do this, it's important to spend time gathering input from all stakeholder groups to ensure the plan is comprehensive. It's also important to note that changes may need to be made to the plan as the project moves forward. Here's the general framework.

1. Plan Purpose and Approach

It is always beneficial to include a high level description of the plan like why it exists and a general idea of how you will implement the plan on your project. Think of this as a summary section. It helps you capture the essence of what you have detailed in the plan.

2. Communication Roles

Communication won't come from just one person during your project. Clearly define all roles and their corresponding communication responsibilities. Here are a few roles to consider :

- Project Sponsor
- Project Manager
- Leadership / Management Team
- Steering Team
- Project Lead
- Project Team Member

3. Communication Tools

Selection of the tools that you use and how a message is delivered will vary from project to project. Your preferred tools should be those which can easily be comprehended by the receiving group.

Always keep your receiver in mind when developing the content of the communication and the method in which it will be delivered. Methods that offer opportunities for people to ask questions or provide feedback can provide beneficial.

Brainstorming a list of possible tools can get you started. Here are just a few :



- Meeting summaries
- Status reports
- Newsletters
- Formal presentations
- Surveys
- Internet / Intranet Web Page
- Informal small group meetings
- Brown bag lunch workshops
- Custom project dashboards

4. Communication Methods

There's no single right way to communicate on a project. In fact, your communication plan can and should include a variety of communication methods. Here are a few to consider :

- Email
- Meetings (in-person, phone, or video chat)
- Discussion boards
- Collaboration apps
- To-do lists
- Surveys

4.9.3 Writing a Project Communication Plan

Writing a project management communication plan is as simple as following these 5 steps :

1. List your project's communication needs

Every project is different. Therefore, take the size of the project, the nature of work being done, and even the client's unique preferences into account to determine which types of communication this project needs to succeed.

2. Define the purpose

- Bombarding people with too many emails or unnecessary meetings can interfere with their ability to get work done and cause them to overlook important updates.
- Be purposeful in your plan, and ensure every communication you include has a reason for being. If you're really ambitious, go ahead and outline a basic agenda for the topics that will be covered in each meeting or report.

3. Choose a communication method

Think how your team works best, so they can stay in the loop while still being productive. If your client prefers the personal touch of a phone call, build that into your plan too.

4. Set a cadence for communication

Establishing a regular frequency for communication streamlines the process by setting clear expectations from the get-go. This not only frees you from fielding random requests for status updates. It also enables project members to carve out space for important meetings and reports ahead of time.

Identify the owner and stakeholders

Assigning ownership creates accountability so your carefully crafted plan can reach its full potential. As the project manager, you will be responsible for most communications, but there may be some you want to delegate to others. While you are naming names, list the audience or stakeholders for each communication type too. That way key players come prepared to provide updates when needed.

4.10 Risk Management In Project

Risk is inevitable in a business organization when undertaking projects. PMI defines risk as an uncertain event or condition that has a positive or negative effect on a project's objectives. Basically, risk is any unexpected event that can affect your project for better or for worse.

However, the project manager needs to ensure that risks are kept to a minimal. This can be done by having a risk management in a project. Risk Management is the process used by project managers to minimize any potential problems that may negatively impact a project's timetable.

Risk could be any unexpected event that might affect the people, processes, technology, and resources involved in a project. Unlike Issues, which are certain to happen, risks are events that could occur but you may not be able to tell when. Because of this uncertainty, project risk requires serious preparation in order to manage them efficiently.

Risks can be mainly divided between two types, negative impact risk and positive impact risk. It is not that project managers face only negative impact risks as there are positive impact risks too. Once the risk is identified, project managers need to come up with a mitigation plan or any other solution to counter attack the risk.

4.10.1 Project Risk Management

The project risk management consists of six processes listed as follows :

1. Plan risk management
2. Identify risks
3. Perform qualitative analysis
4. Perform quantitative analysis
5. Plan risk responses
6. Control risks

We will explore the inputs, tools and techniques and outputs (ITTOs) of the risk management processes here :

1. Plan Risk Management

- In this process, the risk management activities are defined, and the major output of this process is a risk management plan. This process is started when the project is conceived and it continues through the project. The goal here is to increase the probability of the success of other risk management processes.
- The major inputs to this process are the project charter (the document which appoints the project manager and provides high level description of the project), the project management plan (which includes the schedule, scope and cost baselines), and the stakeholder register (which contains all the project stakeholders, and their roles).
- In planning risk management, the project manager must analyze the various risk attitudes (risk appetite, thresholds, and tolerances) of stakeholders in order to determine the appropriate resources and risk management activities required for the project.



2. Identify Risks

- The risk identification process involves determining and documenting the risks that can affect project events. This helps the project team to anticipate uncertainties.
- The inputs to this process include key elements of the project management plan such as the risk, cost, quality, human resource and schedule management plans, and scope baseline. Other inputs include the stakeholder register, procurement documents and all other project documents that can provide insights about the risks that a project may face.

To identify risks, the project documents should be reviewed. Also, information gathering methods should be employed. Some of the recommended information gathering techniques include :

- (i) **Brainstorming** : This involves bringing together a multi-disciplinary team of experts, coordinated by a facilitator (usually the project manager) to generate ideas that are used to identify and categorize the risks that might occur on a project.
- (ii) **Delphi Technique** : This is a way to gather consensus of experts by seeking their opinions independently. The goal here is to ensure that the experts are not influenced by the decisions of other experts so as to eliminate bias.
- (iii) **Interviewing** : This involves performing one-on-one interviews with stakeholders to identify risks.
- (iv) **Root cause analysis** : This involves analyzing a problem to determine the underlying causes of the problem and to determine if these causes are still project risks that should be documented.

3. Perform Qualitative Risk Analysis

- The qualitative risk analysis involves prioritizing risks for further analysis (quantitative analysis) or action. The goal here is to determine the most important risks so the project team can focus their attention on those risks. This is done by determining the probability of occurrence of the risks and their impact on the project.
- The major inputs of the qualitative risk analysis process are the identified risks, the project management plan and the scope baseline. Other inputs can include industry studies and prior information from previous projects.

4. Perform Quantitative Risk Analysis

- This process involves quantifying the effect of the risks on the overall project objectives. It is not uncommon to have risks that have effects that cannot be accurately measured and in this case, a project manager has to decide how much time and effort can be spent exploring these risks.
- The major inputs to this process include the risk register, the risk management plan, and the cost and schedule management plans. Other inputs to this process include external factors in the industry and internal organization information from prior projects.

5. Plan Risk Responses

- After all the analysis, the project team needs to create a plan to respond to these risks, in the event that they occur. The plan risk process involves designing actions to take advantage of positive risks (opportunities) and to reduce threats to the project objectives.
- The core of planning risk responses are the strategies for addressing the risks. The strategies that a project manager would employ for addressing risks is usually dependent on the nature of the risk, the impact, and the resources (time, human and material resources) available to the Project Manager.

Control Risks

- The Risk control process involves implementing risk responses, identifying new risks, monitoring residual and secondary risks and ensuring that the risk process is effective throughout the project.
- Inputs to the process would include the project management plan, the risk register and the work performance information.
- To control risks, risk reassessments, audits and analysis are carried out throughout the course of the project to determine the impact of the risks and the effectiveness of their responses.
- For effective risk control, variance analysis is also carried out to measure deviation from the initial project baselines. Also, the technical performance of the project team is measured regularly to ensure that no quality issues have occurred due to risk factors.

4.10.2 Project Risk Management Planning

Project risk management plan is a set of steps that can identify, anticipate, and employ solutions in case the project runs into issues/problems. A good project risk management plan can face unexpected problems that arise, as the planner has taken into consideration all the possible scenarios that can go wrong while executing the project.

An excellent project risk management plan can decrease the level of problems affecting the project by around 80% – 90%, which is a good range to be in.

It is essential for any project on the line to include a plan to manage the risks anticipated for that project. All projects have a percentage of risk hovering them and it always falls in need to have a project risk management plan at hand.

The project risk management plan should contain the following attributes and elements :

- o **Process :** A process is adopted in order to identify, analyze, evaluate, and mitigate risks throughout the project life cycle.
- o **Budget :** There is always risk on costing of the project as when the project starts there are bound to be changes as the project's proceeds. The method of dealing with such a change needs to be elaborated in the project risk management plan.
- o **Work Breakdown Structure :** The strategies involved in the project risk management are to be transferred to the WBS such as how and when needs to be included in the project risk management plan.
- o **Risk Register :** The frequency of reviewing the risk register is an important part in the project risk management plan.
- o **Roles and Responsibilities :** When the project runs into an issue with risk attached to it, the plan will let the project member know about the in-charge of different scenarios.
- o **Reporting Structure :** This is the same as with the roles and responsibilities but briefly elaborates on the reporting structure in the situation of encountering a risk and in whose hands do the decisions need to lie.
- o **Risk Categories :** Risk needs to be carefully categorized and slated for proper organization of information.

There are 6 basic steps that need to be followed in order to develop an all encompassing and successful project risk management plan. They are as follows :

1. Identifying the Risk and Creating a Risk Register

- Before thinking about managing and mitigating risks, It's important to know them and identify them correctly. If you miss on a risk while identifying possible threats, you are putting the project and its completion at risk itself.

- All the identified risks are detailed down into the Risk Register and a level is attached to each risk put down. These levels are based on the likely occurrence of the risk in the due course of the project life cycle and its seriousness.

2. Analyzing and Evaluating Risks

- Once the risks associated to the project are identified, the next step is to analyze and evaluate each risk to determine their effect on the successful completion of the project. Risks should be analyzed and evaluated considering the following two criteria:
 - (i) Likelihood
 - (ii) Level of Impact
- Project managers are urged to rate each risk listed into the risk register on the scale of low, moderate, and high likely occurrence rate and low, moderate, and high seriousness of impact rate. They can create a matrix to draw out these evaluations so as to gain a wholesome idea about the risks and their influence on the project.

3. Identifying Risk Triggers

- At this stage, the project manager can determine the roles and responsibilities that each team and the team members take up when faced with a risk scenario. Authoritative power is given to individuals to manage and settle the budgets for each risk and they are responsible for coming up with ideas and a plan for those ideas, with the project manager in tow.
- Roles and responsibilities can be distributed based on the department, working title, or expertise of the individual or team.

4. Brainstorming for Solution Ideas

- Each team now takes up their risks and brainstorms into ideas that subdue the threats. These should be preventive measures or contingency plans taken by the team at the start of the project to decrease or eliminate the effects these risks have on the completion of the project.
- Opportunities are most often the positive risks in the project and, more so often, these opportunities can in fact neutralize the negative risks that we focus on. Project managers should urge the project risk management team through ways of the project risk management plan to pay close attention to even the opportunities to mitigate risks.

5. Creating a Plan

- The risks are identified, the possible solutions or measures are taken into account, what is left to create is an action plan for these. This action plan is the fundamental unit of the project risk management plan and for a project manager owning this plan, they will need to document all the possible solutions to all the different risks identified across the project. These plans are basically risk mitigation strategies in play to keep the risks at bay. These risk mitigation strategies will either reduce the chances of the risk being accomplished or will reduce the impact of the risk at hand. These risk mitigation strategies are born out of the ideas belted out the brainstorming session held. There are two types of mitigation strategies. They are as follows :
 - (i) **Preventative** : This strategy is designed in a manner so as to reduce the likelihood of the risk or seriousness of the risk way before the risk is even realized.
 - (ii) **Contingency** : These are planned actions in the event of the risk being realized. The risks that are at the highest priority will need to be attended to first by the project manager and their mitigation plans need to be realized before the project starts or as per the action plan. The risks with a lower priority can be taken care of later, but cannot be ignored or neglected.

Monitoring and Reviewing Risks

6. While the project proceeds as per the project plan, alongside runs the project risk management plan taking care of all the risks that the project might encounter on its way to completion.
- Since all the proceeds of the project risk management plan is documented in the risk register, it's important to review this document at regular intervals of time. Consider the review period to be fortnightly.
- Project risk management is an iterative process and should be seamlessly woven into the management of your entire project. It should be closely integrated to the issue management framework because unresolved issues slowly succeed to become potential risks.

4.11 Risk Identification

As a project manager working on a new project it's necessary for you to carry out a thorough risk management analysis to ensure that the project is delivered by an agreed deadline and at an agreed cost. Risk management will ensure that the core functionalities of the project will be delivered and that the design standards will not be compromised.

The risk management process on a project consists of four steps :

1. Risk identification
2. Risk assessment
3. Risk response development, and
4. Risk response control

- Risk identification is the process of listing potential project risks and their characteristics. The results of risk identification are normally documented in a risk register, which includes a list of identified risks along with their sources, potential risk responses, and risk categories.
- This information is used for risk analysis, which in turn will support creating risk responses. Identified risks can also be represented in a risk breakdown structure, a hierarchical structure used to categorize potential project risks by source.
- Though the major work on risk identification is usually done in the beginning of a project, it's important to remember that risk identification is an iterative process; new risks can be identified throughout the project life cycle as the result of internal or external changes to a project.

4.11.1 Identifying Risks

- This process involves preparing checklists of potential risks and evaluating the likelihood that those events might happen on the project. Some companies and industries develop risk checklists based on experience from past projects.
- The checklists can be helpful to the project manager and project team in identifying both specific risks on the checklist and expanding the thinking of the team. The past experience of the project team, project experience within the company, and experts in the industry can be valuable resources for identifying potential risk on a project.

Identifying the sources of risk by category is another method for exploring potential risk on a project. Some examples of categories for potential risks include the following :

- o Technical
- o Cost
- o Schedule
- o Client
- o Contractual

- Weather
 - Financial
 - Political
 - Environmental
 - People
- The result is a clearer understanding of where risks are most concentrated. This approach helps the project team identify known risks, but can be restrictive and less creative in identifying unknown risks and risks not easily found inside the WBS.

4.11.2 Identification Essentials

Risk identification is a process of brainstorming. It involves continuous implementation as new phases, experiences, and viewpoints are introduced. Being vital to the management process, there are some essentials to risk identification that guarantee maximum results.

1. Team Participation

Face-to-face interactions between project managers and the team promise better and more comprehensive communication. The team must feel comfortable to share and find hidden or elusive risks.

2. Repetition

Information changes and appears as the risk management process proceeds. Keeping identified risks current and updated means the system is focused on mitigating the most prevalent issues.

3. Approach

Certain objectives require distinct approaches to best combat identification failure. One method is to identify all root causes, undesirable events, and map their potential impacts. Another is to identify essential performance functions the project must enact to be successful then find possible issues with each function or goal.

4. Documentation

Consistent and exhaustive documentation leads to comprehensive and reliable solutions for a specific project or future risk management team's analysis. Most communication is recorded by a project manager and data is copied, stored, and updated for continued risk prevention.

5. Roots and Symptoms

It is essential in the risk identification phase to find the root causes of a risk instead of mistaking them with the symptoms. A symptom can be confused with the root cause, making it critical to discover the origin of risks and denote what their symptoms are.

6. Project Definition Rating Index (PDR)

PDR is a risk assessment tool that helps develop mitigation programs for high-risk areas. It facilitates the team's risk assessment within the defined project scope, budget, and deadlines. It also provides further detail of individual risk and their magnitude, represented by a score.

7. Event Trees

Commonly used in reliability studies and probabilistic risk assessments, event trees represent an event followed by all factors and faults related to it. The top of the tree is the event and it is supported by any condition that may lead to that event, helping with likelihood visibility.

4.12 Risk Register

A risk register, also known as a risk log, is an important component of the risk management system. A risk register is a tool that helps you track details of the risks associated with a project and address them as they arise. It is created during the early stages of a project. A risk register is used to identify, assess, and manage risks to acceptable levels through a review and updating process.

4.12.1 Purpose of a Risk Register

- The purpose of a risk register in project management is to record the details of all risks that have been identified along with their analysis and plans for how those risks will be addressed.
- Risk register identifies risks along with their severity. It also outlines the actions and steps to be taken to mitigate the risk. The risk register database can be viewed by project managers as a management tool for monitoring the risk management processes within the project. It is the responsibility of the project manager to ensure that the risk register is updated whenever necessary. The task of updating the risk register is usually delegated to the project control function.

The list of risks that are identified and recorded in the risk register drives the following risk management processes.

1. Perform Qualitative Risk Analysis

In the Perform Qualitative Analysis process, details are added to the existing list of risks in the risk register including the priority, urgency, categorization of risks, and any other trends that were noticed while performing this process. Risks that have been managed, avoided, or are no longer relevant can be removed from the risk register. The associated risk action plans can also be deleted from the risk register.

2. Perform Quantitative Risk Analysis

In the Perform Quantitative Risk Analysis process, the risk register is updated with the probabilities associated with each identified risk and the probability of meeting the cost and time projections. Additionally, risk priorities are updated and trends that have been observed are also noted.

3. Plan Risk Response

- In the Plan Risk Response process, a specific response plan is created to manage each risk. These risk response plans are updated in the risk register as an output of this process.
- While managing risks, not all risks are negative there are positive risks as well which are called opportunities. A project manager should devise strategies for managing negative risks or threats as well as positive risks or opportunities.

4. Monitor and Control Risk

In the Monitor and Control risks process, risk management plans are re-assessed and re-evaluated. The risk register is updated with information on new risks. This information should be regularly updated in the risk register, whether it is changing to the risk estimates or actual numbers such as costs related to weather damage.

4.12.2 Risk Register Creation

- As per the PMBOK Guide, the risk register is the output of the Risk Identification process. This process is a part of the planning process used to identify the risks, which could impact the project and understand the nature of those risks.
- Although the Risks Identification process is performed early on in the project, risks change over time and new risks can arise. Therefore, it may be necessary to perform the Identify risks process multiple times throughout the project.

4.12.3 Contents of Risk Register

- Risk Category :** Risks are categorized as per their severity. Some of the categories created are scope, time, cost, resources, environmental, or another key category. Using these categories helps tease out likely risks and groups them into relevant categories for future reference.
- Risk Description :** A brief description of the potential risk is recorded. For instance, the first potential risk identified in the Resources category is: "There is conflict over resources and team members don't have enough time due to competing demands."
- Risk ID :** A unique identification number is used to identify and track the risk in the risk register. If Resources is Category 8, then the first risk identified in this category has a unique ID of 8.1.
- Project Impact :** A description of the potential impact on the project as a result of the risk is also written. For example: "The project schedule may slip, budget may increase and project scope may not be achieved."
- Likelihood :** Here, the estimated likelihood or probability that the risk will occur at some point and become a project issue is recorded. This can be qualitative: high, medium, or low; but it can also be quantitative if enough information is available. For our example, we know that resources have been over-committed in the past and we assess the likelihood of occurrence as "High."
- Consequence :** The potential consequence or impact of the risk if it becomes a project issue is also written. For our project, time is a fixed constraint, and so any risk that has the potential to significantly delay the project schedule has a "High" consequence.
- Risk Rank :** This is the magnitude or the level of the risk. It is a combination of likelihood and consequence. As they are both "High" in our example, then the risk rank is also "High."
- Risk Trigger :** The triggers that indicate the need to implement contingency plans are mentioned in the risk register. For example, "If resource conflicts have not been resolved three weeks before the scheduled start date, then implement contingency plans."
- Prevention Plan :** This is an action plan to prevent the risk from occurring. For our example, the Prevention Plan includes: Liaise with functional managers and team members to pre-empt future conflicts; and specify and agree resource needs (staff and equipment) with functional managers.
- Contingency Plan :** This is an action plan to address the risk if it does occur. For our example, the Contingency Plan includes: "Train and up-skill existing team members in combination with HR department."
- Risk Owner :** This is the details of the person responsible for managing the risk and implementing the Prevention or Contingency Plans. Stakeholders, members of the project team, the Project Manager and the Project Sponsor can all be risk owners.
- Residual Risk :** This is the risk that remains after treatment is carried out. After treatment, we assess the residual risk level as "Low"

4.13 Qualitative Risk Analysis

- Qualitative risk analysis is the process of evaluating the potential losses to a project from a particular risk. It is analyzed using a combination of known information about the situation, knowledge about the underlying process, and judgment about the information that is not known or well understood.
- A qualitative risk analysis prioritizes the identified project risks using a pre-defined rating scale. Risks are scored based on their probability or likelihood of occurring and the likely impact on project objectives.
- Probability/liability is commonly ranked on a zero to one scale (for example, .3 equating to a 30% probability of the risk event occurring).

- The impact scale is organizationally defined (for example, a one to five scale, with five being the highest impact on project objectives - such as budget, schedule, or quality).
- A qualitative risk analysis also includes the appropriate categorization of the risks, either source-based or effect-based.

4.13.1 Reasons to Perform Qualitative Risk Analysis

- Project managers and teams have to deal with competing demands as there is often more work to be done in less time. Therefore, prioritization of our work becomes important.
- As there is always one or the other risk possible, the evaluation of risks becomes necessary to discriminate between different risks. Thus it creates the necessity for performing a qualitative risk analysis. This helps us determine the time and budget to invest in responding to our risks. With many risks, sometimes we also choose to do nothing if the probability and impact are not great enough to merit a response. Thus, we simply accept the risk.
- Qualitative Risk Analysis is necessary after risk factors have been identified. It should be performed for every project, no matter the size, deadline, or quality.
- The reason being that qualitative risk analysis examines every single risk that could lead to project disaster. It prepares the team for "worst case scenarios" and how to avoid or handle the risks if they do happen.

4.13.2 Methods of Qualitative Risk Analysis

- Here, the risk scale is textual. You calculate risk in low, medium, or high probability. It also can be colour coded, numeric, or a combination of all.
- In this respect, the measurement is more detailed than with quantitative risk analysis. Quantitative measures in monetary (funding, expenses, costs) and schedule (days, weeks, months and years) terms.
- A properly conducted qualitative risk analysis highlights potential issues in a project that can or will limit progress. With qualitative risk analysis, you will note the complexity of the risk, probability, and impact to create a proper plan of action.

We consider four of the most useful Qualitative Risk Analysis techniques applied in project management, which are as follows :

1. Delphi Technique

This is a form of risk brainstorming. Delphi Technique makes use of expert opinion to identify, analyse and evaluate risks on an individual and anonymous basis. Each expert then reviews other expert's risks, and a risk register is produced through continuous review and consensus between the experts.

2. SWIFT Analysis

Standing for "Structured What-If Technique", this is a simplified version of a HAZOP. SWIFT applies a systematic, team-based approach in a workshop environment, where the team investigates how changes from an approved design, or plan, may affect a project through a series of "What If" considerations. This technique is particularly useful in evaluating the viability of Opportunity Risks.

3. Decision Tree Analysis

Similar to Event Tree Analysis, but without providing a fully quantitative output, Decision Tree Analysis is most often used to help determine the best course of action wherever there is uncertainty in the outcome of possible events or proposed plans. This is done by starting with the initial proposed decision and mapping the different pathways and outcomes as a result of events occurring from the initial decision. Once all pathways and outcomes have been established, and their respective probabilities evaluated, a course of action may be selected based on a combination of the most desirable outcomes, associated events and probability of success.

4. Bow-tie Analysis

This is one of the most practical techniques available in helping identify risk mitigations. Bow-tie Analysis starts by looking at a risk event and then projects this in two directions. To the left, all the potential causes of the event are listed and, to the right, all the potential consequences of the event are listed. It is then possible to identify and apply mitigations (or barriers) to each of the causes and consequences separately, effectively mitigating both the probability of risk occurrence and the subsequent impacts, should the risk still occur.

4.14 Quantitative Risk Analysis

- Quantitative Risk Analysis is a project management process that numerically analyzes the effects of identified risks on the entire project objectives. The benefit of this process is that it creates information of the quantitative risks to support the decision-making of project managers to minimize the uncertainty of the projects.
- This particular project management process is used on the risks that have been identified and prioritized by the Perform Qualitative Risk Analysis process that can substantially impact the competing demands of the project.
- Thus, Quantitative Risk Analysis is used to analyze the effects of the risk on the project objectives. It is used in evaluating the aggregate effects of the risks that affect the project. It is important to take note that the process is used to provide numerical priority rating to the individual risks.
- The concept of quantitative risk analysis is of fundamental importance when it comes to assist the project management team or the project management team leader to take the action at the onset or prior to the onset of the project to adequately and appropriately ascertain the approximate level of risk that so may exist in regards to the conduction of the given project and/or series of projects.

