PROJECT MANAGEMENT

UNIT I: Project Management Framework

Project Management: Basic Concepts - Understanding Projects, Project Management, Project Lifecycle and Project Management Knowledge Areas - Triangular Relationship: Project, Program, and Portfolio - Project Environment: Identifying Environmental Factors and Process Assets - Understanding Organizational Structures and Organizational Culture - Introducing the Project Stakeholders - Technical Project Management Skills: Strategic and Business Management Skills, Leadership Skills, Three Skills: Negotiation, Influencing and Problem Solving - Project Integration Management: Developing Charter and Plan - directing, managing, monitoring and controlling project work, project closure.

What is a project?

Projects are a set of interdependent tasks that have a common goal. No matter what the project is, each project is broken down into objectives and what needs to be done to achieve them, ensuring that the project stays on track and is completed 'as per plan'. A project is *not* something routine. Day-to-day operations and maintenance are not considered projects because they do not have a definitive start and end. The Project Management Institute (PMI) defines a "project" as "a temporary endeavor undertaken to create a unique product, service or result."

The primary constraints of a project are:

- Time – the schedule for the project to reach completion
- Cost – the budget allocated for the project to meet its objectives and complete it on time
- Scope – the specific deliverables of the project
- Quality – the standard of the outcome of the project

Components of a Project:

- Goal: What are you trying to achieve?

- Timeline: When are you trying to achieve it?

- Budget: How much will it cost to achieve?

- Stakeholders: Who are the major players who have an interest in this project?

- Project manager: Who is going to make sure everything that needs to be completed gets completed?

What is project management?

Project management is the practice of applying knowledge, skills, tools, and techniques to complete a project according to specific requirements.

Proper execution of this practice comes down to identifying the problem, creating a plan to solve the problem, and then executing that plan until the problem has been solved. That may sound simple, but there is a lot that goes into it at every stage of the process. With the proper management plan, the project will be completed on time and within budget.

The roots of project management can be traced as far back as the building of the Pyramids in Giza and the Great Wall of China. However, the modern development of this practice began in the 19th century when railway companies purchased tons of raw materials and employed thousands of people to work on the transcontinental railroad.

By the early 20th century, Frederick Taylor applied PM concepts to the workday, developing strategies for working smarter and improving inefficiencies, rather than demanding laborers work harder and longer. Henry Gantt, an associate of Taylor's, took those concepts and used bars and charts to graph when certain tasks, or a series of tasks, were completed, creating a new way to visualize project management.

What are the stages of project management?

The five project management process groups are:

- Initiating: The goal for this phase is to define the project.

- Planning: This phase includes developing a roadmap for everyone to follow.

- Executing and Monitoring: In this stage, the project team is built and deliverables are created. PMs will monitor and measure project performance to ensure it stays on track.

- Closing: The project is completed, a post-mortem is held, and the project is transferred to another team who will maintain it.

Why is project management important?

Project managers will help your organization:

- Have a more predictable project planning and execution process

- Adhere to project budgets, schedules, and scope guidelines

- Resolve project roadblocks and escalate issues quicker and easier

- Identify and terminate projects that do not have relevant business value

- Become more efficient

- Improve collaboration across and within teams

- Identify and plan for risks

Project Management Life Cycle

To execute projects successfully – to meet its objectives, a clear understanding of the project management life cycle is essential. The project management life cycle basically describes the high-level process of delivering a project and the steps involved to successfully deliver the project. The project management life cycle can be defined as a structured, timely and methodical process for effectively initiating, planning and executing a project for a successful outcome – which is to meet the intended objectives of the stakeholders funding the project. Each project phase addresses a specific aspect of the process of managing a project from its conception to completion. Although these phases are described sequentially, in practice many of these phases may overlap or be applied concurrently during the lifetime of a project.

Phases of the Project Management Lifecycle

The project management life cycle is divided into 5 phases:

1. Project initiation
2. Planning
3. Execution
4. Monitoring & control
5. Closure.

1. Project Initiation

Key project management steps involved in the Initiation phase

- Conduct a feasibility study to identify the primary problem the project will solve and whether the project can deliver a solution to that problem

- Create a business case and define the project at a high level
- Create a Project Charter or project initiation document that outlines the vision, objectives and goals of the project
- Identify the high-level scope of the project and define the product or service the project will deliver
- Identify key project stakeholders
- Once the project gets a go-ahead, assemble the project team and establish a project office

A business case, a feasibility study and a Project Charter together fulfil the requirement of the Initiation phase to determine if the project is to be approved or not. Once the project is approved, one or more project initiation meetings are held to finalize the project. This is where the project initiation phase ends and the planning phase begins.

2. Project Planning

This phase begins after the project receives a green light in the Initiation phase.

Key project management steps involved in the Planning phase:
- Create a Statement of Work document to flesh out the details of project deliverables
- Develop a Work Breakdown Structure
- Create a project plan, assign team members (and other resources) to the various tasks and build a detailed project timeline
- Identify the Project Team roles and other resources for the project. At this stage, the Project Manager – working with a project staffing function – will most likely identify specific people for some of the key roles needed for the success of the project.
- Create a risk mitigation plan to identify potential risks and develop a strategy to minimize them
- Incorporate an effective change management plan for necessary changes in the project and to avoid bottlenecks
- Create a communication plan to schedule interactions with relevant stakeholders

3. Project Execution

The execution phase involved actually carrying out the activities that are identified in the project plan. This is where the rubber hits the road and the project ultimately comes to reality!

Key project management steps involved in the Execution phase:
- Identify and assign the project team Assign the team and other resources to the project tasks and begin work in the planned manner
- Provide necessary guidance to the team on how tasks should be completed
- Monitor progress of the team

- Communicate with the stakeholders on a regular basis to ensure that the project deliverables are acceptable

4. Project Monitoring & Control

This phase typically runs in parallel with the Project Execution phase and involves keeping the project on track and ensuring that objectives and project deliverables are met.

Key project management steps involved in the Monitoring and Control phase:

- Tracking the progress of various project tasks
- Measure budget, timeline and quality performance of the project
- Conduct user reviews and collect feedback, and take any corrective actions needed
- Track all changes to the project scope (whether from team members or the stakeholders) and report on their impact to project goals.
- Monitor overall project performance, including all project plan changes, and ensure that all stakeholders and the project team are on the same page about the project status and its expected outcomes.

5. Project Closure

Project Closure is the final phase of the project management life cycle, which indicates the end of the project and the final delivery of the project deliverables. Project Closure involves completion of the final delivery of a project and its approval by the stakeholders. Once the project's closure is formally approved, other aspects of the closure can be carried out. The project manager conducts a "post-project review" meeting. or commonly referred to as a retrospective- to review the lessons from the project, and the challenges that were faced during the project. It gives an opportunity to comprehend lessons learned to improve productivity in the future. Once the above activities are completed, the project team members are released to other projects.

Project Management Knowledge areas

Project Management is the process of leading the work of a team to achieve all the goals of a project within its given constraints. The project team is led by a project manager. The Project Management Book of Knowledge (PMBOK) includes the ten (10) knowledge areas that every project manager should master in order to successfully and efficiently lead their project team. Knowledge areas are not linear, as these skills can be utilized across many steps in any project.

- **Project Integration Management**

This knowledge area focuses on combining the separate processes of the project to comply with the common objective. Project managers also revisit this step if changes have to be made during the lifecycle of the project.

- **Project Scope Management**

The scope of the project must be properly defined at the beginning and unplanned tasks or budgetary concerns should not expand the workload in between the lifecycle. Project scope management handles this aspect.

- **Project Schedule/Time Management**

Depending on the team division, there are different schedules. It is vital for project managers to keep a check on the schedules of allotted tasks and if necessary, they must adjust deadlines.

- **Project Cost Management**

The project manager has to control the budget of the project to align with the planned and approved costs. You may check how a project cost management plan is made.

- **Project Quality Management**

This is to establish benchmarks in quality and is usually done at the beginning of the project. Each stage in the lifecycle needs to meet optimal quality standards.

- **Project Resource Management**

It is vital to understand the strengths and expertise of individual team members in order to assign work. It is needed to assemble a team by finding the right people who are able to deliver results as per the objective. Project resource management also helps personnel become successful in a planned manner.

- **Project Communications Management**

This kind of management is important for keeping everyone in the team and stakeholders in the loop. Without having proper control in communications with anyone involved, a plan does not work efficiently.

- **Project Risk Management**

Identifying potential risks in every stage of the lifecycle is important for delivering the desired objective. Project managers also analyze risks that may affect quality, time, scope and costs.

- **Project Procurement Management**

Here, all the contractors outside the organization required for the project must be acquired. Project managers look into their involvement during the project and monitor them.

- **Project Stakeholder Management**

Stakeholder satisfaction is important for every project. It is also essential to identify the stakeholders both internally and externally and their levels of involvement in the project lifecycle.

Triangular Relationship: Project, Program, and Portfolio Management

Organizations use different levels of management to ensure teams are working toward business objectives regarding strategy, financial growth or maintenance and operational efficiency. Three common levels of strategic management are project management, program management and portfolio management. Understanding these three types of strategic management can help you see how your work contributes to larger organizational objectives.

What is project management?

Project management is the process of organizing resources, coordinating teams, setting deadlines and monitoring the progress of individual projects. The professionals in charge of project management are called project managers, and they're responsible for:

- Collaborating with clients or client managers to determine project goals and scope
- Managing the budget
- Coordinating team members and resources
- Conducting risk analysis
- Setting milestones and checking teams' progress throughout the process
- Holding meetings to share client feedback, get progress updates or troubleshoot problems
- Providing updates to clients and client managers
- Running reports during and after project completion

What is program management?

Program management is the process of overseeing multiple related or unrelated projects that strive toward the same objectives and are best managed as a group rather than individually. The professionals in charge of program management are called program managers, and they're responsible for:

- Coordinating multiple teams across different professional disciplines
- Developing overall strategic, financial and operational objectives
- Making cross-organizational road maps
- Handling project interdependencies
- Conducting risk mitigation
- Collaborating with team leaders to determine how each project aligns with objectives
- Securing operational and financial resources to prevent conflicts or delays
- Creating program timelines and milestones
- Uncovering and outlining the benefits of every project

What is portfolio management?

Portfolio management, also referred to as project portfolio management, is the process of determining the strategic purpose of every current and future or potential project or program. Portfolio managers are responsible for:

Implementing project and program management approaches and processes

Determining the most important businesses objectives

Establishing financial and budgeting initiatives

Overseeing large-scale resource allocation

Making sure that all projects and programs help achieve program-level goals

What are the differences between project, program and portfolio management?

Here are the differences between these three important management types:

Scope

One way to understand the scope of these three levels of management is that multiple projects make up a program and multiple projects and programs make up a portfolio.

Here's another way to understand the scope:

Project management: This process focuses on one project at a time, and a project may have multiple segments that make it more complex.

Program management: This process focuses on a group of projects and handles overall coordination between teams.

Portfolio management: This process oversees all projects and programs in an organization, but focuses on the overarching goals and how projects and programs align with those goals.

Uses

Here's how each of these types of management is useful in a team:

Project management: You apply project management when overseeing a single project and its team members, budget and deadlines.

Program management: You use program management to assess groups of projects and their alignment to goals, coordinate teams across different departments and improve processes.

Portfolio management: You use portfolio management when overseeing an entire organization's projects and programs, determining returns on investment, predicting the outcomes of programs and projects and create effective change-making initiatives.

Project Environment

When the business case and the project charter, and later, the project management plan and its subcomponents are prepared, the project environment surrounding the project should be examined thoroughly to delineate the factors that may have a negative or positive impact on the project activities and its outcomes. In PMBOK Guide 6th Edition, this environment is composed of enterprise environmental factors (EEFs) and organizational process assets (OPAs). PMBOK Guide 7th edition refers to them as the project environment. The project environment is composed of two components – internal and external,

which are described in detail in the following sections.

Internal Environment

The internal environment in which a project is developed consists of the factors that are internal to the organization, but outside the project itself. These factors include elements such as organizational culture, structure, and governance as well as security and safety measures. Other tangible elements include geographic location as well as distribution of facilities and resources, infrastructure, IT software and hardware, resource availability, and employee capability. The internal environment also includes organizational process assets, which are processes, policies, and procedures as well as organizational knowledge bases (e.g., financial data, historical information, lessons learned, project files from previous projects).

External Environment

A project's external environment consists of the factors that exist outside of the organization. It includes market conditions, social and cultural influences and issues, legal restrictions, commercial databases, academic research, government or industry standards, financial considerations, and physical environmental elements. This environment can also affect projects conducted by organizations. For example, economic environmental forces generally include such elements in the economy as exchange rates and wages, employment statistics, and related factors such as inflation, recessions, and other shocks—negative and positive. Additional factors include hiring and unemployment, employee benefits, factors affecting organizational operating costs, revenues, and profits, all of which are affected by global, national, regional, and local economies. Politics and governmental policies, international wars, natural disasters, technological inventions, and sociocultural forces could directly affect our organization and the projects or may interact with other forces such as economic forces.

EEF and OPA in Project Management

In the world of project management, there are two critical terms that every aspiring project manager must know: Enterprise Environmental Factors (EEF) and Organizational Process Assets (OPA). EEF and OPA refer to the internal and external factors influencing a project's success. Understanding these two concepts is crucial for any project manager who wants to deliver projects successfully.

What are EEF and OPA?

EEF refers to external factors like laws and market trends, which can impact a project. OPA refers to internal assets such as procedures and templates that help manage projects. Effective project management requires understanding both, as they can influence project success during planning.

Importance of EEF and OPA

Effective project management requires understanding internal and external factors that can impact the project's outcome. Enterprise Environmental Factors (EEF) refer to external factors like legal restrictions or marketplace conditions, while Organizational Process Assets (OPA) are internal assets like knowledge repositories or templates. By considering both EEF and OPA during decision-making and the execution of management processes, a project manager can increase efficiency and improve overall performance with the help of a project management office.

Understanding Enterprise Environmental Factors

Understanding the external factors that can affect a project's success is essential in project management processes. These external factors fall under the purview of Enterprise Environmental Factors (EEF), which include government regulations, industry standards, and market trends. On the other hand, internal tools such as Organizational Process Assets (OPA), including policies, procedures, and knowledge repositories, aid in managing projects effectively. Aspirants preparing for PMP or PMI-ACP exams must understand these concepts to perform better on the exam.

Factors impacting EEF

External Enterprise Environmental Factors (EEF) that affect project management include government regulations, market trends, industry standards, organizational culture, legal environments, and stakeholder expectations. Identifying and considering these factors are essential during project planning as they significantly impact the project's success.

To manage projects effectively, there are internal Organizational Process Assets (OPA) such as tools, procedures, knowledge base, templates & work authorization systems.

EEF examples

External EEFs, like legal restrictions, political climate and marketplace conditions, and internal EEFs, such as organizational culture and resource availability, including enterprise environmental factors, can influence a project's success.

Understanding Organizational Process Assets

Effective management of projects requires organizations to have Organizational Process Assets (OPA) such as templates, guidelines and policies. These resources help project teams complete tasks efficiently while maintaining consistency. OPA is a vital component outlined in the Project Management Body of Knowledge (PMBOK), which guides managing processes for any performing organization. Incorporating OPA into project management processes allows aspirants to succeed by following best practices and knowledge repositories.

Types of OPA

In project management, Organizational Process Assets (OPA) refers to an organization's accumulated

knowledge base, processes, and procedures. The two types of OPA are Explicit (documented processes, templates, guidelines) and Tacit (knowledge, skills, experience). Utilizing both types can improve management practices' efficiency.

OPA examples

As an integral part of project management practices, Organizational Process Assets (OPA) comprise documented processes such as templates and guidelines used by the performing organization. Additionally, they include tacit knowledge in the form of expertise and experience possessed by individuals. Leveraging these assets can lead to improved efficiency of project management processes.

Differences between EEF and OPA

Enterprise Environmental Factors (EEF) and Organizational Process Assets (OPA) are crucial concepts in project management. External EEF, like legal restrictions and market conditions, can impact the project environment, while internal EEF, like governance and organizational culture, can affect project management. Meanwhile, OPA includes documented processes such as templates and guidelines that can help streamline project management processes. Proper utilization of these concepts will lead to improved outcomes for future projects.

Comparison between EEF and OPA

Effective management of a project requires understanding the differences between EEFs and OPAs. EEFs refer to external factors like market conditions or legal restrictions, while OPAs are internal processes and accumulated knowledge. Both can impact a project's success significantly. To manage a project effectively, it's essential to consider both EEFs and OPAs during the planning phase. Stakeholders can achieve better outcomes by understanding how these factors interplay with a project's environment.

Conclusion

In conclusion, Enterprise Environmental Factors (EEF) and Organizational Process Assets (OPA) are critical elements that are crucial in project management.

Organizational Structure and Culture

The definition of organizational structure and culture is important to the success of a business. It is necessary that a business owner or operator understands the difference between the organizational structure and the culture of the business.

The best organizational structure will depend on the company and its employees. There is no one best method to apply for guaranteed business success. It will also depend on the goals of the business. If a business wants to be effective, it needs to have a strong organizational structure and culture. You can often tell when a business has an effective organizational structure or culture in place.

Understanding Organizational Culture

Organizational culture is the expectations of the business. These are unwritten rules that dictate the attire, work ethic, and overall structure of the business. A new employee will often have to learn and follow these rules to fit into a business and its culture. Consider it the personality of the business. This culture sets the standards for the workplace and affects how the employees are expected to act.

TYPES OF ORGANIZATIONAL CULTURE

Clan Culture: emphasizes collaboration across teams and a horizontal structure.

Adhocracy Culture: allows individuals to share ideas and encourages the company to take risks.

Market Culture: focuses on financial success and how each employee contributes to revenue.

Hierarchy Culture: emphasizes career paths and provides clear managerial processes.

Organizational culture might include the following:

- Commonly shared beliefs.
- Values that dictate the employees' behaviors.
- Agreed upon assumptions.

Most organizations have a unique culture that sets them apart from other businesses. These unspoken culture rules affect the employees, managers, and owners of the business.

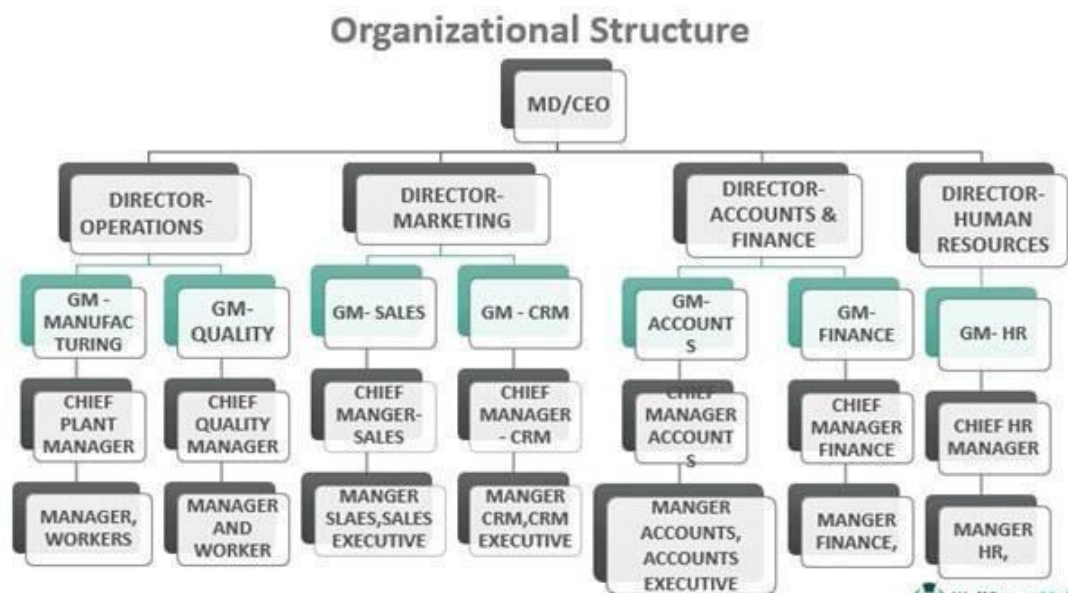**Understanding Organizational Structure**

Organizational structure is a system that determines employee hierarchy, functions, and workflow and provides a transparent and fair reporting system. It is an enterprise environmental factor guiding how an

organization runs its operations. As organizations grow, their requirements change, and the structure must adapt to support its objectives.

Types of Organizational Structure

An organizational structure guides how activities in your company are carried out to achieve its goals. It determines how information flows within the organization and between departments. It defines the chain of command and job responsibilities.

The organizational structure depends on many factors, such as governing style, leadership style, workflow, hierarchy, etc.

The PMBOK Guide defines eight types of organizational structures:

1. Organic or Simple Organization
2. Functional or Centralized Organization
3. Multi-divisional Organization
4. Matrix Organization
5. Project-oriented (Composite or Hybrid) Organization
6. Virtual Organization (Network Structure)
7. Hybrid Organization

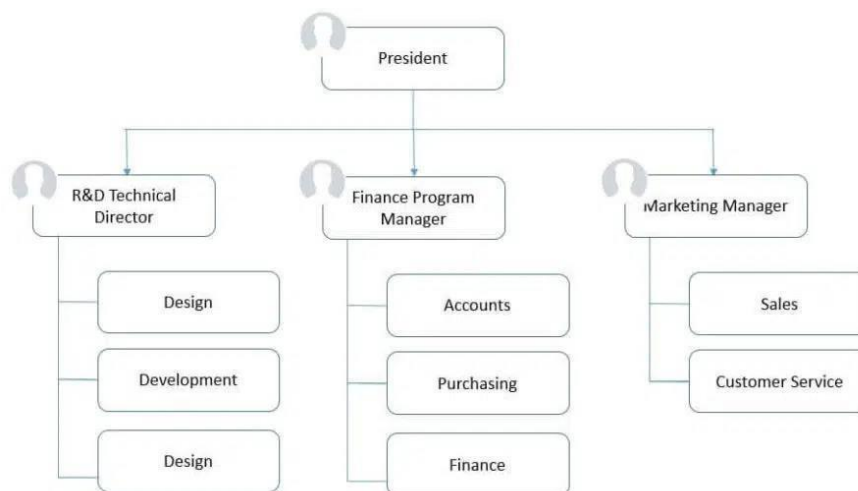**#1. Organic or Simple Organizational Structure**

This is one of the simplest types of organizational structure. Here, you work alone or side by side with another employee.
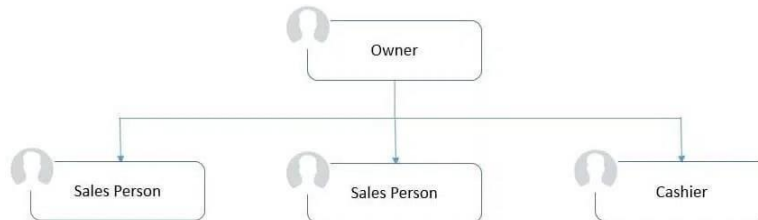
You may be the only employee in your company. Instances of this type are a solopreneur, OPC (One Person Company), or a freelancer.

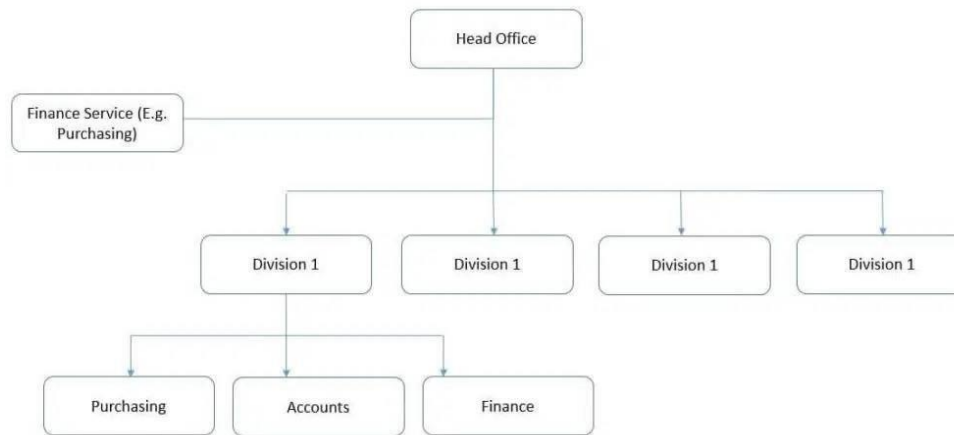**#2. Functional (Centralized) Organizational Structure**

Functional organizational structure is the most commonly used organizational structure. Here, the organization comprises various departments; each department has workers with similar skills: sales, marketing, and finance, to name a few.

This helps organizations maximize the efficiency of each functional group.

#3. Multi-Divisional Organizational Structure

This organizational structure may have many functional divisions with little centralization. Generally, these divisions are independent. Although they will guide a part-time staff, project managers do not have much authority. Under a multi-divisional structure, the organization is divided into various divisions. Employees with diverse skills are kept together in groups based on a similar product, service, or geographic location. Each division has the resources required to function and can work independently.

#4. Matrix Organizational Structure

This is the most commonly used organizational structure. Matrix organizational structure is a hybrid of a functional and projectized organizational structure. Here you have two command structures: vertical and horizontal. Employees may belong to a functional group and work on a project, so this structure combines the best of both worlds

A matrix organizational structure can be of three types:

1. Strong Matrix Structure
2. Balanced Matrix Structure
3. Weak Matrix Structure

Strong Matrix Structure

Strong matrix organizations are closer to a projectized organization. The project managers have the highest authority, control over the budget, and a full-time team reporting to them.