4.14.1 Importance of Quantitative Risk Analysis

1. **Better Overall Project Risk Analysis :** Individual risks are evaluated in the qualitative risk analysis. But the quantitative analysis allows us to evaluate the overall project risk from the individual risks.
2. **Better Business Decisions :** Business decisions are rarely made with all the information or data we desire. For more critical decisions, quantitative risk analysis provides more objective information and data than the qualitative analysis. While the quantitative analysis is more objective, it is still an estimate.
3. **Better Estimates :** It helps in preparing accurate estimates. For example, a project manager estimated a project's duration at eight months with a cost of Rs. 3 million. The project actually took twelve months and cost Rs. 3.8 million. The reason for this variation is the fact that the project manager did a Work Breakdown Structure (WBS) and estimated the work. However, the project manager failed to consider the potential impact of the risks (good and bad) on the schedule and budget.

4.14.2 Usage of Quantitative Risk Analysis

Quantitative Risk Analysis is more often used for

- Projects that require a Contingency Reserve for the schedule and budget.
- Large, complex projects that require Go/No/Go decisions which may occur multiple times in a project.
- Projects where upper management wants more detail about the probability of completing the project on schedule and within budget.

4.14.3 Quantitative Risk Assessment Tools & Techniques

Quantitative Risk Analysis tools and techniques include but are not limited to :

1. **Three Point Estimate** : This technique uses the optimistic, most likely, and pessimistic values to determine the best estimate.
2. **Decision Tree Analysis** : It is a diagram that shows the implications of choosing one or other alternatives.
3. **Expected Monetary Value (EMV)** : This method is used to establish the contingency reserves for a project budget and schedule.
4. **Monte Carlo Analysis** : This technique uses optimistic, most likely, and pessimistic estimates to determine the total project cost and project completion dates. For example, we could estimate the probability of completing a project at a cost of Rs. 20M. Or what is a company wanted to have an 80% probability of achieving its cost objectives. What is the cost to achieve 80%?
5. **Sensitivity Analysis** : This technique is used to determine which risks have the greatest impact on a project.
6. **Fault Tree Analysis (FMEA)** : This technique uses the analysis of a structured diagram which identifies elements that can cause system failure.

4.15 Probability and Impact Matrix

- **Risk Probability** is the determination of the probability of a risk occurring. This can be based on either historical project information or the interviews or meetings with individuals who have knowledge of the probability of risks occurring. When determining the probability of a risk occurring it is often given a score such as high = 3, medium = 2, or low = 1.
- **Impact Assessment** is the evaluation of the impact of a risk if it were to occur. If the risk occurs would it be catastrophic to the project or a minor inconvenience. An impact assessment is generally conducted in meetings or in interviews with individuals who have the appropriate knowledge to evaluate the impact of a risk. Upon completion of an impact assessment a risk is often given an impact score such as high = 3, medium = 2, or low = 1.
- **Probability and Impact Matrix** is a tool for the project team to aid in prioritizing risks. There may be several risks in any project. Depending on the size and complexity of the project in hand, the risks may vary somewhere from double digits to triple digits. But we often do not have the time and money to look into all these risks, let alone the response action. So, it is necessary to find a way to identify those critical risks which needs the most attention from the project team.
- **Probability and Impact Matrix** uses the combination of probability and impact scores of individual risks and ranks/prioritizes them for easy handling of the risks. In other words, the probability and impact matrix helps to determine which risks need detailed risk response plans. It is vital to understand the priority for each risk as it allows the project team to appreciate the relative importance of each risk.
- For example, a risk with a high probability/likelihood of occurring and which will have a high impact on the project objectives will likely need a response plan.
- **A Probability and Impact Matrix** is a visual representation of the results from Risk Probability and Impact Assessments. The matrix generally used is a 3x3 matrix (with Low, Medium, High rating for Probability and Impact) or 5x5 matrix (with Very Low, Low, Medium, High and Very High ratings for probability and impact). A sample Probability-Impact Matrix is given Here for your reference.

		Impact				
		Trivial	Minor	Moderate	Major	Extreme
Probability	Rare	Low	Low	Low	Medium	Medium
	Unlikely	Low	Low	Medium	Medium	Medium
	Moderate	Low	Medium	Medium	Medium	High
	Likely	Medium	Medium	Medium	High	High
	Very likely	Medium	Medium	High	High	High

Fig. 4.15.1 : Example of Probability-Impact Matrix

- If a particular risk has a moderate probability and the estimated impact of this risk is major, then you look into the respective row and column to identify the risk rating. For a moderate probability and major impact, the risk rating in the matrix is "Medium". The colours are visual indications of the seriousness of the risks.
- Risks can be prioritized for further quantitative analysis and planning risk responses based on their risk rating. Ratings are assigned to risks based on their assessed probability and impact. Evaluation of each risk's importance and priority for attention is typically conducted using a look-up table or a probability and impact matrix.
- Such a matrix specifies combinations of probability and impact that lead to rating the risks as low, moderate, or high priority. Descriptive terms or numeric values can be used depending on organizational preference.
- Each risk is rated on its probability of occurrence and impact on an objective if it does occur. The organization should determine which combinations of probability and impact result in a classification of high risk, moderate risk, and low risk. In a black-and-white matrix, these conditions are denoted using different shades of gray.
- These risk-rating rules are specified by the organization in advance of the project and included in organizational process assets. Risk rating rules can be tailored in the Plan Risk Management process to the specific project.

4.15.1 How to Use the Tool ?

The Risk Impact/Probability Chart is based on the principle that a risk has two primary dimensions :

1. Probability

A risk is an event that "may" occur. The probability of it occurring can range anywhere from just above 0 percent to just below 100 percent. (Note: It can't be exactly 100 percent, because then it would be a certainty, not a risk. And it can't be exactly 0 percent, or it wouldn't be a risk.)

2. Impact

- A risk, by its very nature, always has a negative impact. However, the size of the impact varies in terms of cost and impact on health, human life, or some other critical factor.
- The chart allows you to rate potential risks on these two dimensions. The probability that a risk will occur is represented on one axis of the chart – and the impact of the risk, if it occurs, on the other.
- The basic form of the Risk Impact/Probability Chart is shown in Fig. 4.15.2.

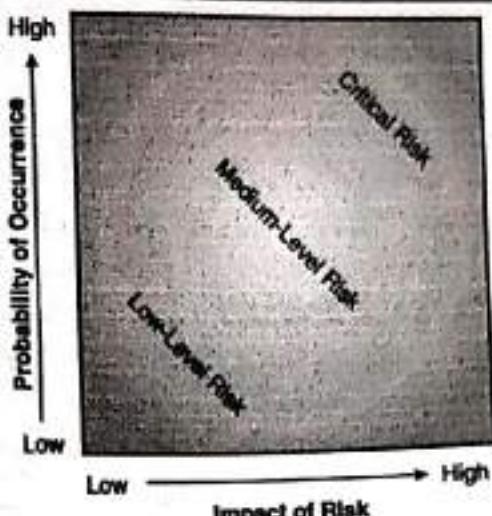


Fig. 4.15.2 : Risk Impact/Probability Chart

The corners of the chart have these characteristics :

- (i) **Low impact/low probability** : Risks in the bottom left corner are low level, and you can often ignore them.
- (ii) **Low impact/high probability** : Risks in the top left corner are of moderate importance – if these things happen, you can cope with them and move on. However, you should try to reduce the likelihood that they'll occur.
- (iii) **High impact/low probability** : Risks in the bottom right corner are of high importance if they do occur, but they're very unlikely to happen. For these, however, you should do what you can to reduce the impact they'll have if they do occur, and you should have contingency plans in place just in case they do.
- (iv) **High impact/high probability** : Risks towards the top right corner are of critical importance. These are your top priorities, and are risks that you must pay close attention to.

4.15.2 Preparation of Probability-Impact Risk Matrix

1. **Determine the Data to Use** : While preparing the matrix, the first thing to be done is to decide on the type of data that will go into your matrix. You may use data from prior research or a survey of informed people.
2. **Decide on the Size of Your Matrix** : Next is to decide on the size of your matrix. The simplest matrix is 2×2 , with high and low levels each for impact and probability. A 3×3 involves three levels each : high, moderate and low, for impact and probability. Some matrices use even more levels.
3. **List Events to Include in the Risk Matrix** : Next is to list all events to be entered into the risk matrix. Make an Event Coordinates Table with five columns. Label the first column "Event," and in that column write all the events you have listed. Label the second column "Impact," the third column "Probability," the fourth column "Impact Sector" and the fifth column "Probability Sector."
4. **Gather Impact and Probability Data** : After listing the events gather impact and probability data for each event. If you use survey data, average your survey data to a single figure. If you use previous research data, you will have to use some method (like weighted averaging) to come to a single figure for probability and impact of each event.
5. **Enter Impact and Probability Data** : Enter final data for impact and probability for each event into the Event Coordinates Table. Enter the data in the "Impact" and "Probability" columns, respectively.
6. **Determine How to Categorize Impact Data** : Determine how to categorize your impact data. If you have a 2×2 matrix, you might set a "High Impact" event as anything above the midpoint of the range of your figures for impact. For example, if the range of potential financial losses is 0 to 20 million, you might set the dividing line between

"High Impact" and "Low Impact" events at 10 million. Alternatively, you might set the dividing line arbitrarily, for example, perhaps any losses above 1 million are "High Impact."

The same decisions must be made for a matrix of size 3 x 3 levels or more: You must determine the boundaries of your "High Impact," "Moderate Impact," and "Low Impact" areas. Write the categorization of the impact data for each event – for example, "High Impact," "Moderate Impact," and "Low Impact" – in the "Impact Sector" column on the Event Coordinates Table.

- Determine How to Categorize Probability Data : Determine how to categorize your probability data. If you have a 2 x 2 matrix, set a "High Impact" event as anything above 50 percent in probability. With a 3 x 3 matrix, divide the probability range equally across the three areas of "High," "Moderate," and "Low Probability." Write the categorization of the probability data for each event – for example, "High Probability" or "Low Probability" – in the "Probability Sector" column on the Event Coordinates Table.

4.16 Risk Response Strategies for Positive and Negative Risk

- A risk is not always negative. A risk is known as a positive risk or opportunity if the impact is positive which you may want to actualize. Similarly, a risk is known as a negative risk or threat if the impact is negative, and in this case, you will want to lessen its impact.
- As risks differ, strategies to manage them also vary.

4.16.1 Negative Risk Response Strategies

Strategies can be made to deal with negative risks. Ideally, you would like to avoid the risk, but in most cases, it is not possible to do that all the time. Thus, you will utilize strategies. Some of them are

1. Escalate

- You use the escalate risk response strategy when you identify risk and find that you cannot manage it on your own because you lack the authority, resources or knowledge required for a response.
- You will contact your project manager or the top management to inform them about it and ask them to take the responsibility of managing the risk when this kind of situation happens. You won't take any further action except to note it down in the risk register once the top management or PMO accepts your request to take responsibility for the risk.
- For example, you know that the government is planning to announce a regulation and it could impact your project negatively if approved. You have no legal advisor and other resources to manage this risk, so you will approach your superiors to handle the risk.

2. Mitigate

- You will try to lesser the impact of the risk in this risk response strategy. You can do so by either trying to decrease the probability of the risk happening or the effect of the risk. This strategy decreases the severity of the risk.
- For example, you find that a team member may leave for a specific duration during the peak of your project. This is a negative risk; therefore to minimize the impact of his absence, you find another employee with similar qualifications from your organization and inform his boss that you may need him for your project for some time. This employee may not be as capable as the old employee, but he can cover for the old employee.

3. Transfer

- You use this strategy when you lack skills or resources to manage the risk, or you are too busy to manage it. In the transfer risk response strategy, you transfer the risk to a third party to manage it. Though transferring does not eliminate the risk; it only shifts the responsibility of managing the risk to the third party.
- For example, in your project, there is a task to install some equipment, and you have little experience with this task. The task is complex, and few contractors have successfully installed it. Therefore, you find a contractor and ask them to install it and sign a fixed price contract.
- In this way, you have transferred the responsibility of the whole task to a third party, and now it is their responsibility to complete the task within the agreed time and cost.

4. Avoid

- Here, you try to eliminate the risk or its impact. You do this by changing your project management plan, by changing the project scope, or by changing the schedule.
- This is a desired risk response strategy mainly used for critical risks. This is the best technique for all risks; however, it cannot be used most of the time. It is easy to use this strategy if you identify the risk in a very early stage; otherwise, it is difficult to adopt this strategy because in a later stage changing scope or schedule is a costly affair.
- You will have to convince the client or your management to change the scope or schedule to use this strategy. You can only utilize the avoid risk response strategy after their approval.
- For example, you observe that during certain periods of your project there is a chance of rain and you have work planned outdoors at that time. Therefore, to avoid this risk, you move these activities to a few days later to avoid the impact of rain.

5. Accept

- This risk response strategy can be used with both kinds of risks, i.e., positive risks or negative risks. Here you take no action to manage the risk except acknowledging it.
- You use this strategy when the risk is not critical, if it is not possible or practical to respond to the risk through the other strategies, or if the importance of the risk does not warrant a response.
- You can accept the risk either by actively acknowledging it or passively acknowledging it. In the active acceptance you keep a separate contingency reserve to manage the risk, and in passive acceptance, you do nothing except note down the risk in the risk register.
- For example, you are digging to construct a building, and there is a risk that you may find artifacts, though the chances are low. So you note it down and take no action as a response plan may cost you a lot with no guarantee of finding an object of interest.

4.16.2 Positive Risk Response Strategies

Positive risk is also known as an opportunity, which has a positive impact on your project, so you will always want it to happen. The most desired strategy for opportunity is "exploit" which ensures that the opportunity is realized, though it is not possible to use this strategy all the time. Accept is the least desired strategy where you take no action and hope the risk is realized on its own.

1. Escalate

- This risk response strategy is used when there is an opportunity, and you are unable to realize it as you lack the authority to take the necessary steps required to realize this opportunity.
- Therefore, you will approach your top management or the project manager and ask them to look into it. Once they review the request and accept the responsibility to manage the risk, it is no longer your responsibility to manage it, though you will record this risk in your risk register for further monitoring.
- For example, let us say you see an opportunity where if you buy a consumable in bulk, you will get a 20% discount. However, you require much less and buying consumables in a larger quantity will not benefit you as most of it will be wasted.
- So, you ask your PMO to consult with other project managers to see if anyone requires the same consumable. If yes, you can combine the requirements and place the order in bulk and realize the opportunity.

2. Enhance

- In the enhance risk response strategy you try to increase the chance of a risk happening so you can realize the benefits of this risk. In this case, you try to realize the opportunity. You can say that the enhance risk response strategy is the opposite of the mitigation risk response strategy.
- For example, let us say your project will be completed in three months. You find out that the government is about to float a similar type of project in two months. Therefore, you can bid for a new project if you can complete your project in two months. This is an opportunity for you.
- Therefore, you try to compress the schedule with fast-tracking so that the project can be completed ahead of time and you can have a chance to bid for the new project. In the our following example, you are using the enhance risk response strategy because here; you are trying to realize the opportunity.

3. Exploit

- In the exploit risk response strategy, you ensure that the opportunity is realized. Here, you do not try to realize the opportunity; you make sure that the opportunity is realized.
- For example, let us consider that your project will be completed in three months. You learn that the government is about to float a similar type of project in two months. Therefore, you can bid for the new project if you can complete your project in two months.
- You have an opportunity here if you complete the project ahead of time, you will get a chance to bid for your next project. Now you have to ensure that you realize this opportunity. You take every possible measure to ensure that the project is completed ahead of time so you can bid for the new project. You bring new resources, compress the schedule, do overtime, etc.

4. Accept

- This risk response strategy is common for both type of risks; i.e., positive risks and negative risks. In the accept risk response strategy, you take no action to realize the opportunity. You leave the opportunity as is, and if it happens on its own, you will benefit from it. This risk response strategy is used when the cost of the response is high, and there is less of a chance of it occurring or the benefit does not outweigh the effort involved.
- For example, suppose there is a chance you may get some skilled workers from another project at a lower rate if you convince them to join you. However, you do not pursue this matter and instead, let them decide whether they are interested in your project or not.

Share

- You use the share risk response strategy when you are not capable of realizing the opportunity on your own. So, you team up with another company and work together to realize the opportunity.
- For example, suppose that due to the lack of a specific technical capability, you are not able to bid for a project, doing this task and jointly bid for the project.
- Here, you are using the share risk response strategy because the profit will be shared between both parties. A teaming agreement is an example of the share risk response strategy.

Review Questions

- Q.1 Describe Resource Allocation. What are its benefits? (Refer Sections 4.2 and 4.2.1)
- Q.2 Describe Resource Optimization. What are its benefits? (Refer Sections 4.3 and 4.3.1)
- Q.3 Describe Network Crashing. Why is it done? (Refer Section 4.4)
- Q.4 Describe the step by step process of crashing a network. (Refer Sections 4.4 and 4.4.1)
- Q.5 Write a note on Resource Loading. (Refer Section 4.5)
- Q.6 What is Resource Leveling? Why is it done? (Refer section 4.6)
- Q.7 Describe Critical Chain Method. Describe its process. (Refer Sections 4.7 and 4.7.3)
- Q.8 What is a Project Buffer? What are its types? (Refer section 4.7.4)
- Q.9 Describe the critical chain scheduling method. (Refer Section 4.7.7)
- Q.10 Write a note on the stakeholders in Project. (Refer Section 4.8)
- Q.11 Suggest some of the ways of managing the stakeholders. (Refer Sections 4.8 and 4.8.3)
- Q.12 What is Project Communication Plan? Describe the process of its planning. (Refer Section 4.9)
- Q.13 Describe Risk Management in Project. (Refer Section 4.10)
- Q.14 Describe in brief the processes of Risk management. (Refer Sections 4.10 and 4.10.1)
- Q.15 Describe Risk Identification. Identify some of its essentials. (Refer Sections 4.11 and 4.11.2)
- Q.16 Explain Risk Register. What are its contents? (Refer Sections 4.12 and 4.12.3)
- Q.17 Describe Qualitative Risk Management Analysis. Describe any four methods. (Refer Sections 4.13 and 4.13.2)
- Q.18 Describe Quantitative Risk Management Analysis. Describe any four methods. (Refer Sections 4.14 and 4.14.3)
- Q.19 Describe probability and Impact Matrix. How do we use it? Describe. (Refer Sections 4.15 and 4.15.1)
- Q.20 Describe the steps to prepare a probability and Impact Matrix. (Refer Section 4.15.2)
- Q.21 Explain the negative risk response strategies. (Refer Section 4.16.1)
- Q.22 Explain the positive risk response strategies. (Refer Section 4.16.2)

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CHAPTER

5

Project Executing, Monitoring and Controlling

Module 5

Syllabus

Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings. Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit. Project procurement management, contracting and outsourcing.

5.1 Introduction

- The project management monitoring and controlling starts as soon as a project begins. Monitoring and controlling project work is the process of tracking, reviewing, and regulating the progress in order to meet the performance objectives. It is a very important part of Project Management.
- Project Work involves tracking the actual project performance with the planned project management activities. It can mainly be looked as a Control function that takes place at all stages of a project i.e. from Initiation through Closing.
- This process of monitoring and controlling project work is extremely important as it can happen that you are able to complete the project on-time, however, have not been able to meet the desired quality levels.
- Similarly, your project has increased scope, however, have exceeded limits of time and cost. The project manager must balance the requirements of different knowledge areas to control the project through Monitor and Control project work. Project Managers create performance measures or use existing organizational performance measures to identify project performance at regular intervals during the course of the project. Monitoring and controlling project work involve monitoring any other performance measure that the project manager has created or used for this project.

5.2 Project Monitoring

Project monitoring is an integral part of the project management. It provides understanding of the progress of the project so that appropriate corrective actions can be taken when the performance deviates significantly from the planned path.

5.2.1 Characteristics

- It consists of regular systematic collection and analysis of information to track the progress of the project implementation against pre-set targets and objectives.
- It is an important management tool which provides continuous feedback on the project implementation progress as well as assists in the identification of potential successes and constraints to facilitate timely decisions.
- Effective monitoring of the project is a critical element of good project management. It supports informed and timely decision making by the management and provides accountability for achieving results. It is a key part of project cycle management. It is to be built into the project at the planning stage. It is not an 'add on' tool which can be used during mid-way of the project implementation. On the other hand, it is to be woven throughout the project.

5.2.2 Advantages

project monitoring clarifies project objectives, links activities and their resources to objectives, translates objectives into performance indicators and sets targets, routinely collects data on these indicators, compares actual results with targets, and reports progress to the management and alerts the management about the problems which frequently gets cropped up during the implementation of the project.

It provides information to the management whether the project is proceeding as per schedule relative to the targets or there is time over run in the project implementation. It also focuses, in particular, on the efficiency and the use of resources during the project implementation. It provides support to the management in its efforts to complete the project in time and within the budget.

Project monitoring activities take place in parallel with the project execution activities so that, while the project work is being executed, the project is being monitored by implementing the appropriate level of oversight for the purpose of the mid-way corrective actions.

High quality monitoring of the project progress encourages timely decision making, ensures project accountability, and provides a robust foundation for successful completion of the project.

It is through the continuous monitoring of project performance that the management has an opportunity to learn about what is working well, what is lagging behind, and what challenges are arising.

Project monitoring provides records of activities and results, and signals problems to be remedied along the way. It is normally descriptive in nature and does not explain why a particular problem has arisen, or why a particular outcome has occurred or failed to occur.

It helps the management for the fine-tuning of the implementation activities, reorientation of the project implementation by making appropriate changes in future planning.

Without effective monitoring it is normally impossible to judge if work is going in the right direction, whether progress and success can be claimed and how further efforts can be improved.

5.2.3 Project Monitoring Activities

- Project monitoring activities involve
 - o The monitoring of actual project progress as compared to the planned project progress and the collection of key progress metrics such as risks, issues, changes and dependencies
 - o The reporting of project status, costs and outputs and other relevant information, at a summary level, to the management.
- The format and timing of project monitoring and reporting varies in each organization and also depends upon such items as the size, duration, risk and complexity of the project.

Project monitoring is carried out

- Measuring progress of project activities against established schedules and indicators of success
- Identifying factors affecting the progress of project activities
- Measuring the response of the decision taken on the project activities and its effect on the progress of project implementation
- Minimizing the risks of project failure.

5.2.4 Steps In Project Monitoring

Timing and method of project monitoring are significant aspects of the project management. Important steps in project monitoring include the following.

1. Study of the project, its schedule, and costs.
2. Selection of the parameters to be monitored.
3. Selection of the frequency of reporting and its format.
4. Collection of data for the parameters being monitored.
5. Analysis of the data by using appropriate monitoring technique.
6. Presentation of the analyzed data and reporting it to the management.
7. Review of the presented data by the management for decision making.

5.3 Project Monitoring and Controlling Cycle

The project management monitoring and controlling starts as soon as a project begins. Monitoring and controlling project work is the process of tracking, reviewing, and regulating the progress in order to meet the performance objectives. It is the fourth process group in Project Management Life Cycle. From the perspective of Knowledge Management Area, this involves the management tasks, such as tracking, reviewing, and reporting the progress of a project. Moreover, the process is majorly concerned with :

- Measuring the actual performance against the planned performance
- Assessing performance to determine whether or not any corrective or preventive actions are indicated, the status, reported and/or appropriate risk response plans are being executed.
- Maintaining an accurate, timely information base concerned with the project output and its associated documentation till project completion
- Providing information to support status reporting, progress measurement and forecasting
- Providing forecasts to update current cost and current schedule information
- Monitoring implementation of approved changes as they occur

Inputs

The inputs to the process of project monitoring and controlling are :

1. Project Management Plan
2. Schedule Forecasts
3. Cost Forecasts
4. Validated Changes
5. Work Performance Information
6. Enterprise Environmental Factors (EEF)
7. Organizational Process Assets (OPA)

Tools and Techniques

The tools and techniques for this process include :

1. Expert Judgement
2. Analytical Techniques

Following are the outputs of monitoring and controlling project work :

1. Change Requests
2. Work Performance Reports
3. Project Management Plan Update
4. Project Document Update

5.3 Monitoring and Control Processes

5.3.1 Monitoring and Control processes include :

1. Monitoring and Controlling Project Work

The Monitoring and Controlling Project Work process collects, measures and disseminates performance information and assesses measures and trends to forecast potential items requiring corrective action. This includes monitoring project risks and ensuring that they are being managed according to the project's risk plans.

2. Integrated Change Control

The Integrated Change Control process ensures that changes as a result of project corrective actions and other controlling factors are managed across the project knowledge areas. Integrated change control takes place throughout the project, from project initiation through project closure.

3. Scope Verification

The scope verification process ensures that project deliverables are formally accepted.

4. Scope Control

The Scope Control process ensures that changes to project scope are controlled.

5. Schedule Control

The Schedule Control process monitors and controls changes to the project schedule.

6. Cost Control

The Cost Control process monitors and controls costs and changes to the project budget.

7. Performing Quality Control

The quality control performance process measures specific project results to determine whether the project is meeting quality standards.

8. Managing the Project Team

This process tracks team member performance, provides feedback, resolves issues and coordinates changes to maintain and improve project performance.

9. Performance Reporting

The Performance Reporting process collects and distributes performance information — including status reports, progress reports and forecasts.

10. Managing Stakeholders

This process manages stakeholder communications and works with stakeholders to ensure that requirements are satisfied and issues are proactively resolved.

5.4 Information Needs and Analysis

- An information need is an unstructured statement that describes a type of information required by an organizational unit to enable it to meet its objectives and support its functions.
- Information needs analysis technique is used to identify all of the information necessary for use in achieving specified goals or objectives, such as performing an activity, satisfying customer needs, or making strategic decisions.
- The result of applying this technique is typically a summary which shows the information needs for each business activity, by type of usage, and by a pre-defined category. Other information, typically included in the information needs summary, are the business objects supported, current availability, information medium, current source systems, requirements satisfaction, and the relative importance of the business activity.

Purpose

The purpose of information needs analysis technique is to identify and set priorities for the information needed to support business activities in order to reach established business goals.

5.4.1 Objectives

- To identify and set priorities for the information needed to support business activities and to reach the business goals.
- To gain further insight into the business structure for subsequent improvement of the information architecture.
- To understand the implications of these priorities for current and planned systems, technical facilities, etc., as part of an enterprise engineering project.
- To facilitate commitment to the strategy developed to meet reengineering or other enterprise goals and objectives.

5.4.2 Benefits

There are several benefits to utilizing the information needs analysis technique.

- It enables us to gain further insight into the business structure to support subsequent improvement of the information architecture.
- It enables an understanding of the implications of established priorities for current and planned systems and technical facilities.
- It facilitates commitment to the strategies developed to meet enterprise-wide goals and objectives.

5.4.3 Procedures

- Identify source material and source interviews, focus groups, or questionnaires.
- Review materials and itemize a list of information needs.
- Consolidate needs and develop an information needs summary diagram.
- Collect additional data, as required, to complete the information needs summary diagram.
- Determine the relative importance of each information need.
- Confirm results.
- Use as input into information architecture development or impact assessment.

5.5 Reporting of Information In Project Management

- Reporting of information is a critical process in any organization. Information is used to let stakeholders know about the status of the project. They also use it to make good decision. Project management reporting is complicated and it often involves multistage activities. The activities that are involved in management reporting include general documentation, financial control, business presentations and email communications. The project managers need to treat the information as harvestable data which can be summarized and interpreted using reporting systems.
- Reporting systems are defined as processes, procedures, and facilities that are used to generate and gather reports using one or more information management system. This is also responsible for the distribution of report to the stakeholders of the project.
- The organization should invest in peripherals that can support the collection and distribution of information and these include IT infrastructure and even shared storage environment.
- An efficient reporting system is crucial for the execution of project activities. The thing is that unless the organization uses an appropriate reporting system, the project team and other people concerned with the project will not be able to know the complete details of the project.

5.5.1 Types of Project Management Reports

Project reporting involves more than simply communicating the latest project updates to your team and stakeholders. You can also use project reports to mitigate risk, monitor budgets and timelines, and build more accurate project plans.

Here are a few project reports you might find useful :

1. The Project Timeline Report

- One of the critical elements that define a project is the timeline. A project by definition is a temporary endeavour; meaning it has a start and an end which means it has a defined timeline. The timeline should be a visual overview of the project from start to finish.
- One thing that sponsors care about is that the project will be delivered by an agreed date, especially where the project has a mandatory delivery date.

2. The Project Budget or Financial Report

A project is constrained by three elements scope, schedule and cost. Therefore, a project budget is an important report. Ideally, the report will show budget versus actual costs.

3. The Project Team Contact Data

- The team members working on the project are often from various departments, companies and even spread across the world. The role of the project manager is to bring the group of people together to form a productive team.
- Creating and distributing a list of team members, their roles and how to reach them is an important step in ensuring clear channels of communication

4. The Project Risk Register

- Managing project risks is often overlooked or miss understood by project managers. Creating an initial Risk Register is key to managing project risks. Start by building a list of all the things that could impact the project.
- Early on in the project, there will be a lot of these. As the project progresses and things become more clearly defined, many of these will be addressed. It is important to review and update this list often throughout the project.

5. Team availability report example

If you want to build an accurate project plan, you need to know what resources you have available to get the job done. A team availability report shows you how much work each team member has on their plate so you can make smart resourcing decisions for your project.

6. Status report

A weekly status report is an easy way to keep your team and stakeholders informed and manage expectations as a project progresses. We recommend reviewing these quick hits in your status report :

- (i) Work that's complete
- (ii) Work that's coming up
- (iii) Overall project completion and budget spent
- (iv) Action items
- (v) Project risks or issues

7. Project health report

A project health report provides a high-level snapshot of project status. It's great for sharing on screen meetings with your team and stakeholders so everyone knows at a glance what's on schedule, what's running behind, and what's already overdue.

8. Risk assessment report

A risk management enables you to identify and categorize project risks based on their severity and likelihood of happening. That way you can prioritize issues and nip risk in the bud before it wrecks your project success.

9. Time tracking report

A time tracking report gives you visibility into how much time your team is actually spending on project tasks so you can see how it tracks with your project estimate. This helps you spot potential budget overages before they happen and provides valuable insight for future project estimates.

10. Baseline report

A baseline report compares your original timeline with your actual project timeline so you can learn from the past as you scope out future projects. It's also handy for showing how changes or delays affect the overall project timeline.

5.5.2 Project Management Reporting Best Practices

1. **Set a cadence :** A reporting schedule establishes regular touch points so everyone knows when to expect and perhaps even provides important project updates. Just be sure you keep the lines of communication open between scheduled reports.
2. **Mind your data :** A report is only as good as the information in it. Check that project details are current and correct before sharing reports with clients and stakeholders.
3. **Write to your audience :** Clients and executive stakeholders don't need to be bogged down by nitty-gritty project details. Keep it succinct with bullet points and avoid technical jargon so it's a friendly read for everyone.
4. **Add visuals :** A picture is worth a thousand words. Use charts and graphs when possible to make your report easy to digest.
5. **Be honest :** If the project is behind schedule or over budget, don't shy away from mentioning it in your report. The sooner an issue comes to light, the sooner it can be resolved and the more likely you are to win your client's trust.

6. Invite discussion : A project report should be a springboard for conversation, not a static document that's set in stone. Create space for feedback and discussion so everyone's on board with the project's next steps.

5.6 Stakeholder Engagement

- Engaging with the Stakeholders is the practice of interacting with and explaining the project stakeholders of the overall benefit of the project. The successful completion of a project also depends on the favourable view of the stakeholders. Stakeholders play a significant role in the success of a project as their requirements, expectations, perceptions, personal agenda and concerns influence the project and impact the outcomes. Successful stakeholder engagement is therefore a vital for professional project management. The key benefit of Manage Stakeholder Engagement process involves seeking extended support from stakeholders for the projects success.
- The process of communicating and working with stakeholders to meet their needs / expectations, address issues as they occur and build appropriate stakeholder engagement in project activities throughout the life-cycle of the project is termed as Management Stakeholder Engagement process.

5.6.1 Importance of Stakeholder Engagement

- Stakeholder engagement builds and maintains relationships with the stakeholders. It helps in preserving the active support and commitment of the people to implement changes.
- By understanding a stakeholder's motives and agenda it becomes possible to influence the change process positively and to address issues that may be potential barriers to change.

At its most basic level, a stakeholder engagement approach typically includes :

- (i) Stakeholder assessment, including their interests, influence and potential impact on them.
- (ii) Identification of key concerns, risks and mitigating actions.
- (iii) Outputs from stakeholder mapping used as a basis for flexible communications.
- (iv) Creation and monitoring of the stakeholder action plan using stakeholder mapping information.

5.6.2 Activities involved In Stakeholder Engagement process are

- Ensuring commitment of stakeholders at all stages of the project.
- Ensuring stakeholder expectations are met. The tools used could be negotiations and communication.
- Anticipating future problems and address potential concerns throughout the life-cycle of the project.

Critical Points of Managing Stakeholder Engagement

- Stakeholder influences are the highest at the start of the project and as the project progresses the influences continue to reduce
- Project sponsors assistance to be taken by the project manager whenever required

Inputs To Manage Stakeholder Engagement

- It includes Stakeholder Management Plan, Communications Management Plan, Change-log and Organizational Process Assets. The communications management plan includes a documentation of stakeholders needs for communication requirements.
- Tools and techniques used to Manage Stakeholder Engagement include effective communication methods such as the use of email, meetings, process updates through the intranet, war rooms, among others. Project manager uses effective interpersonal skills including active listening, building trust, resolving conflict and overcoming resistance to change.

Outputs Of Manage Stakeholder Engagement

- Issue Logs, Change Requests, Project Management Plan Updates and Project Document Updates are common outputs. Organizational Process Assets get updated with additional information like :
1. **Stakeholder notification** : It is important to notify stakeholders about project updates, any issue closures, etc.
 2. **Project reports** : Project reports such as status dashboards, lessons learned, issue logs, etc are to be included.
 3. **Project presentations** : Presentations made formally or informally also form as outputs of manage stakeholder engagement.
 4. **Project records** : It includes correspondence, memos, meeting minutes, etc are included in project records.

5.6.3 Ways to Engage Project Stakeholders

1. **Identify stakeholders early** : You can't engage stakeholders until you know who they are. As you are initiating your projects, start identifying your stakeholders.
2. **Get stakeholders talking to one another** : Invite key stakeholders to the initial project meetings when you are developing the project charter. You should try to surface and resolve conflicts as soon as possible.
3. **Seek to understand before being understood** : Steven Covey shared this principle years ago. It still holds true. Furthermore, people want to know that you really want to hear their perspective first.
4. **Listen, really listen** : Part of understanding is to find out time to sit face-to-face, when possible, and listen attentively. Ask probing questions.
5. **Lead with Integrity** : Meaningful engagement requires trust. Say what you mean; mean what you say. And then do what you said you would do.
6. **Engage your stakeholders in the estimates** : Ask the people that will do the work for estimates. And help stakeholders to understand that there is greater uncertainty in the early estimates. Commit to providing refined estimates as your projects progress.
7. **Work With your team** : The best project managers work with their stakeholders to break down the projects into deliverables and tasks. This helps everyone to have a better understanding of the project. Furthermore, stakeholders will more likely support a plan that they helped create.
8. **Manage expectations** : Each of your stakeholders has expectations. Working with your team will clarify many of these aspects of the project.
9. **Be grateful** : The project managers know two simple words—thank you. When team members and other stakeholders complete activities, respond to emails and voicemails, make you aware of things you didn't know, respond with thanks.
10. **Communicate Well** : Ninety percent of a project manager's job is communication. Develop and maintain a communications plan. Creative project managers minimize a potential communications breakdown by communicating through a variety of channels, not one or two.

5.7 Team Management

- A Project Team is an organized group of people who are involved in performing shared/individual tasks of the project as well as achieving shared/individual goals and objectives for the purpose of accomplishing the project and producing its results.
- The team consists of the full-time and part-time human resources supposed to collaboratively work on producing the deliverables and moving the project towards successful completion.

Successful projects are usually the result of careful planning and the talent and collaboration of a project's team members. Projects can't move forward without each of its key team members.

Team management is an integral part of a project manager's role. The project manager identifies the tasks and determines the project roles required to execute the tasks and the skills required to perform the tasks. He has to acquire team members.

But it is not enough to plan resources. Acquire them and delegate tasks to them to have a successful project. The project manager needs to manage the team such that he/she is able to extract optimum performance levels from each team member and at the same time the team is motivated to work on the project and the project objectives are achieved.

The process of managing project team addresses specific team management challenges associated with communication, recognition and assessment of team objectives. The project manager takes responsibility of managing project team and ensuring success of team management activities.

The project manager should use the following interpersonal skills for managing project team :

- (i) Leadership is a critical skill for teambuilding and teamwork management. A high level of leadership allows the project manager to communicate the project vision and organize the project team to achieve high performance.
- (ii) Influencing is critical for bearing influence on project stakeholders and their decisions. The project manager needs to develop this interpersonal skill to reach mutual agreements with project team members and address critical issues.
- (iii) Effective decision making is an ability to undertake the decision-making process which entails conducting negotiations with stakeholders and project team for the purpose of studying environment factors, developing personal quality of team members, stimulating team creativity, and managing risks and opportunities.

The process of Team Management involves the use of specific project team management methods and techniques which are listed are as follows :

1. Method of communication and supervision is used to track current work and attitudes of project team members. By means of live conversation and observation, the project manager communicates with team members and reviews their achievements in the context of deliverables, accomplishments and interpersonal issues.
2. Method of performance appraisals allows measuring performance of project team members to clarify project team roles and responsibilities, review constructive feedback, discover unresolved issues, develop individual training programs, and outline specific goals for future project activities.
3. Method of conflict management allows handling conflicts in a team environment to achieve higher productivity and positive working relationships among team members. The method is used within the conflict management process and managed by the project manager. The following characteristics of conflict should be considered while performing the conflict management process :

(i) Nature of conflict : A conflict may be a team issue or an individual issue.

(ii) Openness to conflicts.

(iii) Time : A resolution of conflict should focus on the present not the past.

The following outputs can be obtained from the successful project team management process implementation :

1. Change requests are generated during the course of the process and submitted to the project management team. Change requests allow reducing the probability of issue occurrence and mitigate a negative impact on project activities. The major purpose of change requests is to ensure development of preventive actions to reduce team member absence, achieve appropriate role clarification, and avoid gaps in project schedules and timelines.

Project Management (MU)

2. Project management plan updates generally include changes to team member roles, responsibilities and authorities which all together are parts of the staff management plan.
3. Project management organization assets include lessons learnt, documentations, historical records, various templates, and standards. All this information can be collected and then used later in future projects.

5.7.1 Characteristics of Better Team Management**1. Transparent Communication**

The project manager should inform about the project, its benefits to all stakeholders, client information etc. to team members. Resources will be more committed to the tasks if they know the bigger picture and the value of the project than just their tasks and task objectives.

2. Performance Tracking

- The project manager needs to track performance of each team member. He should be aware of which tasks are done by which team member, the status and level of performance. The team member should be given appropriate feedback. If the resource is doing well, appreciating in front of other team members boosts the morale and inspires others to do well.
- If the team member has achieved a major breakthrough, an award or an appreciation mail keeping senior management informed will also motivate the team member. Performance reports that measure the progress of team members using time, cost and quality parameters should be generated regularly. This will help measure performance over the course of the project.

3. Handling Incompetent Performance

- If any team member is not doing well, concrete details with examples should be given to him as to why the manager thinks he is not doing well. Other team members can be asked to assist/guide him in some tasks. The team member can be given other tasks which he may perform properly.
- If the resource is not performing well for a long time, it may be best to release him from the project. A monthly meeting with project team members on their performance can be used to share constructive feedback. The organization's performance appraisal process should include the feedback from the project.

4. Training

- Training is a useful motivational tool. Appropriate training needs must be identified for resources and arranged as per organization's criteria. Training in new skill sets, new technologies act as a carrot to motivate employees to give their best performance.
- It helps in talent management. Team members who show potential leadership skills can be given training in leadership courses. Employees with high technical skills can be sent to technical trainings and workshops on architecture and design so that they can be groomed to take on the next level challenges.

5. Conflict Resolution

- Each individual is different and there can be issues and conflicts between team members. It is not necessary for team members to be the best of friends but they should work towards achieving project objectives and act as part of one team. Project managers should anticipate conflicts and disagreements beforehand and take steps to avoid issues.

If there are conflicts between team members, project manager should take steps to resolve issues. There can be an open communication forum with all involved so that issues can be sorted or people can reach a middle path so that the team works together as one unit for successful project completion.

Project Communication

5.8 Excellent communication is a critical component of project success. In fact, according to the Project Management Institute (PMI), most project failures are due to communication problems. Project communication management ensures that does not happen.

It consists of three processes that help make sure the right messages are sent, received, and understood by the right people. The processes included in this area have changed over the years, but in the current version, there are three primary project communication management processes.

These are :

1. Plan Communications Management
2. Manage Communications
3. Monitor Communications

5.1 Plan Project Communications Management

The first step is to plan how you will manage communications on your project and across all of your stakeholders. This is done by creating a project communications management plan.

It's important to ensure the following factors are addressed in your plan :

- (i) **Audience** : This is a list of all stakeholders affected by the project. It should include team members, sponsors, customers, and other interested parties. Consider everyone impacted by the project or who influences its success.
 - (ii) **Objective** : Identify the objectives of your communications. You may use some communications for awareness, like a status report, and others that require action, such as requiring a sponsor to authorize spending, or a customer to approve project testing.
 - (iii) **Message** : Decide and create message for each type of communication. This is the actual content that will be shared. Key components to be communicated include scope, schedule, budget, objectives, risks, and deliverables.
 - (iv) **Channel** : Choose the right channel through which the message will be delivered. Will it be a formal report emailed out? An informal verbal debrief during a team meeting?
- Your communication plan should be detailed enough to lay out exactly what will be sent, to whom, how, when, and who is responsible. Involving your stakeholders in the creation of this plan is important. You need to understand their communication preferences and expectations.

5.8.2 Manage Project Communications

Once the plan has been created and approved, it's the project manager's job to ensure it's managed well. This means that the plan needs to be reviewed and updated on a regular basis to reflect any changes to the project or its stakeholders. The project manager also has to manage the execution of the communication management plan.

This includes :

- (i) Collection and analysis of data.
- (ii) Creation of messages for communication.

- (iii) Transmission or distribution of communications.
- (iv) Storage of any communication reports, files or documents.
- (v) Retrieval of any stored communications.
- (vi) Disposal of any old communications upon project closure or a set date.

5.8.3 Monitor Project Communications

- This process used to be called 'control communications,' but was updated in the 6th edition of the PMBOK. Despite the title change, the process is the same. It involves monitoring and controlling project communications throughout its lifecycle.
- This may include :
- Confirming communications go out as planned.
 - (i) Confirming they are received by the proper stakeholders.
 - (ii) Confirming messages are understood.
 - (iii) Confirming any relevant feedback is provided to the appropriate project members.
- The actual type of monitoring, including method and frequency, should be a part of the communication management plan.

5.8.4 How to be Successful at Project Communication Management ?

Successful project managers use formal and informal communication methods across various channels. This helps increase the chances communications are received. Using simple language, sticking to relevant topics, and keeping messages concise will increase your chances communications will be understood.

The following communications skills can also increase a project manager's chances of success :

1. Strong active listening skills
2. Proficient writing skills
3. Excellent speaking ability
4. Asking questions and probing for more information
5. Setting and managing expectations
6. Motivating people to become and stay engaged
7. Conflict resolution skills
8. The ability to summarize and recap what you have heard

5.8.5 Key Components to an Effective Project Management Communication Plan

1. **Develop the purpose :** This is your team's mission statement, the "why" behind everything you are doing on this project.
2. **Set the goals :** Once you have the purpose in place, you can realistically set your goals for the project. What are the primary indicators of success?
3. **Determine the key players :** Which team members and stakeholders need to be involved and to what extent? Who should be at all the meetings, and who should only be involved from an approval standpoint? Does everyone understand their roles?
4. **Discuss task dependencies :** Make sure to look for potential roadblocks and risks along the way. On top of that, each team member should know what needs to be done before they get started on their task.

- 4 Be realistic on time and scale : Deliver what you say you are going to deliver. And, remember the cardinal rule of communication in project management-don't overpromise!
- 5 Adjust when needed : Just like most things in life, a project probably won't go like you plan. Be flexible enough and honest with your team to adjust on the fly when needed.

5.8.6 Communication Methods

Given the organizational and geographical diversity of project teams – it is important to consider all methods of communication. Today's enhanced technology allows us to communicate easily wherever the team members may be. A communication strategy should be conceived at the project planning stages, so key is its influence on the success or the project.

Communication methods can either be active or passive.

- 1 ACTIVE communication methods being those used to communicate in the here and now, for example the use of :

- Face to Face meetings
- Video conference, meeting – one on one, or group
- Telephone conference, or voice only web conference
- Webinars, becoming increasingly popular for the delivery of presentation based activities
- Telephone – good old fashioned call
- Stand up presentations in person

- 1 PASSIVE communication methods would be those which recipients can adopt in their own time, for example :

- Pod cast
- Web cast
- Email
- Intranet bulletin boards
- Blogs
- Website
- Project newsletter – paper based
- Table top presentation

Always ensure that a mix of active and passive methods of communication is used to compliment each other. This should be considered as part of the overall project management communication strategy.

5.9 Project Meeting

- Project meetings refer to an effective method to distribute information and communicate with the team and stakeholders.
- A Project Meeting is a regular event that involves everyone, who shares or is interested in the project, in communicating with other participants and stakeholders by discussing issues, making proposals, approving or rejecting offers, for the purpose of generating group decisions that contribute to quicker project delivery, according to the planned goals and expected results.

Project meeting are held in many ways such as

- 1 Regular Team Meetings are the most frequent meetings that can be organized and conducted many times during the course of the project implementation process. Regular (daily, weekly, monthly) meetings are scheduled and itemized in the communication management plan.

2. Change Control Meetings are organized by a change control board and intended for reviewing change requests. The board makes decisions about approving all the changes occurred and communicating with stakeholders for information and follow-up actions.
3. Status Review Meetings are organized on a regular basis to exchange and analyze information on current progress of the project and its performance. During such a meeting, the project manager distributes performance reports among the participants to allow the team and stakeholders to gain visibility into current performance levels and task progress. Status review meetings are also known as performance reviews.

5.9.1 Planning Project Meetings

- As a Project manager one must be ready to plan and conduct project meetings on a regular basis. Project meetings help to make sure that the project is progressing as planned and problems are being solved in the right way.
- The following project meeting planning steps help understand how to organize the meetings and what essentials are required to make your effort more effective.
 - (i) **Set Objectives :** This step assumes that if you don't set clear meeting objectives, the meeting is doomed to fail because it gives no results, and no solution will be generated. Before deciding on scheduling a meeting date, make sure you have set a series of SMART objectives. SMART means Specific, Measurable, Achievable, Relevant and Timely.
 - (ii) **Write a Meeting Agenda :** Developing and following an agenda allows you to make the project meeting shorter yet more effective. You get more chances to finish the meeting with expected results and in a timely manner.
 - (iii) **Keep Documents Organized :** You need to make the meeting documents as short as possible. With the piles of paper to hold the meeting, you are likely to fail because they can de-motivate and mislead your team and cause mess. It is better to keep 1 or 2 sheets of paper to maintain the meeting.
 - (iv) **Invite the Right People :** Members of the project team are obviously the major attendees of project management meeting. However, from time to time meetings also require some seniors.
 - (v) **Create an Appropriate and Comfortable Physical Environment :** Project meeting should be conducted in a comfortable and well-ventilated room, especially if it's summer time. Give your participants ice cold water, tea, coffee or/and some non-alcoholic beverages that make your listeners feel more comfortable.
 - (vi) **Start and Finish the Meeting on Time :** People do not like if an event goes out of schedule, and probably there's nothing more frustrating than late meetings. You should make sure every attendee is aware of the start and finish time.

5.9.2 Types of Meetings

1. **Kickoff :** It presents the project goals, introduce the participants, and decide on certain logistical questions; the first time a team gets together, the project sponsor usually speaks to them and generates enthusiasm.
2. **Planning :** It develops the project plan; assign roles and responsibilities; make decisions about how the project will be carried out.
3. **Walk-through :** It is conducted to read through the project plan and/or significant documentation to uncover problems and clarify information.
4. **Problem Solving :** The aim here is to solve problems that require several members of the team and/or management; generate alternative solutions.

- 5. Debrief : It is done to provide critical information to higher levels of management. Focus on goals, results, budget, schedule; seek approval for next steps where appropriate.
- 6. Presentations : It is conducted to make a formal presentation to managers, stakeholders, and others about the results at the end of the project.
- 7. Milestone : This meeting is called to conduct formal reviews of progress against plan at critical points defined in the project plan when important interim steps are completed; present interim results.

5.9.3 Managing a Project Meeting

It is important for the team to get together periodically to make decisions. You may facilitate meetings that involve people who do not report to you or who have higher positions in the company than you do. They may want to take over the meetings. Establish clear procedures at the beginning. Let people know that although you will be chairing the meetings, they will be making the decisions. Your role is to help the group make good decisions.