Balanced Matrix Structure

A balanced matrix has properties of both functional and projectized structures. Here, project managers have a low-to-moderate authority and a part-time team. Both the project manager and the functional manager

manage the budget.

Weak Matrix Structure

A weak matrix is closer to a functional structure. With a weak matrix, project managers have low authority and no control over the budget; they will have a part-time team.

#5. Project-Oriented (Composite or Hybrid) Organizational Structure

As its name suggests, projectized organizations deal with projects. Project managers have a full-time role and comprehensive authority to complete the project successfully. They control the budget and have a full-time team report to them.

A team-based structure is another name for a projectized organizational structure. This type of organizational structure is seen in small-to-medium-sized organizations that only deal with projects.

#6. Virtual Organization or Network Structure

Many experts call this a virtual corporation. The central organization is connected to outside firms via the internet. The outside firm can be a vendor, client, or associate. This structure helps businesses achieve corporate growth and greater profit. The organization keeps its core business while adjunct processes are outsourced in a network structure. This organization structure is also known as a hollow corporation, hollow organization, or network structure. In a virtual organization, the project manager has a low-to-moderate authority and mixed control over the budget, and they may or may not have a full-time team reporting to them.

#7. Hybrid Organizational Structure

True to its name, this type of organizational structure may use any combination of the organizational structures. Suppose yours is a functional organization whose typical needs are easily met by conventional departments in some cases. However, your organization will create a separate project team to complete unique tasks. A hybrid organization is a mixed structure that serves organizations with diverse needs. Responsibility, authority, and other factors are also mixed depending on the structure.

#8. PMO (Project Management Office)
PMO is also a mixed organizational structure. Here, project managers have the highest authority. They control the budget and have a full team reporting to them. This concludes the summary of organizational structures. Organizational structure, on the other hand, is the legal structure of the business. The

organizational structure might include the following:

- The method in which you register your business.
- The formal system of roles and authority within the business.
- The organizational chart.
- The policies and methods used to assign manager tasks.
- The hierarchy structure.

The Structural Characteristics of the Hierarchy

The hierarchy structure consists of the organizational chart, which includes who reports to whom and who is assigned individual roles within the business. The hierarchy structure includes the following elements:

- Characteristics: the specific policies and regulations used to manage the behaviors of management.
- Height: the number of levels within the hierarchy.
- Control span: how many employees are beneath each manager.
- Departments: the specific groups of employees and available resources within each department.
- Centralization: the upholding of policies and regulations throughout all levels of the hierarchy.
- Standardization: the standard of rules and regulations.
- Formalization: the formality of documenting rules and procedures.
- Specialization: the level of special skills within each department.

Things That Affect Organizational Structure

There are a few things that can affect the organizational structure of a business. Business owners have a direct effect on corporate strategy. This is the standard of approach that will be used to grow and structure the business. Growth can also affect the organizational structure.

As a business grows, it will need additional managers and employees, which can change the current organizational structure. Diversification can also be an influential factor as the number of products or services within the business expands.

Concerns of environmental uncertainty can also affect the organizational structure of the business. When a business has a high level of environmental uncertainty, its managers and employees are more likely to be organic with their practices. On the other hand, when a business has very little environmental uncertainty, they are less likely to be organic with their daily business practices.

Flexible Organizational Structures

Many business owners believe that a flexible organizational structure is the most empowering type. A flexible organizational structure includes fewer managers, less centralization, and less formal rules and regulations. A flexible structure is set at the department level of the hierarchy.

This type of flexible structure can encourage employees to think for themselves and to experiment with new ideas. It gives freedom to all employees in the hierarchy, regardless of their level in the organization. A flexible schedule may not work for every type of business, so it is important for a business owner to consider if a flexible structure would work for their organization or not.

Organizational culture and structure each require their own strategy. Understanding the difference between the two is necessary to create a strategy that works best for the business based on its specific needs.

Stakeholder in Project Management

Definition of a project stakeholder

According to the Project Management Institute, project stakeholders are defined as: "Individuals and organizations who are actively involved in the project, or whose interests may be positively or negatively affected as a result of project execution or successful project completion." Not only that, but the list of stakeholders can change throughout the project's journey: a certain stakeholder's influence might become more or less important depending on the project phase, for example. Your job as a project manager is to keep all stakeholders informed, involved, and on-board throughout the project's progression. Here's what you need to know about your stakeholders: who they are, what they do, why they matter, and how to work with them.

Types of stakeholders in project management

There are two main types of stakeholders in project management, internal and external.

Internal stakeholders

Internal stakeholders are people or groups within the business, such as team members, managers, executives, and so on.

External stakeholders

External stakeholders are — as you can probably guess — people or groups outside the business. This includes customers, users, suppliers, and investors.

Examples of stakeholders in a project

The stakeholders in each particular project will vary depending on the type of project and industry, but here are a few examples of the types of stakeholders in project management you might need to consider:

- Project manager

- Team members

- Managers

- Resource managers

- Executives

- Senior management

- Company owners

- Investors

- Sponsors

- Financiers (the people, not the cakes)

- Suppliers

- Vendors

- Consultants

- Customers

- End users

So how do you know which stakeholders you need to focus on for your particular project? For that, you need to do a stakeholder analysis.

How to do a stakeholder analysis

As soon as your project charter is complete and the scope of your project is defined, you can use it to start mapping out your stakeholders. Here's how to get the ball rolling with a basic stakeholder analysis process.

1. Identify your stakeholders

First step, you need to identify who your stakeholders actually are. To do this, draw on your project charter and any other project plans and documentation to compile a full list of your project stakeholders, both internal and external.

Bear in mind that some stakeholders won't come into play until later in the project lifecycle — but if you can anticipate who they'll be in advance, you can start to get their buy-in, build the relationship from the outset, and help them to feel involved from the beginning.

2. Prioritize your stakeholders

Once you've identified all of your stakeholders, you can start to prioritize them. Prioritizing your stakeholders is important because it helps you understand where to invest your resources. In other words, it helps you — as the project manager — to identify who the key decision makers are at any given moment, so you can ensure that you're talking to the right people, at the right time.   There are a few methods of doing this stakeholder prioritization, but one simple way is to plot them out using a power/interest (or power/influence, or impact/influence) grid. The power/interest grid helps you to identify your key stakeholders by answering two key questions that help you to group them into one of four categories:

- **What level of power do they have?:** How important is it that they're happy with the project's progress and results? How integral are they to the project's success? How influential are they to the project, to other stakeholders, to the team, and so on? (Remember: a stakeholder's influence can be positive or negative!)

- **What level of interest do they have?:** Is this project super important to them, or are they only tangentially connected to it? Is it something they're directly accountable for? Are they reliant on it for other work or results? Are they opposed to the project or concerned about it in some way?
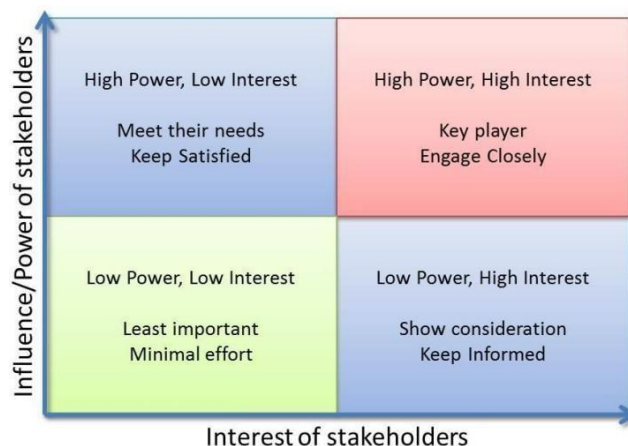
As we can see from the (highly technologically-advanced) matrix above, stakeholders who fall into the top-right quadrant (powerful + interested) are the ones you should be giving extra attention to, because they're the ones who can have the most impact on your project — for better or for worse.

3. Understand your stakeholders

Now that you know who the key players are and which ones to prioritize, you need to get a full grasp of their expectations for the project. For key stakeholders, this might involve meeting up for a short face-to-face

interview or conversation where you discuss things like:

- What their definition of project success looks like

- Any concerns or reservations they have about the project or its outcomes

- What their expectations for the project are

- What impact a positive or negative project outcome would have on them

- Whether there are any anticipated conflicts of interest with other stakeholders that you need to be aware of

How to manage your project stakeholders

Identifying your stakeholders and their needs is just one piece of the stakeholder management puzzle. But it doesn't end there. For a successful project, your key stakeholders' requirements, project objectives, and happiness should be an ongoing concern throughout your project. Now, that doesn't mean that the stakeholder is always right — and your job as a project manager will sometimes involve pushing back on your stakeholders and re-balancing their expectations with the project charter and project plan you all agreed on at the start.

The tricky part is in balancing everyone's needs, requirements and objectives so you can keep your stakeholders happy — while also delivering the project you set out to deliver. Here are a few ways you can establish some best practices for stakeholder management and develop better stakeholder relationships at every phase of your project.

Document each stakeholder's roles and needs

Engaging stakeholders throughout a project involves strategies such as early and continuous involvement through workshops, interviews, and feedback sessions, ensuring their voices are heard in decision-making processes. Developing a clear and shared project vision and objectives can align stakeholders' interests and motivation. Regular and transparent communication, including progress updates and issue resolution, maintains their engagement. Involving stakeholders in risk assessments and mitigation planning shows their concerns are taken seriously.

Technical Project Management Skills: Strategic and Business Management Skills, Leadership Skills:

What is technical project management?

Technical project management involves the work of a technical PM, someone who communicates with technical and non-technical stakeholders about a project. These managers also oversee technical or IT-related projects using their technical and management skills. Often, their role involves tasks such as planning, executing and monitoring teams and their assignments through the project life cycle.
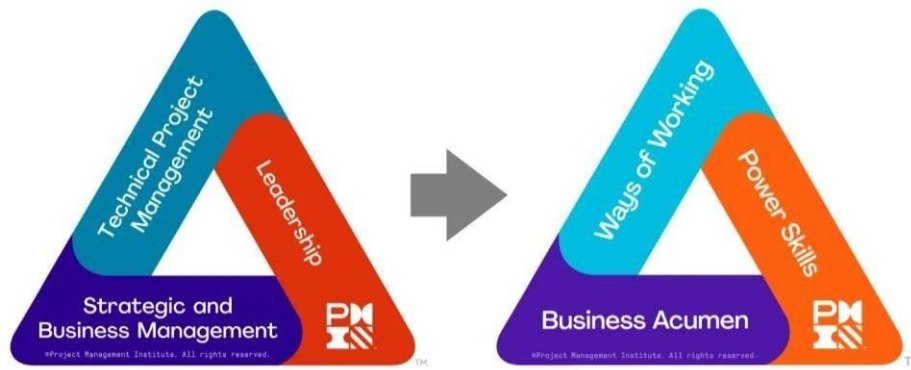
Talent Triangle

After interviewing many industry experts, PMI found that most project managers had technical ability, but often lacked leadership and business strategy skills. Ironically, the survey also found that companies seek for technically sound, individuals with leadership and business strategy skills. This is because the latter two competencies can support longer-range strategic objectives contributing to company's growth. They concluded that there is a demand in for PMs with knowledge in all three areas together called the Talent Triangle.

The three areas of the Talent Triangle

The three areas of the Talent Triangle are technical project management, leadership, and strategy and business management.

Technical Project Management: A successful project manager must have domain specific technical know-how, knowledge about their industry, and also project specific knowledge. Relevant training and certifications will help them with domain specific knowledge and expertise. The technical skills are,

- A knowledge of programming skills, such as SQL, HTML, Java, or C++
- A knowledge of bookkeeping, billing, and telecommunications
- The ability to market and maintain data
- The ability to work with media, such as to edit or create content
- Project planning, budgeting, and risk management skills
- An understanding of security, both physical and cyber.

Leadership: Essential leadership skills for project managers start with motivating and inspiring teams.Other leadership skills including negotiating, communicating, listening, influencing skills, and team buildingare also important, especially to the extent that they contribute towards improving team performance.

- **Motivating and inspiring**. Leaders develop a vision and then continually communicate that vision throughout the organization, working with the team to achieve the vision. Leaders keep their people enthusiastic in doing their work and focused on the project vision. They encourage the team members to do their best and accomplish the work with full self-satisfaction for the making their contribution towards the project vision.

- **Team building**. Leaders help the team members help each other, as they make their individual and group contributions toward achieving the project goals.

- **Negotiating and communicating.** Leaders get the team members and project stakeholders to work effectively with one another, considering all parties with shared or opposed interests, with intent to compromise before reaching a team decision. Leaders create a project environment where team members can be honest and open in communicating with each other, understanding each team member's communication style, and able to communicate effectively with project stakeholders.

- **Listening and influencing**. Leaders are active listeners, understanding and considering the team members' perspective before making team decisions that will affect the team. Leaders get project team members and other stakeholders to collaborate and cooperate with each other, working towards a common goal.

Strategic and Business Management: Project managers must align their actions and make decisions to take company's projects forward. They must work to meet company goals, develop innovative strategies and negotiate well. Strategic and business management skills project managers must have are cost benefit analysis, strength and weakness analysis, legal compliance, market awareness and conditions, and customer relationship management.

Big picture thinking

This refers to a manager's ability to assess the impact of issues or challenges beyond the organization that might arise or will have a future impact on any potential strategy (including Government policy, economic opportunities, competitive threats etc) make sure that the strategy that is evolved makes appropriate accommodations.

Listening skills

This is the ability to both genuinely hear and understand other people when they provide input to possible strategic options and to quickly discover their full communication or message so that the input is properly accommodated. This aids employee buy-in and future execution.

Commercial acumen

This refers to a manager's ability to assess the potential investment and economic payoff of different strategic options so as to select the one that has the greatest commercial benefit.

Planning and Organizing

Planning and organizing is about the ability to organize people, ideas, resources and the time available to you, in order to give yourself the best possible chance to shape a coherent strategy.

Collaboration ability

This refers to a manager's capacity to work positively and flexibly in group situations at all levels, maintaining an open and helpful attitude as much as possible so that the best ideas about possible strategies can emerge.

Critical/Lateral thinking

This refers to a manager's capacity to think rigorously and broadly about issues, challenges or problems that may lie ahead when strategizing and to then critically r laterally think in order to optimize the route to finding potential solutions that work.

Execution skills

This refers to a manager's capacity to maintain a firm eye focus on useful output results execute a written strategic plan and to achieve the stated outcomes (and go beyond mere input activity). Execution skills also involves resourcing the strategic plan, putting it into action, and managing those actions. From the above broad perspective, shown below are the **TOP three** skills that a Project Manager MUST have to achieve greater results in their projects.

They are 1. Negotiation skills; 2. Problem solving skills; and 3. Influencing skills

1. Negotiation Skills

Negotiating skills include methods of communicating, influencing, planning, strategizing, employing tactics to obtain an amicable result. Invest in learning the ART of negotiation. As a Project Manager, you will be involved in numerous negotiations:

Vertical. With your peers in negotiating resources from their department into your project. Or agreeing on a solution with your fellow peers.

Upwards. Negotiating with your bosses on team grievances, bonuses, deadlines, cost allocations, risks and issues, among others.

Downwards. Negotiating with your resources on their performance, conflicts with their peers and delivery timelines, among others.

Vendors / Suppliers. Negotiating contracts, conflicts, price and delivery demands, among others.

2.Problem Solving Skills

Problem-solving skills helps you to resolve obstacles in project situations. Every project involves issues on a daily basis. Every problem requires deliberation and decision making skills from the Project Manager. Hence, the Project Manager would need to sharpen and strengthen their mind in resolving complex issues.

Some of the ways that you could be effective in problem-solving include:

Creativity: This could be either a thorough understanding of the process or through intuition. **Research:** Search engines provide vast research options. In addition to more rigorous investigations and research projects. **Team Work:** When two or more minds meet and brainstorm an idea, a vast mastermind is formed that could lead to an immense number of ideas to resolve a problem. **Risk Assessment:** Systematic identification of potential problems and risk responses could mitigate many project challenges ahead of time.

"Whatever the problem, be part of the solution. Don't just sit around raising questions and pointing out obstacles."

Influencing Skills

Influencing is your ability to convince, getting buy-in, change others opinion and beliefs – in this case, your project team, senior management, vendors/suppliers, and various other stakeholders – without using force or coercion, and motivating them to work together towards the results you desire.

There are a number of ways that you could apply your influencing skills, that includes

- creating rapport with your stakeholders,
- the art of emphatic listening,
- using questioning techniques that leads people towards the answer that you desire,
- being a master of body languages (including mirroring techniques),
- being calm, relaxed and
- having good sense of humor.

Project Integration Management

"Project Integration Management includes the processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management

Process Groups."- A Guide to the Project Management Body of Knowledge (PMBOK 6). In other words, project integration management is an organized approach that ensures all processes within a project are synchronized and executed efficiently, and resources remain on track to achieve the project goals. It helps project managers to balance stakeholder expectations and customer needs while optimizing tasks and resources, steering the project toward success. Project managers who have to align the work of cross functional teams in accordance with dependencies, manage schedules and track resources, will benefit from this unified approach.

Why is Project Integration Management Important?

A project manager is required to oversee many components of the project, such as scope, schedules, costs, and resources. He or she must avert risk and facilitate smooth communication. Quality must be ensured, and clients and stakeholders must be appeased! With the right integration management strategy, all these diverse elements can be tracked, and balanced against each other to achieve the desired outcomes. For instance, the project scope might suddenly change, necessitating a course correction which will lead to delays in the schedule, as well as cost overruns. Without an integration strategy in place, things could get out of hand very quickly.

Here's what can be achieved through integration management:

- Processes and tasks can be organized and listed out.
- Team members can be allocated responsibilities.
- Shared resources and their overlapping schedules are managed.
- Work efficiency within teams is enhanced.

A well formulated integration plan can make sure that all project components are in order to improve efficiency and, therefore, boost productivity and you can learn all about it in our PMP course online.

7 Processes in Project Integration Management

The seven important steps in project integration management are:

1. Project charter
2. Scope statement
3. Project management plan
4. Direct and manage project work
5. Monitor and control project work

6. Perform integrated change control
7. Close project or phase

Process	Project Phase	Key Deliverables
Develop Project Charter	Initiating	Project Charter
Develop Preliminary Scope Statement	Planning	Scope Statement
Develop Project Management Plan	Planning	Project Management Plan
Direct and Manage Project	Execution	Deliverables
Monitor and Control Project Work	Monitoring and Control	Change Requests
Perform Integrated Change Control	Monitoring and Control	Change Requests Status Updates
Close Project or Phase	Closure	Final Product

Developing a project charter.

Traditionally, the project sponsor or project manager writes the project charter. It serves multiple purposes throughout the project life cycle. This high-level document provides the project manager with the authority to execute the project and likely won't require adjustment as work proceeds. It also outlines the initial roles and responsibilities of all team members and establishes goals and project deliverables.

<mark>Project Charter</mark>

Project Name		Project name		
Project Manager		Project manager name	**Organization**	Organization name
Sponsor		Sponsor name	**Organization**	Organization name
Executive Committee Sponsor		Executive Committee that is responsible for the project		
Document Version and Date		Version number and date of this	document.	

Document Change Control			
Revision Number	Date of Issue	Author(s)	Brief Description of Change

Write the scope statement.

What is Included in the Project Scope Statement?

The project scope statement helps visualize the complete project and its deliverable. It includes the following:

1. **Product Scope Description:** A detailed description of the product to be produced.
2. **Product Acceptance Criteria:** These are the criteria by which the consumers will readily accept the product as it satisfies their expectations.
3. **Project Deliverables:** These are the project output, including elements like software or documents.
4. **Project Exclusions:** These elements are outside of the project's boundaries.
5. **Project Constraints:** These include resource, organizational, political, technological, and any other constraints that affect performance.
6. **Project Assumptions:** These are conditions accepted to be true for your project to function smoothly—for example, the availability of employees when required.
7. **Milestones:** Significant stages in a project's timeline where crucial events occur.
8. **Agreement:** This shows stakeholders' sign-off at the end of the statement, indicating their support.

Develop a project management plan.

The project management plan brings all aspects of the planning phase together into a single document. It includes elements such as:

- Project goals

- Budget

- Risks

- Scope

- Work breakdown structure

- Stakeholder management plan

- Change management plan

This fixed plan should not change without a formal change request.

Direct and manage project work.

Direct and manage project work is a project management process that allows you to lead a team, handle resources, and oversee the completion of a project. Applying the direct and manage process may help managers choose the best approach to address these issues and ensure the completion of the original project.

Other activities managers can perform during the direct and manage process include:

- Improving project interfaces with stakeholders and clients

- Handling vendors and processing their invoices

- Setting up new deadlines and project milestones

- Establishing protocols to handle project data

- Opening and supervising communication channels

- Providing feedback to employees and suppliers

- Facilitating communication between team members and the company's upper management

- Creating emergency protocols to address project risks

Inputs and outputs of direct and manage project work

Project inputs comprise the assets that contribute to a project's success, while outputs refer to all physical and non-physical assets the project produces when it reaches its main objective.

Inputs

1. Project plan

This is the plan designed by the project manager and refers to the steps and tasks that team members may execute to reach project success. This plan usually defines stakeholder responsibilities, project milestones,

roles, project phases, and the monitoring process. Usually, this plan also contains sub-plans to describe each project activity in more detail. For instance, if a manager designed a project plan for the construction of a building, the plan may contain sub arrangements to explain phases such as land and foundation or wall and roof construction.

2. Project document

The project document contains the project's ongoing details, such as each completed phase, changes made to any activities, lessons learned from previous projects, milestones, and deadlines. It can contain communication details, such as project reports, meeting minutes, and e-mails. This information helps project managers know who generated each communication document and the purpose of the document.

The project document also refers to pending activities, scheduled events, foreseen risk factors, and opportunities. It's important for project managers to ensure their team members record each activity in the document, as they can use it later to audit and evaluate the entire project.

3. Change requests

These are the changes requested by the client or the upper management and executed by the project manager and their team. These changes tend to adjust the project scope, budget, and timeline. They also look for improving quality, correcting errors or omissions, and saving resources. As some changes are predictable and others typically emerge during the project execution, it is important to have protocols and procedures established to handle these unforeseen changes.

4. Enterprise environmental factors (EEFs)

These are factors that project managers consider when they're making decisions about a project, but also factors that can limit the project and affect its success. They comprise infrastructure, which refers to the equipment, facilities, and technology team members can use to complete their tasks, and cultural and structural elements, which refer to the organization's values, vision, mission, business objectives, and structure or the way the organization operates.

EEFs also refer to risk tolerance, which means the degree to which a project manager and project stakeholders are comfortable with the risks associated with the project. For instance, if the project aims to invest in mutual funds, the manager might evaluate those funds that contain stable instruments, such as government bonds, or those that offer higher returns but higher risk, such as hedge funds.

5. Organizational process assets (OPAs)

These are project guidelines and procedures that team members follow when working on a project. They explain the channels and ways used by stakeholders to communicate and share information. They also comprise instructions issued by the client, project manager, and upper management and standardized guidelines, which are parameters set by the client and the project management.

Outputs

Here are the outputs of the direct and manage process:

1. Deliverables

Deliverables comprise the results of a project, and managers can use them to track progress. These results depend on project objectives, and clients and upper management can suggest amendments and changes after reviewing them. For instance, within a construction project, the building design generated by an architect comprises one deliverable, and the client can suggest some changes after reviewing it.

2. Performance data

Performance data comprises observations and notes taken by the manager during the course of the project. It can also contain measures and rates relevant to the project. For instance, in a construction project, performance data consists of the number of days taken to complete a building.

3. Change requests

These are formal requests made by the client and stakeholders to introduce changes to the project. These changes can modify deliverables, strategies, or documents. Sometimes, third parties, such as consultants or authorities, can propose or enforce changes.

4. Updates

These refer to updates made to the project plan, such as adding a new sub-plan or deadline. It also refers to changes made to the project document, such as registering an omitted activity or refining the description of a deliverable. For instance, the project manager might update the project plan if new stakeholders are participating in the project

5. Monitor and control project work.

This entails the consistent tracking and reporting on progress of the work to stakeholders. It ensures they have a clear on-going idea of:

- Where the project is heading
- Whether it's on schedule

- And on (or preferably under) budget

This aspect of the process is unique, in that it doesn't really follow during the order we've specified. Instead, it's something that can be performed throughout the process, to ensure each stage is on track. Measure performance against the project management plan as a whole, so you get the best overview of where work may stray off-scope or off schedule.

Perform integrated change control.

Integrated change control is the process of reviewing all change requests within a project, analyzing those requests and implementing approved changes. Through integrated change control, project managers may have a more organized structure for changing a project. They can also determine the effects of a proposed change before implementation, allowing them to make better decisions for the project.

Types of changes

When there is a request for a change, it typically falls into one of these actions:

- **Preventative action:** Preventative action is an activity that works to ensure that future performance aligns with the project management plan. For example, adjusting the size of a team before beginning the project may ensure the completion of work by a deadline.
- **Corrective action:** Corrective action is an activity that works to correct an issue and realign the future performance of the project with the project management plan. For example, adding more team members to speed up a project that is on track to extend beyond a deadline.
- **Defect repair:** Defect repair is an activity that fixes an issue with a product. For example, fixing a bug in a software program.
- **Updates:** Updates are changes to project documents. For example, updating the requirements of a project based on feedback from a client.