Follow these simple guidelines to keep meetings on track :

- 1. Use technology to facilitate your meetings.
- 2. Plan meetings in detail : Ask the team members for items or objectives.
- 3. Establish the purpose and objectives : Every meeting needs a purpose, something to be accomplished. Objectives are specific results that provide measures for success.
- 4. Circulate the agenda in advance : Include any information that needs to be reviewed ahead of time for discussion and decision making. Construct the agenda and times to achieve the desired objectives.
- 5. Stick to the agenda : Review the meeting purpose and objectives. Follow the times you have assigned. If it looks as if an item will require additional discussion, ask the group if they want to extend the discussion and which agenda item should receive less time.
- 6. Assign roles : Most meetings need someone to facilitate the meeting, someone to document the meeting and/or write on the flip chart, and someone to monitor time.
- 7. Start and end on time : If someone is late for a meeting, begin without him or her. Don't punish the people who come on time.
- 8. Record brainstorming items or other important information on a flip chart to keep ideas in front of people and to stimulate discussion. Transcribe these notes as part of the minutes as necessary.
- 9. Ask each person to speak in turn : This helps keep the discussions orderly and ensures that everyone's ideas are heard.
- 10. Keep the group focused on the purpose, objectives, and agenda.
- 11. Recap the meeting : At the end of the meeting, review the decisions, accomplishments, and action plan to make sure every decision will be carried out by a particular person within a particular timeframe.
- 12. Provide meeting documentation to participants as soon as possible after the meeting.

Meeting Documentation

Taking the minutes at the meetings of the project team often falls to the administrative professional. Meeting documentation should be brief and to the point. In most cases there is no need to keep details of all of the discussions. Record the decisions that the group makes and an action plan of what will be done by whom, and when and how these activities will be measured. If the group generates a list of ideas, record them for future reference. Circulate the document immediately. Add new tasks to the master plan.

Meeting Dynamics

Meetings include many complex interactions. Some of them are predictable. Try to anticipate these interactions and deal with them as they occur. These are often referred to as team, group or meeting dynamics. Some of these are related to the task and some to the personalities.

5.10 The Earned Value Method

- Earned Value Analysis (EVA) is one of the key tools and techniques used in Project Management to have an understanding of how the project is progressing. EVA monitors the progress of the project based on its earnings or money. Both, schedule and cost are calculated on the basis of EVA.
- Project control takes place against the cost baseline using a technique called Earned Value. In this technique, several variables are determined from actual progress on the project tasks, and several more variables are calculated from them, and reported.

5.10.1 Features of EVA

1. Earned Value Analysis is an objective method to measure project performance in terms of scope, time and cost.
2. EVA metrics are used to measure project health and project performance.
3. Earned Value Analysis is a quantitative technique for assessing progress as the software project team moves through the work tasks, allocated to the Project Schedule.
4. EVA provides a common value scale for every project task.
5. Total hours to complete the project are estimated and every task is given an Earned Value, based on its estimated completion (%) of the total.
6. Earned Value is a measure of 'Progress' to assess 'Percentage of Completeness'

5.10.2 Need for EVA

- EVA provides different measures of progress for different types of tasks. It is the single way for measuring everything in a project.
- Provides an 'Early Warning' signal for prompt corrective action. The types of signals can be the following :
 - (i) **Bad news :** Holding on to the bad news does not help. The project manager needs to take an immediate action.
 - (ii) **Still time to recover :** In case, the project is not going as per schedule and may get delayed, the situation is needed to be taken care of by finding out the reasons that are causing delay and taking the required corrective action.
 - (iii) **Provides timely request for additional funds.** While there is time to recover, the need for additional resources or funds can be escalated with an early warning.
 - o It allows 'rolling up' the progress of many tasks into an overall project status.
 - o It provides with a uniform unit of measure (dollars or work-hours) for the progress.

5.10.2 (a) Inputs

There are three inputs to the Earned Value method. Each of these variables must be obtained from each task's actual progress:

1. **Planned Value (PV)** is the planned expenditure of funds to the date of analysis, taken from the project schedule. For example, if a task is anticipated to last from January 1 to January 10 and today is January 5, PV = 50% of task budget.

- Earned Value (EV)** is the actual progress of the task to the date of analysis. This is expressed as the percentage of the total effort and/or resources expended, and could be measured in units completed (such as number of fence posts driven, or number of holes dug), or hours of labor expended. For example, if the same task above is 40% complete, $EV = 40\%$ of task budget.

- Actual Cost (AC)** is the actual expenditure of funds to the date of analysis. This is usually tracked via software or manually with receipts, etc.

5.10.2 (b) Calculations

The calculations are relatively simple. In order to report on project progress, there are four variables which tell the project manager about the health of the project.

- Cost Variance :** The amount that the project is above or below budget at the point of analysis.

$$CV = EV - AC$$

Cost Performance Index : The amount that the project is above or below budget, relative to the overall size of the project.

$$CPI = EV / AC$$

Schedule Variance : The amount that the project is ahead or behind schedule at the point of analysis.

$$SV = EV - PV$$

Schedule Performance Index : The amount that the project is ahead or behind schedule relative to the overall size of the project.

$$SPI = EV / PV$$

5.10.2 (c) Analysis

Calculations give the following meaning

- A positive CV means the project is under budget (positive = good). Negative means over budget. The CPI tells you how much above or below the budget it is, in percentage terms, for example, $CPI = 1.25$ means the project is 25% below budget.
- A positive SV means the project is ahead of schedule (again, positive = good). Negative means behind schedule. The SPI tells you how much ahead or behind schedule the project is, in percentage terms, for example, $SPI = 0.9$ means the project is 10% behind schedule.

5.10.2 (d) Forecasting

The variables tell you where the project is right now or at the point of analysis. This is very useful for decision making. The following three metrics tell where the project was trending.

- Estimate at Completion (EAC) :** This is the estimated final cost of the project. There are several ways to calculate this, based on the assumptions that are made.

- If past project performance is expected to continue :

$$EAC = BAC / CPI$$

- If past project performance is considered one-time, and future performance will revert back to the planned rate :

$$EAC = AC + BAC - EV$$

- If the cost and schedule performance both factor into the future performance (the previous formulas used only the cost performance) :

$$EAC = AC + [(BAC - EV)/(CPI \times SPI)]$$
- When something unexpected has arisen and you need to throw out the original estimate and produce a new one. In this case, start with the AC already spent :

$$EAC = AC + \text{New Bottom Up ETC}$$

2. **Estimate to Complete (ETC)** : This represents the amount left to spend to complete the project. It's the amount of money that needs to be "in the bank" to complete the project.

$$ETC = EAC - AC$$

3. **To Complete Performance Index (TCPI)** : This value tells you how efficient you need to be to complete the project according to the original plan. For example, if you were inefficient at CPI = 0.9 throughout the first quarter of the project, a TCPI = 1.03 means you have to pick it up and be 3% more efficient than the original plan to finish on target.
- In order to finish on the original budget :

$$TCPI = (BAC - EV) / (BAC - AC)$$

- In order to finish on the revised budget if current project performance continues :

$$TCPI = (BAC - EV) / (EAC - AC)$$

- These forecasts could be used to update financial metrics such as Net Present Value (NPV), payback period, or Return on Investment (ROI) which were used to justify the project.

5.11 Milestone in Project Management

- A project lasts for a fixed period of time which could be a few weeks to several years. In some cases, for large-scale construction projects or public works, they are run for decades. To track progress along the way and ensure the key deliverables are being achieved according to the timeline, project managers use Milestones.
- A Milestone in a project signifies a change or stage in development. Milestones are powerful components in project management because they show key events and map forward movement as per your project plan.
- Milestones act as signposts throughout the project life cycle ensuring that the project stay on track. Without project milestone tracking, you are just monitoring tasks and not necessarily following the right path in your project.
- Milestones can do more than just showing progress. They can help you communicate about what's happening with your project.

5.11.1 Usage of Project Milestones

Milestones in project management are used to mark :

- The start of significant phases of work
- The end of significant phases of work
- Deadlines
- When an important decision is being made
- Other fixed points in time that need calling out specifically

5.11.2 Effective Measurement of the Project Progress

One of the most important aspects of a project manager's job is measuring progress on each task. Here are just a few effective ways of tracking project progress as a project manager.

1. Create a Project Outline

Working with team members to create a project outline can be a great way of tracking project progress. Each member of the team can give input for setting up realistic project goals and learn what's expected of them individually and as part of a group.

2. Establish Goals and Milestones

Measuring progress can look very different from person to person and project to project. The more familiar a project manager is with each employee's skills and limitations, the better sense he or she will have of how to hold them accountable. Setting up tailored goals and milestones with each member of the team also goes a long way toward team satisfaction.

3. Check In Regularly

To track the progress of a project, regular check in is important. Having a quick, informal chat at the beginning of each work session can establish trust between project managers and workers and help workers feel cared about and checked in. Communication is always key to make sure a project runs smoothly.

4. Ask How You Can Help

There are many ways a project manager can help workers feel less stressed or overwhelmed by tasks. For example, suggesting tools that are available to help workers with their organization skills is always a great option.

5. Establish Clear Deadlines

Keeping the end goal in sight is always helpful for measuring progress. Being clear about deadlines can help workers stay on track and complete tasks without getting overly stressed or overwhelmed. Tracking project progress becomes far easier once everyone knows what the project timeline is. Some project managers prefer to work with one final deadline, while others like to establish a deadline per milestone or goal.

5.11.3 Effective utilization of Project Milestones

Although milestones can be useful in keeping a project on track and keeping employees motivated, project managers must know how to use them to make sure they are effective. Here are some things to keep in mind when implementing milestones in your project planning.

1. Frequency : As milestones can work as a motivational technique, project managers have the tendency to overuse them. This frequency of use can make meeting milestones seem more commonplace and can actually cause workers to become less motivated overall. Therefore, be sure to limit milestones to goals that can be considered junctions on a critical path and important deliverables.
2. Timing : While it is important not to present milestones too frequently, it is also important not to space them too far apart. This will cause your staff to lose momentum and motivation. Ideally, try to space milestones so they land approximately two weeks from each other.
3. Visibility : Project managers should be sure that their team is aware of each milestone by distributing the necessary details to each team member and keep them displayed prominently in the workplace.

 Project Management (MU)

4. Accountability : Every member of your team must realize the importance of meeting milestones in a timely fashion. If your team is unable to meet a milestone by its due date, a discussion should be held as to why this happened and what can be done to increase productivity in the future.
5. Fallibility : It is important to understand that not every milestone can be met with success. In fact, it's a good idea for project managers to create milestones which may be more difficult to meet and may end up in failure. This can provide a learning experience for workers and give them something to aim for in the future.

Project Management Milestone Examples

Milestones make it easier to keep projects on track by calling out major events, dates, decisions, and deliverables. Here are a few examples of project milestones you might include in your plan:

- Start and end dates for project phases
- Key deliveries
- Client and stakeholder approvals
- Important meetings and presentations
- Key dates or outages that may impact your timeline

5.11.4 Benefits of Project Milestones**1. Monitor deadlines**

- No plan is ever complete without a list of deadlines. The best way to make them noticeable is to use the project management milestones and deliverables technique. It is beneficial to make the deliverables project milestones.
- Milestones are great for this purpose because they are called out a diamond in project plans.
- While you should list the tasks and effort leading up to a project milestone, be sure to present the milestone at the end of those tasks to signify a delivery, or even a presentation of, the deliverable.

2. Spotlight important dates

It's important to keep all of the important events in mind when you are planning a project because they could possibly impact your project schedule.

3. Identify potential project bottlenecks

- Many projects rely on the work produced by external teams or partners to make forward progress. If you are not tracking those external factors somewhere, there's a great chance you will forget to follow-up on it.
- That's why it's important to list these deliverables as project milestones if you are working on a project that depends on someone or something outside of your project.

5.12 Change Request

- A change request is a proposal to alter a product or system, often brought up by the client or another team member. During a project, this can happen when a client wants to change or alter the agreed upon deliverables.
- During a project, a change request can often be met with dread. But the fact is, they are a reality in the business world and often, change requests are submitted for legitimate reasons. In our constantly changing business environment, it is impossible for anyone to really know exactly what they will need to achieve their objectives at the start of a project.
- So the best way to handle change is by managing it rather than avoiding it. Although teams should resist unnecessary changes, it is important to stay open to new opportunities that could bring more value to the project and the organization.

Change requests can also be initiated internally as well and can include things like changing or upgrading software. In general, there are two types of change requests: those that are inside the scope and those that are outside the scope of the project.

Change requests that are inside the scope involve small corrections to an existing requirement. They usually have minimal impact on the budget or the rest of the team. On the other hand, change requests that are outside the scope take a considerable amount of time to implement and have a more sizeable impact on the budget.

Change requests should also be clearly documented in writing containing all the important details. It is important that all involved parties know what the change entails and what is expected of them.

Examples for typical change requests are :

- o Modifying the project processes
- o Modifying project plans and (usually extending) deadlines
- o Modifying project management methods that aim at reducing project costs or increasing or reducing the project scope

If a customer wants to make alterations to project deliverables they should submit their change request to the project manager and work together on a new or adjusted project order.

12.1 Steps for Managing Change Request

A change request will often come up throughout the course of most projects so it is a good idea to have a plan to handle them ahead of time. Often, change requests are necessary and can offer many benefits. Managing this process in an effective way can allow for greater internal communication, efficiency, and alignment with overall business goals.

Here are five tips on effectively managing change requests :

1. Request for supporting materials

- The person who is making the change must be as specific as possible. Ask that person to put his request in writing and provide any supporting materials that might be helpful.
- Have that person articulate his request for the change and the anticipated benefit of the change request is. This will help your team determine whether or not the change request is worth the effort.

2. Determine whether the change request is inside or outside the scope

- It is a good idea to consider what the scope of the change request is. If your team chooses to implement this change, what new requirements will this put on the project? You should consider all aspects of the project that will be impacted by implementing this change request.
- If the request is outside of the scope, a lot of problems might end up popping up such as going over-budget or having to waste too much time on the project.

3. Assess the priority of the change request

- Before your team implements any changes to the project you should consider any possible risks. What is the expected benefit of the change being proposed? Is this change request the result of an actual need to respond to a change in the marketplace or would it simply be nice to have?
- You can consider the opinion of the person who proposed the change request, but at the same time, use common sense. The client might not know what's in their own best interests. Have clearly defined guidelines for evaluating the urgency as there may be varying opinions amongst team members.

4. Approve or reject the change request

- Now that you know how important the change request is and understand the impact it will have on the project, the team can either approve or reject the request.
- Different organizations will have different ways of going about the approval process. Generally, a change request that will require minimal additional work can be approved within the team. Whereas a change request that would require a month's worth of additional work may require executive approval.

5. Decide on a course of action going forward

- If the change request is approved then the project deliverables will need to be updated. This can include plans and schedules, business process documents, and the requirements documents.
- Once these updates have been made, the project manager can communicate the new course of action to everyone who will be impacted. Now you can delegate the necessary tasks to the people in charge of implementing these new changes.

5.12.2 Tips for Evaluating Change Requests

- The project change management plan should include information about how change requests are evaluated. It's vital that the criteria for this evaluation be determined before it's needed so that time is not wasted reaching consensus. Setting these parameters will help balance change with overall business goals and benefits.
Here are some typical questions to consider when evaluating a change request :
 - o Does this change add to or alter the business requirements?
 - o Is there a work-around, or is this change necessary for the overall success of the project?
 - o Does this change require an increase in funding?
 - o Will this delay the project end date?
 - o Even though this change may have a negative impact on this project, does it result in significant business upside that make it worthwhile?
 - o Does enacting this change now make more sense than delaying it? Will the delay end up costing the company more money in the end?
 - o Have all the affected stakeholders been considered, and do they endorse the change?
 - o Are there contractual ramifications to consider? For example, will commitments with outside vendors be unfulfilled because of this change?
- The answer to these questions will help approve or reject the change request with complete certainty.

5.13 Scope Creep

- Scope creep is a situation when a project stretches far beyond its original vision and deadline. Scope creep is one of the biggest causes of project failure. It usually starts with a small change request, just a minor readjustment of the project scope which is followed by one more request then another and another.
- Before you know the small change turns the project into a different shape altogether. Instead of five deliverables, you now have 15. But the budget and the deadline are the same.
- So, scope creep refers to small, continuous requests that stretch the project beyond its originally defined scope. Since these change requests are often small, they tend to "creep" up on the scope. Hence the term used is "scope creep".

5.13.1 Causes of Scope Creep

1. Not having a clear scope : Clarity is extremely important on any project. If you don't clearly define your scope at the beginning, it can cause big problems down the line.
2. Not having client agreement : If the client isn't bought into the scope, they are likely to change their mind and the deliverables later on.
3. Not involving the client throughout : Gone are the days where you do a month or two of work and then send the final results of this period to your client for feedback. This results in surprises, with finalized work having to be redone, and impacts the project timeline and budget.
4. Not raising issues proactively : Hiding behind issues and not being transparent with the client or stakeholder seems easier at first, but you will come to regret it later on.
5. QA needing more time than estimated : The age-old issue of Quality Assurance estimation gives troubles. How accurately you estimate how many bugs will be raised, how long they will take to fix always has an impact.
6. Not prioritizing among features : In a Waterfall-style project, your product will likely be built step-by-step until you reach the whole, shiny, new thing. This could lead to thinking everything is a priority. If you don't have clear priorities among features, it's hard to understand what can be removed when adjustments to requirements begin to surface.
7. Not agreeing on how to handle change : If you haven't agreed on how to handle change at the beginning of a project, it only makes sense that it's going to be difficult to work through changes in scope at a later date.
8. Poor Estimation : Estimation is very difficult to get right. It's a challenge to be accurate at the beginning of a project when there are many unknowns. Certain things may not get accounted for, and you end up tied to this extra scope to be able to deliver your overall project.
9. Not evaluating new requests : It's easy to take on new requests or ideas from clients or team members, believing that they are the right path forward. If you don't evaluate these requests properly you could end up accepting new scope, duplicating work or building unnecessary features without noticing.
10. Not involving users early enough : Many projects go to the final stages before actually putting it in front of real users. It's tempting to fool ourselves thinking that we know the users well enough to avoid interacting with them. If you are not incorporating user feedback early on, you can go far down a route that doesn't test well with users. At that point, your scope can suddenly spiral.

5.13.2 Ways to Manage Scope Creep

1. Be proactive. Determine and agree upon a change management process upfront.
2. Prioritize. Look at what can be descoped to accommodate new requests.
3. Be transparent. As soon as scope creep appears, bring it up with clients and stakeholders.
4. Analyze impacts. Work out the impacts (both positive and negative) of changes, and present solutions to your client or stakeholder in order to move forward.
5. Embrace it. Work out what's necessary for a testable, usable product—if that means changing scope, look at ways to incorporate the changes.

5.13.3 Steps to avoid Scope Creep

No matter how thoroughly your project is planned, scope creep always comes around. Careful control of project scope should start before the beginning of actual work on the project.

Here's a checklist of scope control steps that won't allow scope creep to usurp your project.

- Identify all stakeholders and understand their goals :** You should do it even before you start working on the project. Identifying visions, interests and requirements of all involved parties in advance is a necessary step of project planning phase. It reduces the risk of scope changes in the middle of your project work and helps avoid conflicts caused by unaccounted interests.
- Clearly define project scope :** It is another indispensable step of the planning phase that needs close attention. It's important not only to define what is included in the project scope but also to list what is not included. This minimizes the risk of misunderstanding and reduces the number of new requests, suggestions, and requirements.
- Plan room for changes in advance :** Not all risks can be foreseen and prevented, and thus modifications are inevitable at times. That's why change control and management procedures should be clearly defined and documented, and room for possible amendments needs to be provided. Make sure your change management process is focused on project goals, and carefully document steps required for making a decision on a project scope modification.
- Take action as early as possible :** Identify and address possible scope creep at its early stages. New suggestions from clients or sponsors, updated requirements, or feedback from the team on time estimate changes need to be heard, documented, and communicated to involved parties for consideration. The sooner you make a decision on a change, the less harmful effect it will have on the project course and result.
- Know when to say no :** It's tempting to implement all suggested features and functions, but it's rarely good for project delivery time, budget, and the product itself. Saying no to unreasonably time-consuming and expensive features and parts of work is crucial for delivering a quality product on time. Make sure you have a justification for saying no.

5.14 Project Audit

- Project Audit is a project evaluation technique designed to determine the true status of work performed on a project and its conformance with the project statement of work, including schedule and budget constraints.
- It is an independent and structured assessment of the state of affairs conducted by a competent examiner. By inference or extrapolation, it provides insight into the work needed to meet project objectives and the adequacy of the schedule and budget to do so. In addition, it can illuminate mistakes that can cause project failure and thus can trigger timely corrective action.
- A project audit is a project of its own, and as such, no one size fits all. It takes an experienced and knowledgeable project manager to conduct an audit from beginning to end, and to adapt it according to the environment.

5.14.1 Benefit of Project Audits

Project audits can help identify when a project is about to go off-course. In addition, a project audit can provide the following benefits :

1. Improve project performance.
2. Increase customer and stakeholder satisfaction.

- 1. Save costs.
- 2. Control scope and avoid scope creep.
- 3. Provide early problem diagnostics.
- 4. Clarify performance/cost/schedule relationships.
- 5. Identify future opportunities for improvement.
- 6. Evaluate performance of the project team.
- 7. Inform client of project status/prospects.
- 8. Reconfirm feasibility of/commitment to project.

The benefits of project audits become especially evident in large organizations running large projects. Multi-million dollar projects can easily derail due to poor management techniques causing the investors millions of dollars. In this scenario, the cost of not performing periodic project audits can be much higher than the cost of performing it. Multiple audits, perhaps one per phase, are recommended for large projects.

5.14.2 Preparing for the Project Audit

The aim is to ensure that the audit team receives full and uninterrupted access to all required information, people and facilities during their audit. This includes emails, and documents developed by the project team. Having everything at your fingertips makes it easy to answer questions when they arise.

When you conduct an audit, determine whether the PM has addressed the key items in each phase of the project cycle. This includes :

1. Initiation Phase

- Identify the main objective of the project.
- Write the project charter.
- Get sign-off on the project charter.

2. Planning Phase

After you complete reviewing the Initiation Phase, review the actual project plan or Work Breakdown Structure (WBS). You should focus on how well defined the WBS is and how well tasks and dependencies have been scheduled. Make sure the planning is sound. Failing to plan is planning to fail.

- Create a Project Management Plan.
- Establish project deliverables.
- Write a scope statement.
- Determine a project budget.
- Distinguish project activities.
- Work out a schedule.
- Determine special skills needed to complete planned tasks.

3. Execution Phase

Once the planning phase has been reviewed, the execution phase review takes place. Many projects suffer from scope creep during this phase. Has the project team stuck to their scope? Poor communication, misunderstandings and lack of information may have caused issues.

- Put together the project team.
- Administer and guide the project team.
- Conduct status review meetings.
- Communicate project information.
- Implement quality assurance measures.
- Make sure the control measures are sound and the correction procedures are well described.

4. Controlling Phase

- Measure performance against the plan.
- Evaluate the corrective measures.
- Manage change requests.

5. Closing Phase

- Once most of the work of the project is done, we approach to closing phase. Has the project been documented and closed properly ?
 - o Manage acceptance of project deliverables.
 - o Document lessons learned during the project.
 - o Archive project records.
 - o Formalize the closing of the project.
 - o Release project resources.
 - o Write final Status Report.
- In general, you must try to understand all the processes. How well suited is the methodology to this particular project? Are all the processes required in place? Did they miss anything from the methodology that should be there?

5.14.3 Phases of Project Audit

Phase 1 : Success Criteria and Questionnaire Development

1. **Success Criteria Development :** Interview the core project sponsor and project manager to determine their "success criteria" for the project audit. This ensures that their individual and collective needs are met.
 2. **Questionnaire Development :** Develop a questionnaire to be sent to each member of the core project team and selected stakeholders. Individuals often complete the questionnaire in advance of an interview. It helps them to focus their thoughts.
- The actual interview provides the facilitator with the opportunity to gain deeper insights into the interviewee's comments. The questionnaires help them to reflect on the project's successes, failures, challenges and missed opportunities.
3. **Project Audit Questions :** There are many questions that can be asked. It is easiest to develop open-ended questions for the interviews. These questionnaires can be used for team members and/or other stakeholders who cannot attend an interview.
- Develop the questions so that they help to identify the major project successes; the major project issues, concerns and challenges; how the team worked together; how vendors were managed; how reporting and meetings were handled; how risk and change was managed, etc.

Phase 2 : In-depth Research

Conduct individual research interviews with the Project Sponsor, Project Manager and Project Team members in order to identify the past, current and future issues, concerns, challenges and opportunities.

Conduct individual research interviews with stakeholders including vendors, suppliers, contractors, other project internal and external resources and selected customers.

Assess the issues, challenges and concerns in more depth to get to the root causes of the problems.