6 steps for integrated change control

Here are six steps you can use to implement an integrated change control process within your organization:

1. Create a project management plan

A project management plan is a document that outlines the scope, details and deadlines of the project. It's important to have an initial project management plan so that you can compare requested changes to the

original plan. This allows you to better see how the changes can adjust the plan and impact other elements of the project.

For example, a marketing company needs to adjust its social media strategy for a specific client. With a project management plan, they can easily view the section related to social media, see what their current social media marketing strategies are and how these compare to the requested changes. This can help keep things organized and prevent them from having to gather the information at the time of the request, which can lead to faster implementation.

2. Create a log of the change request

Once someone requests a change to the project, the project manager records the change in a changelog. The request can come from several sources, such as a team member, client or other stakeholders. The changelog is a document that records all requested and implemented changes throughout the project's lifespan. By keeping a log of all change requests and their outcomes, project managers can monitor the status of requested changes and review previous requests to see if there are any that repeat.

3. Analyze the impact of the change

Before implementing a change, it's important to analyze the impact that change will have on the project. The project manager or a group responsible for analyzing change request impact typically does this analysis. Some common questions the analysis seeks to answer include:

- How will this change affect the schedule of the project?
- Are there any additional costs that come with this change?
- Does this change impact the overall risk of the project or introduce additional risks?

To conduct this analysis, project managers gather information related to the project and the change request. For example, if a team requests additional members to help them complete a project faster, the project manager may ask for details such as how many people they need and for how long. Using this information, the project manager can better estimate the cost impacts. In addition, they can estimate how implementing this change may affect the schedule and how the schedule changes if they do not implement it.

4. Decide on a course of action

After a thorough change analysis, the project manager decides on a course of action. They consider the different factors and determine whether the change is appropriate. For example, a project manager may decide that adding more team members is not worth the additional cost and would instead prefer to extend the deadline by a week.

5. Communicate the decision

Once the project manager decides on the change request, they can communicate this decision in two ways. First, they update the changelog, recording whether they approved or denied the change request. Then, they communicate the decision to the relevant stakeholders. This may include sending out an email or scheduling a meeting, depending on the project or size of the change.

6. Update the project management plan

If the project manager approves the change request, it's important to update the project management plan to reflect the new circumstances. This keeps the document relevant and allows the project manager to make future changes based on the most current information. For example, if the project manager denies the change request for more team members, they may update the project management plan with a new timeline

Close project or phase.

It consists of two activities.

CLOSING ACTIVITIES

     1. Reports

     2. Resources

     3. Lessons learned

HANDOVER ACTIVITIES

     1. Deliverables
     2. Risk and issues

UNIT II: Project Scope and Resources

Project Scope Management: Developing the Project Scope Management Plan - Tools and Techniques for Collecting Requirements - Defining the Project Scope - Input and Output of Scope Definition - Creating a Work Breakdown Structure (WBS) - Controlling Scope - Validating the Scope of Project Deliverables - Project Resource Management: Developing the Resource Plan - Tools and Techniques - The Resource Management Plan - Estimating Activity Resources - Acquiring Project Resources - Developing the Project Team and its process - Managing and motivating the Project Team - Controlling Project Resources.

PROJECT SCOPE MANAGEMENT

Project Scope Management refers to a set of processes that must be completed in order to deliver a "project," which could be a product, service or result with specific features or functions. Scope Management focuses on "how we get there" or perhaps more accurately "what steps do we take to get there?" These steps are defined and mapped so that project managers and supervisors can determine the amount of work needed and where to focus efforts of the team in order to complete the project.

STEPS IN PROJECT SCOPE MANAGEMENT

Project Scope Management Overview

5.1 Plan Scope Management

.1 Inputs
  .1 Project management plan
  .2 Project charter
  .3 Enterprise environmental factors
  .4 Organizational process assets

.2 Tools & Techniques
  .1 Expert judgment
  .2 Meetings

.3 Outputs
  .1 Scope management plan
  .2 Requirements management plan

5.2 Collect Requirements

.1 Inputs
  .1 Scope management plan
  .2 Requirements management plan
  .3 Stakeholder management plan
  .4 Project charter
  .5 Stakeholder register

.2 Tools & Techniques
  .1 Interviews
  .2 Focus groups
  .3 Facilitated workshops
  .4 Group creativity techniques
  .5 Group decision-making techniques
  .6 Questionnaires and surveys
  .7 Observations
  .8 Prototypes
  .9 Benchmarking
  .10 Context diagrams
  .11 Document analysis

.3 Outputs
  .1 Requirements documentation
  .2 Requirements traceability matrix

5.3 Define Scope

.1 Inputs
  .1 Scope management plan
  .2 Project charter
  .3 Requirements documentation
  .4 Organizational process assets

.2 Tools & Techniques
  .1 Expert judgment
  .2 Product analysis
  .3 Alternatives generation
  .4 Facilitated workshops

.3 Outputs
  .1 Project scope statement
  .2 Project documents updates

5.4 Create WBS

.1 Inputs
  .1 Scope management plan
  .2 Project scope statement
  .3 Requirements documentation
  .4 Enterprise environmental factors
  .5 Organizational process assets

.2 Tools & Techniques
  .1 Decomposition
  .2 Expert judgment

.3 Outputs
  .1 Scope baseline
  .2 Project documents updates

5.5 Validate Scope

.1 Inputs
  .1 Project management plan
  .2 Requirements documentation
  .3 Requirements traceability matrix
  .4 Verified deliverables
  .5 Work performance data

.2 Tools & Techniques
  .1 Inspection
  .2 Group decision-making techniques

.3 Outputs
  .1 Accepted deliverables
  .2 Change requests
  .3 Work performance information
  .4 Project documents updates

5.6 Control Scope

.1 Inputs
  .1 Project management plan
  .2 Requirements documentation
  .3 Requirements traceability matrix
  .4 Work performance data
  .5 Organizational process assets

.2 Tools & Techniques
  .1 Variance analysis

.3 Outputs
  .1 Work performance information
  .2 Change requests
  .3 Project management plan updates
  .4 Project documents updates
  .5 Organizational process assets updates

Here are 10 final tips to have successful project scope management:

1. **Understand the project** – You must identify and understand the interests, needs, and goals of the client and have a firm grasp on the objectives of the project.

2. **Identify the project requirements** – In order to know what resources are needed, you must identify the requirements to complete the project. You will then need to assemble a team, define roles and allocate tasks.

3. **Hire a qualified project manager** – The best plan in the world will fall apart if you do not have the right project manager. They should be adept at managing a team, with a clear understanding of how to allocate tasks based on the skills and personalities of each person.

4. **Define milestones** – In order to complete a project, you must define key phases of a project or milestone. You must also define how to evaluate and approve each phase/milestone.

5. **Maintain communications** – You must be able to communicate with the stakeholders, the project manager, supervisors, contractors, and team members to discuss issues and changes so that everyone remains on the same page.

6. **Identify team members' strengths and weaknesses** – Being aware of the strengths and weaknesses of team members will make the team more efficient so you can meet the project requirements.

7. **Take advantage of management tools** – There are many resources in online project management software. These tools can be a centralized platform to track, manage, share, and communicate with everyone involved in the project.

8. **Practice risk management** – Managing potential risks is essential in order to identify potential threats, and avoid mistakes and cost overruns that could derail a project.

9. **Test deliverables** – In order to deliver a project successfully, you need to develop tests at critical milestones. This will ensure the requirements of each step have been met.

10. **Evaluation of the project** – After a project is complete, the project manager should review and evaluate the various components of the project and the project as a whole. The objective is to identify successes as well as areas where improvements can be made to prevent mistakes on future projects.

STEP-1: DEVELOPING THE PROJECT SCOPE MANAGEMENT PLAN:

1. **Define project stakeholders & expectations**
a. Once you know which stakeholders you're dealing with, it's time to gain clarity on what they would like you to do. A good way to do this is by holding a meeting for the purpose of laying out project requirements and making sure everyone is on the same page. It's highly recommended to show stakeholders' visuals of what you see as being the end deliverables, as visuals are a great way to ensure that there are no misunderstandings.

2. **Detail the project requirements in a SOW (Scope of Work)**
a. Now that you know what exactly your stakeholders want to be done, you can send them a SoW (Statement of Work) and ask for a signature. This will give you the security that you're on the same page and you have correctly understood what is wanted out of the project.

3. **Further break down project tasks with a WBS (Work Breakdown Structure)**
a. With a WBS, you can visually show team members the breakdown of tasks expected of them. You can also use a WBS to track progress throughout the project by checking development against the WBS.

4. **Document how the WBS will be implemented**
a. It's important to put someone in charge of ensuring that whatever is on the WBS is carried out in real life. Without this in place, there isn't much point in spending time creating a WBS.

5. **Determine how deliverables will be handed to stakeholders**
a. Imagine you had a deliverable all ready to be sent off, but instead of being sent off to the right people, it remains with your project team…until the annoyed phone call comes, asking why the deliverable is late. There needs to be a procedure in place for who is going to hand over the deliverable and to whom

6. **Prepare a change control process to effectively handle change requests**
a. As mentioned above, a change control process is an important part of a scope management plan. When a change request is made, you can handle it cooly and calmly by getting the stakeholder requesting the change to fill out the change request form. You can then discuss what actions will be necessary for your team to handle the scope change, such as an increased budget or timeline, or additional personnel. And don't forget, if the change request is not something feasible, you have the right to say no!

STEP- 2: COLLECTING REQUIREMENTS

Collect requirements process is the second process of scope management knowledge area. In order to define the scope, the requirements of the stakeholders must be collected first. The main purpose of the collect requirements process is gathering stakeholder requirements in a project.

You will need to collect the requirements of all the stakeholders, which may include the client, senior management, investors, government regulators, neighbours or nearby landowners. You will determine the project timeline, allocation of resources, and set the goals of the project.

There are 5 categories of project requirements:

- Business requirements
- Stakeholder requirements
- Product requirements
- Transition requirements
- Quality requirements

Tools & Techniques for Collecting Requirements:

Scope Management draws the boundaries of a project and it also shows what will be delivered during Project Closure process group.

What are the Stakeholder Requirements?

In Project Management, requirements are described as "**what stakeholders expect from a project, or from the product of the project**". Requirements of the project stakeholders must be gathered in the

project and managed properly. After requirements are finalized, these must be included in the scope and tracked throughout the project. Also, how requirements are met with the project deliverables must be demonstrated to the project stakeholders to complete a project successfully.

Note that, there will be several requirements in a project and we just listed three of them here to illustrate requirements of a project in your mind.

High-level requirements of a project are defined in the <u>project charter</u>. The project charter is created in the <u>project initiation</u>. As long as high-level requirements of a project are determined, these are included in the project charter. But, **new requirements will be received later and requirements will be gathered and finalized during planning**. Therefore, collect requirements process involves more specific inputs.

- **Technique #1: Interviewing**
  Interviewing is the first collect requirements technique. It can be done through a meeting, through a phone call or through e-mails. In this collect requirements technique <u>Project Manager</u> interviews the stakeholders to get their requirements. There can be a checklist, a list of questions or project manager can just ask the stakeholders to express their expectations from the project in a free form. Project manager notes down and stores the requirements received from the project stakeholders.

- **Technique #2: Focus Groups.**
  Focus group is the second collect requirements technique and it is used to get a specific set of stakeholders' requirements. For instance, you can organize a meeting with executive directors in your company to get their requirements first, and then organize a separate meeting with the functional managers to get their requirements.

- **Technique #3: Facilitated Workshops**
  In facilitated workshops, stakeholders with different perspectives are brought together. Let's consider that you will manage a software project. You can bring analysts, software developers, test engineers, operation team, and customer together. Each group of project stakeholders will look to the project from their perspective and express their requirements.

- **Technique #4: Brainstorming**
  Fourth collect requirements process technique is called Brainstorming and it is actually a Group Think. Because several people come together to list requirements of a project. And during the meeting, new ideas are generated from existing ideas. This helps to identify new requirements.

- **Technique #5: Nominal Group Technique**
  This is actually a collect requirements process technique to prioritize ideas rather than generating new requirements. In nominal group technique, meeting participants rank the most successful ideas. This helps to focus on more valuable or prioritized ideas first in generating project requirements. Nominal group technique is usually used in brainstorming meetings. Because there will be several

ideas coming from several stakeholders. If these are not ranked, focusing the stakeholders on a narrower topic and finalizing requirements will be tough.

- **Technique #6: Delphi Technique**

  In the sixth collect requirements process technique which is called Delphi technique, a request for information is sent to project stakeholders anonymously. Stakeholders list their requirements individually and send back these requirements. Then, these results and collected results are sent again to project stakeholders. This technique to collect requirements anonymously is mainly for not affecting stakeholders' decision based on the owner of the requirement. For instance, if a senior director and functional manager are sending their requirements, if the functional manager would know the requirements of the senior director, because of the hierarchical relationship, he can be affected by the requirements of the senior director. Resending requirements and getting back feedback goes until a consensus is reached among the stakeholders.

- **Collect Requirements Process Technique #7: Idea/Mind Mapping**

  This collect requirements process technique is actually a diagram of ideas or notes to help generate, classify, or record information. Ideas or parts of a project are drawn on the table, and new ideas or parts that can be in the project are generated.

  Let's go over Idea/Mind Mapping collect requirements process technique over an example. An airplane will consist of parts such as wings, cockpit area, tail, and passenger cabin. And when thinking about what can be in the passenger area, we can list toilets, seats, serving kitchen area etc.
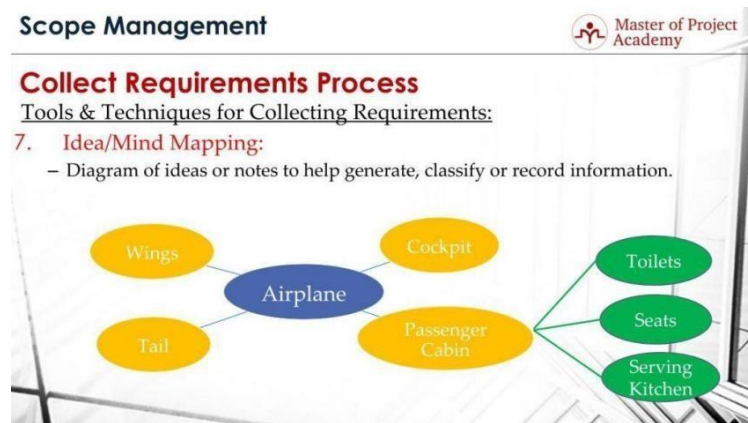
Collect Requirements Process Technique #8: Questionnaires and Surveys

Ninth technique for collect requirements process is Questionnaires and Surveys and it is used for large groups where there are several stakeholders that you have to collect their requirements. Let's consider that you have more than 200 stakeholders in a project that you need to contact and collect their requirements. Organizing a meeting or interviewing one-by-one will take a long time to finalize requirements. In this case, to prepare a questionnaire and survey and to collect requirements of several stakeholders will be easier with this technique.

Collect Requirements Process Technique #9: Observation

In the collect requirements process technique called observation, a potential user of the product is watched to identify requirements. For instance, in order to determine the user experience or most used features of an e-commerce shopping website, a consumer can be observed. Based on the steps that the consumer will take, project requirements can be identified or prioritized.

Collect Requirements Process Technique #10: Prototypes

In this collect requirements process technique, a model of the proposed product is developed and then this model is presented to stakeholders for feedback. Let's consider that a smartphone manufacturer will produce a new smartphone. In order to get feedback from stakeholders, features and functionalities from existing smartphones can be combined in a prototype. And this prototype can be presented to a set of consumers to get their feedback.

Collect Requirements Process Technique #11: Group Decision Making

In this collect requirements process technique, several opinions are evaluated in a group. There can be several requirements about a project and each stakeholder might express their own requirements. In the end, these must be evaluated whether these requirements will be in the project scope.

There are four approaches in Group Decision Making technique:

1. **Unanimity:** In this case, everyone agrees with the idea that is being evaluated. So it is qualified to be in the final list.
2. **Majority:** In this case, more than 50% of the group agrees on a requirement. In order to put a requirement on the final scope, if this approach is applied, more than half of the group must agree on it.
3. **Plurality:** In this case, largest block in a group agrees on a requirement. For instance, if 40% of the group agrees, 30% of the group disagrees and 30% of the group does not have a decision since the largest part of the group agrees, the requirement will be qualified to be in the scope.
4. **Dictatorship:** In this approach, one individual makes the decision for the group on a requirement. For instance, if the Senior Director is in the group and if he has the privilege to approve or disapprove a requirement, regardless of what other participants think, Senior Director's decision will determine whether the requirement will be in the project scope.

Step-3: Define Scope Of Project: Inputs, Tools, Techniques, and Output

The process of collecting requirements identifies all the essential requirements, but one can't assure that all the requirements are mentioned or included in the project. But, the defined scope process selects the final project requirements from the requirements documentation delivered during the collect requirements

process. Hence, the project manager can develop a detailed description of the project and product which is called the project scope statement.

How to Define Scope of Project?

Define Scope is a process of developing a detailed description of the project and product. The key benefit of the defined scope process is that it describes the project's boundaries by defining which of the requirements collected will be included in the project.

Define Scope of Project – Inputs

The following are included in the defined scope process as the inputs:

1. Project Charter
2. The Project Management Plan
3. Project Documents
4. Enterprise Environmental Factors
5. Organizational Process Assets

1. Project Charter

The project charter is a document that provides the high-level project description and product characteristics. It also enlists all the project approval requirements. If a project charter is not being used to its fullest in any organization, then comparable information needs to be developed and used as a basis for the detailed project scope statement

2. The Project Management Plan

Both Project Management and scope management plans have the same characteristics but whereas the Project Management plan documents how the project scope will be defined, validated, and controlled.

3. Project Documents

Examples of project documents that can be listed as inputs for defining scope are as follows;

1. Assumption Log

The role of the assumption log is to identify the assumptions and constraints about the project, product, stakeholders, environment, and other factors that can influence the project and the product scope.

2. *Requirements Documentation*

The process of identifying the list of requirements that are to be incorporated into the project scope.

3. *Risk Register*

The risk register mainly contains response strategies that may affect the project scope by reducing the project and the product scope to avoid or mitigate a risk that is to occur in the project.

4. **Enterprise Environmental Factors**

The factors which can influence the Define Scope process include:

1. Organization's Culture

2. Infrastructure

3. Personnel Administration

4. Marketplace Conditions

5. Organizational Process Assets

The factors that influence the Define Scope process include:

1. Policies, procedures, and templates for a project scope statement

2. Project files from previous projects

3. Lessons learned from previous phases and projects

Define Scope of Project – Tools and Techniques

The following are included in the tools and techniques for defining the scope of a project:

1. Expert Judgement
2. Data Analysis
3. Decision Making

4. Interpersonal & Team Skills

5. Product Analysis

1. Expert Judgment

With regards to the technique of expert judgment, one has always to consult a group or an individual who has exceptional knowledge in dealing with similar projects.

2. Data Analysis

The best example of a data analysis technique that can be used in this process is alternatives analysis. This alternatives analysis helps in evaluating ways to meet the requirements and objectives that are identified in the project charter.

3. Decision Making

Multi-criteria decision analysis is the best example of this particular process. Under this technique, a decision matrix is used to provide a systematic analytical approach for establishing necessities like requirements, schedules, budget, and resources to clarify the project and product scope further.

4. Interpersonal and Team Skills

An example of interpersonal and team skills is the facilitation process. This process is mainly used in workshops and sessions happening with key stakeholders who are always high on expectations. The ultimate goal of this process is to reach a cross-functional and shared understanding of the project deliverables.

5. Product Analysis

Product analysis is used to define the products and services related to a particular project. The process includes asking questions about a product or service and generating answers to describe the use, characteristics, and other relevant aspects of what is going to be delivered. The following are the examples related to the product analysis process:

1. Product breakdown
2. Requirements analysis
3. Systems analysis
4. Systems engineering

5. Value analysis

6.   Value engineering

Define Scope of Project – Outputs

The following are included as the outputs of the defined scope process:

1. Project Scope Statement

A project scope statement is a detailed description of the project scope, which includes significant deliverables, assumptions, and constraints. It also documents the project scope and the product scope and describes the project's deliverables and the work required to deliver them. Based on the level and degree of detail the project scope statement defines the work that will be performed, and the work that is minimized can help determine how well the Project Management team can control the overall project scope.

The important components of the project scope statement include:

1. *Product Scope Description*

   A method used to elaborate on the characteristics of the product that are defined in the project charter and requirements documentation.

2. *Acceptance Criteria*

   A set of conditions are required to be met before the final deliverables are accepted by the stakeholders.

3. *Deliverable*

   Any unique and verifiable product that is required to be produced to complete a process, phase, or project.

4. *Project Exclusion*

   A method to exclude the feasible products from the scope of the project to help the project manager to manage the stakeholder's expectations.

Elements of the Project Charter and the Project Scope Statement

The following are the elements of the project charter and project scope statement respectively:

2. Project Documents Updates

    1. Assumption Log

       The role of the assumption log at this stage is to update the log with additional assumptions or constraints which were identified during the project process.

    2. Stakeholder Register

The documentation consists of all of the stakeholder requirements that are to be met and also registers the important deliverables that are in the pipeline of the project manager.

    3.   Requirements Documentation

A method that is used to record the requirements of a particular project. This documentation will keep all the deliverables that are met and the other deliverables that are to be accomplished by the <u>project manager</u>.

    4.   Requirements Traceability Matrix

A method that is used to compare the project's scope, requirements, and deliverables are all the same when they are compared with the project's baseline that was created during the Project Management plan.

<u>STEP 4: CREATE WBS</u>

- Work breakdown structure (WBS) in <u>project management</u> is a method for completing a complex, multi-step project. It's a way to divide and conquer large projects to get things done faster and more efficiently.

The Work Breakdown Structure (WBS) involves subdividing the project deliverables into smaller units. Basically, you break down the project into phases, including the tasks required in order to complete each phase.

Different types of work breakdown structures

1. **WBS spreadsheet:** You can structure your WBS efficiently in a spreadsheet, noting the different phases, tasks, or deliverables in the columns and rows.

2. **WBS flowchart:** You can structure your WBS in a diagrammatic workflow. Most WBS examples and templates you may find are flowcharts.

3. **WBS list:** You can structure your WBS as a simple list of tasks or deliverables and subtasks. This is the most straightforward approach to make a WBS.

4. **WBS Gantt chart:** You can structure your WBS as a Gantt chart that represents both a spreadsheet and a timeline. With a Gantt chart-structured WBS, you can link task dependencies and show project milestones.

How to Make a Work Breakdown Structure

1. **Gather critical documents**
   - Gather critical project documents.
   - Identify content containing project deliverables, such as the project charter, scope statement and project management plan (pmp) subsidiary plans.
2. **Identify key team members**

   - Identify the appropriate project team members.
   - Analyze the documents and identify the deliverables.

3. **Define level 1 elements**

   - Define the Level 1 Elements. Level 1 Elements are summary deliverable descriptions that must capture 100% of the project scope.
   - Verify 100% of scope is captured. This requirement is commonly referred to as the 100% Rule.

4. **Decompose (breakdown) elements**
   - Begin the process of breaking the level 1 deliverables into unique lower level deliverables. This "breaking down" technique is called decomposition.
   - Continue breaking down the work until the work covered in each element is managed by a single individual or organization. Ensure that all elements are mutually exclusive.
   - Ask the question, would any additional decomposition make the project more manageable? If the answer is "no", the wbs is done.
5. **Create WBS dictionary**
   - Define the content of the WBS Dictionary. The WBS Dictionary is a narrative description of the work covered in each Element in the WBS. The lowest Level Elements in the WBS are called Work Packages.
   - Create the WBS Dictionary descriptions at the Work Package Level with detail enough to ensure that 100% of the project scope is covered. The descriptions should include information such as, boundaries, milestones, risks, owner, costs, etc.
6. **Create gantt chart schedule**
   - Decompose the Work Packages to activities as appropriate.
   - Export or enter the Work Breakdown Structure into a Gantt chart for further scheduling and project tracking.

The difference between WBS and a work breakdown schedule

Various detailed project documents support the WBS. Amongst them are a risk management plan, quality plan, procurement plan, communications plan, staffing plan, and a work breakdown schedule plan.

The work breakdown schedule includes the start and completion dates for all tasks, activities, and deliverables defined in the WBS.

Example:
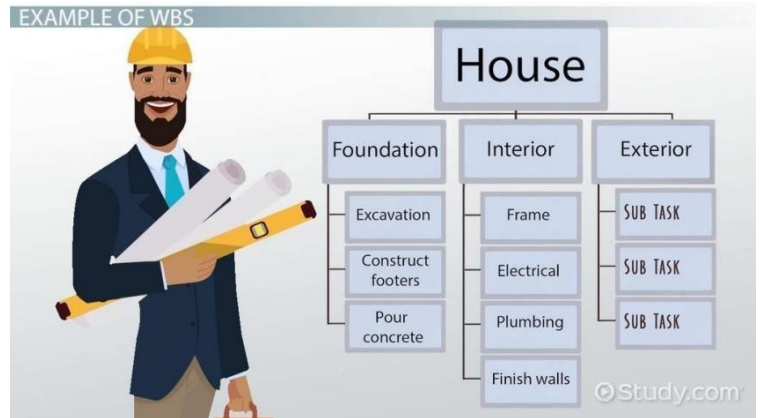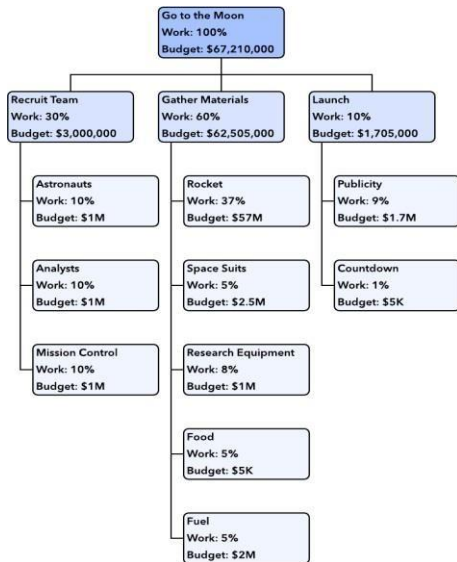
STEP-4: VALIDATE SCOPE

Validate Scope is the process of formalizing acceptance of the completed project deliverables. A process that shows the stakeholders have received what was agreed upon and formalizes their approval. It is primarily concerned with the recognition of the

product by validating each deliverable.

Validate Scope should include:

- Whether the project deliverables are accepted?

- Who accepts project deliverables?

- Under what conditions deliverables will be accepted?
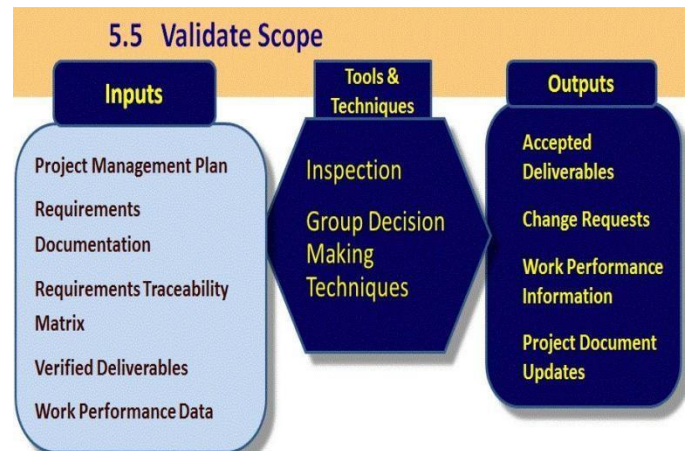
STEP-5:CONTROL SCOPE

This refers to the process of monitoring progress and managing changes that come up during the project. It monitors "scope creep," which happens when additional tasks are added/changed, without making the necessary changes to the scope in terms of schedule, costs and resources.

Scope creep (also known as "requirement creep" or "feature creep") refers **to how a project's requirements tend to increase over time**.

This is an essential part of the process as changes can result in

- lost time,
- cost overruns, and
- require the reallocation of assets and manpower.

Project Resource Management

"Give me six hours to chop down a tree, and I will spend the first four sharpening an axe." – Abraham Lincoln

Spending time creating a good resource management plan is like "sharpening the axe."

RESOURCE PLANNING- MEANING

Resource planning is a strategic approach to ensuring resources are used in the most effective way, across a single project or a portfolio of work. When executed properly, organizations achieve maximum efficiency and optimization in their use of resources, without under- or over-utilizing any one resource.

Resource planning allows organizations to respond with greater flexibility as markets evolve and projects change. As new disruptive technologies enter the market at ever increasing speeds, the ability of organizations to turn on a dime becomes paramount. Business goals that were important yesterday, may have little to no value tomorrow. Companies must do everything possible to achieve the flexibility necessary to pivot as goals and strategies shift.

A resource plan identifies, organizes, and lists the resources required to complete a project. Because most organizational expenses are resource related, it's essential that they're used as efficiently as possible.

A resource plan maps out how and when company resources will be used.

A resource plan acts as a blueprint to help ensure projects and work are executed on time and on budget. But that's no easy task – especially when resources are numerous and various projects requiring an assortment of skillsets are in progress across an enterprise.

Importance of Resource Planning

Effective use of resources is among the most important (and often challenging) activities companies undertake. Resource planning that's executed properly and managed carefully will help improve the overall health of the organization by ensuring:

- **Maximum resource utilization**

In the past, people were often placed on teams simply because they were available at the time. Minimal attention was paid to their skillsets or the other work they were doing. The result was skills gaps that exacerbated project delays even when the skills existed somewhere in the company. And project delays

often led to more project delays. To avoid this, companies have placed a strategic focus on maximizing resource utilization.

- **On-time delivery**

Companies strive to deliver projects on schedule. Doing so helps build customer satisfaction and loyalty, boosts internal morale, and ensures future projects start on time. Project resource planning is key to on-time delivery.

- **On-budget delivery**

Companies also strive to complete projects on budget. Overspending can cause project cancellations, missed revenue, and reduced profitability. Without a clear understanding of resources and resource capacity, managing budgets is a shot in the dark.

- **Predictable project timelines**

A deep understanding of available resources and skillsets allows organizations to estimate the amount of time required to perform individual tasks and to complete each project. That knowledge enables organizations to plan well into the future, as well as plan for changes, disruptions, or new opportunities.

- **Improved project flow**

Faster project flow is a result of good resource planning. When the <u>right people work on the right projects at the right time</u>, projects move forward at maximum speed and with fewer mistakes.

Resource planning should provide real-time visibility and forecasting of shortfalls and bottlenecks to support resourcing decision making.

- **Bridged capacity gap**

A shortage or excess of resources can be identified by comparing resource demand against existing capacity. Detecting a lack of skillsets required for a future project allows managers to bridge the gap. This helps prevent organizations from hiring new talent when the problem is simply a misallocation of resources. It also prevents companies from experiencing unplanned stoppages in production.

- **More accurate estimates**

Carefully managing resources and skillsets help ensure more accurate project timelines and budgeting. This can also help executives estimate when projects will begin to impact revenue, costs, and even profitability. The release of a new app, for example, may have a significant impact on company revenues, so accurate estimates are essential.

- **Core Elements of a Resource Plan**

The goal of a resource plan is to identify and assign the resources necessary to execute the work. While largely focused on human resources and time, it may also involve equipment, tools, supplies, production materials and so on, depending on the nature of the project or program. The following five components are a part of virtually any comprehensive resource plan.

- **People**

People are the core necessity of your business and your most valuable asset. They're also one of your most expensive. Therefore, an important part of resource planning is understanding exactly who you have in your organization, their availability to deliver projects, programs, and/or keep-the-lights-on work, and their talents.

- **Skillsets, capacity, availability, and utilization**

Besides identifying the people you have, you need a thorough understanding of their strengths and skillsets – especially when those skillsets are rare or in high demand. Experts in many areas are hard to find and can be very expensive.

That means the total capacity of individuals with specific skillsets must be clearly understood. For example, if you have only two developers with highly desired skills, you need to know exactly how and when those skills will be used. You must know when those developers have availability and whether the work they're doing could be reassigned to others.

- **Time**

Time tracking is a mechanism that measures progress, and it goes hand in hand with resource planning. It helps organizations to set realistic expectations, anticipate deliverables, and meet deadlines. It also illustrates how the teams are performing against budgets and timelines.

As team members record the time spent on projects, managers can see how the work is moving forward and estimate the remaining time required to complete it. This allows for adjustments to be made earlier in the project rather than at the end when less can be done to address problems.

- **Data**

Data is the key to ongoing project success. It can be used to maximize resource utilization and ensure projects remain on time and on budget. Data collected from past projects can be used to forecast the cost and time requirements of future work. It's important that the right data is collected, and that it's fully leveraged to provide actionable intelligence.

- **Accurate forecasting**

For resource planning to be effective, you must have the ability to forecast. You must be able to anticipate the skillsets, time, and budget required to execute the work. Without these elements, your company can't achieve the visibility required to operate at maximum efficiency. This comes back to the right tools collecting the right data and allowing you to leverage that data to the greatest degree possible.

Forecast resource demand across multiple projects, considering named resource, role, team, skill set, & other attributes.

- **Time and budget management**

Your resource plan should include the following:

- The rates of the people scheduled to work on the project
- The estimated time required to perform each task (or group of tasks)
- The overall budget

DEVELOPING A RESOURCE PLAN

A resource plan can be split into five stages, though these should not be viewed as stand-alone or purely consecutive activities. In fact, many of the following stages should be managed and updated through a continuous planning process.

1. Identify resources

Assuming team members, their skills and experience are already understood and entered into your resource planning software, start by understanding what skills will be required for the project you're currently planning. This helps you determine the resources you'll need, with what levels of expertise, and for what amount of time.

2. Procure resources

Once you understand project requirements, you'll need to assign specific resources. To do this, managers use their resource management tool to check the availability of individuals that meet the requirements and assign them to the project. Smaller projects are scheduled out fully, while more extensive projects may be broken down and scheduled by quarter.

Either way, it's important to remember that this plan will be fluid and subject to change as personal schedules alter, circumstances change, and some resources are pulled into higher priority work or are assigned to cross-functional teams. Adjusting the plan is a continuous process.

3. Visualize resources

The ability to visualize resources makes resource planning easier. While many managers still rely on Excel spreadsheets, a resource management tool simplifies the process by storing the information in one easily accessed, easily viewed location. From there, managers drill down into specific resources to understand current roles, skills, rates, and availability.

4. Manage resources

The ability to visualize resources and their attributes simplifies the ability to manage them. Part of managing these resources may involve repositioning them as high-value, high-priority projects come along that require the use of already booked individuals. This process ensures the best person is available for the project.

Due to its fluidity, this stage of managing resources runs throughout the life of the project – another reason why a tool that identifies the skills required, illustrates availability, and allows you to assign tasks with a click is invaluable.

5. Monitor resources

Once resources have been assembled into a team tasked with project execution, resource managers shift into monitor-and-adjust mode. In this phase, they respond to any changes in resource requirements, keeping a close eye on capacity and utilization.

Moreover, they learn from the plan, noting specifically what changes were required, for what reason and at what point in the process. This information is used to create future resource plans with the idea that each plan will become more accurate as time progresses

<ins>What are the tools used in the planning phase?</ins>

The tools that are used by resource managers help them apply the resource management techniques and stages of resource planning effectively.

- **Resource management plan**: This is the plan created for the resources early in the resource management cycle. This resource planning tool has all the vital details of timelines, project specifications, resource lists, and resource allocation. The entire resource management process revolves around this basic plan, and it can be tweaked as the project progresses. The plan should cover every small detail that is required to avoid overlooking some important equipment or material that is needed. Financial management of resources is one of the primary aspects of resource management.

- **Resources Breakdown Structure (RBS)**: The ordered list of the components of the resource plan forms the RBS. It should detail all the people involved and all the resources that money is spent on. An RBS is not a task breakdown but rather a resource breakdown.

- **Responsibility Assignment Matrix (RAM)**: This document defines the roles and tasks that each person is responsible for. It also sets out who each person reports to regarding their tasks. Some RAMs use the RACI method where R stands for Responsible, A for Accountable, C for consulted, and I for Informed.

- **Resources histogram**: This is a visual resource planning tool that helps all members of the team get an overview of the entire resource allocation. This overview also helps identify over or under allocation of resources to certain tasks in comparison to others

Resource management plan

Project Resources Management important in project planning stage. A resource management team (or) the responsible project team is in charge of ensuring that the resources required for a project are obtained, accounted for, and utilized.

Resources is not only the manpower. It includes

- Materials
- Tools
- Equipments
- Labor (or) Staff

Types of Project Resources

Project resources can be simply defined as anything that's needed to execute project tasks, including the people executing the work. Here are some examples of project resources.

Time

Raw materials

Human resources

Machinery and equipment

Financial resources

Information and data

The Project Resource Management processes

- Plan Resource Management – The process of defining how to estimate, acquire, manage and utilize physical and team resources.
- Estimate Activity Resources – The process of estimating team resources and the type and quantities of material, equipment and supplies necessary to complete project work.
- Acquire Resources - The process of obtaining team members, facilities, equipments, materials, supplies and other resources necessary to complete project work.

- Develop Team - The process of improving competencies, team member interaction and the overall team environment to enhance project performance.
- Manage Team - The process of tracking team member performance, providing feedback, resolving issues and managing team changes to optimize project performance.
- Control Resources - The process of ensuring that the physical resources assigned and allocatd to the project are available as planned as well as monitoring the planned versun actual use of resources and performing corrective actions as necessary.

1. Plan Resource Management

Plan Resource Management is the first and the initial step of the project resource management Knowledge Area. It involves various aspects like defining the process of estimating, acquiring, managing and using physical and human resources. This process is usually performed only once or at few predefined points throughout the project lifecycle to help in establishing the way of approach and level of management required for managing resources. These aspects are majorly influenced by the type and complexity of the project.

This process consists of various inputs, tools & techniques and outputs which I have listed down in the below table:
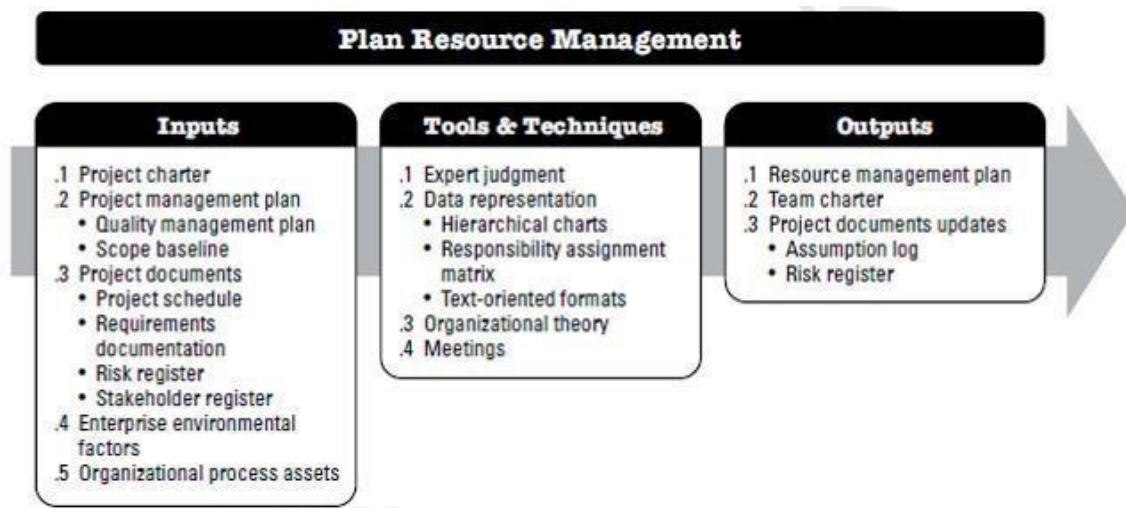
2. Estimate Activity Resources

Once you are done with planning, the next process is Estimate Activity Resources. In this process, the resources required for the project along with their type and quantity of tools, equipment, raw material, and supplies are being estimated. This process is generally executed after specific time intervals throughout the project lifecycle. With this, you can pinpoint what type of resources you need, in what amounts and what should be their characteristics in order to finish the project successfully.

There are various inputs, tools & techniques and outputs involved in this process that I have listed in the below table:

Inputs	Tools & Techniques	Outputs
.1 Schedule management plan .2 Activity list .3 Activity attributes .4 Resource calendars .5 Risk register .6 Activity cost estimates .7 Enterprise environmental factors .8 Organizational process assets	.1 Expert judgment .2 Alternative analysis .3 Published estimating data .4 Bottom-up estimating .5 Project management software	.1 Activity resource requirements .2 Resource breakdown structure .3 Project documents updates

3. Acquire Resources

Acquire Resources is the third process of project resource management Knowledge Area that deals with collecting the various human resources, facilities, tools and equipment, supplies and raw materials required to deliver the project. This process helps in outlining and guiding the selection process of the project resources and then assigning them to their specific activities/tasks. Thus, it is performed at periodic intervals throughout the project lifecycle and helps in preventing running out of resources.

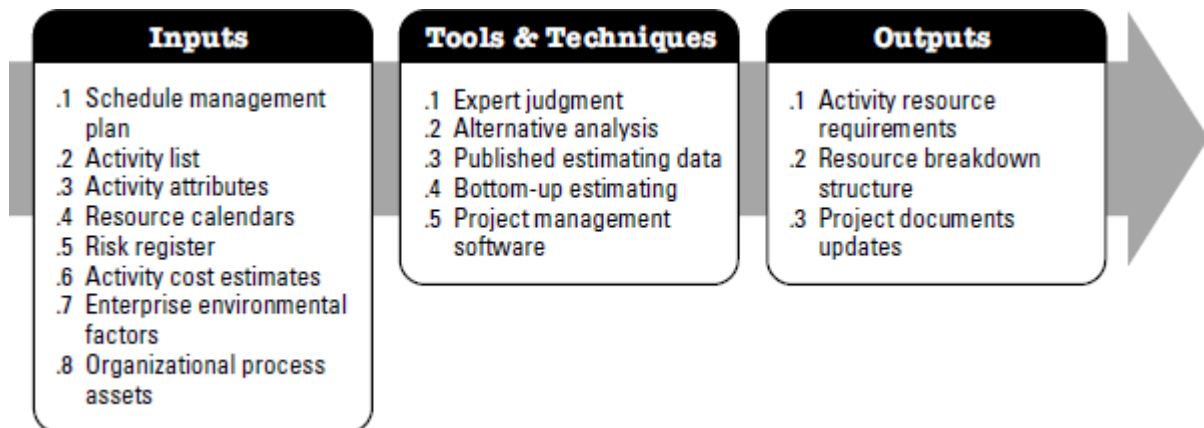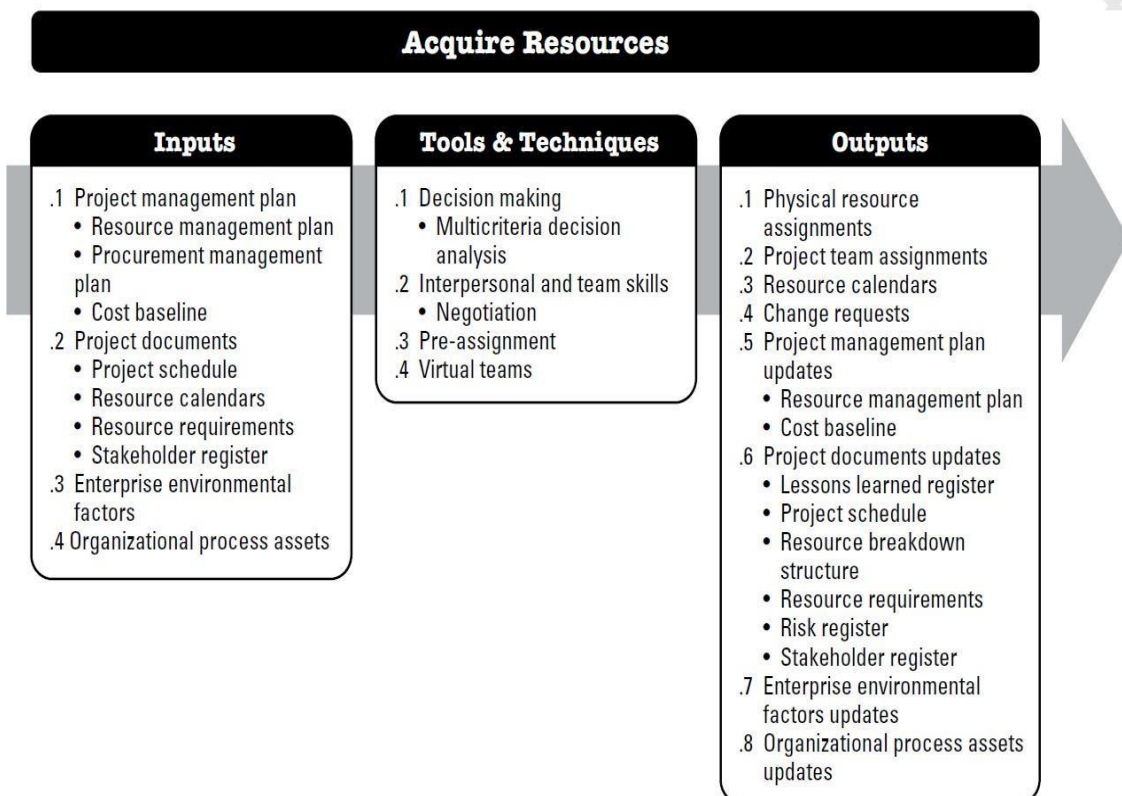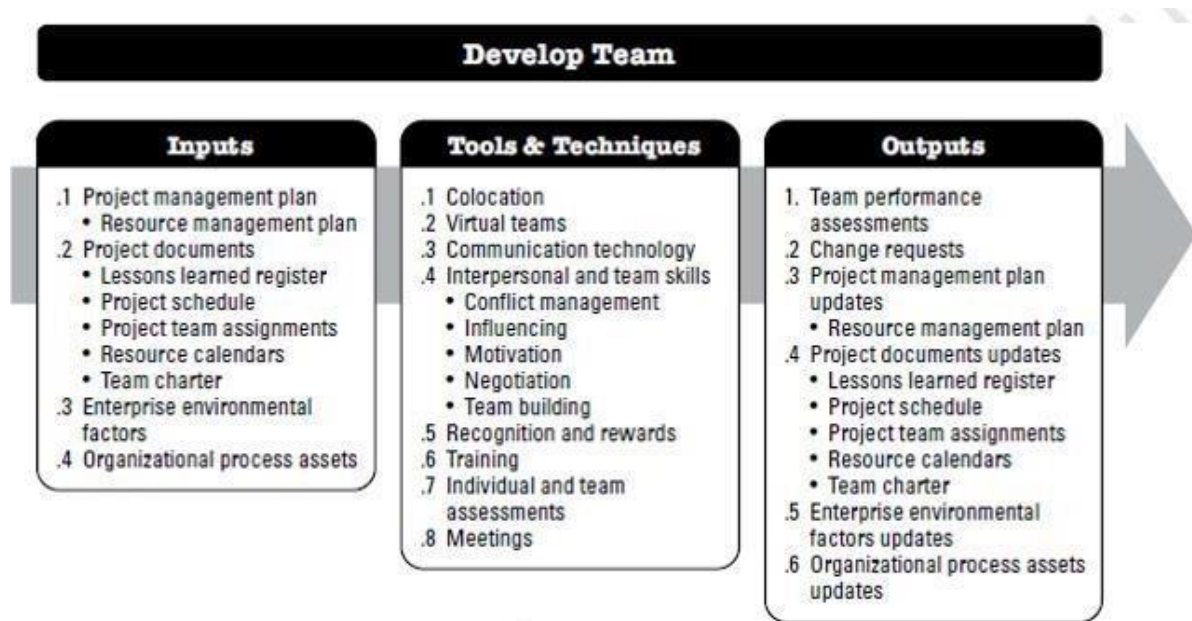This process consists of various inputs, tools & techniques and outputs which I have listed in the below table:

Acquire Resources

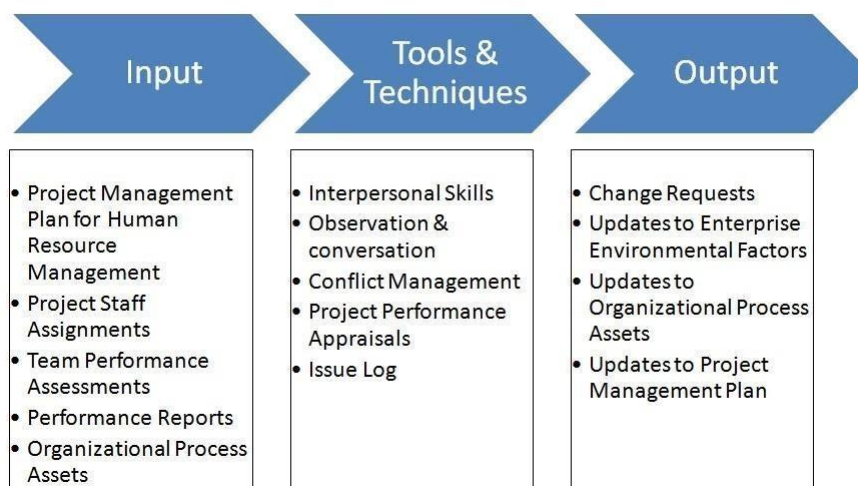| Inputs	Tools & Techniques	Outputs
.1 Project management plan • Resource management plan • Procurement management plan • Cost baseline .2 Project documents • Project schedule • Resource calendars • Resource requirements • Stakeholder register .3 Enterprise environmental factors .4 Organizational process assets	.1 Decision making • Multicriteria decision analysis .2 Interpersonal and team skills • Negotiation .3 Pre-assignment .4 Virtual teams	.1 Physical resource assignments .2 Project team assignments .3 Resource calendars .4 Change requests .5 Project management plan updates • Resource management plan • Cost baseline .6 Project documents updates • Lessons learned register • Project schedule • Resource breakdown structure • Resource requirements • Risk register • Stakeholder register .7 Enterprise environmental factors updates .8 Organizational process assets updates

4. Develop Team

Next process of this Knowledge Area is to *Develop Team*. As the name suggests, this process purely concentrates on the development of team bonding and assigning them with rewarding work, future opportunities, and career development. It helps in enhancing the overall team performance by improving team members' competencies, interactions, and the environment. This process is performed throughout the project lifecycle and intensifies teamwork, improves interpersonal skills of the individuals, motivates the team and reduces attrition.