Review all historical and current documentation related to this project including:

- o Team Structure
- o Scope Statement
- o Business Requirements
- o Project Plan
- o Milestone Report
- o Meeting Minutes
- o Action Items
- o Risk Logs
- o Issue Logs
- o Change Logs

Review the Project Plan to determine how the Vendor Plan has been incorporated into the overall project plan.

Interview selected Stakeholders to identify and determine what their expectations of the project had been and to identify to what extent their expectations have been met.

Review the Project Quality Management and the Product Quality Management to identify the issues, concerns and challenges in the overall management of the project and to identify the opportunities that can be realized through improvements to the attention of project and product quality.

Identify the Lessons Learned that can improve the performance of other future projects within the organization.

Phase 3 : Report Development

- Compile the information collected from all of the interviews.
- Compile the information collected from individuals who only completed the questionnaire.
- Consolidate the findings from the project documentation review.
- Identify the issues, concerns and challenges presented through the review of the Project Quality Management and Product Quality Management plans and isolate the opportunities you believe may be realized.
- Identify all of the project's issues, concerns and challenges.
- Identify all of the project's opportunities that can be realized through this report's recommendations.
- Identify the Lessons Learned that can improve the performance of future projects within the organization.
- Finalize the creation of the report and recommendations on the basis of the findings and present this detailed report and recommendations including the road map to get future projects to the "next level" of performance.

5.15 Project Procurement Management

- Every organization acquires material or services to complete its business needs. The process of buying materials and obtaining services from vendors or dealers is called procurement.
- Material Procurement is a very important part of project management. It involves the process of selecting vendors, establishing payment terms, strategic vetting, negotiating contracts and actual purchasing of goods. Procurement is concerned with acquiring all of the goods, services, and work that is vital to an organization. Thus, Procurement is essentially, the overarching or umbrella term within a lot of activities can be found.
- Procurement should be done in such a way that materials are ordered in correct quantity, with a proper value at the proper time. It is subdivided into following parts :
 - o Primary Procurement
 - o Secondary Procurement

5.15.1 Primary Procurement

- Primary or Basic procurement is a process of acquiring goods or services in the right quantity, at the right price, and at the right time. It is critical to maintain a right balance between quantity, price, and time.
- For example, Organizations try and keep inventory levels at a minimum, due to the prices associated with high levels of inventory; at the same time, it can be detrimental to stop production due to shortage of raw materials. Though getting the minimum price for a product or service is often necessary, however it is equally important to maintain a balance between the product availability, quality, and vendor (seller) relations.

Procurement in most modern organizations follows some sequential steps which are described as follows :

1. **Requirement and Information Gathering** : Procurement process starts with gathering information about a product and its quantity. Then for the required products and services, it is necessary to look for suppliers who can satisfy the requirements.
2. **Identifying and Contacting Supplier**: After gathering the requirements, one looks for the suppliers who can fulfill those requirements. Based on that, quotation requests or information requests are sent to the suppliers or they are contacted directly.
3. **Reviewing Background of Suppliers** : Once the supplier is known, the product/service quality is checked, and any necessities for services such as installation, warranty, and maintenance parameters are investigated. Some samples of the products can be obtained for quality examination.
4. **Negotiation** : Some negotiations with suppliers are made regarding the price, availability, and delivery schedule of the products/services. Thereafter, a contract is signed that is a binding legal document between the supplier and the ordering party. A contract will include all necessary information such as price and quantity of material, delivery date, etc.
5. **Order Fulfillment** : Ordered material is shipped, delivered to the ordering party, and the supplier is paid accordingly. Training and installation of product or services may also be included.
6. **Consumption, Maintenance and Disposal** : As the products/services are consumed, the performance of the products or services is evaluated and any follow-up service support, if required, is analyzed.
7. **Contract Renewable** : Once the products or services are consumed or the contract expires and needs to be renewed, or the product or service is to be re-ordered, the experience with the vendors and service providers is reviewed. If the products or services are to be re-ordered, the company decides whether to order from the previous supplier or think about new suppliers.

5.15.1 (a) Primary Procurement Activities

The following Fig. 5.15.1 illustrates the flow of basic procurement activities :

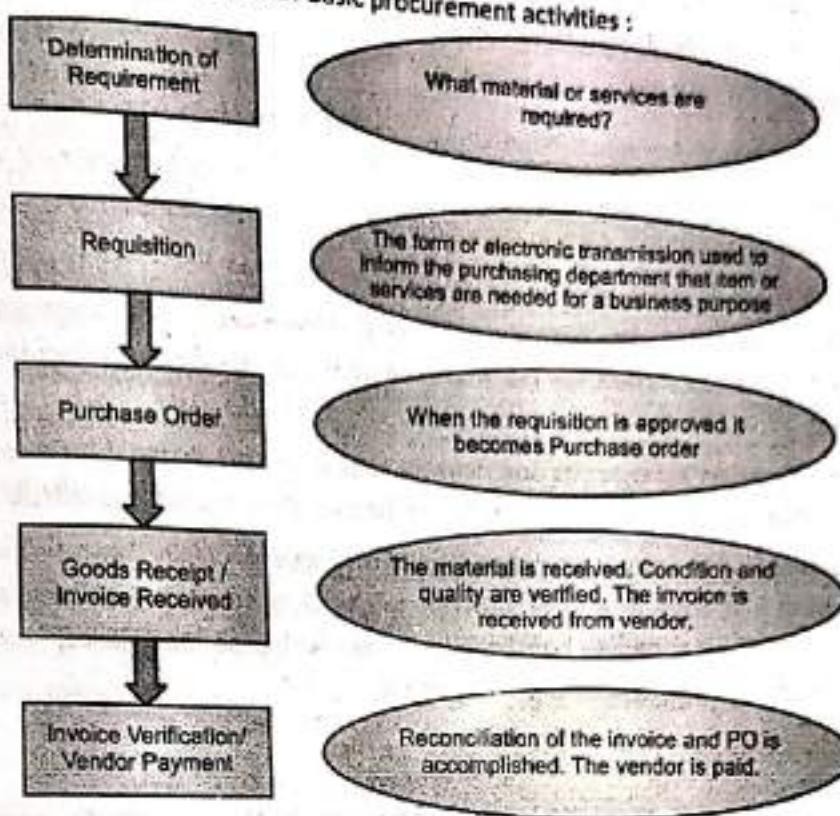


Fig. 5.15.1 : Flow of basic Procurement Activities

A brief introduction of the Procurement Activities is given as follows :

1. **Determination of requirement** : It is the logical subdivision where it is determined what material or services are required, and which supplier can fulfill the requirements.
2. **Creating Purchase Requisition** : It is the phase in which the purchasing department is informed about the requirement of items or services. A requisition is an internal document.
3. **Creating Purchase Order** : It is the phase when an order is created from requisition and it is approved and assigned to a supplier.
4. **Goods receipt/ Invoice Received** : It is the phase in which the material is received by the company and its condition and quality are being inspected. In this phase, an invoice is received from the vendor (seller).
5. **Invoice verification/ Vendor Payment** : It is the phase in which the vendor is paid from the company and reconciliation of the invoice and PO is accomplished.

5.15.1 (b) Types of Primary Procurement

- Procurement for Stock Vs Consumption

- External Vs Internal Procurement

1. Procurement for Stock Vs Consumption

The following points show the difference of Procurement for Stock vs. Consumption :

- **Procurement for Stock** : A stock material is a material that is kept in stock. These materials are kept in stock once received from the vendor. The stock of this material keeps on increasing or decreasing based on the amount of quantity received or issued.

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- **Procurement for Direct Consumption :** When the procurement is for direct consumption, i.e., it will be consumed as soon as it is received, the user should specify the consumption purpose. To order a material for consumption, the material may have a master record within the system.

2. External and Internal Procurement

The following points show the difference of External vs Internal Procurement :

- **External procurement :** It is the process of procuring goods or services from external vendors. There are three basic forms of external procurement generally supported by the purchasing component of the IT system.
 - (i) **One-time orders** are generally used for material and services that are ordered irregularly.
 - (ii) **Longer-term contracts with the subsequent issue of release orders :** For materials that are being ordered regularly and in large quantities, we can negotiate deal with the vendor (seller) for pricing or conditions & record them in a contract. In a contract you also specify the validity date.
 - (iii) **Longer-term scheduling agreements and delivery schedules :** If a material is ordered on an everyday basis and is to be delivered according to an exact time schedule, then you set up a scheduling agreement.
- **Internal Procurement :** Large corporate organizations may own multiple separate businesses or companies. Internal Procurement is process of getting material and services from among identical company. So, each of these companies maintains a complete bookkeeping system with separate Balance, Profit & Loss Statements so that when trade occurs between them it will be recorded.

5.15.2 Secondary Procurement

Secondary Procurement is the stocks that are managed differently as these stocks do not belong to the company. They are kept at some particular location. Secondary procurement is divided into the following categories :

1. **Consignment stocks :** Consignment stocks are those materials that are available at the store premises but it still belongs to the vendor. If you utilize the material from consignment stocks you have to pay to the vendor.
2. **Third-party processing :** In third-party processing, a company passes on a sales order to the associate external vendor who sends the goods directly to the customer. The sales order is not processed by the company, but by the vendor. Third-party items can be entered in purchase requisitions, purchase orders, and sales orders.
3. **Pipeline handling :** In pipeline handling, the company need not order or store the material involved. It is obtainable as and when required via a pipeline (for example, oil or water), or another style of cable (such as electricity). The material that is consumed is settled with the vendor on a regular basis.
4. **Returnable Transport Goods :** The Company orders goods from a vendor. The goods are delivered with returnable transport packaging (pallets, containers) that belongs to the vendor and is stored at the customer premises until they return it to the company.
5. **Subcontracting :** The vendor or the subcontractor receives components from the ordering party with the help of which it produces a product. The product is ordered by your company through a purchase order. The components required by the vendor to manufacture the ordered product are listed in the purchase order and provided to the subcontractor.
6. **Stock Transfer using stock transport order :** Goods are procured and supplied within a company. One plant orders the purchase order, the stock transport order. You will be able to request and monitor the transfer of goods with a stock transport order.

5.16 Project Contracting

every day, many projects and infrastructure works are undertaken across the world. These projects are of different types ranging from software, construction, telecom, to scientific, and oil & gas. Every project has stakeholders/clients and vendor/seller/supplier in common.

In other words, every project is initiated by an organization with the help of suppliers for the various needs of the procurement. In project procurement management, these two parties are generally termed as 'buyer' and the 'seller' and the agreement between the two is called the "contract."

Contracts are an essential part of procurement management. It creates a legal binding between the buyer and the seller. Contracts are necessary for project management as they provide relief on either side.

It is managing the risks involved in procurements. A contract is required to share and bear the individual's responsibilities in completion of the project. This is more so in larger and complex projects.

5.16.1 Contract Manager

The Contract Project Manager plays a very critical role Project Contracting. He/she manages contracts throughout the projects and their life cycle. On many occasions, he also plays the role of a Liaison person between the companies, employees, vendors, customers. He creates the contract's repository and is solely responsible for maintaining all the contractual records. The company uses these records for their projects, which finally become part of Record Management.

Key responsibilities

- Draft, develop, negotiate and execute the contract.
- Create policies and procedures to the contract and ensure the effectiveness.
- Liaison person and a contract facilitator.
- Manage and close the contracts throughout the project duration.
- Create a contract repository and update periodically.

5.16.2 Contract Management

- Contract is an agreement between two parties in general. In project management, it's a formal agreement between a buyer and a seller. The agreement is made to procure goods and services required for the agreed project. This document needs to be prepared by the Project Manager.
- It is done in coordination with Procurement Manager during the project planning stage. It has to be documented as a Procurement Management plan, which is a part of the primary Project Management Plan.
- Contract Management, a part of the Project management, deals with the vendor/seller/supplier. It also manages the procurements according to the terms and conditions set in the 'Contract.' The terms and conditions are agreed mutually between the buyer and seller.
- Contract management is the art and science of managing a contractual agreement throughout the contracting process. Though many times the contracts are simple and straight, sometimes, they are more complex. It happens in larger projects as many procurements and suppliers are involved.
- The procurement contract being a formal document must be carefully designed. It should also be mutually agreed to avoid the complications between the buyer and the seller. It is all to execute the project smoothly for the timely completion.

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- Guidelines to be considered while deciding on procurement contract :
 - o Complexity of procurement
 - o Location of procurement
 - o Availability of suppliers/contractors
 - o Local governing regulations
- These guidelines assist in deciding the type of contract suitable for the project undertaken. The following are the types of contracts generally followed in Project Management.

5.16.3 Types of Contract

- Most of the contractual relationships are broadly categorized as either
 1. Fixed-Price contract
 2. Cost reimbursable
 3. Time & Materials Contract

The third type of contract is seldom used.

1. Fixed Price Contracts

- In this category, the contract involves a fixed price for a defined product or service or the result to be supplied/provided. These types of contracts are recommended when the scope of service is completely defined and final.
- Types of Fixed Price contracts used in managing projects

(i) Firm Fixed Price (FFP)

The prices of the goods and services are set and are never subjected to change unless the scope is changed and agreed mutually. This type is favorable mostly to the buying organizations. Because the extent of buying the goods remains unchanged and recurring buying happens.

(ii) Fixed Price Incentive Fee (FPIF)

The price ceiling is set, and the seller needs to perform and fulfill the contract requirements within that price. All the costs above the price ceiling are the responsibility of the seller. This type gives both the buyer and the seller some flexibility for performance with technical incentives. The incentives are tied to achieving agreed upon metrics such as cost, schedule and technical expertise of the seller.

(iii) Fixed Price with Economic Price Adjustments (FPEPA)

It is suitable when the contracts are executed in different countries and payments are made in a different currency. Also, if the seller's work lasts for a few years (3-5 years generally) this contract is fitting. This contract gives an option to make adjustments in the predefined final payment as agreed to in the contract due to changed conditions such as inflation rates.

2. Cost Reimbursable Contracts

This type of contract involves cost reimbursement for the costs incurred during completion of the contractual job. It is along with a pre-defined fee representing seller profit. It is recommended if the scope of the work is expected to change during the contract period.

This type of contract includes :

(i) **Cost Plus Fixed Fee (CPFF)**

The seller gets all the allowable costs agreed in the contract. The seller also receives a fixed fee payment, which is calculated as a percentage of initial estimated project costs. Unless the project scope changes, this fee remains unchanged.

(ii) **Cost Plus Incentive Fee (CPIF)**

The seller gets the reimbursements for all the costs incurred on performing the work agreed in the contract. Based on the final costs incurred (greater or lesser than the initial planned cost), both the buyer and the seller share their expenses. The sharing is based upon a pre-negotiated cost-sharing formula. Generally, it is an 80/20 split over the target costs based on the actual performance of the seller.

(iii) **Cost Plus Award Fee (CPAF)**

In this type, the seller gets his/her legitimate reimbursements. But a majority of the fee is received upon meeting some technical/subjective performance that is pre-set in the contract. This solely depends on the buyer's determination and the seller's performance.

3. Time & Material Contracts (T&M)

This is a hybrid type of contract combining the features of Fixed as well as Cost Reimbursable contracts. This is often used when contractual requirements (scope) is not known/ prescribed. Also, this type of contract is suitable for acquisition/hiring of experts, project staff required for a particular period.

5.17 Project Outsourcing

- The process of outsourcing is an effective means for businesses to get projects completed efficiently, especially if the project at hand requires skills that are beyond the capabilities of a business's current employees.
- Project outsourcing has been proven to improve core business competency and helps companies cut back on capital expenditures, since the tools needed to accomplish the project are already provided as oppose to purchasing new ones.
- Hence, if you are a business owner and you would like to optimize the productivity of your enterprise without spending too much, the project outsourcing services can definitely help you accomplish such goal.
- Process outsourcing by industries around the world has seen considerable growth from during last few decades. It started with business process outsourcing and now has reached to knowledge process outsourcing.
- Surprisingly, outsourcing of project management services is still in its infancy. Judging from the growth in outsourcing of other business processes there seems to be very good opportunity for project management outsourcing.
- Some organizations have successfully outsourced their project control functions to outside vendors. The main challenge in the growth of project management outsourcing is in accepting project control as a separate function and in delegating this to other departments or vendors.

5.17.1 Project Management Outsourcing

- In the past most outsourcing that has been done has been in the IT sector and a large part has been for project-based assignments. For these, project management was an integral part and was included as part of the scope of the vendor or service provider. Considerable importance is given by clients and the service providers for project management.
- Many clients view project management skills of the vendors as criteria before they are awarded contracts. So when an outsourcing assignment is given to a vendor for example software development, project management is considered a part of it.

- By project management outsourcing, we do not mean the contract for providing the main service. Instead, we look at particular instances for example :
 - o A client outsources project management functions to a vendor or service provider
 - o A service provider outsources a part of its project management functions to another vendor or service provider
 - o Project management functions are considered separately and awarded as a separate assignment within an organization.

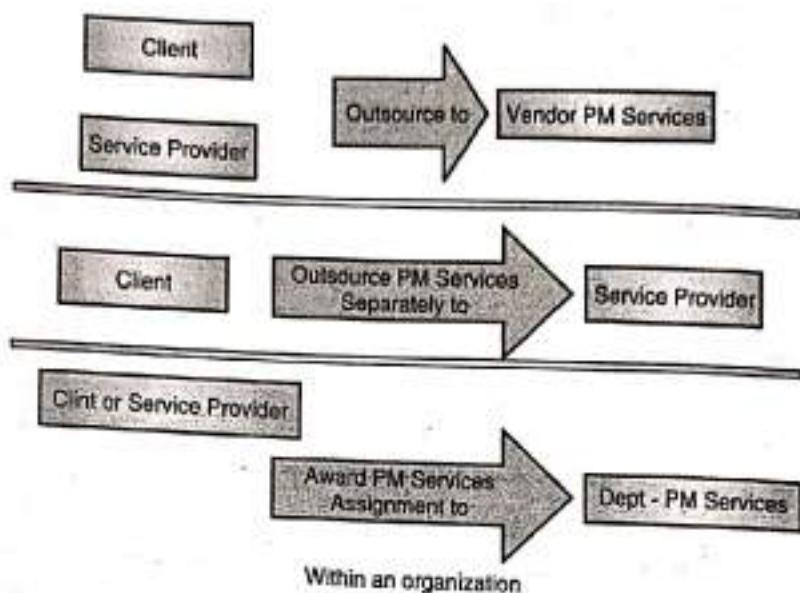


Fig. 5.17.1 : Project Management Outsourcing

5.17.1 (a) Pros and Cons of Project Management Outsourcing

Pros

- Clients can focus on core competencies
- Faster ramp up time or time to market
- Fresh look from an outside view
- Vendor can ensure that best practices are followed and can provide latest trends in specific sectors
- Preparation for similar projects in future.

Cons

- Commitment and resources required internally, even though external resources are used
- Relationship with vendor needs to be managed otherwise no benefits are accrued
- Because ownership of resources does not exist with client, vendor can discontinue the relationship
- Depending on the nature of the project, data security may be compromised
- May cost more if the relationship does not work out.

5.17.1 (b) Using IPECC to Understand Project Management Outsourcing

The IPECC process groups of the PMBOK® Guide provides us a basis to understand what processes or functions in project management can be outsourced and what should not be outsourced.

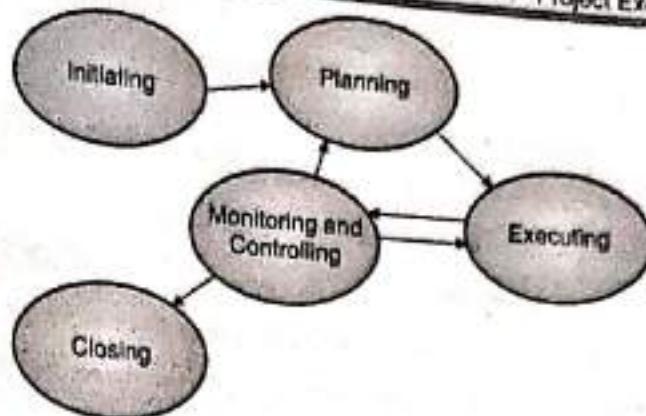


Fig. 5.17.2 : IPECC and PM Outsourcing

Functions or Processes that Can Be Outsourced

Initiating is a key area where senior management is involved and requires their active inputs and executing is an area that directly deals with people and is the heart of a project. So, these are not the preferred areas for outsourcing. However, many of the functions in planning, monitoring/controlling, and closing could be considered for outsourcing.

Some examples are as follows :

1. Planning : WBS and schedule development, preparing cost estimates/baseline, quality and risk planning, tool/software support.
2. Monitoring and controlling : Analyzing/control schedule and cost, reporting status information, tool/software support, project management information systems, project audits, and earned value analysis.
3. Closing : Post project appraisal.

In addition to this, formulation of project management methodology, training for project management can be outsourced.

Review Questions

- Q.1 Explain the characteristics and advantages of Project Monitoring. (Refer Sections 5.2, 5.2.1 and 5.2.2)
- Q.2 Describe Project monitoring & controlling process. (Refer Sections 5.3 and 5.3.1)
- Q.3 What is Information need of a project? Describe its objectives. (Refer Sections 5.4 and 5.4.1)
- Q.4 Explain the reporting of information. Describe any four types of report. (Refer Sections 5.5 and 5.5.1)
- Q.5 Write a note on stakeholder engagement. (Refer Section 5.6)
- Q.6 Describe the ways to engage project stakeholders. (Refer Section 5.6.3)
- Q.7 Explain team management. Write some of its characteristics. (Refer Sections 5.7 and 5.7.1)
- Q.8 What is project Communication? How can you manage project Communications. (Refer Sections 5.8 and 5.8.2)
- Q.9 What is project meeting? Explain its planning steps. (Refer Sections 5.9 and 5.9.1)
- Q.10 Describe the Earned value method. Write its method. (Refer Section 5.10)
- Q.11 What is the significant of milestones in project management? (Refer Section 5.11)
- Q.12 What are the ways to use milestones effectively? (Refer Sections 5.11.2 and 5.11.3)
- Q.13 Write a note on Change Request. Write the steps for managing change request. (Refer Sections 5.12 and 5.12.1)

- Q. 14 What is scope creep? Describe some of its causes. (Refer Sections 5.13 and 5.13.1)
- Q. 15 Describe the ways to avoid scope creep in projects. (Refer Section 5.13.3)
- Q. 16 Write a note on project Audit. (Refer Section 5.14)
- Q. 17 Write the steps to prepare for Project Audit. (Refer Section 5.14.2)
- Q. 18 What are the phases of Project Audit? Explain (Refer Section 5.14.3)
- Q. 19 Describe project Procurement management. What are its types? (Refer Section 5.15)
- Q. 20 What is Project Contracting? Describe the types of Contracts. (Refer Sections 5.16 and 5.16.3)
- Q. 21 Describe project Outsourcing. Write its advantages and disadvantages. (Refer Sections 5.17 and 5.17.1)

**CHAPTER
6****Module 6**

Project Leadership, Ethics and Closure

Syllabus

Introduction to project leadership, ethics in projects, Multicultural and virtual projects. Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority, areas of further study.

Project Leadership

6.1

- Leadership is the ability to establish vision and direction, influence and align others towards a common purpose and empower and inspire people to achieve success.
- Project leadership is the act of leading a team towards the successful completion of a project. Project leadership requires skills in both management and leadership. It is a soft skill.
- Leadership for long has been growing in relevance and importance as more and more projects are being delivered in a more complex and uncertain environment. The role of leadership in a project is to promote the project objectives, encourage positive relationships, support effective teamwork, raise morale, and empower and inspire individuals.

An effective leadership :

- o Set standards of behavior and performance
- o Motivate the team members to high performance and
- o Rally the team members when the project has problems to overcome.

6.1.1 Role of Project Leader In Managing Projects

A project leader is the in-charge of project activities and plays a vital role in ensuring each member in the team contributes and adds value to the project. This requires familiarity with team management, data reconciliation and time-tracking.

Following are a few areas of work for a project leader :

1. **Project Estimation :** Once a project matches the business goals, the next step taken by a project leader is to estimate its costs, efforts, resources, time, benefits and even potential risks. After each activity and resource is assigned a budgetary allocation, the project spending can be finalized. Estimate of skills and their availability for the project is another important work area.
2. **Building Team :** Teams are the engine driving projects forward. Building a great team requires project leaders to be proficient at understanding the internal team dynamics. Besides ensuring everyone gets a fair chance to play to their strengths, a key project leadership skill lies in facilitating healthy dollops of team collaboration.