Develop Team

| Inputs	Tools & Techniques	Outputs

.1 Project management plan
  • Resource management plan
.2 Project documents
  • Lessons learned register
  • Project schedule
  • Project team assignments
  • Resource calendars
  • Team charter
.3 Enterprise environmental factors
.4 Organizational process assets
	.1 Colocation
	.2 Virtual teams
	.3 Communication technology
	.4 Interpersonal and team skills
	  • Conflict management
	  • Influencing
	  • Motivation
	  • Negotiation
	  • Team building
	.5 Recognition and rewards
	.6 Training
	.7 Individual and team assessments
	.8 Meetings
		1. Team performance assessments
		.2 Change requests
		.3 Project management plan updates
		  • Resource management plan
		.4 Project documents updates
		  • Lessons learned register
		  • Project schedule
		  • Project team assignments
		  • Resource calendars
		  • Team charter
		.5 Enterprise environmental factors updates
		.6 Organizational process assets updates

5. Manage Team

Since the project team is acquired and developed, the next step is to manage them. In this process, each and every team members performance is monitored and tracked, their problem areas are identified and the issues are resolved and feedbacks are given in order to optimize the project performance. This process is generally performed throughout the project lifecycle and helps in influencing team behavior, managing the conflicts and resolving brewing issues.

Input	Tools & Techniques	Output
• Project Management Plan for Human Resource Management • Project Staff Assignments • Team Performance Assessments • Performance Reports • Organizational Process Assets	• Interpersonal Skills • Observation & conversation • Conflict Management • Project Performance Appraisals • Issue Log	• Change Requests • Updates to Enterprise Environmental Factors • Updates to Organizational Process Assets • Updates to Project Management Plan

6. Control Resources

Control Resources is the final process of the project resource management Knowledge Area. In this process, the project managers ensure that the resources that are assigned and allocated for the project activities are available, monitor their estimated usage vs actual usage and subsequently take corrective actions to keep the project on track. This process is implemented throughout the project lifecycle and helps in ensuring that the necessary project resources are deployed to the correct places at the correct time and are released when the project comes to an end.

This process consists of various inputs, tools & techniques and outputs which I have listed down in the below table:
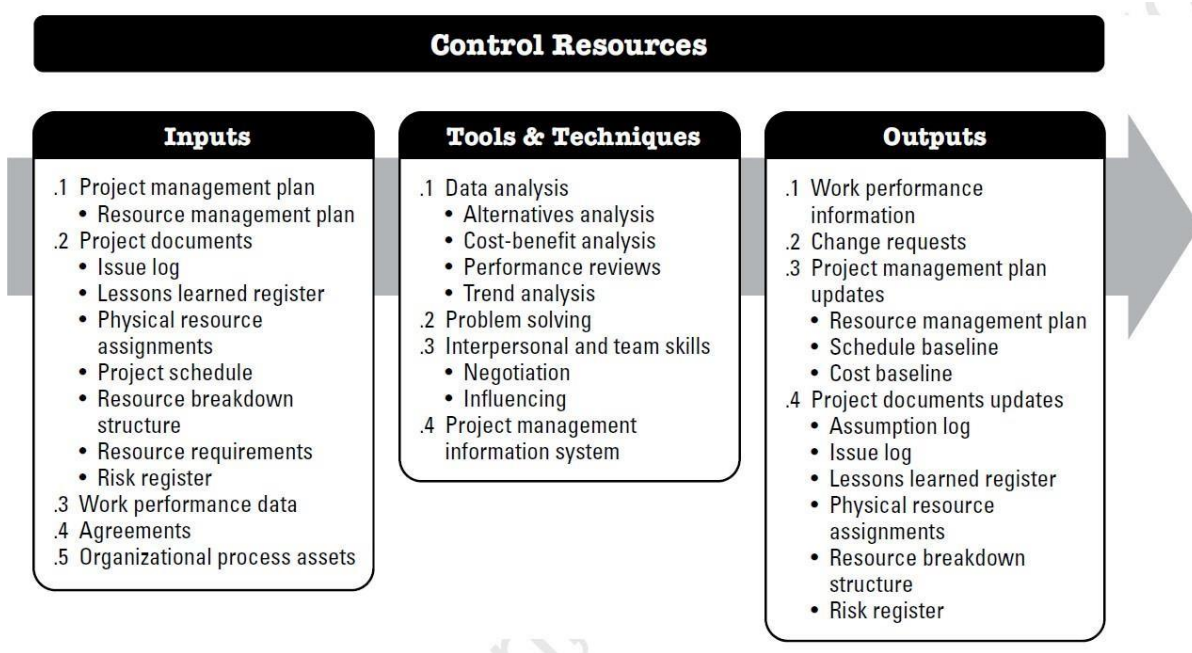
TOOLS USED IN PROJECT MANAGEMENT PLAN

- ### A bottom-up approach

A bottom-up approach A bottom-up approach, on the other hand, looks at the fundamental and qualitative metrics of multiple companies and picks the company with the best prospects for the future.

A bottom-up approach begins at micro level (e.g. looking at a single company's financial statements) and then broadening out.

- ### Alternatives analysis

Alternatives analysis is the process of achieving the same outcome through different means or ways.

- ### Problem solving analysis

Problem solving analysis involves identifying the overriding problem and establishing the causes and effects related to that problem. A key element of this analysis will ensure that "root causes," not just the symptoms of the problem, are identified and subsequently addressed in the project design

- **The Project Management Information System**

The Project Management Information System generates reports for every task, creates charts and graphs of all the collected information and analyzes data that can be shared with the team and stakeholders. It facilities effective communication among team members

- **Colocation**

Colocation is the concept of placing all the resources of a project team in a single physical location, so that the project can be completed in a good way. Colocated teams helps to improve communication, productivity, and team relationships.

- **Project Management Software**

Project Management Software is software used by a wide range of industries for project planning, resource allocation and scheduling. It enables project managers as well as entire teams to control their budget, quality management and all documentation exchanged throughout a project. This software also serves as a platform for facilitating collaboration among project stakeholders. Ex- Trello, Jira ,Asana etc.

- **Expert judgment**

Expert judgment is when you call in an expert to get a skilled opinion. It's an estimation methodology for project planning that relies on the expert's opinion to estimate quantitative project details, such as timelines and potential resources.

The main components of an effective resource management strategy

Here are the main components that go into an effective resource management strategy:

- **Understand the goals of the project:**

 You need a good grasp of the end objectives in order to define the path to getting there. What are the key deliverables? Document them.

- **Know your budget:**
  Most project managers are measured on how well they keep project budgets in check, and resources can form one of the biggest components of the budget. You need to know how much you have all together and be able to estimate how much of that should go toward resources.

- **Know where your project resources come from**.

Do you have all you need internally? Will you need vendors, freelancers, or contractors?

- **Know what you'll need contractually.**

For example, your company probably has preferred contracts to use with vendors, and you may need new contracts if you're bringing temporary workers on board.

- **Define the roles of the project team.**

Who do you need and what do you need them for? Which stakeholders ultimately sign off on deliverables? Defining roles and responsibilities is essential for minimizing any conflict or confusion.

- **Have a robust set of policies and procedures.**

For example, you'll need policies for obtaining new resources and for managing your resource's workloads.

- **Define how performance will be measured on the project**.

Your KPIs should be directly related to the project goals.

Resource Management Techniques

Project managers implement the following resource management techniques to forecast, plan, allocate, level and optimize resources during the execution of a project.

1. Resource Forecasting

Project managers must do their best at estimating what resources are needed for a project and how those resource requirements fit with the organization's current plans. To do this, you must define your project scope to identify all project tasks and their required resources.

2. Resource Allocation

Resource allocation consists in evaluating available resources, capacity, resource schedule and the tasks that need to be completed to find the team members with the most relevant skills and make sure they have all the project resources they need when they need them.

3. Resource Leveling

Resource leveling is the process of re-assigning work to a project team to solve overallocation or scheduling issues. Resource levelling is used when limits on the availability of resources are paramount. It simply answers the question 'With the resources available, when will the work be finished?'

4. Resource Utilization

Careful resource planning is equally as important as resource tracking. Project managers need to keep track of resource utilization to spot any resources that aren't being used efficiently. Then they can simply reallocate those resources or make changes to the resource management plan.

5. Resource Smoothing

Resource smoothing simply consists in delaying non-critical tasks to complete a project on time with the available resources. Resource smoothing is used when the time constraint takes priority. The objective is to complete the work by the required date while avoiding peaks and troughs of resource demand

Benefits of creating a resource management plan

- Creating a resource management plan is highly beneficial for the successful management of your project. Some of the main benefits include:

- The ability to foresee potential roadblocks. Projects don't move ahead without resources, so your resource management plan plays a key role in establishing the availability of resources and any constraints. For example, if you know that someone's availability to work on your project is dependent on them finishing something for another project, you can make contingencies in case they are held up.

- Your plan provides visibility and transparency. For example, others can see the bandwidth of team members by looking at the resource management plan. This helps with planning for any other projects.

- You can measure the effectiveness of your plan and use that information to inform future projects. For example, utilization vs. efficiency is an important measure for project managers because it indicates how much real work is getting done.

- Balance your team's workload. Over-scheduling is a recipe for eventual burnout, a condition no one is immune to. By staying on top of scheduling, you can ensure that team members aren't overstretched.

- Get in early where resources are limited. For example, if you need to hire contractors, but every business in town is heavily booked, the earlier you can get on their schedule the better. The same goes internally – you might have essential people who are in high demand and require a lot of notice of work to be done.

- Stay on top of costs and quickly calculate costs associated with resources to keep your project within budget

PROJECT MANAGEMENT-UNIT III: Project Schedule, Cost and Evaluation

Project Schedule Management: Developing the project network – constructing a project network (Problems) – PERT – CPM – crashing of project network – resource levelling and resource allocation - Project Cost Management: Developing Cost Management Plan - Project Evaluation: Under certainty: Net Present Value, Benefit Cost Ratio, Internal Rate of Return, Payback Period, ARR – Theoretical Framework for Project Evaluation under Risk and Uncertainty: Risk Adjusted Rate Method, Certainty Equivalent Method, Probability Method, Sensitivity Analysis and Decision Tree Analysis.

Project Schedule Management

In every organization, projects are an essential method to build value. Running an organization with a lack of ideas and no proper schedules planned for projects would lead to failure. No matter what the size or scope of your project is, the project schedule articulates when each activity should be done, what is already done, and the sequence in which things need to be finished. In the present business environment, each organization ought to have the ability to manage and schedule with close-fitting budgets, resource scarcity, and the most recent technology patterns. This article discusses Project Schedule Management in detail and explains how you can plan, develop, maintain, and control the schedule of any project.

What is Schedule Management?

Schedule management is a procedure that requires the establishment of policies and documentation for maintaining, developing, managing, and controlling the schedules for time and resources for the completion of the project. The strategic benefit of the schedule management process is, that it will monitor and manage the schedule throughout the project.

The procedure of scheduling begins with the projects that are expected to deliver according to the requirements of the stakeholder. Schedule Management includes the technical work that generates productivity and brings in change that handles aspects such as risk management and stakeholder management.

Project Schedule Planning in Project Management

The procedure of building policies, methodology, and project documentation gives direction and guidance on how the task timetable will be overseen all through the project. The intention of a project schedule is to organize and focused based on the advancement of the Schedule Management Plan.

The project plans should consider the following aspects,
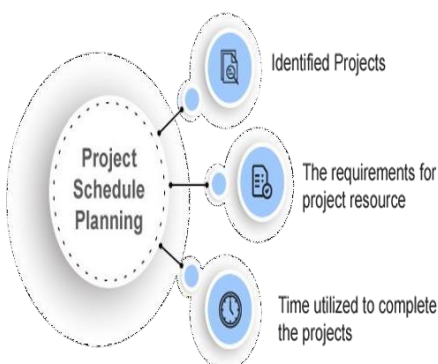
The planning of the project schedule is an essential activity that incorporates identifying the project activities, sequencing them, and defining objectives for those activities alongside the project schedule management plan. As relevant as the project management scheduling ability is by all accounts, competency ought to obtain with significant experience.

Develop Project Schedule in Project Management

Developing Project Schedule refers to planning the timing and sequence of project activities. A project schedule assigns work to be done and indicates due dates to complete the tasks and deliverables. The project schedule portrays:

1. Time (duration) estimates for all project tasks

2. Start and finish dates for the tasks

3. Names of staff resources assigned to complete the tasks

4. Sequence of tasks

A noteworthy segment of a project schedule is a work breakdown structure (WBS). The project schedule is built to reflect the work breakdown structure.

Project scheduling is the key to ensuring the original project plan, and the final project outcome is at least close enough to call the project a success. Developing project schedules helps the project team to keep the necessary activities on track. PMBOK's Schedule Management knowledge area explains the critical processes in developing a project schedule.

Developing a Project Network:

A project network diagram is an interconnection of activities that shows all project tasks, duration, logical relations, and activity interdependencies within the project.

Project network diagrams are also known as project schedule network diagrams.

A project network diagram consists of blocks, circles, lines, dotted lines, arrows, etc., and you can see relationships among activities with a quick look.

You can find the sequence of activities and verify the <u>scope of work</u>. It is also a good communication tool that helps you communicate your progress and issues with project stakeholders.

Project Network Diagram Terminology

The following are a few project network diagram terms.

Activity Dependency: An activity can be as a predecessor or a successor. A predecessor comes before an activity, while a successor comes after an activity.

Lead: A <u>lead</u> is the amount of time an activity can be advanced.

Lag: A <u>lag</u> is a waiting time between two tasks.

Float: Float in project management refers to time elapse or delay. This could either be <u>a free float or a total float</u>.

Free Float: This is the allowable time for an activity to slip without affecting its successor.

Total Float: This is the number of days an activity can be delayed without delaying the project's finish date.

Critical Path: This is the longest path on a network and determines the project's duration. Any delay in critical activity will affect your project duration.

How to construct a Project Network Diagram

The work breakdown structure ends in work packages, and work packages end in tasks or activities. To draw a network diagram, you have to go through the following steps.
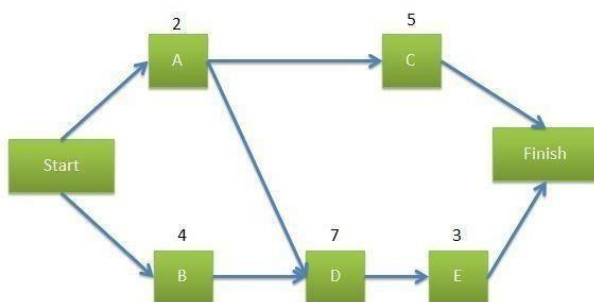
1. **Identify Activities:** First of all, you must identify all project activities. Ensure that these cover all project tasks.
2. **Sequence Activities:** Here, you arrange the activities in order of occurrence.
3. **Estimate Activity Duration:** This is where you find how long an activity will take to complete.
4. **Develop Project Schedule:** This is where you develop the project network schedule diagram.
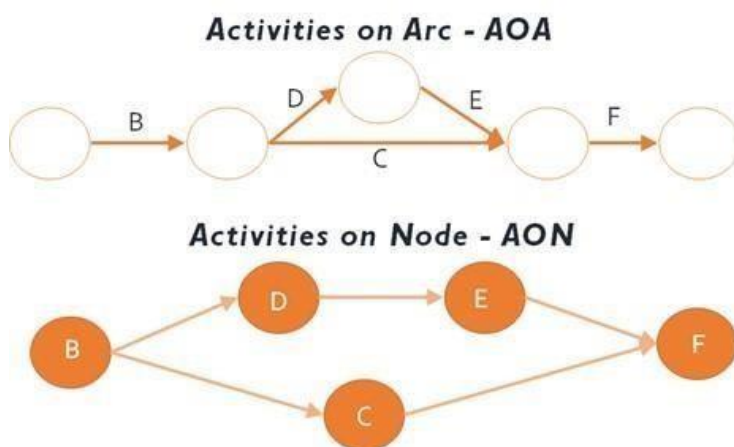
Types of Project Network Diagrams

A project schedule network diagram can be of two types:

1. Activity on Arrow Diagram
2. Activity on Node Diagram

Activity on Arrow Diagram

Here, activities are indicated on arrows and milestones on nodes in a circle. Since milestones are events, they have zero duration.

PERT (Program Evaluation and Review Technique) is an AOA schedule network diagram example.AOA uses only finish-to-start task dependency.

Activity on Node Diagram

Activity on Node diagrams are used in developing project network diagrams and schedules. They are more common than Activity on Arrow diagrams. An Activity on Node diagrams is also known as a Precedence Diagram Method (PDM), and it has four types of project management dependencies.

Start-to-Start: <u>In this relationship</u>, activity A cannot start unless B has started. For example, pipe laying cannot start unless excavation has commenced.

Start-to-Finish: <u>In this relationship</u>, activity A must start before we can finish activity B. For example, normal power must be restored (start) before you can shut down (finish) the standby power.

Finish-To-Finish: <u>In this relationship</u>, activity A must be finished simultaneously with activity B. For example, an alkylation reaction generates a large amount of heat in petroleum refining. So, cooling water circulation can only be stopped (finish) after alkylation has stopped (finish).

Finish-to-Start: <u>In this relationship</u>, activity A cannot start until activity B is finished. This is the most common dependency in network diagrams.

Uses of Project Network Diagrams

Project network diagrams have the following uses:

- Managing project schedules
- Determining project duration
- Allocating resources appropriately
- Appreciating the relationships between project activities
- Assigning buffers where necessary

Pros and Cons of Project Network Diagrams

We have discussed the project network schedule diagram; let's now see its pros and cons.

Pros

- Shows all tasks visually
- Identifies process bottlenecks
- Helps develop the project schedule
- Shows task dependency

Cons

- Developing a project schedule diagram takes time
- For a big project, the diagram can be complex

- A minor mistake can affect the schedule

Program Evaluation and Review Technique (PERT)

The US Navy developed Program Evaluation and Review Technique in 1957 to plan the schedule for the Polaris Project.

This project scheduling diagram technique helps find duration estimates when activities have uncertainties, and that is why this technique is called a probabilistic technique.

The PERT helps you develop network diagrams when you have a large one-time project with no or least historical data. The PERT uses a three-point estimation technique to provide you with activity duration estimates.This weighted average reduces bias and uncertainty from the estimation and improves accuracy. These estimates are:

- Most Likely Estimate(TM)
- Optimistic Estimate(TO)
- Pessimistic Estimate(TP)
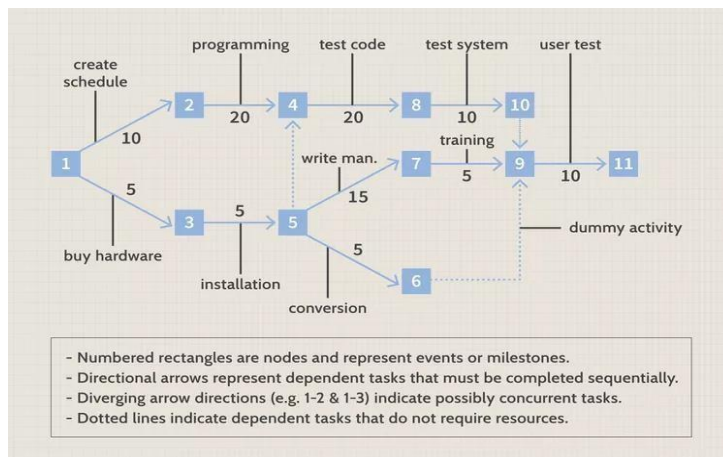
The formula to calculate the PERT is as follows:

PERT Estimate = (Tp + 4Tm + To) / 6

Here:

- **Tm** is the Most Likely Estimate. In this estimate, the chance of completing an activity is highest.

- **To** is the Optimistic Estimate. This estimate considers the best-case scenario, so the duration estimate is the shortest here.

- **Tp** is the Pessimistic Estimate. This is a worst-case scenario. Here, you determine the estimate considering all unfavorable conditions, so this is the longest duration the activity will take to complete.

PERT provides a better estimate by considering all possible scenarios; it is a planning tool for estimating project duration. It is also useful in <u>risk management</u>, <u>risk management planning</u>, and <u>Monte Carlo Analysis</u>.

CRITICAL PATH METHOD (CPM)

In 1950, a joint venture between the Dupont Corporation and the Remington Rand Corporation for managing plant maintenance projects led to the (CPM). Today, it is commonly used with all forms of projects such as construction, software development,research projects, product development, engineering, plant maintenance and so on. Any project with interdependent activities can apply this method of scheduling. Whenever an activity is scheduled by various planning techniques, the necessary resources such as capital, equipment, labour or other inputs are needed for executingthe work package or an activity.

The fact is that necessary resources are not always available when desired so, activities must be scheduled at time when resources are available. It is also important to note that the cost and duration of the project are interdependent variables. Altering project schedules influences costs and it should be possible to alter the activity schedules so as to achieve optimum trade-offs between the project cost and the scheduled completion date.

The CPM is the graphical representation of the interrelationships between the tasks in a project tobe performed in a well-defined sequence. It lays stress on the following two aspects ofa project:

- The effect ofapplying more men or other resources to shorten the durationof given jobs

- The increased cost of these additional resources

The Procedure of deciding the critical path is executed through the following steps.

- Firstly, the project is categorized into a series of labeled activities. These activities are then arranged in a logicalsequence and represented graphically with an arrow diagram.

- All the nodes and activities are then numbered. The time required for each activity iscalculated and indicated in the arrow diagram.

- The earliest start and ending time along with the latest start and finish time are then calculated and jotted down.

- The total float for each activity is then determined by taking the difference between the earliest andthe latest time for each node.

- The critical activities (zero float activities) are then identified and connected with the beginning andthe ending node in the network diagram by double line arrow. This gives the critical path.

- The totalproject duration is then calculated.

- In case the total project duration needs to be reduced, the critical activities of the network are crashed.

- The cost is optimized and the network is thenupdated accordingly.

Since project schedules change on a regular basis, CPM allows continuous monitoring of the schedule. It enables the project manager to track the critical activities and ensures that the non-critical activities do not interfere along with the critical ones.

The following example illustrates CPM in detail.

A small maintenance project consists of the following jobs whose precedence relationships are given in following Table

Job	1–2	1–3	2–3	2–5	3–4	3–6	4–5	4–6	5–6	6–7
Duration(days)	15	15	3	5	8	12	1	14	3	14

1. Draw anarrow diagram representing the project

2. Find the total float for each activity

3. Find the critical pathand the totalproject duration

Answer
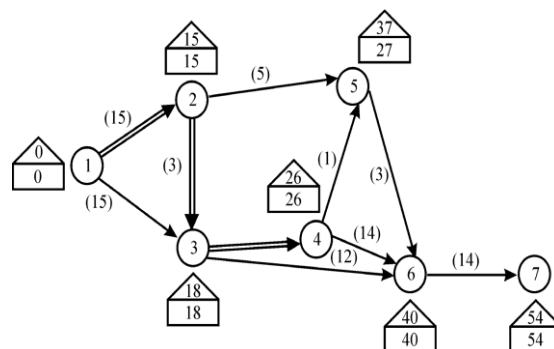
To calculate the critical path and total project duration we first need to find the forward and backward pass calculations.

- **Forward Pass Calculation**: In this calculation, it is estimated that the earliest start and the earliest finish time ES_j

- **Backward Pass Calculation**: In this calculation, we calculate the latest start and latest finish time LF_i, given by $LF_i = \text{Min}_i (LF_j \text{ '}t_{ij})$ where LF_j is the latest finish time for the event j.

The following table gives the calculation for critical path and total float.

Activity	Normal time	Earliest		Latest		Total Float
		Start	Finish	Start	Finish	$LF_j - ES_j$ or $LF_i - Es_i$
1–2	15	0	15	0	15	0
1–3	15	0	15	3	18	3
2–3	3	15	18	15	18	0
2–5	5	15	20	32	37	17
3–4	8	18	26	18	26	0
3–6	12	18	30	28	40	10
4–5	1	26	27	36	37	10
4–6	14	26	40	26	40	0
5–6	3	27	30	37	40	10
6–7	14	40	54	40	54	0

From the above table, we observe that the activities 1–2, 2–3, 3–4, 4–6, 6–7 are the critical activities and the critical path is given by 1–2–3–4–6–7. The total project completion time is 14days.

Advantages of CPM

A CPM schedule simplifies the planning of work assignments in advance and helps improvecommunication among those who are responsible for project performance. The CPM also helpsin better project planning by providing evaluations and forecasts the success of alternative plans ofaction. Following are the advantages ofthe CPM:

- It helps the top management to focus on the critical activities and their timely accomplishment.
- It provides theknowledge of critical and non-critical activities and their completionin time.

This helps the management to divert the resources from non-critical to critical activities. The performance of an activity on the critical path is essential otherwise it may postpone the project completiontime.

- It creates the best way of planning and scheduling a construction project by showingthe critical path.

- It provides the complete information about the importance, duration, size and performance of an activity.

Disadvantages of CPM

The CPM also suffers from certain drawbacks such as high cost, time consumption, poor time estimate provisionand resource allocation.

Some other disadvantages of the CPM are as follows:

- The CPM is based on the estimation of duration of activities which is impracticalin real life.

- In case there are changes in the predetermined network, the entire evaluation of the project has to be repeated and a new critical path is required to be created all over again.

- It does not include statistical analysis in determining the time estimates.

- The CPM can become complicated when it involves larger projects.

<u>Crashing of Networks</u>

Crashing of networks is the phenomenon of reducing the overall duration of the project. The crashing of networks is carried out by deploying more resources to one or more activities.

Crashing of activity refers to allocating more resources so that completion time for that activity and overall project time also reduce. You may change activity completion times by allocating more resources to it.

Crashing an activity (Crashing of networks): Reducing the time required to complete an activity (in hopes that this will reduce the completion time of the entire project) by

assigning additional resources to that activity but reducing the duration time of the activities on the critical path may change the critical path.

- **Normal time (NT):** the expected time to complete an activity
- **Normal cost (NC):** the cost to complete the activity in its normal time
- **Crash time (CT):** the shortest possible time in which the activity can be completed
- **Crash cost (CC)**: the cost to complete the activity in the shortest possible time (i.e., the cost to complete the activity in its crash time)
- **Crash cost per time period** = (CC – NC) / (NT – CT). It is also known as the cost slope of activity in the network.

Approaches to Crashing a Project Network

There are various approaches can be used for the crashing of networks. Crashing of networks simply means crashing a project network's different activities. Here different methods are discussed which are used for the crashing of activities.

- "**Minimum-time schedule**" method:

1. use the normal times for each activity to determine the critical path
2. crash every activity from its normal time to its crash time (minimum duration time) – this gives the minimum-time schedule

If you must make the minimum time but want to reduce the cost, you can un-crash activities that aren't critical, beginning with those that are most expensive.

- "**Minimum cost schedule**" method:

1. use the normal times for each activity to determine the critical path
2. crash the activity on the critical path that has the lowest cost to crash per unit of time until the activity duration time cannot be reduced any further, or another path becomes critical, or the additional costs of crashing outweigh savings from crashing
3. repeat step 2 until the cost of continuing to crash the project is greater than the savings from crashing

4. when there is more than one critical path, it may be necessary to simultaneously crash an activity on each path; if so, select the activities that give the lowest total cost per unit of time.

Generally, the distribution of the activity times is unknown and must be estimated. A typical method of dealing with the situation is to estimate three activity duration times for each activity, optimistic, most likely, and pessimistic. Use these estimates to estimate a normally distributed activity time:

Optimistic time (a): the probability of completing the activity in less than a is about 1%

Most likely time (m): the estimated average time required to complete the activity

Pessimistic time (b): the probability of taking longer than b is about 1%

Assumptions Involved in Crashing of Networks

Crashing of networks is done to reduce the overall duration of the project. It increases the direct cost and reduces the indirect cost of various resources. The crashing of networks is done with the help of many rules and assumptions.

1. Duration of activities along the critical path determines the project completion time

2. Duration time of one activity is independent of the duration times of all other activities..

3. If a project has two critical paths, the critical path with the largest variance should be used to calculate the probability that the project will be completed within a certain time.

Crashing Example: The network and duration given below shows the normal schedule for a project. You can decrease (crash) the duration at an additional expense. The Table given below summarizes the time-cost information for the activities. The owner wants you to you to finish the project in 110 days. Find the minimum possible cost for the project if you want to finish it on 110 days. (Assume that for each activity there is a single linear, continuous function between the crash duration and normal duration points)

Activity	Normal duration (days)	Crash Duration (days)	Normal Cost	Crash Cost
A	120	100	12000	14000
B	20	15	1800	2800
C	40	30	16000	22000
D	30	20	1400	2000
E	50	40	3600	4800
F	60	45	13500	18000

Solution: Assume that the duration-cost relationship for each activity is a single linear, continuous function between the crash duration and normal duration points. Using the normal duration (ND), crash duration (CD), normal cost (NC), and crash cost (CC), the crash cost slope for each activity can be determined as follows;

$$S_A = \frac{CC - NC}{ND - CD}$$

$$S_A = \frac{14000 - 12000}{120 - 100} = \$100/day$$

S_B = \$200/day

S_C = \$600/day

S_D = \$60/day

S_E = \$120/day

S_F = \$300/day

Overall duration is 130 days and there are multiple critical paths (B-F-E and B-C-D-E). Total project cost at this duration is the normal cost of $48300 plus the cost of crashing the activity D by 10 days (60 * 10 = $600) for a total of $48900.

The next activity to be crashed would be the activity E, since it has the least-cost slope ($120 per day) of any of the activities on the critical path. Activity E can be crashed by a total of 10 days. Crashing the activity E by 10 days will cost an additional $120 per day or $1200.

The project duration is now 120 days and the total project cost is $50100. There are now three critical paths (A, B-C-D-E, and B-F-E). The next stage of crashing requires a more through analysis since it is impossible to crash one activity alone and achieve a reduction in the overall project duration. Activity A is paired with each of the other activities to determine which has the least overall cost slope for those activities which have remaining days to be crashed.

Activity A ($100) + activity B ($200)

Activity A ($100) + activity C ($600) + activity F ($300)

The least-cost slope will be activity A + activity B for a cost increase of $300 per day. Reducing the project duration by 5 days will add 5*300 = $1500 dollar crashing cost and the total project cost would be $51600. Activity B cannot be crashed any more.

Final step in crashing the project to 110 days would be accomplished by reducing the duration of activity A by 5 days to 110 days, reducing activity C by 5 days to 35 days, and reducing activity F by 5 days to 55 days. The combined cost slope for the simultaneous reduction of activity A, activity C, and activity F would be $1000 per day. For 5 days of reduction this would be an additional $5000 in total project cost. The total project cost for the crashed schedule to 110 days of duration would be $56600.

Resource Leveling

Project managers often turn to resource leveling to ensure that the time lines for any project can be correctly predicted and conflicts arising out of time, scope, or insufficient resources can be tackled early on without it snowballing into a huge problem, forcing employees to work overtime. Understanding what leveling resources is, its use, importance, and related information are vital to enhancing productivity and reducing burnout by eliminating over-allocation and minimizing the risk of resource burnout.

It is a technique in project management that resolves various conflicts, such as schedule conflicts or over or under-allocation of resources, to ensure that the available resources can be utilized to their fullest extent and the project gets completed at the earliest.

Resource leveling is mainly done by setting realistic project deadlines by extending or curbing a project's start and finish dates. It helps maintain the project's cost while not forcing the employees to overwork.

Importance of Resource leveling

Resource leveling is vital to understanding and creating realistic timeline for when the project can be completed by utilizing the available resources without creating budget issues, maintaining the quality of work, and avoiding project delays. Here are some reasons why this technique is important:

- **To Optimize Your Resources**

It helps you assign tasks in a way that optimizes the resources. For example, it helps you assess the projects with a flexible deadline and can use a few employees to identify projects that require additional resources to complete the task on time.

- **To Minimize Deficits**

It minimizes loss in labor and cost by managing the resource demand in a way that prevents delay of projects and does not exceed the cost and capacity of the company's financial resources.

- **To Prevent Task Overloading**

Resource leveling ensures that the over allocation of work is avoided. By adjusting deadlines, the project manager can resolve this and ensure that the team maintains its productivity.

- **To Ensure the Quality of a Project Output**

By maintaining high team productivity, resource leveling prevents the downfall of the quality of the project and successfully manages client expectations for project deliverable.

How to Select a Resource Levelling Strategy in the Real World?

Unexpected delays and other conflicts are a part of the real world and can crop up anytime without announcing their arrival. It can prevent such problems by adjusting the two most important variables - project deadlines and available resources. The correct strategy can help you optimize resources, extend deadlines, narrow the project scope, and garner more resources. Given below are four scenarios to help you understand where and how a resource-leveling strategy can be applied for the best possible outcome:

Scenario 1: Add More Resources and Extend the Deadline
Extended deadlines and additional resources can deliver the best work for high-quality

projects. After meeting with the stakeholders and explaining that the initial project assumptions were insufficient, you can accommodate the additional resources by revisiting the resource allocation plans.

Scenario 2: Add More Resources to Meet the Same Deadline

The crashing strategy will often help with projects where deadlines cannot be extended. You can bring in additional resources to divide the workload. One problem that might arise out of this is the lack of training for the new team members. Senior team members can train the newcomers, but this will take away from the time required to complete the work. Thus, to solve this issue, newcomers should only be allotted tasks that require the least effort.

Scenario 3: Use the Same Resources and Extend the Deadline
Stakeholders should be contacted at the earliest opportunity to approve the extended deadline for high workloads if possible. This method ensures no additional team members are required, and the existing resources get the time needed to complete the project without compromising the quality of the deliverables.

Scenario 4: Use the Same Resources to Meet the Same Deadline

When no additional members can be acquired, nor can deadlines be extended, the only way to complete the project on time is to remove all low-value tasks and focus only on the most important aspects of it. This way, you can reduce project scope and execute several tasks at once by all available resources working together to ensure the project is delivered on time.

Example : **Obtaining additional resources**

An IT team has been trying to fix various virus-infected computers in a company. After realizing that the company software would not be able to handle the virus, the team invested in new anti-virus software to fix all the infected computers.

Common Methods of Resource Leveling

Below are common resource leveling methods project managers use to tackle various project conflicts efficiently.

- **Critical Path Method**

A common leveling technique, this method involves a visual mapping of the project's 'critical path' to decide the start and end dates, dependency and duration, and so on. This method does

not take resource limitations into account. Project managers use this technique to identify which task will require the longest to complete and manage such tasks efficiently to ensure no delay.

It allows appropriate resources to be allocated to those tasks, and the project execution begins. If the team faces any unexpected problems, project managers might adjust resources to ensure the timely completion of the critical paths.

- **Critical Chain Management**

The critical chain method is considered an advanced version of the critical path method as it considers the resource limitations that the critical path method does not. This technique considers the resource dependencies as well as the task. The 'critical chain' here refers to the task with the longest path. In this method, only one task can simultaneously be assigned to a resource.

Projects are scheduled according to the required resources for the tasks, and their availability is reassessed if and when needed.

This method also uses a buffer period to ensure the project is not delayed. It is placed right before the completion date, after the last task, to round up any incomplete tasks.

- **Fast-Tracking**

When multiple tasks are run parallelly to deliver the project on or before the deadline, that is called fast-tracking. Only up to a certain extent can activities be overlapped with one another. Parallel activities could be those without dependency, and the ones with dependencies could be staggered.

- **Project Crashing**

When a project timeline is too short to be completed by the available resources, additional resources are allocated to complete the tasks on time. This technique is used when fast-tracking fails, and the project manager assesses high-priority tasks and allocates resources that would provide high value at the lowest cost.

Resource Levelling Tools

Successful levelling is often achieved after some experience; here are tools you can use to help you expertly execute projects till then.

- **Use Gantt Charts**

    This <u>visual bar chart</u> maps a project schedule and is used for identifying and planning the critical path that can be rearranged later. It helps provide an overview of the project duration, start and end dates, and task dependencies.

- **Leverage Project Management Software**

Allocation conflicts can be easily resolved using <u>project management software</u> with an additional resource leveling algorithm that could give an insight into the team member's schedules, thereby preventing double booking or schedule conflicts.

- **Draw Network Diagrams**

A chart can be created called a <u>network diagram</u> which will chronologically show the tasks assigned with a series of boxes and arrows. It is often <u>used</u> to identify the critical and non-critical paths of the project schedule and track the project's progress.

- **Use Previous Projects as a Reference**

Learning from past projects and using them as a reference for upcoming projects will help me plan the schedule better and more efficiently.

<u>ResourceAllocation</u>

Resource allocation is the process of organizing a company's assets for different activities and tasks. By conducting resource allocation, a key step in project management, business leaders can make sure their teams have the necessary support to achieve strategic goals. A project manager allocates the resources for a project.

<u>Types of resources :</u>

- **Labor:** Part of resource allocation is taking advantage of the talents, qualifications and professional experience of employees and delegating tasks and positions that match employee skill level. Labor also includes external services or contingent staff a company hires for support, such as IT, consultation or marketing agencies.
- **Equipment:** This kind of resource is any machine or tool, hardware or software, that companies use to create products, provide services or complete other business-related tasks. For example, for a construction company, their equipment could be excavators, bulldozers and CAD software.

- **Space:** Companies require space in which to complete work, develop products and offer services, and they may lease or buy physical facilities and headquarters. For example, an interior design firm may decide to lease an office space in which supervisors can meet with clients and employees can complete designs.

- **Materials:** The resource of materials involves any physical supplies that help a company generate outputs or products or facilitate services. This includes raw materials like steel, oil and lumber, inventory for sale to customers and office supplies like computers, desks, chairs, printers, stationery and writing tools.

- **Money:** Sometimes, part of resource allocation involves assigning budgets and funds to different business departments to complete project phases. These teams can use the money to purchase resources, pay employee salaries and even make investments to generate more revenue for the company.

Importance of resource allocation

Resource allocation in project management is important because it's a way to organize and plan a project. Preparing a plan for an activity in advance can ensure teams collaborate effectively and perform well.

Here are some reasons resource allocation is essential for businesses:

- **Ensuring projects are successful:** The success of projects depends on whether they have the right resources. Business leaders can ensure the achievement of goals by allocating money, labor, equipment and materials correctly.

- **Minimizing costs:** Planning resource allocation can help a company identify the best resources for a project at the best prices. They can determine the most cost-effective strategies, increase profitability and generate high returns on investments.

- **Submitting projects on time and within budget:** Organizing resource availability at the beginning of work processes can support team efforts to complete a project on time and within budget. This can then lead to client satisfaction and brand awareness.

- **Improving products and services:** With the proper resources, companies can develop products and services that are high-quality and competitive in consumer markets. They can also improve allocation over time to foster product innovations.

- **Optimizing employee skill sets:** Assigning human resources or team members to various types of projects can help them build skills and develop professionally. This

can optimize their ability to contribute to a company's mission and objectives.

- **Improving employee productivity:** Employees who have the right resources and opportunities to complete tasks can typically engage more enthusiastically with their work and perform better. They can operate at high productivity levels and work together efficiently.

How to allocate resources in project management?

Here are four steps for how to allocate resources well in project management situations:

1. Develop a project plan

First, develop a project plan outlining the idea, goals and team for the project. Divide the project into focus areas, phases and tasks and create a work breakdown structure for it. This can then help you establish a broad timeline for each deliverable.

2. Establish the resource requirements for each project task

Once you've created a table with each project task, you can determine the resource needs for each component. These may be human or non-human resources. For human resources, establish the skills and competencies you're looking for in team members.

For non-human resources, delineate the specifications you're seeking for equipment and supplies. While you're listing these resource needs, predict a budget for each project or project phase.

3. Find resources and funding

After confirming your resource needs, you can then use software to identify the availability of resources internal or external to your company. You may want to hire new employees, rent equipment or make other decisions to acquire support for the project. Factor in the costs of these resources to the overall financial plans of your project and business.

4. Allocate resources according to plan

After securing your resources, allocate them according to your plan. Make sure all business leaders have a clear knowledge of the resources available to them. Monitor resource usage and performance using dashboards and reports, and adjust your plan as needed. For example, you may want to replace resources or reallocate some to a high-priority project.

Common problems in allocating resources

Here are some common challenges that resource managers may encounter, with some ideas to prevent or solve them:

- **Outdated software:** While some companies still use outdated software for the central organizational structure for their resource management, it may be beneficial to use cloud-based software instead. This allows project managers to make changes in real-time, avoid discrepancies and miss communications and save time and effort due to computer automation features.

- **Changes in project scope:** Especially when working with a client, a project manager may want to be adaptable to unexpected changes in project scope and scale and strains on resources. One of the best ways to respond to this kind of situation is to update the resource and project schedule and use creative problem-solving skills to reallocate resources effectively.

- **Mismanagement of employee talents:** It's essential for a business to manage employee talents well and assign the right tasks to the right team members. Make sure experienced employees have responsibilities fitting their skill level to foster engagement and interest, and direct junior employees to work on beginner tasks to prevent burnout.

- **Changes in resource availability:** In any project, there may be unexpected changes in human or non-human resource availability, because employees may become sick, machines may break or other issues may occur. Create backup plans for these situations in advance so you can address them immediately and overcome these challenges with ease.

- **Lack of communication:** Effective communication is key in ensuring the success of a project, and it's important for managers to make sure everyone involved has access to resource plans and requirements. Consider using cloud-based project management software to share documents, calendars and schedules and allow team members to collaborate in real-time.

Examples of resource allocation

Here's an example from the agriculture industry:

Jacquelyn owns a farm and wants to create a resource allocation plan for the upcoming quarter. She decides to focus on allocating resources for a project to install a high tunnel system on her farm. As this kind of project requires a large amount of capital but might produce a high return on investment, she allocates 20% of her revenue to it. To cover the cost of the resources, she applies for grant funding for small farms

Project Cost Management

Cost management is the process of planning and managing the budget of a business or project. In the case of a project, it helps the project manager estimate what the project will cost and set controls to reduce the chances of the project going over budget. Cost management is one of the most important responsibilities of a project manager; projects always need resources such as materials, labor and equipment, which generate costs. Those costs must be estimated and controlled throughout the project life cycle to complete the project.

How to Manage Project Costs in 4 Steps

The four steps below outline how the cost management process works in project management.

1. Resource Planning

Resource planning is the process of forecasting future resource requirements for a business, project or scope of work. To create a resource plan, you need to start by defining the project scope, a document that details the project activities that will be done. Once the project activities have been defined, project managers usually rely on historical data, expert opinions, and resource planning tools such as a resource breakdown structure (RBS) to estimate the resources that will be needed.

2. Cost Estimating

Cost estimating consists of assigning costs to the resources you need to execute your projects, such as labor, materials and equipment. Cost estimating is one of the most important steps in the cost management process because it lays out the base for your project budget. There are several project cost estimating techniques you can use depending on the characteristics of your project.

3. Cost Budgeting

Based on your cost estimates, you can now create a project budget, which is simply the sum of all your project costs. Make sure to include all types of project costs, including direct, indirect, fixed and variable costs. A project budget should also include contingency reserves in case there's work that needs to be redone, or a risk has struck the project and risk mitigation strategies need to be taken.

4. Cost Control

Cost control refers to all the activities, guidelines and procedures taken to minimize and track project costs. Poor cost control can affect the profitability of a project, but luckily project management software can help you to easily keep track of costs with tools such as timesheets, workload planners and project dashboards.

Cost Management Plan

A cost management plan sounds simple. It's an outline of the cost estimation for the project—but that includes all allocation and how the project manager will control those costs to bring the project in as budgeted. A cost management plan must take into account the resources that impact the project budget, whether materials or people. There are also fixed, variable and overhead costs. All these must be calculated to know what your financial commitment to the project will be.

Last but not least is the stakeholder, who has invested interest in keeping costs down. Cost overrun is a problem many projects experience, but not one that stakeholders will tolerate well. Keep the stakeholder in mind when formulating your cost management plan. They need to stay in the loop and get reports throughout the project.

Developing a Cost Management Plan

Here are some key elements that must be included in a cost management plan:

- **Estimation Methods:** Explain which cost estimation method was employed, such as

parametric, bottom-up, three-point, etc.

- **Units of Measure:** To measure costs accurately, it's important to establish units of measure for your labor, materials and equipment. Some examples of measurement units can be staff hours, square feet, tons, kilograms, etc.

- **Cost Baseline:** Based on your cost estimates, you must define a <u>cost baseline</u> that marks the spending limit for your project.

- **Cost Control Thresholds:** Establishing thresholds to monitor cost performance is important. This simply means that when cost variation reaches a certain percentage, the project team will take cost management actions.

- **Performance Measurement Methods:** Establish how the <u>cost performance</u> will be measured to see if you're meeting the goals and expectations of the project. To do so, you'll need a cost tracking system and earned value management (EVM) techniques.

- **Reporting Guidelines:** You need to have a format and communication channels to report your findings as you monitor the project's progress and present this data to your stakeholders.

<u>Importance of Cost Management</u>

The main reason why cost management is so important in project management is that your cost management plan includes the guidelines and procedures needed to stay on budget. This is critical because otherwise, the organization could lose money as costs exceed profits.

The cost management process begins in the <u>planning phase of the project</u>, where costs are estimated and then a project budget is defined. Then, when the project is executed, the expenses are carefully monitored and recorded to make sure that they're aligned with the budget.

When you have a project budget, it sets a baseline for project costs. That means it governs the decisions and directions you take when managing costs on your project. This helps you keep the project on track without overspending.

Project Cost Estimate Template

ProjectManager

Estimate Tempate

[Company Name]						
[Street Address]		Date:				
[City, State, Zip Code]		Quote #:				
[Website]		Customer ID:				
[Phone/Fax]		Valid Until:				
[Prepared By:]						
[Customer]						
[Name]						
[Company Name]						
[Street Address]						
[City, State, Zip Code]						
[Phone/Fax/Email]						
Job Description						

Project Phase	Vendor/Contractor	Labor	Materials	Total	Notes
Task		$ 15.00	$ 30.00	$ 45.00	
Task		$ 10.00	$ 15.00	$ 25.00	
Task				$ -	
Task				$ -	
Task				$ -	
Subtotal		$ 25.00	$ 45.00	$ 70.00	
Project Phase	Vendor/Contractor	Labor	Materials	Total	Notes
Task				$ -	

Cost Management Tips

The following are some tips to keep in mind as you're working on managing your project costs.

- **Plan for Inflation:** Pricing is not set in stone, and any good budget is going to take this into account by allowing for a range of costs.

- **Account for Natural Disasters or Potential Events:** Expect the unexpected might sound silly, but you must have room in your budget for a weather event, personal issue or another unknown that will delay the project.

- **Other Unexpected Costs:** Not all unexpected costs are random. There can be legal issues, penalties associated with the project or unexpected labor costs, all of which you can't budget for, but can inform your budget.

- **Track in Real-Time:** Having software to monitor the budget as you execute the project is key for managing costs. However, if you're looking at data that isn't current, you won't be able to act swiftly enough to resolve issues. Therefore, you want to have software with real-time data tracking.

- **Respond Promptly:** Regardless of how you discover a discrepancy in your project cost, you must act immediately. The longer you wait, the more money is wasted.

- **Size Accordingly:** Some people think smaller projects don't need project cost management. But small or large, you'll want to manage cost.

Project Evaluation

Project evaluation is the process of measuring the success of a project, program or portfolio. This is done by gathering data about the project and using an evaluation method that allows evaluators to find performance, improvement, and opportunities.

Key Components of Project Evaluation

Like a well-oiled machine, project evaluation relies on several crucial components to operate seamlessly and deliver insightful results. These integral components form the foundation of a comprehensive evaluation, ensuring it is practical, transparent, and valuable.

1. **Clear objectives:** Having a defined set of goals at the outset provides a benchmark against which the project's progress can be evaluated. These objectives should be specific, measurable, attainable, relevant, and time-bound (SMART).

2. **Evaluation criteria:** The criteria form the backbone of project evaluation. They include efficiency, effectiveness, impact, sustainability, and relevance of the project.

3. **Data collection:** A robust data collection mechanism is essential for an accurate project evaluation. It involves gathering relevant qualitative and quantitative data from various sources to provide a comprehensive picture of the project.

4. **Data analysis:** This involves interpreting the collected data to derive meaningful insights. The analysis should be objective, systematic, and capable of addressing the evaluation criteria.

5. **Stakeholder involvement:** Including all stakeholders – from team members to clients and sponsors – in the evaluation process enhances its comprehensiveness and ensures diverse perspectives are considered.

6. **Reporting:** The findings from the evaluation should be compiled into an easily understandable report, highlighting key insights, areas of improvement, and recommendations for future projects.

7. **Feedback and improvement:** The ultimate goal of project evaluation is to identify areas of improvement. Therefore, constructive feedback mechanisms and a focus on learning and growth are key components of this process.

These components form the fabric of project evaluation, empowering project managers to evaluate their initiatives accurately, learn from their experiences, and steer future projects toward success.

Project Evaluation: Pre-Project, Mid-Project, and Post-Project

Imagine setting off on an exciting road trip. You should check your vehicle before you depart, assess your journey at intervals, and reflect on the experience after you return. Much like this road trip, the project management journey also necessitates evaluation at the pre-project, mid-project, and post-project stages. Let's navigate through each step:

- **Pre-Project Evaluation**

The pre-project evaluation, akin to the preparatory check before a road trip, occurs before the project commences. It sets the stage for a successful project by:

1. **Feasibility check:** Assessing the project's feasibility in terms of available resources, budget, and time.

2. **Risk assessment:** Identifying potential risks and strategizing mitigation plans.

3. **Goal setting:** Defining clear, measurable, and realistic project objectives.

4. **Stakeholder analysis:** Understanding and aligning stakeholder expectations with the project's objectives.

- **Mid-Project Evaluation**

Just as periodic checks during a road trip help ensure everything is running smoothly, a mid-project evaluation monitors the project's ongoing progress. It is instrumental in:

1. **Performance tracking:** Checking whether the project is on track to achieve its objectives.

2. **Risk management:** Identifying and addressing new risks or challenges during project execution.

3. **Adjustment implementation:** Making necessary adjustments to the project plan based on performance and feedback.

4. **Stakeholder communication:** Updating stakeholders on the project's status and any changes in the project plan.

Post-Project Evaluation

After completing a road trip, reflecting on the experience provides valuable insights for future trips. Similarly, a post-project evaluation focuses on learning from the project's outcomes to improve future projects. It includes:

1. **Outcome assessment:** Measuring the project's outcomes against the initial objectives.

2. **Success validation:** Determining the success or failure of the project based on the defined criteria.

3. **Lessons learned:** Identifying strengths, weaknesses, opportunities, and threats encountered during the project.

4. **Future recommendations:** Suggest future projects based on the evaluation findings.