3. **Strategic Project planning :** The crux of advanced project management and strategic leadership lies in scoping out a project. While no one would take up a project that poses no benefit the frequency of scope change can either reduce or increase the benefits of doing a particular project. A popular project leadership skill lies in striking a balance between seeking fresh challenges and thinking along the lines of long-term benefits. This is why seasoned leaders plan a project portfolio strategically. The process involves identifying volatile shifts in demand and acquiring a scalable capacity for it.
4. **Tracking Milestone Delivery :** These days traditional methods of managing projects are being swapped in favour of agile delivery. And the biggest advantage is in how visible a project's progress is. Rather than having to wait till the very end to spot and fix errors with a back track, the evolution in the role of a project leader has enabled them to actively track the milestones reached against each release within a project.
5. **Maintaining Project Health :** The reason to regularly check the health of a project is to record quality audits, avoid future mistakes, review employee performances as well as record timelines, targets and deliverables. Project health keeps track of decisions concerning the project's selection, business case, approval or rejection of scope changes and actions taken to resolve issues. It lets project leaders match resources against priorities and inject flexibility where required so that the project stays the course and makes use of the right and adequate supply of resources.
6. **Risk Mitigation :** Project leaders know from experience that risks are inevitable. That's why they rely on intuition and forecasting insights to identify and combat old, new or common risks. As a project leader, you have to be better informed of the risks and the ways to counter them. You can work together to create a risk chart depicting the severity, likelihood and mitigation plan.
7. **Conflict Resolution :** Project leaders have to deal with people and the likelihood of asymmetries between expectations and reality. Simply put, once the resources are assigned to projects, competing interests arise despite there being a task priority log. Add to which, newer priorities override existing ones and displace schedules, which can result in teams becoming dysfunctional and uncooperative.

6.1.2 Project Manager Leadership Skills

Some of the project leadership skills you'll need to advance professionally would include

1. **Inspiring and Motivating :** While there are several leadership styles, the ideal project leader is one who demonstrates his/her readiness to add value to the project. As he has to lead a team it is important him to be inspiring and motivating to his team members. He must be followed by people.
2. **Negotiation Skill :** A skill best seen during the bidding stage, negotiation skills not only win you feasible contracts but also lets you communicate with different stakeholders in a language they understand.
3. **Communication Skill :** A project leader spends most of his time in conversation with others, be it with his teams, clients or reporting bodies. Thus, an effective communication skill goes a long way in making him effective. Not only will it help him align roles to the company vision but will also enable him to see work from your team's perspective.
4. **Future Centric :** As a project leader, one must have a good understanding of what is in store in coming days. Being futuristic is a positive quality of a leader. It helps him set him the right vision for his team.
5. **Influential :** Good leaders need to be influential. He must have the ability to establish and strengthen inter-departmental business ties. This way, he stays informed of resources with the right cultural mindsets, ability and skills. They come in handy in the future when he needs to find the right person for a new opportunity.

6.1.3 Leadership Styles

- There are different leadership styles that a project leader must have in order to be effective in their role in leading the team. The different kinds of leadership styles are :
- Coercive Leadership : This style is rarely used by project managers and is more apparent during crisis situations especially when a project deadline is looming and in danger of being missed. If this style is to be summed up in one phrase, it would be "Do what I tell you."
 - Authoritative Leadership : Authoritative leaders inspire an entrepreneurial spirit and vibrant enthusiasm for the mission, which would be valid for any project. This style works best when the team needs a new vision because circumstances have changed, or when explicit guidance is not required.
 - Affiliative Leadership : This is a very common management style used by project managers and has a positive impact on the project team. This leader works to create emotional bonds that bring a feeling of bonding and belonging to the organization. This style works best in times of stress, when teammates need to heal from a trauma, or when the team needs to rebuild trust.
 - Democratic Leadership : This leader builds consensus through participation. An example of this is where each team member in a Project Management Office (PMO) contributes towards defining and measuring the objectives of the PMO. The democratic style is most effective when the leader needs the team to buy into or have ownership of a decision, plan, goal, or if he or she is uncertain and needs fresh ideas from qualified teammates.
 - Pacesetting Leadership : This leader expects and models excellence and self-direction. The pacesetting style works best when the team is already motivated and skilled, and the leader needs quick results. This style is common, especially when a project is coming up to key milestones. Although this style generally has a negative impact on the project team, there are merits and contexts to when it could be applied with positive results.
 - Coaching Leadership : This style of project management encourages team members to develop their own capacity and capability as project contributors with a positive impact on the project team. The coaching style works best when the leader wants to help teammates build lasting personal strengths that make them more successful overall. It is least effective when teammates are defiant and unwilling to change or learn, or if the leader lacks proficiency.

6.2 Project Ethics

In the world of project management, ethics plays a significant role in day-to-day interactions and behavior. Ethics enables stakeholders, employees, vendors, and taxpayers to sleep at night knowing Project Management Professionals (PMPs) are held to strict and high standards when they make decisions or act on their behalf to execute on projects.

6.2.1 Ethics Plays a Critical Role In PM in These Primary Ways

- It elevates the profession and raises future standards.
- It increases the faith and trust others bestow.
- It imprints on individual moral mindsets and behavior.
- It improves business relationships at all levels.
- It promotes fair decision making.

- It reduces project risks.
- It provides a greater chance of success.
- It reduces anxiety and stress and ultimately turnover in projects.

6.2.2 PMI Code of Ethics means for PMPs

- It means PMPs have a responsibility to hold themselves accountable for their own successful or failed decisions and actions, as well as any repercussions.
- It means being respectful and demonstrating a high regard for oneself, others, and any resources entrusted with.
- It means fostering excellence through mutual respect, trust, confidence, cooperation, and diversity.
- It means the views of others are encouraged and valued.
- It means practicing fairness at all times, making decisions, and remaining impartial and objective. Behavior must be free from self-interest and self-gain, prejudice, or favouritism.
- It means demonstrating honesty through words and conduct at all times.

6.2.3 Ethical Dilemma

- While Ethics are important for all organizations and their employees and other stakeholders, they are more important for project managers who execute complex projects and interact with a wide variety of stakeholders.
- Indeed, being ethical and following ethical norms can be said to be prerequisites for project managers who have to practice ethics and observe ethical rules.
- Let us take a look at some of the most common types of ethical dilemma in business, and how you can navigate safely through them.
 1. **Accountability** : When things go wrong, it is human nature to try to avoid the consequences and place the blame somewhere else. Not only can this damage careers and reputations, it creates additional project issues by concealing the real source of the problem. Project managers should understand the importance of owning their own mistakes, and of recognizing situations in which team members or other stakeholders are attempting to shift the responsibilities for problems that arise.
 2. **Conflicts of Interest** : At the enterprise level, when projects involve large numbers of people and several of outside vendors, there are ample opportunities for stakeholders to give inappropriate preference to certain teams or companies. As a project manager, you should make sure that all parties involved in a project understand your company's standards for bidding and vendor selection, and that the definition of a conflict of interest is clear to everyone.
 3. **Workplace Culture** : While today's workplace environments are generally more respectful and inclusive than they were a few decades ago, no organization has perfected its company culture. Project managers should be very familiar with their company's code of conduct and should ensure that all employees, contractors and business partners understand what is expected of them. This is particularly important with projects that include team members from multiple countries as behavior that is acceptable in one culture may be viewed as harassing or even threatening in another.

4. **Health and Safety Concerns :** On large enterprise projects, the stakes are high, and so is the pressure to get the job done. Unfortunately, this pressure sometimes leads stakeholders to ignore or even conceal issues that might jeopardize the health and safety of project team members or the public. While these issues are more likely to arise in industries such as construction, health care or manufacturing, project managers in every industry should be ready to raise the alarm any time they see a potentially hazardous situation.

6.2.4 Traits of Ethical Professionals

Ethical professionals beyond being honest, responsible, respectful and fair share some common traits when it comes to acting on and resolving ethical issues

- **Clarity and discernment :** The ability to grasp and understand situations clearly, accurately and objectively.
- **Superior Judgment :** The act or process of forming an opinion or making a decision after careful thought based on accurately discerning the facts, issues and impact of the decision made on the future.
- **Integrity :** Being honest and fair.
- **Intestinal fortitude :** The inner strength of mind and will that enable you to act in the face of adversity.
- **Courage to do what is right :** The ability to do something that you know is correct and appropriate regardless of the risk to yourself.

6.3 Multicultural Projects

- Any project where people bring different assumptions about working norms either in product development or team behavior is a multicultural project. Even when all project participants are from one country, the project manager may still have to deal with multiple cultures and those cultures' expectations and behavior.
- Some of the team differences are strictly cultural, while others stem from varied management styles and strategies, but all these differences will eventually show up during the project. Some project managers try to manage those differences by mandating common practices and techniques across the project.

6.3.1 Problems of Multicultural Projects

Any strictly technical problem solving is always secondary to managing the people interaction issues. When managing multicultural projects, following problems are generally experienced :

1. **Different definitions of milestone and handoffs :** Leading project teams often misunderstand their commitments and handoffs to other groups. Sometimes the different definitions are due to a lack of understanding of the actual words. Sometime people differ on their meaning of commitment. Whatever be the cause, different meanings for milestones can be overcome with complementary product development practices, especially in project planning, project scheduling, and technical review.
2. **Uneven project communications and reporting of project state :** This frequently leads to lack of trust in other teams. If you don't know what other people are doing, you may not feel you can trust them especially when geography and culture separate teams. This lack of trust can be a huge obstacle to project success. You might know what other people are doing, but you might not know what they are saying. Language differences and everyone's relative ability to use one common language can create many problems in a project.

Therefore, it is important to make sure that the language you use for written and spoken communications is adequate for

everyone. There can also be communications problems with regard to holidays, vacations, and overtime. Be specific about what vacations mean, the impact of everyone's national holidays on the project's schedule, and general expectations about overtime – these will all affect how the project participants work with each other and report on project state.

3. Uneven ability to use common tools, including the project's Intranet : This leads to inability to share designs, source code, tests, and any other project information. When some members of the project team can't use the project resources, they may resent the people who can use the project resources. In addition, they may stop trying to share their work with the rest of the project team.

6.4 Virtual Projects

- A Virtual project is a project in which team members are dispersed geographically and potentially on other dimensions and are working together to accomplish a specific task under time and resource constraints.
- Virtual project management is the system by which virtual teams collaborate for a finite period of time towards a specific goal to be achieved within time within budget and according to specifications.
- Virtual teams are defined as groups of geographically and organizationally dispersed knowledge workers brought together across time and space through information and communication technologies in response to specific customer needs or to complete unique projects.
- Technology helps create the "virtual workspace" that the team uses to communicate and collaborate. Virtual project management is the emerging trend of managing remote teams or managing teams in locations separate from your own.
- A lot of the responsibilities and the project life cycle are the same : the key difference is not all project team members are in one place. The demand for virtual project managers is growing as companies wish to expand outside of the local talent pool. Additionally, remote work in general is a growing trend.
- As managers become more comfortable with the idea that teams can succeed even when separated, virtual positions are sure to grow. These employees can easily work from their living rooms, the local library, or a favorite coffee shop.
- Virtual projects are a rapidly developing medium for project management. Determining what traditional methods apply will advance knowledge for future projects. What distinguishes a virtual project is the absence of a common worksite. Whether the project team is dispersed on different sites of the same organization or in different countries, the team does not reside together.
- Lacking face-to-face options for managing work, the project team must create the same success by imposing process structure and rigorous team management. Clearly some types of projects do not lend themselves to virtual implementation, but for technical and collaborative work by professional knowledge workers, virtual projects can capture the best ideas and produce results across physical space.
- Like any product, a large virtual project also goes through development stages. The design of a project, and subsequent selection of its life-cycle template, should reflect the phase bias of the project itself as well as the phase bias of the sponsoring industry.

6.4.1 Tools and Technology for the Virtual Team

- Tools for communication need to be in place before the team begins work. Technical materials are fundamental to the team's ability to generate useful work products. The technical environment should provide the means for online document review, interactive meetings, training, discussion threads, research and survey data, benchmarking, quality review, data collection, and reward systems for sustaining team commitment.

Tools should include your company's internal options or :

- (i) Project scheduling and tracking tools
- (ii) Central communications database and document libraries
- (iii) Survey tools and requirements management tools replacing face-to-face contact
- (iv) Work templates and process descriptions
- (v) Standards for project management and for work production. PMI's A Guide to the Project Management Body of Knowledge
- (vi) Program management files

If the organization's larger infrastructure does not contain the tools to capture, share and reference key documents, then the project team should develop them within the communications plan for its own use. If the project cannot arrange the proper technology, put it in the risk plan for management signoff.

6.4.2 How Virtual Project Management Works ?

- There is no right way to be a virtual project manager. Ultimately your success will depend on a company's existing strategies around communication and project management. A huge change Project Managers experience when they go virtual is that communication has to be infinitely better.
- For example, video conference calls should include plenty of time for employees to ask questions, or speak up if they need an assignment clarified. Virtual PMs have to be empathetic individuals who are able to pick up on feelings of chaos or general confusion within a team.
- Being a virtual PM, you will definitely have to invest in digital project management software to help update you on the progress of certain projects or initiatives. Being able to look online and see your team's work communicated digitally is imperative especially if you are working in a different timezone. You'll also be required to invest in some sort of video conferencing tool.

6.4.3 Benefits of Virtual Project Management

Here are just a few benefits of the virtual project management structure.

- 1. **Larger talent pool** : When you are allowed to hire outside of city limits, you open yourself up to a wider range of talent. You could see the resume of a PM and find out they actually moved across the country one year ago. With virtual project management, you are still able to bring them on board.
- 2. **Cost-effective** : Virtual project management is a way to hire great talent without having to pay the moving costs of bringing them to your location. This can save you a lot of change, especially if your business hopes to hire internationally.
- 3. **Help managers and employees grow** : A remote work structure is still new to many. New employees may push themselves harder to prove it can work. In other words, a remote team or a remote project manager may work harder than teams that are in-house.

6.4.4 Challenges of Remote Work

Here are a few challenges of the virtual project management structure.

- 1. **Time differences** : If you are across the world from all of your employees, chances are you aren't working the same hours. This can be difficult. What if the accountant budgets a project incorrectly and you need him on the phone immediately. This is something to consider in a remote environment.



2. **Miscommunications :** Miscommunications are inevitable even in a face-to-face setting they are even more likely in a remote-work environment. Virtual project managers have to be prepared for miscommunications and try their best to over communicate to prevent them. When these miscommunications occur, project managers have to find a diplomatic solution that reinforces a strong team bond.
3. **Disconnection to team :** In a traditional setup team members are able to have employee engagement such as team happy hours, celebratory dinners, workshops, and daily life together. Being a remote member it can be difficult so you are less likely to get to know your colleagues which in turn can decrease respect and understanding.
Project managers willing to go virtual or any company hoping to go completely remote should study up on remote team best practices to understand how to make a dispersed team feel connected.

6.5 Customer Acceptance

- Customer acceptance is an important part of a project completion. As a project manager, you must ensure that your customer is satisfied with the deliverables produced by your project. To ensure this you need to implement an Acceptance Management Process.
- This process allows the customer to sign off on each deliverable in the project once it has been completed. By allowing the customer to approve deliverables as 100% complete as you move through the project, you will substantially increase your chances of project success.

6.5.1 Getting Customer Acceptance

Acceptance Management is the process of reviewing deliverables within the project and gaining the customer's acceptance that they are 100% complete. By gaining customer acceptance for each deliverable produced, you can :

- Identify customer acceptance issues early in the project.
- Improve deliverables to meet a customer's requirements .
- Maximize customer confidence in the delivery of the project.
- Keep customers happy and increase your chances of success.

Following are the steps to perform Project Acceptance Management :

Step 1 : Complete your Deliverables

- The first step in the Acceptance Management Process is to identify the completion of each project deliverable. The project team members inform the Project Manager that a deliverable is complete and is ready for acceptance testing.
- After the Project Manager considers that deliverable has been completed in its entirety the Acceptance Test is initiated. The Project Manager might opt to perform the test immediately or depending on the size and complexity of the deliverable, he or she may wait until other related deliverables are also complete and test the entire group simultaneously. Many Project Managers wait until the end of the Execution phase before they perform Acceptance Tests.

Step 2 : Perform Acceptance Testing

- The Project Manager schedules acceptance tests for deliverables produced by the project. These tests involve reviewing each deliverable to determine whether it meets the criteria stated in the Acceptance Plan. There are various testing methods you can use, including :

- (i) Physical inspection of the deliverable
- (ii) Third party audit of the deliverable
- (iii) Analysis of the processes used to create the deliverable
- (iv) Review of Project Plan re: time spent creating the deliverable
- (v) Review of Financial Plan re: cost of creating the deliverable
- (vi) Review against the Quality Plan re: quality of the deliverable

To increase your chances of gaining customer sign-off, you may wish to involve the customer in the acceptance testing process itself. This gives the customer additional confidence that the deliverables meet the acceptance criteria and that the testing methods used to determine the completion of each deliverable are comprehensive and effective.

After the acceptance test is complete, the Project Manager commissions any additional work needed to meet specified acceptance criteria. Upon completion of that additional work, the deliverable is re-tested to determine whether it has achieved the required level of quality. This process continues until the deliverable is ready for customer sign-off.

Once the testing is complete and the deliverable is ready for sign-off, the Project Manager completes an Acceptance Form within their project management templates, which describes the acceptance criteria and the overall results of the acceptance test. This should give customers confidence that deliverables meet their requirements in full and should be accepted as 100% complete.

Step 3 : Gain Customer Acceptance

- The customer reviews the Acceptance Form and decides to :
 - o Commission its own acceptance test
 - o Request further information about the testing activities
 - o Not approve the deliverable and raise a formal issue
 - o Approve the deliverable as 100% complete
- Throughout the Acceptance Management Process, the Quality Manager keeps an Acceptance Register up-to-date to allow the Project Manager to monitor and control acceptance of project deliverables.
- To gain the full customer acceptance of all deliverables in your project, consider using these acceptance project management templates: Acceptance Management Process, Acceptance Form and Acceptance Register.

6.6 Project Termination

Project termination is one of the most serious decisions a project management team and its control board have to take. It causes frustration for those stakeholders who sincerely believed that the project could produce the results they expected, or still expect. The project manager, his team members and very important stakeholders of the project will feel that they personally failed. They also will be scared of negative consequences for their careers; their motivation and consequently, productivity will decrease significantly.

6.6.1 Steps to Avoid the Negative Consequences of Project Termination

1. Clearly communicated reasons why and how the project supports a strategy, and under what conditions it does not
2. Clearly set and communicated project success criteria (in terms of scope, schedule, and budget), if possible clearly set and communicated termination criteria.

3. High level management attention, even for smaller projects, and even then when everything still seems to be on track
4. Periodical review meetings with the control board
5. Open discussions with the control board about problems and possible solutions or alternatives, including termination
6. In case the project has to be terminated, a clear commitment of the control board and high level management towards the project management team in order to enable the team to follow the project closure procedures
7. Upon successful termination, similar rewards and incentives for the project manager and his or her team as with regular project closure

6.7 Reasons for Project Termination

Technical reasons

- Requirements or specifications of the project result are not clear or unrealistic
- Requirements or specifications change fundamentally so that the underlying contract cannot be changed accordingly
- Lack of project planning, especially risk management
- The intended result or product of the project becomes obsolete, is not any longer needed
- Adequate human resources, tools, or material are not available
- The project profit becomes significantly lower than expected, due to too high project cost or too low project revenue
- The parent organization does not longer exist
- The parent organization changes its strategy, and the project does not support the new strategy
- Force majeure (e.g. earthquake, flooding, etc.)
- Necessary conditions disappear
- Lack of management support
- Lack of customer support

6.8 Various Types of Project Termination

- Projects are a means by which organizational strategy is implemented, and may often have social, economic, and environmental impacts that far outlast the projects themselves. Projects are time bound, and must terminate.
- The substantive objective of a project is to attain the objectives and close the project. It is important to finish well. Nobody remembers an effective startup, but everyone remembers an ineffective project termination; the consequences are long lasting.
- Certain projects are required to finish before target termination to remain competitive and to get faster returns on the investment. On the other hand, many projects are aborted midstream, for both voluntary and involuntary reasons.
- As for voluntary motives, the business need for the project may no longer exist, and continuing the project will only produce a "white elephant" with little congruence or fit with organizational strategy. Legal problems and environmental concerns may arise, necessitating the dissolution of the project to avoid severe penalties that may exceed any benefit from the project.
- On the other hand, involuntary failure of the project may occur due to insufficient financial support, poor leadership, weak front-end planning, and excessive negative impacts of project stakeholders.

It is also possible to terminate a project that has not attained all its objectives. Such projects have inflexible deadlines, such as widely advertised conference dates. Whether the preparations and fine details of such a project is complete or not, the project itself has to terminate on the due date. This seems to be common where the deliverable is a service. Not all projects are terminated in the conventional sense. There are four fundamentally different ways to terminate a project:

- (i) **Termination by extinction** : The project may be stopped because it has been either successful or unsuccessful. Examples of successful projects include the launch of a software program; the inauguration of an automobile production line; and, the completion of a new school building. Unsuccessful projects may include a drug manufacturer that has failed efficacy tests; a project that is no longer cost-effective; and, a disposal site that has failed to meet environmental standards.
- (ii) **Termination by addition** : This is where a project is made more or less an external, but full-fledged addition to the parent organization. For example, a new department of a university would be built as an extension of existing university facilities to operate with substantial independence from other segments of the institution.
- (iii) **Termination by integration** : This is the most common way of dealing with successful projects, and the most complex ones. The output of the project becomes part-and-parcel of the operating systems of the parent or client, becoming embedded in day-to-day operations. This requires thorough integration with primary operations at various levels distributing the output among existing functions.
- (iv) **Termination by starvation** : As the term suggests, the financial, human, and material resources needed to execute the project are curtailed or withheld. The project is effectively dead, and merely on minimal life-support system for legal reasons. Termination by murder, or "projecticide" is an interesting variation, where the incomplete project is terminated without warning.

6.9 Process to Terminating a Project

The closing phase of project management involves several steps. Work through the following checklist to ensure your project is successfully completed.

1. Formally transfer all deliverables

The first step to closing out your project is to finalize and transfer the project deliverables to the client. Go through your project plan to identify all deliverables and make sure they have been fully completed and handed off.

2. Confirm project completion

- Next, confirm the project is complete. It's not enough to declare a project done yourself. Each person involved needs to agree on the project's completion before you can formally close it out and move on. If you skip this step, you may continue to receive and be charged for change requests by the client.
- To confirm the project's completion, you will need to obtain approvals for the project deliverables i.e., all stakeholders must agree that you delivered on all parts of the project plan with official sign-offs from the project stakeholders. Be sure to document this step so you have proof that the project close was formally signed off.

3. Review all contracts and documentation

Once you have completed the project hands-off and received approvals from the clients, you can begin closing out your contracts. Review all the project documentation to ensure all parties have been paid for the work and there are no outstanding invoices.

4. Release resources

Formally release resources from the project, including suppliers, contractors, team members and any other partners. Notify them of the end of the project. Confirm any final payments or obligations, and officially release them so they are free to work on other projects.

5. Conduct a post-mortem

- A post-mortem or project review is one of the most valuable steps of the project closure process. This is a time to review the successes, failures, and challenges of the project and identify opportunities for improvement going forward.
- As you begin your post-mortem, conduct a performance review of the project. In other words, calculate the project's performance in terms of cost, schedule, and quality.
- Next, conduct a survey or hold a meeting with the project management team to get feedback on how the project went. These individual answers will help paint a more comprehensive picture of the project's performance.
- With the project performance and feedback in mind, you can then identify lessons learned and opportunities for the future.

6. Archive documentation

Once you have completed your project post-mortem, you can finalize all documentation (contracts, project plans, scope outline, costs, schedule, etc.) and index them in the company archives for later reference. Be sure to keep clear notes on the project's performance and improvement opportunities so you can easily reference and implement them on similar projects in the future.

7. Celebrate

- The end of a project is a big accomplishment and represents the culmination of many hours of hard work and dedication from a team of contributors. An end-of-project party is a great way to acknowledge your team's hard work and increase morale.
- Plus, a happy team is more likely to work with you in the future so you can build on your past successes and become a more effective unit going forward. Once the paperwork is filed, and the reviews are over, kick back and take time to celebrate the successful close together—you have earned it!

6.10 Preparation of Final Reports

- The final report is an internal project management tool which reviews the implementation process of the project and presents the project's outcomes and results.
- It provides an opportunity for the project managers within the implementing entities to summarize, upon closure of the project, the project's achievements, outline the problems encountered, as well as the good practices and lessons learned.
- The final report should include a particular focus on assessing the extent to which the expected accomplishments were delivered, as illustrated by the indicators of achievement.
- In the final report implementing entities are also requested to elaborate on the sustainability of the projects' efforts, the presence of multiplier effects and supplementary funding.