Just as periodic checks ensure a smooth road trip, evaluations at different project stages contribute to its successful completion and the continuous improvement of project management practices.

The Best Project Evaluation Methods under certainty

You may still feel like you're in the dark on how to best start evaluating your projects. **Certainty**: In situations of certainty, outcomes are known with absolute confidence. There is no ambiguity or doubt about future events.

1. Return on Investment (ROI)

Return on investment (ROI) is a financial planning strategy for determining the value of a project to predict how it may perform. Accurately calculating ROI can help organizations make the right investments, which can lead to larger profit margins.

Types of ROI to use for projects

The type of ROI you can use depends on when you're making your calculations. For example, if you haven't started a project yet, your ROI can be used to predict performance. In contrast, if the project is already finished, you can use the ROI you calculate to measure the success of the project, learn from mistakes and plan for future endeavors. Consider applying the following types of ROI to prepare for project costs and evaluate a project after completion:

- **Anticipated ROI**

Also referred to as expected ROI, a financial planner typically calculates this type of ROI before a team begins working on a project. Anticipated ROI combines predicted costs and expected revenue to predict a project's potential for profit and other possible outcomes. Managers and executives often refer to anticipated ROI to evaluate risk and determine if pursuing a project is worthwhile.

- **Actual ROI**

As the name suggests, actual ROI is the real return a completed project generates. Through a combination of recorded costs and revenue, financial planners can use this ROI to compare a project's actual profit to their prediction. Regularly comparing actual ROI to anticipated ROI

can help businesses make more informed investments, which can enhance profitability over time.

- **Positive ROI**

A type of actual ROI, positive ROI refers to a profitable project. Financial planners determine a project is profitable when the revenue it earns exceed production costs. Recognizing positive ROI can help project planners identify trends in effective budgeting, which they may apply to future projects.

- **Negative ROI**

In contrast to positive ROI, negative ROI is when a project's projected costs are more than the amount of revenue it earned. Recording negative ROI can help financial planners prevent unnecessary costs in future projects, which can improve an organization's overall financial health

How to calculate project ROI

To calculate a project's ROI, consider the formula below:

ROI = (Net profit / cost of investment) x 100

To determine your net profit, subtract the predicted expenses for the project from your expected revenue:

Net profit = expected revenue - total expenses

To determine a project's total expenses, financial planners often divide a project into simplified tasks to ensure they've accounted for every step of the process. Then they factor in the cost of materials, how many hours it may take to complete the project, the amount of staff necessary and their hourly wages. They also consider costs for buying or leasing equipment, software and buildings.

Total expenses = material costs + (hours to complete the project x number of people working on the project x hourly wage) + equipment costs + software costs + building costs + additional costs

2. Cost-Benefit Analysis (CBA)

A cost-benefit analysis (CBA) is a process that's used to estimate the costs and benefits of projects or investments to determine their profitability for an organization. A CBA is a versatile method that's often used for business administration, project management and public policy decisions. An effective CBA evaluates the following costs and benefits:

Costs

- Direct costs
- Indirect costs
- Intangible costs
- Opportunity costs
- Costs of potential risks

Benefits

- Direct
- Indirect
- Total benefits
- Net benefits

What Is the Cost-Benefit Ratio?

The cost-benefit ratio, or benefit-cost ratio, is the mathematical relation between the costs and financial benefits of a project. The cost-benefit ratio compares the present value of the estimated costs and benefits of a project or investment.

Cost-Benefit Ratio Formula

This is a simplified version of the cost-benefit ratio formula.

Cost-Benefit Ratio= Sum of Present Value Benefits / Sum of Present Value Costs
Here's how you should interpret the result of the cost-benefit ratio formula.

- **If the result is less than 1:** The benefit-cost ratio is negative, therefore the project isn't a good investment as its expected costs exceed the benefits.

- **If the result is greater than 1:** The cost-benefit ratio is positive, which means the project will generate financial benefits for the organization and it's a good investment. The larger the number, the most benefits it'll generate.

Present Value Formula

The present value of a project's benefits and costs is calculated with the present value formula (PV).

$PV = FV/(1+r)^n$

- FV: Future value
- r= Rate of return
- n= Number of periods

3. Net Present Value (NPV): The Net present value rule is an investment concept stating that projects should only be engaged in if they demonstrate a positive net present value (NPV). Additionally, any project or investment with a negative net present value should not be undertaken.

Understanding Net Present Value (NPV)

Net Present Value (NPV) is the calculated difference between net cash inflows and net cash outflows over a time period. NPV is commonly used to evaluate projects in capital budgeting and also to analyze and compare different investments.

Net Present Value = Present Value of Cash Inflows – Present Value of Cash Outflows

A positive NPV indicates that a project or investment is profitable when discounting the cash flows by a certain discount rate, whereas, a negative NPV indicates that a project or investment is unprofitable.

A discount rate, also known as a required rate of return, is an interest rate that is used to determine the present value of a series of cash flows. For internal projects, the rate can be referred to as the cost of capital, which is the required return that is needed to make a project worthwhile.

Positive NPV projects essentially show that the present value of cash flows generated from a

project or investment exceeds the costs required for the project. Therefore, a positive NPV project or investment is said to "create value." A negative NPV project or investment shows that the costs exceed the cash flows generated, and it is said to "destroy value."

4. Internal Rate of Return (IRR)

IRR is a popular metric used to estimate the profitability of potential investments. It represents the interest rate at which the Net Present Value (NPV) of a project's cash flows amounts to zero. In simpler terms, IRR is the rate at which a project breaks even in terms of NPV.

Internal Rate of Return (IRR) Defined

The rate at which cash inflows equal cash outflows without consideration of external factors.

Internal Rate of Return (IRR) Formula

There are two formulas for calculating the internal rate of return – do not be daunted by the size of them! There are tools and software, such as Microsoft Excel, for calculating the internal rate of return. However, it is critical to know what data to submit into the tool to generate a useable calculation.

IRR Formula Option 1

$$IRR = 0 = CF_0 + \frac{CF_1}{(1+IRR)} + \frac{CF_2}{(1+IRR)} + \frac{CF_3}{(1+IRR)} + \ldots + \frac{CF_n}{(1+IRR)}$$

CF= Cash Flow; n = each period

IRR Formula Option 2

$$IRR = NPV = \sum_{n=0}^{N} \frac{CF_n}{(1+IRR)^n} = 0$$

CF = Cash Flow; n = each period; N = holding period

Project managers should be familiar with the IRR formula so that even if software is used for the calculation, stakeholder questions about the method can be addressed.

Internal Rate of Return (IRR) Key Points for Project Management

The IRR is most used in pre-project and project selection for project feasibility studies or in planning studies for large projects. Consider these points from Project Engineer saying that the IRR of a project is:

- the expected growth rate of a project investment.
- the discount that results in an NPV of zero.
- being higher indicates a more desirable project.
- calculated via iterative methods.
- one metric of several used collectively to justify investing in a project

5. The Payback Period

The term payback period refers to the amount of time it takes to recover the cost of an investment. Simply put, it is the length of time an investment reaches a breakeven point.

People and corporations mainly invest their money to get paid back, which is why the payback period is so important. In essence, the shorter payback an investment has, the more attractive it becomes. Determining the payback period is useful for anyone and can be done by dividing the initial investment by the average cash flows.

Understanding the Payback Period

The payback period is a method commonly used by investors, financial professionals, and corporations to calculate investment returns. It helps determine how long it takes to recover the initial costs associated with an investment. This metric is useful before making any decisions, especially when an investor needs to make a snap judgment about an investment venture.

You can figure out the payback period by using the following formula:

Payback Period=Cost of InvestmentAverage Annual Cash FlowPayback Period=Average Annual Cash FlowCost of Investment

The shorter the payback, the more desirable the investment. Conversely, the longer the payback, the less desirable it becomes. For example, if solar panels cost $5,000 to install and

the savings are $100 each month, it would take 4.2 years to reach the payback period. In most cases, this is a pretty good payback period as experts say it can take as much as 9 - 10 years for residential homeowners in the United States to break even on their investment.

5. **The Accounting Rate of return (ARR)**

The <u>Accounting Rate of return</u> (ARR) is a popular method used in capital budgeting to evaluate the financial performance of a project. It measures the profitability of an investment by comparing the average annual profit to the initial investment cost. This metric provides valuable insights into the project's potential returns and helps decision-makers assess its viability. In this section, we will delve deeper into the concept of ARR, explore its calculation, provide examples, offer tips for interpretation, and showcase a case study.

1. Calculation of ARR:

To calculate the ARR, divide the average annual profit by the initial investment cost and multiply the result by 100 to express it as a percentage. The formula is as follows:

ARR = (Average Annual Profit / Initial Investment Cost) * 100

For example, if a project has an average annual profit of $50,000 and an initial investment cost of $500,000, the ARR would be:

ARR = ($50,000 / $500,000) * 100 = 10%

Theoretical Framework for Project Evaluation under Risk and Uncertainty:

Risk: Risk involves situations where multiple potential outcomes exist, each with a known probability. While the exact outcome is uncertain, probabilities can be assigned to various scenarios.

Uncertainty: Uncertainty, on the other hand, arises when future outcomes are not only unknown but also inherently unpredictable. It involves scenarios where the range of possible outcomes is vast, and probabilities cannot be reliably assigned.

- Risk Adjusted Rate Method,
- Certainty Equivalent Method,
- Probability Method,
- Sensitivity Analysis and
- Decision Tree Analysis.

1. **Risk-adjusted Discounted Rate Method**

When risk premium is added with risk-free rate to get the present value of a risky investment, it is called *risk-adjusted discount rate* (RADR). A risky investment refers to any investment that has a higher risk than normal investments. For example, high-risk investments may include real estate and other such investments.

As investors want to know the present value of risky investments, the riskadjusted discount rate is a highly efficient tool for them. Although the market rate is taken as a standard in investment return calculations, the application of risk adjusted discount rate calculations becomes instrumental in some other cases.

How Does RADR Work?

The RADR method correlates risk with return. This is done because with higher risk, the returns also tend to be higher. This is simple to understand.

- An investment that has an unforeseen higher risk is also subject to unforeseen higher returns.
- The RADR shows a correlation between the risk and the return to show the potential losses or profits of an investment if any.

Merits of RADR Method

The RADR method has certain advantages which include the following −

- It is very simple and easy to understand.
- This is an appealing approach for risk-averse investors (investors who do not seek risk).
- This process helps in reducing the uncertainty and fluctuations in the estimated returns.
- It helps to understand the overall risk level of an investment proposal or project.

Demerits of RADR Method

The demerits of the RADR method include the following

- Getting the accurate risk premium for a future event is challenging. Therefore, finding the present value of risks is also challenging.

- This approach is only completely appropriate for risk-averse investors, while there may be risk seeking investors too in the market.

2. **Certainty Equivalent Method**

    Certainty equivalent is the amount of cash an investor would accept today than going for a larger amount of cash tomorrow. Investors often use this to deny the risk. The *Certainty equivalent* helps investors earn a guaranteed income on their investment rather than going for increased risk on their investment portfolios. It is a method of reducing risk while also reducing the income from given investment instruments.Certainty Equivalent is Popular among Risk-Averse Investors

    Certainty equivalent is quite a popular method among *risk-averse* investors. These investors do not want to invest in high-return but risky investments. Instead, they forgo higher returns for the lesser amount of income during the same period of returns on investments.

    For example, let's suppose that a government bond offers a 3% return on investments. There is another bond that offers 7% returns, but it is not guaranteed as in the case of the government bond. In such circumstances, a risk-averse investor will go for the government bond rather than going for the high-return bond.

    The concept of certainty equivalent is instrumental in evaluating risk. It depends on the *risk tolerance* of an individual and hence differs from person to person. For example, investors nearing their retirement would be high certainty equivalent, as they do not wish to take increased risks on their investments.

Merits of Certainty Equivalent Method

- It shows the investment options that are safer and hence are more reliable.
- Investors can have an idea of the risk they must take for increased returns.
- It shows the minimum returns that are possible from an investment.
- The investors can be certain about the returns of similar other bonds referring to the certainty equivalent bond.

Demerits of Certainty Equivalent Method

Following are the demerits of using the Certainty Equivalent Method −

- It is based on market demands and not a foolproof method of investing.

- The *time value of money* is ignored in the certainty equivalent method.

- It does not apply to all kinds of investments.

- It applies more to risk-averse investors than other forms of investors.

3. **Probability Analysis**

Probability Analysis is classified into two categories. They are,

- Qualitative Risk Analysis

- Quantitative Risk Analysis

Qualitative risk analysis

Qualitative risk analysis is a method that involves assessing the probability and impact of each identified risk, using a predefined scale or matrix. This method helps you rank the risks according to their severity and urgency, and determine which ones require more attention and resources. Qualitative risk analysis is usually done before quantitative risk analysis, as it provides a quick and easy way to filter out the most critical risks and focus on them.

Quantitative Risk Analysis

Quantitative risk analysis is a method that involves assigning numerical values to the probability and impact of each risk, using data, models, and calculations. This method helps you measure the potential effects of the risks on your project's objectives, such as cost, time, quality, and benefits. Quantitative risk analysis is usually done after qualitative risk analysis,

as it requires more time and data to perform. It can help you estimate the likelihood of achieving your project goals, the expected value of your project, and the contingency reserves needed to cover the risks.

4. **Sensitivity Analysis**
- Project analysis is based on cash flows
- Cash flows are uncertain, and are based on assumptions
- Changes in the assumptions can change the decision Sensitivity Analysis examines the sensitivity of a decision rule (NPV, IRR, etc.) to changes in the assumptions underlying a project.

The steps:
- Do a base case analysis, based on expectations about the future.

• Identify key assumptions in the base case analysis - these could be firm specific (revenue levels, operating costs, etc.) or macroeconomic (tax rates, inflation, etc.).

• Change one key assumption at a time, and estimate the decision criterion (NPV, IRR, etc.) - summarize the impact of changing the key assumption on the decision criterion in the form of a table or graph.

• Decide whether or not to take the project based on the risk of changes in the key assumptions. The key assumptions must be either:

• those that matter the most, in terms of affecting cash flows (e.g. revenue levels), or

• those with the most uncertainty (e.g., it does not make sense to vary depreciation rates if they are fixed!).

5. **Decision Trees**

This is a presentation of the decisions and possible outcomes, with probabilities, at each stage of a multistage project.

• Break the project into clearly defined stages.

• List all possible outcomes at each stage.

• Specify probabilities of each outcome at each stage.

• Specify the effect of each outcome on expected project cash flows (the discount rates may also vary at each stage).

• Evaluate the optimal action to take at each stage in the decision tree, based on the outcome at the previous stage and its effect on cash flows and discount rate, beginning with the final stage and working backwards.

• Estimate the optimal action to take at the very first stage, based on the expected cash flows over the entire project, and all of the likely outcomes, weighted by their relative probabilities.

Hence, decision trees are most likely to work when:

• The firm makes decisions on the project in clear stages.

• The outcomes at each stage can at least be classified into broader classes.

• The probabilities of the outcomes and the effect on cash flows can be estimated at the start; this usually implies that the firm has done similar projects in the past. Very often used by oil companies in evaluating opportunities to drill for oil.

Limitations of Decision Trees:

• Decision trees provide a wealth of information to the decision maker, but they also require a wealth of information. Estimating all the outcomes and the probabilities is very difficult when

the product or service is new or unique, and the firm has no past experience of similar projects.

 • The project has to be analyzed in stages, hence decision trees are difficult to apply when investments occur gradually over time, rather than in clear stages.

• The outcomes have to be discrete (e.g., drug will be approved by FDA - yes/no). If the outcomes are not discrete (e.g., how high will the sales be), they have to be discretized into broader classes for analysis (e.g., the sales can be high/medium/low).

PROJECT MANAGEMENT -UNIT IV: Project Cost, Stakeholders, and Communication

Project Cost Management: Developing Cost Management Plan - Estimating Project Costs - Determining Project Budget - Controlling Costs - Performance Measurement Analysis for Cost Control - The Triple Constraint : Scope, Schedule, and Cost - Project Stakeholder Management: Identifying the Project Stakeholders – Planning, managing and monitoring Stakeholder Engagement - Project Communication Management: Project Communication Process, Tools and Techniques - Tools and Techniques for Managing Communication.

Cost Management Plan

A cost management plan sounds simple. It's an outline of the cost estimation for the project—but that includes all allocation and how the project manager will control those costs to bring the project in as budgeted. A cost management plan must take into account the resources that impact the project budget, whether materials or people. There are also fixed, variable and overhead costs. All these must be calculated to know what your financial commitment to the project will be.

Last but not least is the stakeholder, who has invested interest in keeping costs down. Cost overrun is a problem many projects experience, but not one that stakeholders will tolerate well. Keep the stakeholder in mind when formulating your cost management plan. They need to stay in the loop and get reports throughout the project.

Developing a Cost Management Plan

Here are some key elements that must be included in a cost management plan:

- **Estimation Methods:** Explain which cost estimation method was employed, such as parametric, bottom-up, three-point, etc.

- **Units of Measure:** To measure costs accurately, it's important to establish units of measure for your labor, materials and equipment. Some examples of measurement units can be staff hours, square feet, tons, kilograms, etc.

- **Cost Baseline:** Based on your cost estimates, you must define a cost baseline that marks the spending limit for your project.

- **Cost Control Thresholds:** Establishing thresholds to monitor cost performance is important. This simply means that when cost variation reaches a certain percentage, the

project team will take cost management actions.

- **Performance Measurement Methods:** Establish how the cost performance will be measured to see if you're meeting the goals and expectations of the project. To do so, you'll need a cost tracking system and earned value management (EVM) techniques.

- **Reporting Guidelines:** You need to have a format and communication channels to report your findings as you monitor the project's progress and present this data to your stakeholders.

Project Cost Estimation: Good cost estimation is essential for project management success. Many costs can appear over the project management life cycle, and an accurate project cost estimation method can be the difference between a successful plan and a failed one. Project cost estimating, however, is easier said than done. Projects bring risks, and risks bring unexpected costs and cost management issues.Project cost estimation is the process that takes direct costs, indirect costs and other types of project costs into account and calculates a budget that meets the financial commitment necessary for a successful project. To do this, project managers and project estimators use a cost breakdown structure to determine all the costs in a project.

What Is a Project Estimate?

A project estimate is the process of accurately forecasting the time, cost and resources required for a project. This is done by looking at historical data, getting information from the client and itemizing each resource and its duration of use in the project.

To create a project estimate, you should first define your project scope and then create a project cost breakdown structure, which allows you to pinpoint all of your different project costs for each stage of the project life cycle.

Project cost estimation is simplified with the help of project management software like ProjectManager. Add project budgets and planned costs for specific tasks and include labor rates for your team. When you build your plan on our Gantt chart, your estimated project costs will calculate automatically. Plus, as the project unfolds, you can track your costs in real time on our automated dashboard.

What Is a Project Cost Breakdown Structure: A cost breakdown structure (CBS) is a very important project costing tool that details the individual costs of a project on a document. Similar to a <u>work breakdown structure (WBS)</u>, it's a hierarchical chart where each row represents a type of cost or item. This is done at the task level, which is called a bottom-up analysis.

Creating a <u>cost breakdown structure</u> might be time-consuming, but one that's worth the effort in that the result is a more accurate estimate of costs than you'd get with a top-down approach, such as basing all your estimates on the costs of previous, similar projects.

Using a cost breakdown structure is an essential part of project cost management and <u>resource management</u>. By zeroing in on costs at the task level early during the project planning phase, you're less likely to miss hidden costs that could come up later during the project execution stage and throw your project budget off.

Types of Project Costs

There are five main types of costs that make up your total project cost. Here's a quick overview of these types of project costs and how to measure them.

- **Direct costs:** Direct costs are those that occur in a project and are attached to specific activities. These are generally costs that are easier to accurately estimate. They include raw materials, labor, supplies, etc.

- **Indirect costs:** Indirect costs in a project are those that are in support of the project, such as administrative fees. These can include everything from rent to salaries of the administrative staff to utilities, etc.

- **Fixed costs:** Fixed costs, as the name suggests, are those that don't change throughout the <u>life cycle of a project</u>. Some examples of fixed costs include setup costs, rental costs, insurance premiums, property taxes, etc.

- **Variable costs:** Variable costs are costs that change due to the amount of work that's done in the project and are variable in nature. These costs can include hourly labor wages, materials, fuel costs and so on.

- **Sunk costs:** In project cost estimating, when an investment has already been incurred and can't be recovered it's called a sunk cost or retrospective cost.

Some examples of sunk costs include marketing, research, installation of new software, etc.

What Does a Project Estimator Do?

The project estimator or cost estimator, is tasked with figuring out the duration of the project in order to deliver it successfully. This includes determining the resources needed, including labor, materials, etc., which informs the project budget.

In order to do this, a project estimator must understand the project and its phases and be able to research the historical data of projects that were similar and executed in the past. Cost estimators also need to have a firm grasp of mathematical concepts.

Unlike a project manager, who's responsible for the delivery and oversight of the project, a project estimator is focused on the direct and indirect costs associated with the project. Project estimators work closely with contractual professionals to develop accurate estimates, which are presented to project leaders.

Project Cost Estimation Techniques

All of these factors impact project cost estimation, making it difficult to come up with precise estimates. Luckily, there are cost estimating techniques that can help with developing a more accurate cost estimation.

- **Analogous Estimating**

Seek the help of experts who have experience in similar projects, or 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.

- **Parametric Estimating**

There's statistical modeling or parametric estimating, another cost estimation method that also uses historical data of key cost drivers and then calculates what those costs would be if the duration or another of the project is changed.

- **Bottom-Up Estimating**

A more granular approach is bottom-up estimating, which uses estimates of individual tasks and then adds those up to determine the overall cost of the project. This cost-estimating method is even more detailed than parametric estimating and is used in complex projects with many variables such as software development or construction projects.

- **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 an estimation.

- **Reserve Analysis**

Reserve analysis determines how much contingency reserve must be allocated. This cost estimation method tries to wrangle uncertainty.

- **Cost of Quality**

Cost of quality 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. Plus, comparing bids from vendors can also help figure out costs.

- **Dynamic Project Costing Tools**

Whenever you're estimating costs, it helps to use online software to collect all of your project information. Project management software can be used in Congress with many of these

techniques to help facilitate the process. Use online software to define your project teams, tasks and goals. Even manage your vendors and track costs as the project unfolds. We'll show you how.

Free Project Cost Estimation Template

ProjectManager has free templates for every aspect of managing a project, including a free cost estimate template for Excel. It can be used for any project by simply replacing the items in the description column with those items that are relevant to your project.

This free cost estimate template has all the fields you'd need to fill in when estimating project costs. For example, there's the description column followed by the vendor or subcontractor column and then there are columns to capture the labor and raw materials costs. These can be added together by line and then a total project cost can be calculated by the template.

How to Estimate Project Costs in 10 Steps

The U.S. government has identified a 10-step process that results in reliable and valid cost estimates for project management. Those steps are outlined below.

1. **Define the cost estimate's purpose:** Determine the purpose of the cost estimate, the level of detail that is required, who receives the estimate and the overall scope of the estimate.

2. **Develop an estimating plan:** Assemble a cost-estimating team and outline their estimation techniques. Develop a timeline, and determine who will do the independent cost estimate. Finally, create the team's schedule.

3. **Define characteristics:** Create a baseline description of the purpose, system and performance characteristics. This includes any technology implications, system configurations, schedules, strategies and relations to existing systems. Don't forget support, security, risk items, testing and production, deployment and maintenance and any similar legacy systems.

4. **Determine cost estimating techniques:** Define a <u>work breakdown structure (WBS)</u> and choose an estimating method that's best suited for each element in the WBS. Cross-check for cost and schedule drivers; then create a checklist.

5. **Identify rules, assumptions and obtain data:** Clearly define what's included and excluded from the estimate and identify specific assumptions.

6. **Develop a point estimate:** Develop a cost model by estimating each WBS element.

7. **Conduct a sensitivity analysis:** Test the sensitivity of costs to changes in estimating input values and key assumptions, and determine key cost drivers.

8. **Conduct risk and uncertainty analysis:** Determine the cost, <u>schedule</u> and technical risks inherent with each item on the WBS and how to manage them.

9. **Document the estimate and present it to management:** Having documentation for each step in the cost estimate process keeps everyone on the same page with the cost estimate. Then you can brief the project stakeholders on cost estimates to get their approval.

10. **Update the cost estimate:** Any changes to the cost estimate must be updated and <u>reported</u>. Also, perform a postmortem where you can document lessons learned.

Determine Project Budget:

A project budget is the total projected costs needed to complete a project over a defined period of time. It's used to estimate what the costs of the project will be for every phase of the project. Creating a project budget is a critical part of the project planning process.

The project budget will include such things as labor costs, material procurement costs and operating costs. But it's not a static document. Your project budget will be reviewed and revived throughout the project, hopefully with the help of <u>project budgeting software</u>.

Project Budgeting

Project budgeting is the process of estimating the full cost of the project from the very beginning until the end. The project budgeting process involves the following:

- **Budget planning:** Estimating costs and making a budget based on a project estimate

- **Budget tracking:** Keeping track of project expenses during the project execution phase

- **Project budget management:** Setting guidelines and control procedures to guarantee that costs don't exceed the project budget

What Is Project Budget Management?