The final report represents, together with the evaluation report, a key tool for information, learning, transparency and accountability. The assessment contained in the final report will enable implementing entities to distil lessons learned, internalize them and make adjustments for future projects. It will also help the Project Manager to compile lessons learned, promote the sharing of information on good practices and report to the General Assembly on results and impacts achieved.

The combination of final and evaluation reports for each completed project offers a unique opportunity to triangulate information and guarantee the soundness of the project's findings.

Final reports are drafted by project managers in the implementing entities and should follow the outline provided in the report template.

The final report must be submitted to the Project Management Team no later than three months after the financial closure of the project. Ideally, the evaluation report should be submitted with the final report.

The table 6.10.1 summarizes a number of key features of the final report for projects, as compared to the annual progress report, as well as the evaluation report, which is also due three months after the operational completion of every project.

Table 6.10.1 : Annual Progress Report, Final Report and Evaluation Report for the Development Account
Summary table

	Annual Progress Report	Final report	Evaluation report
Scope	Internal monitoring of project.	Internal appraisal of project.	Independent/external assessment of project.
Type	Mandatory for all DA projects.	Mandatory for all DA projects.	Mandatory for all DA projects with a budget of \$300,000 or more.
Timeline	Should be submitted by January 31st for the preceding year.	For 9th tranche projects that closed by December 2017, the final report should be submitted by 31st March 2018. For 9th tranche projects that received an exceptional extension, the final report should be submitted within 3 months of the project's operational closure.	For 9th tranche projects that closed by December 2017, the evaluation report should be submitted by 31st March 2018. For 9th tranche projects that received an exceptional extension, the evaluation report should be submitted within 3 months of the project's operational closure. The evaluation report should ideally be submitted with the final report.
Drafter	Project manager in implementing entity.	Project manager in implementing entity.	External consultant hired by implementing entity.
Budget	No financial resources required.	No financial resources required.	2% of the total budget of the project is initially budgeted to fund the evaluation. Should there be savings and need for additional funds for evaluation, the 2% figure can be revised upwards. If the proposed evaluation budget exceeds 4% of the project budget, prior approval needs to be received from the DA-PMT.

	Annual Progress Report	Final report	Evaluation report
Format	Template available at: https://www.un.org/development/desa/dia/static-guidance-public/	Template contained in this quick guide.	The outline of the evaluation, including evaluation criteria, must be defined in the ToR for the evaluation. All evaluations should be conducted in conformity with UNEG Norms and Standards.

6.10.1 Templates for Final Project Report

- The following template can be used when preparing final reports on projects in order to ensure consistency in format and content across all projects.
- In Section 1 project managers are asked to recap basic information about the project. Following a brief summary of results (Section 2), project managers are then requested to review performance indicators and activities (Section 3), outline the challenges encountered (Section 4), describe good practices and lessons learned (Section 5) and elaborate on sustainability (Section 6), multiplier effects (Section 7) and supplementary funding (Section 8). Alongside any additional information (Section 9), project managers are finally asked to provide financial figures for the project (Section 10).

1. Key Project Features

I. Project title			
II. Project DA code			
III. Implementing Entity			
IV. Start date (Please specify the month and year in which the budget allocation was received)	mm/yy		
V. End date (Please specify the month and year of the project's completion)	a. Original : mm/yy as per prodoc b. Actual date : mm/yy		
VI. Beneficiary countries (Please provide a complete list of the countries that benefited from the project's activities)	1.	4	
	2.	5	
	3.	...	
VII. Implementing partners (Please list UN System and other partners (do not include beneficiary governments))	UN system 1. 2. ...	Other partners 1. 2. ...	

2. Summary of Results

This section should be no longer than one page and should provide a concise and effective narrative of the basic accomplishments of the project. It should not repeat information already provided (for instance, information presented in the project document) but should highlight results, potential impact and any relevant achievement related to the project's implementation (including unexpected results, both positive and negative). If the project (or one of its parts) is considered a success story it should be clearly stated in this section. The information reported in this section might be used for the DA website.

Detailed Review of Achievements and Implementation

The purpose of this section is to understand how the project actually performed against what it intended to accomplish. This should be done through the verification of the indicators of achievement that were developed in the project document as well as through an assessment of the implemented activities.

Entities are kindly requested to fill in the tables are as follows :

- o In Table 6.10.2 the comments column should be used to elaborate on the project's contribution towards the achievement of the expected accomplishments;
- o Table 6.10.3 should list, under each expected accomplishment, the set of activities that were actually implemented by the project. For each activity listed, project managers should highlight whether the activity represents a variation from the project's initial design (project document) and, if so, in what ways (e.g. additional activity/change in activity initially envisioned etc.).

Table 6.10.2 : Review of Performance Indicators

Expected Accomplishment	Indicator of achievement (T0)	Indicator of achievement (T1)	Comments
EA1	(Please specify the baseline, if measured at the start of the project)	(Please provide an estimate or actual values of the indicator at the end of the project)	(Please elaborate on the progress made on the EA based on the Indicator data or other relevant data.)
EA2			
...			

Table 6.10.3 - Review of Activities

Activities Implemented (Please provide the complete list of activities implemented under the framework of the project)	Comments (Please specify whether the activity represents a variation of the project's design. Significant variations that took place should be explained under paragraph 4 (Challenges/problems encountered)).
EA1	
A.1.1	
A.1.2	...
EA2	...
...	

4. Challenges/Problems Encountered

Project managers are asked to elaborate on the problems faced by the project, both in terms of the project's design (e.g. type of activities, expected accomplishments, objectives, etc.) and implementation (e.g. change in country situation, administrative processes, collaboration with partners, etc.). All issues faced, as well as any action taken to address them, should be reported in the table 6.10.4.

Table 6.10.4 : Challenges and Actions

Description of challenges (Please list all challenges faced)	Action(s) taken to solve the issue, if any (For each challenge, please indicate whether and how it was solved)

5. Good Practices and Key Lessons Learned

- In this section entities are requested to elaborate on good practices, with respect to the design or execution of the project, which could be successfully replicated in future programming.
- The section should also outline any relevant finding that can be considered important lessons for future programming.

6. Sustainability

This section should elaborate on the extent to which the achievements of the project are likely to be sustained beyond its completion, leading to durable, self-sustained results. It should also include reference to any follow-up activity to the project that was implemented or initiated by the entity or other partners following the completion of the project.

7. Multiplier Effects

This section should elaborate on whether the project triggered processes for the replication of its activities, in other participating countries, non-participating countries, or, alternatively, any plan to do so.

8. Supplementary Funding

- This section should elaborate on whether additional funding (financial or in-kind) was leveraged to further the implementation of the project (e.g. securing additional participants at workshops, paying for venues/additional activities, etc.). In addressing this section, implementing entities are asked to fill in the table 6.10.5.
- Please note that supplementary funding does not refer to funds leveraged for projects other than the one being reviewed (follow up activities to the project or spin-offs in other countries should be reported in sections 6 and 7, respectively).

Table 6.10.5 : Financial Leveraging

Contributing Entity/Donor	Purpose	Amount raised	
		Cash (USD)	In-Kind

Additional Information

9. In this section any additional information on the project's activities, such as relevant press clippings, media coverage, meeting reports, publications, websites, etc. should be mentioned (if the information is available online, please include the relevant URLs).

10. Financial Information

Project managers are asked to fill in the table 6.10.6 with accurate figures for each object class.

Table 6.10.6

Object Class	Description	A. Budget/Allotment (as per project document) (USD)	B. Revisions to allotments (if any) (USD)	C. Explanations of revisions to allotments (USD)	D. Total Expenditure (USD)
015	Other staff costs - General temporary assistance				
105	Consultants and experts				
115	Travel of staff				
120	Contractual services				
125	General operating expenses				
130	Supplies and materials				
135	Furniture and equipment				
145	Workshops/Study tours (Grants and contributions)				
	Total				

6.11 Lesson Learned Analysis

- The lessons learned analysis is a technique through which we can learn from our mistakes and successes and maximize our performance over time. This is also known as the post-mortem analysis. Generally, this process is held near the completion of a project, but it's more beneficial to hold it during the course of projects. For example, when a milestone has been achieved, we can hold a lesson learned analysis and act based on the learning. There's no need to wait until the end to act, especially if the lesson is something everyone can benefit from.
- The objective of the lessons learned sessions is to share and apply the knowledge derived from both positive and negative experiences. Positive experiences are all the things that we would like to continue doing in the future. Negative experiences, on the other hand, are those things that we should never repeat.
- During a lessons learned analysis, an honest, no-penalty discussion is held with a manager and his/her team. It is frequently used for project work at strategic points and at a project's conclusion. It can also be used to improve change initiatives and for new assignments given to team members.

Lessons learned analysis answers five questions in the following order :

1. What did we expect to occur?
2. What actually happened?
3. What worked well and why?
4. What did not work and why?
5. What needs to be done differently?

- Use of lessons learned is a principal component of an organizational culture committed to continuous improvement and adaptive management. Lessons learned mechanisms communicate acquired knowledge more effectively and ensure the beneficial information is factored into planning, work processes, and activities.
- Consequences of not having a project review of lessons learned are the increased likelihood of repeating actions that might have caused :
 - o Project failures
 - o Budget overruns
 - o Scope creep
 - o Reduced quality from expectations
 - o Missed scheduled deadline
- Lessons learned analysis provide their greatest value when they are

(i) Documented

Documentation of lessons learned should include naming the issue, a brief description of the problem or success, the impact on the project (e.g. time, cost, scope, quality, schedule), and the process improvement recommendations (lessons learned).

(ii) Communicated

Next, it's important to communicate these lessons to the project stakeholders. The stakeholders should be a part of the project review so it's a logical step to communicate lessons learned to them.

(iii) Archived

You should also archive and communicate this project's lessons learned to all project managers.

(iv) Fluid and adaptable to allow evolved conclusions

Finally, lessons learned needs to be open to the idea that alternative conclusions exist. Remember, our lessons learned are based on the best information available at the time of the conclusion. However, with time and experience, our knowledge and interpretation of the data might change.

6.11.1 Process of Lessons Learned Analysis

The process of Lesson Learned Analysis comprises five main elements : defining the project, collecting information, verifying applicability, storage, and dissemination.

1. Define the Project

This is the initial step wherein the need for lessons learned analysis is identified and the process and team to collect lessons are established. It is important to establish the specific need and purpose for lessons, the audience for the product, and individuals that should comprise the project team. Initial engagement from all key players should be

established in advance of the project. Staff with specific expertise or knowledge of the project and other needed skills, such as communication and writing should be selected. The team should then agree to a product format, data collection and analysis methodologies and process, dissemination strategy, and other activities that will be needed.

Collect

This step involves the collection of information through structured as well as unstructured processes such as project critiques, written forms, and meetings. The collection of lessons may come from as many sources as an organization is willing to solicit. Lessons learned can be based both upon positive experiences that achieve organization goals, and on negative experiences that result in undesirable outcomes. For some projects, a collaborative lessons collection process can be as or more important as documenting the lessons.

Verify and Synthesize

In this step, the accuracy and applicability of lessons submitted are verified. Domain or subject matter experts may be involved in coordinating and conducting reviews to determine whether or not a lesson is relevant across many other projects, is unique to a particular department or project, or applies to the organization as a whole.

Store

In this step, the lessons learned are stored which usually involves incorporating lessons into an electronic database for future sharing and dissemination. Information should be stored in a manner that allows users to identify search lessons by keyword.

Disseminate

The final and the most important element is the dissemination of lessons learned. Lessons are of little benefit unless they are distributed and used by people who will benefit from them. Dissemination can include the revision of a work process, training, and routine distribution via a variety of communication media. Lessons can be "pushed," or automatically delivered to a user, or "pulled" in situations where a user must manually search for them.

6.11.2 The Lessons Learned

It is important to know the sort of lessons do we need to capture and build in to planning future projects. Following are the common areas where lessons should be learned :

1. Communications weaknesses

In general, lack of effective communication has always been an area of concern in either programmes or projects. It includes managing key stakeholder expectations, managing third-party suppliers, etc. Having more, better and different types of communication is vital and that might mean getting people together in the same room, face-to-face, to resolve issues more effectively and develop a clearer understanding of the brief and desired outcomes.

2. Management of risks and issues

Risk and issues need to proactively addressed and owned by the project management team. Some people's perception of managing risk is a tick-box activity rather than a necessity to mitigate project failure.

3. Obtaining the right resources to get the job done

Project managers need to be aware of the resources they require during the project. Very often, resource management is a problem. Therefore, it must be looked out for during the Lesson Learned Analysis.

4. Clarity around roles and responsibilities

Project managers need to understand what's expected of them if the PMO takes over the running of the project/programme. There are different skill-sets at work and if a project manager is not adhering to PMO requirements it can affect the relationship. So, this is a kind of lesson we must look out for.

5. Management of benefits

If benefits are not actively managed or tracked through a programme, the likely outcome is certainly a lesson for next time. What you need is a realistic scope at the beginning; establishing clearly what the benefits are and whether they are realistic and achievable? This benefits profile should be developed and tracked right through the whole of the programme and re-aligned if not unachievable.

6. Knowing when and how to stop a failing project

It's about learning to have the confidence to document and demonstrate the signs that project failure is possible. Other issues to look out for include stakeholder u-turns, benefits becoming unrealistic or a project end-date being continually extended when it should really become "business as usual".

6.11.3 How to Identifying Lessons Learned ?

The following guidelines set out ten key steps to facilitating a lessons learned review.

1. **Call the meeting:** If conducting a post-facto process, hold a face-to-face meeting as soon as you can after the project ends, within weeks rather than months.
2. **Invite the right people:** The project leader needs to attend as do key members of the project team. If a similar project is already underway, then there is great value in the new project team attending a "customer" for the knowledge.
3. **Appoint a facilitator:** Identify a facilitator who was not closely involved in the project. The facilitator should be someone who can ask questions from an independent, but nonthreatening standpoint. This isn't an audit, it's an investment.
4. **Revisit the objectives and deliverables of the project :** Ask "what did we set out to do?" and "what did we achieve?"
5. **Go through the project step by step :** Revisit the project plan and identify any deviation from plan. Where were the delays and what went ahead of schedule? What changed and why?
6. **Ask a why Question :** Ask "what went well", "what were the successful steps towards achieving your objective?" and "what went really well in the project?" Ask a "why?" question several times. This is vital, and will get you to the root of the reason. Don't take the initial response at face value. Often people don't even realize what the underlying reason behind a success or failure is.
7. **Identify the positives :** Find out why certain aspects went well, and express the learning as guidelines for the future. This is a key point. Try to avoid expressing lessons learned in a passive, past tense, such as: "Project Foxtrot completed ahead of schedule because the project team remained in-tact throughout the design and execution stages".
8. **Identify the missed opportunities :** Ask "what could have gone better?", "what were the aspects that stopped you from delivering even more?" Identify the stumbling blocks and pitfalls, so they can be avoided in future by asking "what would your advice be to future project teams, based on your experiences here?"
9. **Ensure that participants leave with their feelings acknowledged :** Ask for "Marks out of ten" and "What would make it a ten for you?" to access residual issues.

10. **Record the meeting :** Use quotes to express the depth of feeling. Express the recommendations as clearly, measurably and unambiguously as possible, using the guideline format explained in point 7. Take a photograph of the project team, and ensure that you record contact information (e-mail and telephone) to make follow-up conversations easy for anyone reading the lessons learned. Ensure that you circulate the write-up around the participants for comment, and permission to use specific quotes before sharing more widely.

6.12 Acknowledging Failure and Success

6.12.1 Acknowledging Failure

- It is said, failure is the pillar to success. But this holds true only when you acknowledge failure. An attempt to recognize and overcome failure in projects and succeed in future initiatives can be challenging.
- If your project has been launched before but failed for some reasons, most likely your team and other stakeholders have a negative mindset towards it. But the failure reasons can be addressed and a new project will be successful.
- A thorough analysis of failed project can greatly help understand what was done wrong. You can develop feasible solutions, and remove any barrier for future success.

6.12.1(a) Understand Why Projects Fail

- Many project management initiatives fail at different stages of their life-cycle because of multiple reasons. The failure rate varies greatly from project to project depending on their purpose, type, size and nature.
- For example, according to one of the studies conducted at the Gartner Research Lab, it was found that the larger IT and software development projects were stopped or terminated prior to their scheduled completion date because of inadequate team building, lack of stakeholder commitment, and ineffective budgeting. The average failure rate for those IT initiatives passed the 70% mark, which is critical, Gartner reported. The agency also pointed out that according to their expectations for the current year, the tendency would remain the same, if not worse.
- In order to avoid the same fate for your future projects first you need to understand the reasons why your previous initiatives failed and then learn what needs to be changed for greater success rate.

6.12.1(b) Failure Reasons to Analyze

An analysis of previous projects and reasons for their failure can involve a great deal of options, from auditing documents and reviewing deliverables to holding interviews with stakeholders and evaluating solutions currently in place. When you conduct the analysis, consider the following root causes for failed project management:

1. **Wrong Team Organization :** You need to explore the team organization chart to figure out whether wrong people were involved in the work, from leaders and sponsors to team members and personnel.
2. **Poor Motivation :** Try to find out whether the business organization provides the team with the right attitude and motivation towards the work to be done.
3. **Insufficient Technology Capabilities :** Can you say that the project has been failed because of the wrong technology selected and insufficiency in the capabilities to support what was needed?
4. **Wrong Methodology :** Analyze the methodology employed in the processes and explore whether it was appropriate to the project's procedure and change controls.

5. Environmental Aspects : Find out if there was something that occurred in the market or political environment that made the success unreachable.
6. Constraints Inappropriately Defined : Analyze the key constraints of schedule, budget, scope and quality for their appropriateness to the project and whether they were originally defined reasonably.

6.12.1(c) Recognize the Changes In Failed Project Management

- Once you have identified and understood the root causes, your next step is to develop an approach that could help overcome project failure by avoiding or addressing the issues that caused the past projects to fail.
- A great portion of this task would involve you in reviewing and documenting any if changes occurred in the factors proportional failed PM. For instance, proper candidates to the team were selected and better motivation techniques were employed, so that the overall team organization became more efficient and fitting the performance goals or perhaps the business environment was changed for better, and now the need to deliver the business objectives is more severe than ever.
- You must explore every change in failed project management practice, figure out whether it has increased or decreased the likelihood of success, and document the current need for project implementation.
- Combine all of your records on the changes in a single sheet and then aggregate the results to assess whether the project is worth a new try. Hold a meeting with the stakeholders to highlight the changes and their impact to success and to agree on whether the new project should be undertaken at this time.

6.12.1(d) Adjust the Framework for the New Initiative

- The changes happened in the project environment and increased the success rate now need to be considered against the constraints and goals of the previous projects, so that you can assess what components are still needed today. You must remove any unnecessary items or those increasing the probability of PM failure. Only the most critical components in the scope should be retained, and the objectives should be concise as much as possible.
- According to the assessment of what needs to be included in or excluded from the project scope, you can adjust the current PM framework for your new initiative to increase the chances for succeeding. Your adjustments will help the team focus on the right objectives. You will in turn get improved awareness and buy-in from the stakeholders.

6.12.1(e) Be Optimistic to Overcome Project Failure

- Being optimistic means demonstrating a certain behavior that makes everyone around believe that everything will be ok regardless of how bad the things were in the past. In order to fight project failure, you must show an optimistic attitude towards the new initiative, telling key stakeholders that the new project's outcome will be quite different than the previous failures.
- Do your best to address the natural tendency to be sceptical about resurrecting a failed project. Be persuasive and motivate everyone towards succeeding at the new initiative.
- Communicate the adjusted framework of your project and ensure the stakeholders that this project is reframed in the current context. Tell about the lessons learned from previous unsuccessful attempts and point out all those adjustments that have been made to turn the new project into success.

6.12.1(f) Ways to Overcome Failure

In order for you to succeed in project management, all of the stakeholders need to be entirely involved in your new initiative and be strongly committed to the success. Committing the key players of your project means that the following aspects need to be addressed :

- Efficient leadership, which helps guide the team through the implementation life-cycle.
- Sufficient funding, which ensures the needed finances and technology are in place.
- Proper Communication, because the attitudes and engagement of some stakeholders may change over time, you must continuously communicate with all stakeholder groups to ensure that the project won't lose its momentum and that the enthusiasm won't be depleted.
- Closely collaborate with leaders and supervisors to keep track of any issues in the team environment and detect and solve changes that could negatively impact your project.
- Succeed in PM through Continuous Analysis. Even if your previous failures are considered, the lessons are learned, the stakeholders are committed, and your new project is initiated, you must expect for a more challenging process that ultimately brings the job to a successful close.

6.12.2 Acknowledging Success

- How often do you celebrate project success? Celebrating project completion and specifically successful completion means acknowledging success and mind you, that's very important.
- Most companies do not celebrate ends. They think the completion of a project is a reward in itself. But they are wrong. Achievements and outstanding effort deserve acknowledgement. Take a moment to reflect and feel proud of accomplishments. These moments are rare, and too often leaders fail to savour them but rather rush full-speed ahead into the next tunnel.
- Even when we do celebrate, perhaps too often the focus is on celebrating once the project is over. That can often be after several years of hard constant work. No one feels like celebrating when this is the case. They are all just glad that the project is over.
- That's why it is important for the moral of the team that you celebrate project success along the way.

Consider celebrating at the following point along the project journey :

1. **Project Kickoff** : If you gather the team together and do a formal meet and greet, so that everyone gets to know who's on the 'Team' then there is an opportunity to have an afternoon tea, or pizza lunch to celebrate everyone being on board for the project. By doing this, you will find that there is more team cohesion. It is simply because people realize they are part of a team this way. They see the others who will be working beside them. This helps them know who they can talk to about the project and any issues that arise, as they arise. So consider a small, kickoff celebration
2. **When key project deliverables are completed** : Sometimes it's great celebrating when the key deliverables are completed. There might be several phases within the project. And within those phases are key deliverables. Just stop and celebrate the deliverables being finished. The teams will appreciate the break, even if it is only for an hour. What you will notice by having such celebrations is that the team appreciates being acknowledged for the hard work they have just completed. It gives them the recognition they deserve, and in that, you notice they are more willing to

go back to work and achieve more. Without the acknowledgement, teams become lethargic and complacent and will oftentimes slow down in delivery. What you want is for them to pick up the pace, if anything. Acknowledging them with celebrating success will surely do that.

3. **When tight timeframes are met :** Often, we set tight timeframes and don't recognise the hard work and dedication required to meet those timeframes. Celebrating when this is completed on time is valuable. Again, the team feels recognized for the great work they have achieved. Their moral and willingness to go the extra mile for the team will increase, especially if the Project Sponsor or Project Owner comes in and personally thanks them for their hard work.
4. **Celebrate the successful completion of the project :** Get as many of the team together for a big lunch. That way the key members of the Project Control Board can attend, as well as the Project Sponsor to formally speak their appreciation for the project team. If it is at all possible to get the remote team members to attend this via virtual means, then do so. It is important that they hear the spoken words of these key people first hand.

6.12.3 Key Points of Celebration

Projects are completed every day. While some aren't as successful as others, most organizations treat all those endings in the same way with deafening silence or at most, a sigh of relief. Effective leaders and project managers think about how they will reward, recognize, and yes, celebrate project success. Experience and observation shows that many leaders don't do it well. Following given are five things to consider when celebrating a successful project. It helps all of us getting better at this important activity.

1. **Be Clear on what you are Celebrating :** If there were clear goals and targets when the project began, there is a higher likelihood they will be reached, and there will be a clearer reason to celebrate when those targets are reached. Having something to celebrate isn't the biggest or best reason to have clear goals and targets, but it is one to add to the list.
 2. **Focus on Effort and Results :** We should celebrate success for sure. But sometimes, on big and complex projects, complete and total success might not be achieved. That doesn't mean there isn't value in the effort. Focusing only on effort or activity cheats people of the meaning that comes from achievement. Yet, we can celebrate effort, diligence, loyalty, and commitment, too.
 3. **Show Real Appreciation :** If the project was important, there should be heart-felt appreciation when it is completed. As a leader, be personally invested in the celebration. If you simply assign it to one person, or worse, make the celebration one more project task, it will feel hollow and meaningless. Spend time and energy to make sure that however you celebrate, people know you truly appreciate their work and success.
 4. **Make it Their Celebration :** While you should be personally invested and involved, the celebration is for the team, so it should be something that they appreciate and like. Ask people how they would like to celebrate. Find out what would be meaningful and fun for them. Consider putting that discussion right at the front end of the project. When people know what might happen when they achieve a goal, it adds one more reason to succeed, and something to look forward to.
 5. **Think about More than a Cake :** Remember, Celebrations can include food of course, but there are many other ways to celebrate, too. Creativity rather than another cake might help people see how much you appreciate their work, and create a lasting memory as well. Done well, celebrations can shape your company culture, increasing job satisfaction and long-term retention of team members.
- Celebrating success is more than just a good or nice idea, or even the right thing to do. It can provide meaning, create teamwork, and help achieve even greater success.

6.13 Project Management Software

Project management software is a computer program that helps people involved in the project management process to initiate, plan, execute, monitor and close projects of any size and type. It is designed to plan and document project tasks and activities, build schedules and timelines, solve project issues, manage risks and threats, assign budgets and control costs, establish collaboration and cooperation between project participants, assure and control quality, assemble project teams and organize human resources, and share information.

The list of project management software capabilities is large enough but the main idea of PM application software is to allow you to take your project through all the stages of project life cycle, from project conceptualization and initiation through project execution, control and completion.

The importance of project management software consists in providing you with tools that allow keeping ahead of rivals and continuously working on improvement of tasks, services and processes with very short time-to-market. The best software for project management significantly helps achieve success in developing, producing and delivering your product allowing combining project activities with cross-functional expertise.

Project management software helps project managers and their teams to complete project as per client's requirements and manage time, budget, and scope constraints.

6.13.1 Types of Project Management Software

- (i) **Online** : Many small and medium-sized businesses across different industries are now using online project management software. This type of software uses cloud-based technology and is offered by application service providers as software-as-a-service (SaaS). Nowadays, these applications are expanding their functions and crossing boundaries with their combination of features, and these complicate even more the user's selection process.
- (ii) **On-premise** : Typically resides in the company's own server, which is located in the data center and managed by the company's IT employees. An example of on-premise PM software is Microsoft Project.

Types of Online Project Management Software Industry

- (i) **Simple** : A simple project management software may have fewer features that cover basic functionality, but this does not make them inferior, and may, in fact, be all that is needed by start-ups or small- to -medium-sized businesses. Features included in this type of software are task management, team collaboration, learning materials, email integration, and file management.
- (ii) **Comprehensive** : A comprehensive type has more features that cover core project management functions such as scheduling, resource management, and financial management on top of a more advanced task management feature. Using this type of software is also more expensive. However, it provides more accurate estimates, better control on dependencies, and real-time progress tracking. It is also more complex to use and require more time from its users. Larger organizations and project teams prefer them, especially for more complex projects.

6.13.2 Project Management Software Features

1. **Task Management** : This is the ability to create tasks and manage them during the entire process. Furthermore, the software should have the ability to set dependencies on the task, create and manage subtasks from larger tasks, set a task to repeat or recur at a specified time or date, and allow the assigning of more than one user to a task. The ability to import a list of tasks from an external file such as a spreadsheet should also be included in the task management feature.



2. **Team Collaboration :** The feature that allows any number of team members to not only communicate but hold work-related discussion is a must. The application should provide virtual space for creating discussions easily, save its history and thread, create documents and share them, allows for alerts and notifications, as well as private messaging to one or many recipients.
3. **Learning Materials :** The project management software should have adequate materials that can get any team member, regardless of level of computer proficiency, to hit the ground running. That means catering to all kinds of users, whether they learn well by reading articles, by watching videos, by participating in webinars, or by using the software as they go along. The software that can shorten the learning curve also allows users to devote more time quickly to performing their actual job.
4. **Email Integration :** Email may be the most popular application, so a PM app that can integrate effectively with email is of high value. If the software can receive and send emails within the program, then it has significantly increased productivity by minimizing the time to switch applications. Email can be the source of status updates, and new tasks or progress reports can be sent by email to an already defined list.
5. **Document Management :** This is the ability of the PM application to manage files and documents directly with or without using a third-party solution. The important features include the safe central storage of documents, the ability to attach documents to tasks, put notes and comments to uploaded documents, upload multiple documents using drag-drop, organize documents in folders and have version control over them. The online PM app may provide the storage space or integrate smoothly to a third-party solution that provides it.
6. **Mobile :** Project teams do not usually sit behind desks all the time. Team members can be at a client's site or a remote branch performing their work. Therefore, it is a key feature that the chosen PM software has the ability to be used with a Smartphone. This means that the software should have APIs for iOS and Android mobile devices.

6.13.3 Project Management Software Functions

1. **Planning :** While following the project management basics, you should start your project with planning its main tasks and activities. Deadlines, due dates, time frames, timelines, durations, priorities, are those characteristics of tasks to be planned at the very beginning. The best software for project management will let you plan project tasks.
2. **Tracking :** Once the main tasks of your project have been planned, it is time to perform and track the tasks. Tracking is an activity of monitoring and controlling tasks. Project management application program will let you use tracking tools to monitor and control your tasks and ensure the project is running in schedule.
3. **Measuring :** Without measuring you cannot be sure that your project is undertaken as expected. By means of project management application software, you can use formulas to create and apply key performance indicators (KPIs) and measures.
4. **Reporting :** At the closure of your project, you need to generate reports that show current progress of the project and status of its tasks. Project management application system will allow you to develop project reports and review % complete per task and per goal.

6.13.4 Benefits of Project Management Software

1. **Collaborate on Projects :** People frequently designate individual tasks which are part of a bigger project the whole team is trying to complete. Project management software gives employees a method to collaborate on projects by discussing documents, timelines, outstanding work, etc. .

- 1. **Internal and External Communication :** Project Management software develops a funnel for communication concerning tasks and projects both internally, but also externally with clients and other stakeholders.
- 2. **Budget Management :** Budgets are among one of the most important items in controlling your projects. The way forward for any business depends on how well you can deliver within the budgets provided. Project management software helps the Project Manager to determine the work budget (planned versus actual), so the work can be aligned accordingly.
- 3. **Monitoring :** To attain long-term success for just about any business, monitoring the progress of the work is essential. Dedicated software plays an important role in monitoring the stages of projects, and can provide insights into whether things will complete on time or not.
- 4. **Document Sharing :** Document sharing, whether inside the tool or in a integrated 3rd party system, enables people to find more comprehensive documents, wireframes, specifications, etc., which enables transparency and communication.
- 5. **Communication with Clients and Suppliers :** Companies should be able to talk to and collaborate with clients and suppliers from the same place. Companies using project management software should offer their clients the ability to log in and view only their relevant project data. This way, clients can provide direct feedback, make edits and review progress in the same place.
- 6. **Optimized Decision Making :** Project management software solutions assist in making the right decisions as you have all the details in one designated place. Hence the decision process is enhanced and much more accurate.
- 7. **Enhanced Customer Satisfaction :** When you get a project done promptly and under budget, the client walks away with a smile on their face - and a satisfied customer is one you will see again. Smart project management software offers the tools which allow this customer/supplier relationship to carry on. By applying fundamental project management software strategies, you'll narrow your focus, achieve your goals and improve your deliverability and rate of success.

6.13.5 Microsoft Project

- Microsoft Project is a project management software program developed and sold by Microsoft. It was designed to assist a project manager in developing a schedule, assigning resources to tasks, tracking progress, managing the budget, and analyzing workloads.
- MS Project creates budgets based on assignment work and resource rates. As resources are assigned to tasks and assignment work estimated, the program calculates the cost, equal to the work times the rate, which rolls up to the task level and then to any summary task, and finally to the project level.
- Each resource can have its own calendar, which defines what days and shifts a resource is available. Microsoft Project is not suitable for solving problems of available materials (resources) constrained production. Additional software is necessary to manage a complex facility that produces physical goods.

6.13.5(a) Project Management Features of MS Project

- Resource definitions (people, equipment and materials) can be shared between projects using a shared resource pool. Each resource can have its own calendar which defines what days and shifts a resource is available.
- Resource rates are used to calculate resource assignment costs which are rolled up and summarized the resource level.
- Each resource can be assigned to multiple tasks in multiple plans and each task can be assigned multiple resources. Microsoft Project schedules task work based on the resource availability as defined in the resource calendars. All resources can be defined in an enterprise resource pool.



- Microsoft Project creates budgets based on assignment work and resource rates. As resources are assigned to tasks and assignment work estimated, Microsoft Project calculates the cost equals the work times the rate. This rolls up to the task level, then to any summary tasks and finally to the project level.
- Microsoft Project has been extended with Microsoft Office Project Server and Microsoft Project Web Access. Project server stores Project data in a central database.
- Project Web Access allows user to display and update this data over the Internet. Web Access allows authorized users to access a Project Server database across the Internet. Web Access includes timesheets, graphical analysis of resource workloads and administrative tools.
- Microsoft recognizes different classes of users. These different classes of users can have differing access levels to projects, views and other data.
- Custom objects such as calendars, views, tables, filters and fields are stored in an enterprise global database, which is shared by all users.
- MS Project does more than just create a schedule it can establish dependencies among tasks, it can create constraints, it can resolve resource conflicts, and it can also help in reviewing cost and schedule performance over the duration of the project. So it does help in more than just creating a Schedule.
- MS projects gives answers to following project-related questions.

For example

- o Why this project needs to be run by the organization ?
- o What's the best way to communicate project details to the stakeholders ?
- o What is the risk management plan ?
- o How the vendors are going to be managed ?
- o How the project is tracked and monitored ?
- o How the quality is measured and qualified ?

MS Project can help you

- o Visualize your project plan in standard defined formats.
- o Schedule tasks and resources consistently and effectively.
- o Track information about the work, duration, and resource requirements for your project.
- o Generate reports to share in progress meetings.

6.14 Project Management Templates

- Creating all the documents related with a project from scratch waste a monumental amount of time. This is why every project manager usually has a trusted arsenal of project management templates these days.
- Using templates not only improves your efficiency, it also brings much-needed standardization to your project management process. Instead of creating documents on an ad-hoc basis, you can have a single template for every function that can be used across the organization.
- Borrowing pre-made templates can also ensure that you use best practices in your planning and reporting. If a template has proven to be successful in one organization, there is a good chance it will be useful in yours as well.
- There are a number of project management templates online, but few centrally organized resources.

How to Use Project Management Templates ?

Most PM templates are made in MS Excel. A few text-heavy ones use MS Word. To use these templates, simply download them. Direct file links are marked specifically.

In some cases, you will have to give up your email address in exchange for the file. Once downloaded, edit them with your own details and export in your chosen format. If you don't have Excel or Word, you can use LibreOffice as an open-source alternative. Alternatively, upload the file to your Google MyDrive account.

6.14.1 Most Common Project Management Templates

6.14.1(a) Project Charter Template

This is an important document template that outlines the scope, objectives, and stakeholders involved in the project. It documents everything the project needs and its expected outcomes.

The project charter also doubles up as a business case document. In case you need to convince stakeholders of the importance of a project, or outline the goals to your team, you will turn to the project charter.

Whether you are using one of the project charter templates or creating one from scratch, there are a few elements you should always include:

1. **Project title :** Start with the title. Make sure it is specific enough to make identification easier. A good template to follow is this - "[Project Type] to [Project Objective] for [Project Client/Product]
2. **Executive summary :** Include a high-level summary of the project, its purpose, and its stakeholders.
3. **Project objectives :** Explain the "why" of the purpose in greater detail. Be very specific about the outcomes you seek. It's a good idea to include specific numbers or at least a range. Don't say "increase traffic"; say "increase website traffic by 200% in 6 months".
4. **Business objectives :** Use this section to describe how the project fits into the business' broader strategic goals. For instance, if you are running a campaign to increase traffic to a website, describe how the higher traffic would help the business in achieving its goals.
5. **Project requirements :** Explain the project's requirements in terms of resources - both tangible and intangible - at a high-level.
6. **Project scope :** Use this section to answer the question: "What is the project meant to accomplish?" Focus on both long and short-term goals and objectives, but briefly.
7. **Key deliverables :** Briefly list the key deliverables at different milestones.
8. **Project schedule :** Give a high-level overview of the project's estimated schedule. You don't have to be accurate down to the day, but a broad explanation of key milestones will help.
9. **Project budget :** Give a high-level description of the project's budget. You can break this down by resource requirements if you want to go into more detail.

6.14.1(b) Project Plan Template

There is no fixed "recipe" for making a project plan. You can be as detailed or superficial as you need to be. Unlike the project charter, which is meant for stakeholders on both sides of the table, the project plan is mostly to cue you and your team into the project and its goals.



Here are some things you can include in the project plan Template :

1. **Project identification** : Include details about the project, including its name, description, ID, client, and project manager's name.
2. **Project dates** : Identify the start and estimated end date of the project. You can also include a counter indicating the number of days left until the end date.
3. **Progress** : Mention how much of the project has been completed so far in terms of milestones accomplished.
4. **Tasks/activities/deliverables** : You can include a broad overview of key tasks, activities or deliverables, depending on the level of granularity. In complex projects, for instance, you might want to focus on deliverables, while in smaller projects, you can specify the exact tasks needed to produce said deliverables.
5. **Task details** : Include details about each task's start and end dates, the team or person responsible for it, and the task status.
6. **Timeline or Gantt chart** : You can also include a timeline or Gantt chart showing dependencies and progress for each task.

6.14.1(c) Project Status Reports Template

Creating project status reports is the bread and butter of any project manager's job. You'll have to create weekly, monthly, and even daily reports to alert stakeholders about the health of the project. Creating effective reports is an art; you have to be detailed but succinct.

Make sure to include the following in this template:

1. **Task progress** : Clearly identify all tasks that have been accomplished since the last reporting period, what you are working on currently, and what's coming up in the next reporting period.
2. **Issues, risks and change requests** : List all current issues and their status (open, closed, pending). Also list change requests and their history. Your goal should be to alert stakeholders about any issues that need their immediate attention.
3. **Milestones and deliverable** : Identify all milestones completed since the last reporting period. Also identify upcoming milestones and deliverables as well as their start/finish dates.

6.14.1(d) Work Schedules Template

- As a project manager, one of your core responsibilities is managing your team's schedule. What task each employee has to work on, on what days, and for how many hours is essential for running a project smoothly.
- Most managers turn to weekly, bi-weekly, or monthly work schedules to manage their team's activities. A schedule template usually have the following components :
 - o A title identifying the type of schedule (weekly, bi-weekly, etc.)
 - o The scheduled date or period
 - o The name of the employee
 - o Work assigned to the employee
 - o Number of hours assigned to each task on each day of the week
- As far as project management documents go, work schedules are fairly straightforward.

6.14.1(e) Work Breakdown Structures (WBS) Template

- The work breakdown structure is one of the more important documents you'll create in the course of managing a project. It involves breaking down deliverables into smaller, more manageable chunks.
- A work breakdown structure can have as many levels as necessary, but for most projects, you won't need to go beyond 4-5 levels of decomposition. The deliverables at the last level of any WBS are called a "work package". A work package describes all the work necessary to create a single deliverable. A project, then, is a collection of work packages.
- Creating a work breakdown structure requires a clear understanding of what a WBS actually involves. You also need to understand the project's scope, list deliverables, and determine work packages.

6.14.1(f) Timesheets Template

- Another one of your responsibilities as a project manager is to track and report how your team spends its time. You'll need this not just to track productivity but also to create client reports.
- An automated time tracking solution built into your project management software is ideal for this purpose. Tools like Work Amajig can track what your team is doing and create detailed reports for clients.
- However, in case you don't have access to a time tracking tool, you can also use timesheets and fill them up manually.
- You'll want to include the following details in your timesheets :
 - o Number of billable hours worked by task
 - o Number of billable hours worked by client
 - o Team member details (name, position, contact details, etc.)

6.14.1(g) Communication Plans Template

- As project managers like to say, communication is about 90% of their job. From delegating tasks and solving issues to keeping stakeholders updated on the what, why, and when of the project, you'll spend most of your time communicating. A solid communication plan will make your job infinitely easier.
- Communication plans help you communicate faster, anticipate client needs, alert your team about issues before they happen, and standardize communication across your entire organization. Any well-rounded communication plan template should include the following :
 - o A list of stakeholders on both sides of the table
 - o The interest, influence, and objects of each stakeholder
 - o Every stakeholder's communication preferences in terms of frequency, tone, format, and deliverables
 - o Event-specific communication plan to manage both one-off and recurring meetings
 - o Emergency communication plan to deal with contingencies



6.15 Managing Without Authority

- Managing teams without direct authority over the participants isn't a new concept, and professionals charged with organizational leadership responsibilities are almost certain to find themselves managing indirect reports at some point in their careers.
- If you are new to this, you might feel as though you are set up to fail. While indirect reports contribute to project goals and have defined deliverables, they are connected to project leadership through a "dotted line." And managing these reports often doesn't come with input into HR-related issues. But the lessons you learn from this experience can be invaluable.

Ways to lead without Authority

- The goal of managing without authority is to get others cooperate and engage willingly rather than following directives because you are the boss. This new style of leadership is a blending of personal and interpersonal skills that form the basis of a leader's ability to impact, influence, and inspire others."
- Managing well without authority is entirely possible and people do it all the time these days. We all have certain levels of influence in our work. Some have the influence that ties to their position; some have authority based on their expertise or resources. And everyone can develop influence by building strong relationships.

6.15.1 Strategies to Help You Manage Without Authority

1. **Understand what motivates the team :** What is each team member's motivation for being successful? One may be driven by the promise of earning more money, while another is excited to be able to make contributions. Motivation may be intrinsic or extrinsic. Intrinsic motivation means he or she will take action because it is personally rewarding. Extrinsic motivation occurs when we are motivated to perform an activity to earn a reward or avoid punishment.
2. **Create visibility for your team :** Talk to the managers who are responsible for your team members' careers about what they are doing. Find ways to support and praise the team publicly. Advocate for them and help create visibility company-wide.
3. **Hold discussions with the team at the outset :** Set the expectations about communication channels; how you will communicate with each other and how the team is expected to communicate with you. Explain what hours you expect they will be available and what channels they will use to reach you. Be specific about the kind of information you expect to receive and how frequently you anticipate hearing from them. Make it clear that you are very interested in keeping communication open at all times.
4. **Define the roles and responsibilities for your team :** Take the time to represent what you expect from each of them clearly and tie those expectations into the motivators you have determined will be effective for each person. Establishing clearly defined roles and responsibilities lessen the chances of duplication of effort or frustration between the various people you are managing on the project.
5. **Help the team understand you support their image and brand :** Be transparent. Let them know that you will foster, network and generally be supportive of them, so they know that they are not working in an isolated bubble. Remind them that just because they aren't reporting to their manager for this project doesn't mean there isn't company-wide visibility, and organizational visibility and their reputation at stake. Help them understand that their behavior and their performance in this project can and will impact them positively or negatively in the larger company setting.

6.16 Other Areas of Study In Project Management

In today's era, Project management is no longer the same old stagnant platform. Instead, it is a constantly evolving and developing business domain. It is always advised to keep updated with the changing project management trends.

The reason behind the fact is that Project management is a field that entwines itself through all the domains across a wide range of geologically diverse industries. Also, it is mandatory to tune the Project management strategies in accordance with the prevailing business environment for running a successful and sustainable business.

According to a recent report published by the Project Management Institute, the companies with a well-planned EPMO (Enterprise Project Management Office) report is successfully able to meet almost 48% more than their initial goals and objectives. Following are some of the latest global trends in project management:

1. AI (Artificial Intelligence)

- Artificial intelligence (AI) is currently the talk of the town. The top-notch AI technologies like Siri, Google Home, and Amazon Echo line up the products that take a place in your home. It is of no surprise that there are multiple AI applications that are also associated with the project management functionality.
- The inclusion of AI into the future project management trends will no doubt add a great essence of productivity to the project outputs. It will incontrovertibly help the overall project management workflow with an interactive interface for the available resources and give you the innate capability to respond to your agenda with suggestions and insights. The algorithm based suggestions are bound to add an extra boost of efficiency to the overall process of managing the project.

2. Hybrid Approach

- The one-size-fits-all strategy is now facing extinction. The conventional waterfall methodologies are now being tweaked with the modern strategies and adapted vividly to help with the various processes of project management.
- The implementation of these hybrid methodologies is best suited for the scenarios where the projects are handed over with an exceptionally larger work base with an imperative requirement of multiple project managers to be involved in it.
- Hence, the present corporate world is demanding a considerably higher number of hybrid project managers, who are not exclusively expert in one prescriptive methodology but are well-versed in several multiple methodologies.

3. Emotional Intelligence (EQ)

- Emotional Intelligence is not at all a new concept in today's corporate world. But it is definitely a progressing and inspiring trend in our process-based practical industry. And in a world where productivity and efficiency are all that matters, the chances are high that we might get lost in the diversity of the implemented methodologies. Hence, when the technical skills are staying rock steady, the existence of soft skills has to be ensured at any cost.
- The better you are in managing the people and establishing proper communication with them, the higher are the chances of your plans to proceed without a pitfall.
- So, when you have a constellation of people with various cultural diversities working together, there's definitely going to be some kind of issues among the peer group. And with an effective EQ capability in place, you would be quickly able to resolve these issues with the blink of an eye.



- It's compulsory for a project manager to have a proper understanding of the various aspects of emotional intelligence as it is slowly taking the path of an influential factor in the 2020 project management trends.

4. Analytics

- Project managers are fond of numbers. A majority of their expectations are related to crunching these numbers and peering into the results. And to help them achieve this, perfect and accurate analytics of the performance and the project dashboard is the apt solution.
- The project management analytic tools are going to be more of a cloud-based structure in the coming future. This will help you collect real-time data and reflect the results even more accurately.

5. Cyber Security

- With all the advancements in internet technology around us, it won't be wrong to say that security over the internet is a myth. Until and unless you are securing your data with a highly protected firewall, the concerns about the security of your project is highly valuable as the data getting compromised is only going to increase every minute.
- It has to be accepted that data breaches aren't completely fading away by enhancing the cyber security measures. But once you secure your project management methodologies and strategies from an online threat, you stand a chance of not getting robbed online. And with the rise of cyber-attack at an alarming rate, the chances are more for a formal regulation to be created in order to set a standard of detection, prevention, and response from technology and agencies alike.

6. Remote Teams

- The sharing economy has proven the fact that more organizations are highly appreciative of the use of a distributed team structure. This is because remote teams are comparatively cheaper and way more productive when managed efficiently and effectively with the apt set of management tools.
- And needless to say, remote working teams are gradually becoming standard practice in the world of project management. The present-day project managers are steadily proceeding ahead with the investment of this technology to promote highly effective communication over a wide range of platforms.

7. IoT (Internet of Things)

- The IoT is basically a global network of devices that can use the Internet to communicate with one another as well as with the end-users. And the interesting fact is that IoT bisects with project management on all the aspects ranging from data collection to team collaboration.
- The advantage of IoT in a project management strategy is that the devices can sense and respond to the surrounding happenings automatically through their network, thereby reducing the requirement of involving manual intervention. IoT has a significant role in the 2020 project management trends. It helps to lower the operating costs, minimizing errors and increasing the response time. You also get the leverage to provide the customers with a comparatively faster and better service.

Review Questions

- Q. 1 Define leadership. Describe the role of a leader in the Project management. (Refer Sections 6.1 and 6.1.1)
- Q. 2 Explain different leadership style. (Refer Section 6.1.3)
- Q. 3 Describe Project Ethics. Describe the code of Ethics for PM professionals. (Refer Sections 6.2 and 6.2.2)
- Q. 4 Write a note on Multicultural projects. (Refer Section 6.3)
- Q. 5 What is a virtual project? How a Virtual Project management works? (Refer Sections 6.4 and 6.4.2)
- Q. 6 Describe the benefits and challenges of Virtual project. (Refer Sections 6.4.3 and 6.4.4)
- Q. 7 What is Customer Acceptance? Describe the Process of getting Customer Acceptance. (Refer Sections 6.5 and 6.5.1)
- Q. 8 What is Project Termination? Describe various reasons. (Refer Section 6.6 and 6.7)
- Q. 9 How can we avoid the negative consequences of project termination? (Refer Section 6.6.1)
- Q. 10 Describe various types of project termination. (Refer Section 6.8)
- Q. 11 Describe Completing Final report. (Refer Section 6.10)
- Q. 12 Describe Lesson learned Analysis. Explain its process. (Refer Sections 6.11 and 6.11.1)
- Q. 13 How can we identify the lessons learned? (Refer Section 6.11.3)
- Q. 14 How important is it to acknowledge failure and success of a project. (Refer Section 6.12)
- Q. 15 How can we find out the reasons for project failure? (Refer Sections 6.12 and 6.12.1)
- Q. 16 What are the ways to acknowledge Success? (Refer Section 6.12.2)
- Q. 17 Describe Project management template and its usage. (Refer Section 6.14)
- Q. 18 Describe the types of Project Management Templates used. (Refer Section 6.14)
- Q. 19 How can we manage a project without authority? (Refer Section 6.15)
- Q. 20 Describe some of the areas that can be studied in project management in future. (Refer Section 6.16)

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