Project budget management is a process by which the finances related to the project are administered and overseen. It goes beyond estimating the cost of completing the project and includes tracking those costs and much more. Some of the aspects of project budget management include how you'll estimate the cost of the project and how those costs will be spread across the life cycle of the project. You'll need to determine the metrics and the method by which you'll track those costs to keep to the budget.

Reporting on the budget is also part of project budget management, including how you'll do it and the frequency with which you'll do it. If you find you're going over budget, you'll need to come up with a plan to rein the budget back in. You'll even need to define a process of learning from historical data.

Project management software simplifies project budgeting and project budget management. Take ProjectManager; all you have to do is open up the settings on your Gantt and set a budget baseline. Now you have the planned effort saved and you can use budget tracking features such as real-time dashboards to compare it to your actual effort as you execute the project. You can reset the baseline as many times as you need during the project to always be able to measure your project variance instantly.

As noted, there are many components necessary to build a budget, including direct and indirect costs, fixed and variable costs, labor and materials, travel, equipment and space, licenses and whatever else may impact your project expenses.

To meet the financial needs of your project, a project budget must be created thoroughly, not missing any aspect that requires funding.

Seven essential steps toward creating and managing your project budget:

1. Use Historical Data

Your project is likely not the first to try and accomplish a specific objective or goal. Looking back at similar projects and their budgets is a great way to get a headstart on building your budget.

2. Reference Lessons Learned

To further elaborate on historical data, you can learn from their successes and mistakes. It provides a clear path that leads to more accurate estimates. You can even learn about how they responded to changes and kept their budget under control. Here's a lessons learned template if you need to start tracking those findings in your organization.

3. Leverage Your Experts

Another resource to build a project budget is to tap those who have experience and knowledge—be they mentors, other project managers or experts in the field. Reaching out to those who have created rough order of magnitude estimates and budgets can help you stay on track and avoid unnecessary pitfalls.

4. Confirm Accuracy

Once you have your budget, you're not done. You want to look at it and ensure your figures are accurate. You can use our project budget proposal template for this process. You can also seek those experts and other project team members to check the budget and make sure it's right.

5. Baseline and Re-Baseline the Budget

Your project budget is the baseline by which you'll measure your project's progress once it

has started. It's a tool to gauge the variance of the project. But, as stated, you'll want to re-baseline as changes occur in your project. Once the change control board approves any change you need to re-baseline.

6. Update in Real Time

Speaking of changes, the sooner you know about them, the better. If your project planning software isn't cloud-based and updating as soon as your team changes its status, then you're wasting valuable and expensive time.

7. Get on Track

The importance of having a project management software that tracks in real time, like ProjectManager, is that it gives you the information you need to get back on track sooner rather than later. Things change and projects go off track all the time. It's the projects that get back on track faster that are successful.

If you manage your project expenses using these building blocks you're going to have a sound foundation for your project's success.

Project Budgeting Tips

A project budget is extremely important; without the funds to execute a project, it's dead in the water. We've explained what a project budget is, and how to make one and we've provided examples. But when you're in the thick of it, you need tips. These will help you with project budgeting.

1. **Document your process when putting together a budget.** Documents are essential for tracking the project and reviewing the outcomes.

2. **Create contingencies.** Have a plan B in place. There will always be unexpected costs, delays and other issues that'll impact your budget.

3. **Project budgeting is a team effort.** Seek advice from your team, as they're the ones with experience executing projects. Meet with experts who can provide you with guidance. Any person or organization that has insight should be tapped for their expertise.

4. **Know your resources and their associated costs.** This includes any

maintenance required for equipment, and don't forget your team is also a resource. Know their availability, overtime potential and other overhead costs.

5.   **When estimating costs don't forget about task duration.** These are also estimates and can greatly impact the budget.

6.   **The budget is a great tool for tracking performance.** It can even be used as a communication tool for teams across departments

Cost Control

Cost control is the process of measuring cost variances from the baseline and taking appropriate action, such as increasing the budget allocated or reducing the scope of work, to correct that gap. Cost control is a continuous process done throughout the project lifecycle

Cost Control Techniques

Following are some of the valuable and essential techniques used for efficient project cost control:

1 - Planning the Project Budget

You would need to ideally make a budget at the beginning of the planning session with regard to the project at hand. It is this budget that you would have to help you for all payments that need to be made and costs that you will incur during the project life cycle. The making of this budget therefore entails a lot of research and critical thinking.

Like any other budget, you would always have to leave room for adjustments as the costs may not remain the same right through the period of the project. Adhering to the project budget at all times is key to the profit from project.

2 - Keeping a Track of Costs

Keeping track of all actual costs is also equally important as any other technique. Here, it is best to prepare a budget that is time-based. This will help you keep track of the budget of a project in each of its phases. The actual costs will have to be tracked against the periodic targets that have been set out in the budget. These targets could be on a monthly or weekly basis or even yearly if the project will go on for long.

This is much easier to work with rather than having one complete budget for the entire period of the project. If any new work is required to be carried out, you would need to make

estimations for this and see if it can be accommodated with the final amount in the budget. If not, you may have to work on necessary arrangements for 'Change Requests', where the client will pay for the new work or the changes.

3 - Effective Time Management

Another effective technique would be effective time management. Although this technique does apply to various management areas, it is very important with regard to project cost control.

The reason for this is that the cost of your project could keep rising if you are unable to meet the project deadlines; the longer the project is dragged on for, the higher the costs incurred which effectively means that the budget will be exceeded.

The project manager would need to constantly remind his/her team of the important deadlines of the project in order to ensure that work is completed on time.

4 - Project Change Control

Project change control is yet another vital technique. Change control systems are essential to take into account any potential changes that could occur during the course of the project.

This is due to the fact that each change to the scope of the project will have an impact on the deadlines of the deliverables, so the changes may increase project cost by increasing the effort needed for the project.

5 - Use of Earned Value

Similarly, in order to identify the value of the work that has been carried out thus far, it is very helpful to use the accounting technique commonly known as 'Earned Value'.

This is particularly helpful for large projects and will help you make any quick changes that are absolutely essential for the success of the project.

Project Performance Measurement Techniques

One of the most important aspects of project cost control is cost performance measurement. You can use a number of performance measurement techniques to measure cost performance, including cost variance, earned value management (EVM), and the cost performance index. Details about these three cost performance measurement techniques are provided below.

1. Cost variance

Cost variance (CV) is the most basic performance measure. Simply stated, cost variance is the difference between the earned value and actual costs. A positive variance indicates that

the project is running under budget, while a negative variance means that costs are overrunning. For the purpose of tracking over- or underrun percentages, you may want to use tables, Gantt charts, or bar charts.

Cost variance is typically expressed as a ratio or percent. You can calculate CV by comparing the actual cost of the work (AC) to the earned value (EV). Follow the steps below to calculate cost variance.

- Calculate the difference between the earned value of the project and the actual costs.

- Divide this amount by the earned value.

- Multiply this figure by 100 to obtain a percentage.

- Keep the negative sign for cost overruns.

The project manager's goal in calculating variances is to provide the basis for earned value management. You must understand the problems behind variances and take action that will correct any problems.

2. Earned value management

Earned value management is perhaps the most useful activity in cost control because it combines costs and the schedule into one indicator. It tells you how much the project is physically accomplishing in terms of both cost and time, giving management a more accurate and timely report on project progress.

The concept of earned value management multiplies the project budget (planned value, or PV) and percent-complete figures to arrive at a budgeted dollar value of the work that has actually been completed so far. The main difficulty in using earned value data to measure cost performance is in determining work completion. How does one accurately measure how much of a task is complete, while avoiding subjectivity in measuring performance as much as possible?

There are five methods you can use to assess work completion. They are described below, from the most conservative and least accurate to the most accurate.

- **The zero/100 rule**. Many companies do not assess percent complete incrementally. This removes any subjectivity. A task is assessed as either not done (zero percent complete) or finished (100 percent complete). This method works well for activities with a short

duration—less than a month, for example.

- **The 20/80 rule**. This method is almost as conservative as the zero/100 rule. When it is started, a task is considered to be 20 percent complete, and 20 percent of the PV is charged against its account. When the task is complete, the remaining 80 percent of the budget is applied to the task.

- **The 50/50 rule.** This is probably the most popular method. You assume that once a task has begun, 50 percent of its budget is used. When a task is complete, it has used the other half. For a project with a large number of tasks, this method provides a fairly accurate way to calculate earned value.

- **The milestone method**. This is used for long work packages that are broken down into distinct milestones. A budget is assigned to each milestone instead of to the task as a whole. Value is earned when each milestone is completed.

- **The percent complete**. This method is usually used for long-duration work packages (for example, ones that last three months or more). Your project may not have identifiable milestones, but you are still able to estimate the percentage of the task that has been completed.

3. The cost performance index

You can use the earned value figure to establish another important performance indicator. Calculate the ratio of earned value to the actual costs to find out how efficiently your team is accomplishing the work. This ratio is called the cost performance index (CPI). The formula for calculating CPI is as follows:

$CPI = EV \div AC$.

When the CPI is measured periodically, you can plot CPI figures in a line graph to see the trend over the life of the project. This is called a trend analysis.

You will usually see the cost performance index reported along with its "companion" indicator—the schedule performance index (SPI). The SPI is the ratio of earned value (EV) to the planned costs (PV).

Project managers use the CPI and SPI to rate the cost and schedule performance of their projects. A poor rating provides a warning signal, allowing for corrective action to be taken before it's too late. These indexes fall into three categories:

- If equal to 1.0, performance is exactly as planned.

- If greater than 1.0, performance is better than planned.

- If less than 1.0, performance is poor.

Evidence shows that without corrective action, most projects will continue to perform at their cumulative CPI rate. Once the project is about one-third complete, you will have difficulty recovering from a CPI of less than 1.0 without aggressively managing the remaining tasks.

Remember, it's important to measure the cost performance of your projects. By using the three techniques described above, you can control project costs and ensure the project comes in on-budget.

The Triple Constraint in Project Management: Time, Scope & Cost

The triple constraint of project management has been given many names – the Project Management Triangle, Iron Triangle, and Project Triangle – which should give you an idea of how important the triple constraint is when managing a project. If you're managing a project, then you're working with the Triple Constraint. It's a model of the constraints inherent in managing a project. Those constraints are threefold:

1. Cost: The financial constraints of a project, also known as the project budget
2. Scope: The tasks required to fulfill the project's goals
3. Time: The schedule for the project to reach completion

Basically, the triple constraint states that the success of the project is impacted by its costs, time, and scope. As a project manager, you can keep control of the triple constraint by balancing these three constraints through trade-offs.

How Does the Triple Constraint Work?

As stated above, project managers can increase or reduce the cost, time and scope of a project with trade-offs to keep it on schedule and under budget. Let's see how these project triangle trade-offs work with some examples.

- **Time and Scope:** You can reduce your project scope to also reduce your

project duration if you're running behind schedule. In the opposite case, you can increase the length of your project timeline in case the project stakeholders come up with extra project activities.

- **Cost and Scope:** By reducing the project scope, you'll need to execute fewer tasks, which means lower costs. In the opposite case, a larger project scope means higher costs.

- **Cost and Time:** In some projects, time and cost can be directly related. For example, the costs of renting equipment or labor are directly proportional to the time you need them for.

All these scenarios apply the triple constraint for managing the project, but there are many more possible trade-offs that can occur in a project, which also involve quality, risk and benefit.

How to Manage the Triple Constraint

The triple constraint appears simple, but that's only on the surface. Each of the three points of this triangle can be unpacked to reveal deeper meaning.

<u>Cost</u>

The financial commitment of the project is dependent on several variables. There are the resources involved, from materials to people, which all include costs.

There are also the fixed and variable costs inherent in any project, such as equipment or labor, which must be calculated. This can seriously come into play with the use of contract workers or outsourcing.

This is what project managers do to control costs:

- Estimate the costs for all the tasks in the project scope

- Create a project budget based on the estimated costs of the project

- Use the project budget as a cost baseline, which is employed to control costs during project execution

- Control all project costs to keep spending under the project budget

- Adjust the project budget when necessary

Scope

As mentioned, the project scope refers to all the project work required to complete the project. Managing that work is critical for project success. When managing scope it's critical that you prioritize your tasks, enabling you to plan and assign resources effectively.

To manage scope, project managers:

- Use a scope management plan to clearly define what project activities will be done

- Share the scope management plan with all stakeholders, so everybody is on the same page

- Use change orders to avoid scope creep and keep track of all changes made to the project scope

- Manage stakeholder's expectations to maintain the project scope

- Use task management tools and techniques to keep track of all project activities in the scope

These scope management actions taken by project managers are all essential because the amount of time each task will require is critical to the cost and quality of the final product. This can have a great impact on schedule and cost, especially so if the project is on a large scale.

Time

At its basic, the project schedule is the estimated timeline allotted to complete the project, or produce the final deliverable. Usually, this is figured out by first estimating the time that each project task will take.

A Work Breakdown Structure (WBS) is used to identify all the project activities. Then project managers can use different scheduling techniques such as the critical path method or PERT charts to determine the total duration of the project.

Here's what project managers do to control the project schedule:

- Use a Gantt chart to visualize the project schedule, define task sequences and monitor the duration of each task

- Create policies, procedures and documentation for planning, executing and monitoring the project schedule

- Allocate resources effectively using a resource schedule to avoid bottlenecks

- Compare the schedule baseline to actual progress to determine if projects are on track

Project Stakeholder Management

Project stakeholders are probably the most critical people who play a role in your project's success. Project stakeholders are any group of people that can have an influence or can be influenced by the project. In other words, they have a stake in the project. After completion, whether the project failed or succeeded depends on how much the stakeholders are satisfied.

This is why stakeholders are very critical for any project's completion and identifying and managing them is key for your project's success.

Types of project stakeholders

Project stakeholders can be broadly categorized into two ways:
1. Internal stakeholders

These individuals or organizations are involved in the project from within the organization. *They include (but are not limited to):*

- **The project team:** They are a group of individuals who work on the project to ensure its execution.
- **The project manager:** The project manager has the responsibility of project planning, procuring, and executing the project.
- **The sponsor:** Project sponsors own the project and ensure the provision of resources for the project. They hold responsibility for the project.
- **Internal teams:** Other teams can use the outcome of the project. For example, the sales team.

2. External stakeholders

External stakeholders are affected by the project's outcome even though they are not involved in the project directly. *They can include:*

- The external clients
- The end-user

- The subcontractors
- The government
- The supplier
- The community

Importance of project stakeholders are important

As mentioned earlier, any project's success depends on the satisfaction of the stakeholders. Understanding the needs and expectations of stakeholders is very important for successful project execution. *The role of stakeholders in* project management *is important because of the following reasons:*

- **They bring experience to the table**

Stakeholders often provide invaluable expertise about the project. They have a sound understanding of the relevant process and how things work in the industry. Based on their experience, they can provide clear deliverables and identify project constraints that the project managers might not be aware of.

- **They help identify risks**

The only way to mitigate risks is to first identify them. This is where stakeholders can offer valuable insights. They might raise concerns at the beginning of the project and might want to discuss potential risks. Identifying project risks at the beginning can allow you to prepare accordingly and prepare contingency plans.

- **They help increase the chances of success**

Engaging with stakeholders helps to have a clear view of the project expectations right from the start. It also helps keep them on the same page regarding their expectations of the project, especially as the project progresses. Taking continuous input from stakeholders might increase their interests and stakes in the project. This can increase the chances of the project's success dramatically.

How to identify stakeholders in a project

There has to be a significant effort toward identifying project stakeholders early on. This involves prioritizing stakeholders according to their vested interests in the project as well as their

overall impact and influence on the project. The process of identifying stakeholders ideally starts when your sponsor approves the project charter.

The following documents and techniques can help you identify the stakeholders:

1. Project Charter

This document normally identifies the project head, key sponsors, clients, and influencers. The project charter can provide useful insights for identifying the stakeholders.

2. Reviewing the Enterprise Environmental Factors

The enterprise environmental factors (EEF) may involve factors such as competition, the company's structure, and industry standards. Reviewing these factors can help you identify the stakeholders.

3. Interviewing the influencers

Interviewing the project management experts and key influencers is also instrumental in identifying the key stakeholders.

4. Asking questions

Brainstorming sessions between the project team members and experts are a great way of getting the stakeholders involved. For getting a clearer picture, try answering these questions:

- Who are this project's shareholders?
- Who is involved in the project? Directly or indirectly.
- Who gains if the project is successful?
- Who are the suppliers?
- Who can accept or reject the project?
- Who might be affected by the project's outcome?

Answering questions like these can go a long way in successfully identifying your project's stakeholders.

Stakeholder_Management_Planning

Even though each stakeholder management approach can be different depending on the needs of your project or business, there are some best practices to manage your stakeholder

relations.

Follow these five steps to make sure all of your bases in the stakeholder management plan are covered.

1. Identify your Stakeholders

The first step to any good stakeholder management plan is proper stakeholder identification. Identify who are the key individual stakeholders and stakeholder groups to your project or business. Stakeholder theory can help you better understand who your stakeholders are and how they're affected by your project.

2. Prioritize Your Stakeholders

Note which key stakeholders are going to have a bigger influence over the project, and at which stage their influence becomes lesser or greater. You can use an onion diagram for the stakeholder prioritization process. Always keep an eye on your key stakeholder relations as they can have the highest impact in your project or business.

3. Interview Your Stakeholders

Working with new stakeholders can be tricky at the start. Knowing your stakeholders is key to effective stakeholder relationship management. Because of this it's advisable to interview your project stakeholders, here are some examples.

- What are your expectations for this project?
- Which deliverables are you most interested in?
- What do you hope this project changes after launch?
- How quickly do you see this project rolling out?
- If you feel positively about this project, why?
- If you have worries about this project, why?

4. Create a Power Interest Grid

A power interest grid or project interest matrix is a chart that allows you to determine the level of power and interest that your stakeholders have in the project. It's a very helpful project management tool for stakeholder analysis.

You can identify these four stakeholder groups using this tool. They're listed by importance.

- High power, high interest stakeholders

- High power, low interest stakeholders
- Low power, high interest stakeholders
- Low power, low interest stakeholders

5. Set & Manage Expectations

Clearly identify which stages each key stakeholder will be involved in, and timelines by which their feedback is needed. Create a stakeholder engagement or stakeholder communication plan to define how you'll manage your stakeholder relations. As always, be realistic, transparent and honest at every project management phase

Managing project stakeholders

Managing all the different stakeholders is perhaps the most critical part of your project. It is a project in and of itself. Managing stakeholders effectively will be an ongoing sub-project within your main project and you can't afford to make mistakes here.

1. Involve stakeholders throughout the project

Identify the stakeholders early on along with their types and create a stakeholder management plan. Engage them with interviews and questionnaires from time to time. If the stakeholders are external, add them to your project dashboard so they get a real-time view of the progress. They should also be able to provide feedback for the project deliverables.

2. All stakeholders must agree on the deliverables

Right from the start, all project stakeholders should be on the same page regarding the deliverables of the project. It is crucial to establish people's roles and responsibilities as clearly as possible to avoid any confusion in the later stages of the project. Doing so is the best way to avoid project failure, delays, and cost overruns.

3. Define mechanisms that govern changes

Change requests are a common occurrence in complex projects. Many requirements defined in the earlier phases of the project might need to be revisited later. A pre-defined way of handling change requests is extremely important. Otherwise, issues like scope creep might affect your performance and reduce the productivity of your team.

4. Effective communication is key

Meaningful and valuable communication in project management is vital for the project's success. The frequency of communication is also important and should be selected according to the involvement and interest of a particular stakeholder. Maintaining a stakeholder register from the initiating phase is one of the many proven ways of determining the frequency and method of communication for each stakeholder.

5. Try to see things from their perspective

Part of managing the stakeholders is to visualize the situation from their standpoint. You need to understand what each stakeholder signed up for and what are their specific contexts. If you can relate to their perception about how the project impacts them, you can be better prepared to manage them and their expectation

<u>MONITORING STAKEHOLDER ENGAGEMENT</u>

Stakeholder Engagement inspection is always assessed against the Stakeholder Management Plan. Keep this handy and available. You will want to check that the project's Stakeholder Engagement activities are effective towards:

- managing Stakeholder expectations
- improving the understanding of Stakeholders' needs and expectations
- fostering Stakeholder support
- addressing emerging issues early, before they get too big
- enhancing Stakeholder satisfaction to the degree possible

Useful tools to Monitor Stakeholder Engagement include:

- Survey: to obtain feedback on Stakeholder level of satisfaction with the project. One good question to ask is "In what way is this project meeting (or not meeting) your expectations.
- Counting the number of persons who attend open houses, reply to surveys, etc.
- Complaint log: to analyse customer complaints
- Meetings with Stakeholders (including: open houses, meetings by invite)

<u>Project Communication Management</u>

Project Communications Management includes the processes necessary to ensure that the

information needs of the project and its stakeholders are met through the development of artifacts and implementation of activities designed to achieve effective information exchange.

It is one of the ten key Knowledge Areas that lays the foundation of Project Management framework and plays a major role in keeping the entire project team on the same page.

Without proper communication management, the entire project management framework can crumble down, as a lack of communication may result in the breakdown in various processes. This can further have a negative effect on the final deliverable and thus result in an unsuccessful project.

Project Communications Management covers various processes which ensure that the correct project information is delivered to the correct teams and at the correct time. Effective communication helps in establishing a healthy relationship between diverse stakeholders with varying cultural and organizational backgrounds, expertise levels, interests, and perspectives. Altogether they can influence the project execution and the final product. The complete process of project communications management is an aggregation of two parts:

1. The *first part* deals with the development of a strategy that ensures an effective communication system for stakeholders.
2. The *second part* aims to perform the activities which are required for implementing the communication strategies.

   Some of the highly recommended skills for a project manager that help in establishing effective communication are listed below:

- Strong active listening
- Proficient writing
- Fluent speaking ability
- Questioning and exploring ideas
- Establishing and managing expectations
- Motivating team to become and stay engaged
- Guide team to enhance performance
- Conflict resolution
- Ability to Summarize and reiterate
- Identify the next most efficient step

Along with the above-listed skills, a project manager must also follow the **5 C's** of communication that will help in creating an uninterrupted and systematic communication throughout the project. These five C's are:

- Correct
- Concise
- Clear
- Coherent
- Control

In terms of project management, communication can be of various types:

1. **Written Communication:** It is one of the most precise forms of communication that is transmitted via a correspondence medium. It can be further segregated into two forms:
    a. *Written Formal:* Project charter, scope statement, project plan, WBS, project status, complex issues, contract related communications, Memos etc.
    b. *Written Informal:* email, notes, letters, regular communication with team members etc.

2. **Oral Communication:** This type of communication has a high degree of flexibility is done through the medium of personal contact, the team meets, telephonic etc. It can be further categorized into two forms:
    a. *Oral Formal:* Presentations, speeches, negotiations etc.
    b. *Oral Informal:* Conversation with team members, project meetings, break-room or war-room conversations etc.

3. **Non-Verbal Communication:** It is the most basic form of communication and approx 55% of communication is done in this form. General examples of this type of communication are facial expressions, hand movements, the tone of voice while speaking, etc.

Communication Management Benefits

- *Expectations:* Project communication plan helps in setting standards for how and when communication should take place. This aids a manager in maintaining the project control and ensuring that all the stakeholders receive the required information.

- *Consistency:* With a proper communication plan, a project manager becomes more consistent in handling project activities. Also, it gives the team members a direction following which they can communicate with the rest of the team and stakeholders consistently.

- *Productivity:* Efficient project management plan keeps all the team members well informed about the project happenings. This way they are always equipped with the information that they need instead of halting the work and look for missing information.

- *Outcome:* It establishes a proper and clear communication channel between the team and the stakeholders which ensures that the team knows exactly what the stakeholders want, need and expect from the project output.

- *Controlled Communication:* Communication management also ensures that the right information is delivered to the right people and at the right time. This leaves no space for ambiguity or confusion and provides a smooth flow of communication.

- *Project Team Collaboration:* Good communication often results in better collaboration among the team members and enhances focus on the whole.

- *Effective Kickoff Session:* A well-organized communication management plan gives a good kick off to the projects as it ensures that the project and methodologies are discussed and reviewed at a high-level. Once this is ensured further communication processes are expressed and agreed upon by the team members which gives them a clear picture of what will happen next and what their role in the project.

Project Communication Management Processes

The project communication management Knowledge Area is made up of the following three processes:

1. Plan Communications Management

Plan Communication Mangement is the initial process of project communication management knowledge area. In this process, a systematic and effective plan is developed for

the activities involved in project communication. It majorly makes use of the information like the requirement of each and every stakeholder and teams, organizational assets available and the project needs. Plan communication management process is performed in periodic intervals throughout the project life cycle. It primarily helps in the timely presentation of the relevant data through a documented approach that keeps the stakeholders engaged in an efficient manner.

Plan communication management involves various inputs, tools & techniques and outputs which I have listed in the below table:

Inputs	Tools & Techniques	Outputs

1. Project Charter
2. Project ManagementPlan
   o Resource Managemen tPlan
   o Stakeholder Engagemen tPlan
3. Project Documents
   o Requirements
   o Documentation
   o Stakeholde r Register
4. Enterprise Environmental Factors
5. Organizational ProcessAssets
	1. Expert Judgment
	2. Communication Requirements Analysis
	3. Communicatio nTechnology
	4. Communicatio nModels
	5. Communicatio nMethods
	6. Interpersonal and TeamSkills
	   o Communicatio nStyles Assessment
	   o Political Awarenes s
	   o Cultural Awarenes s
	7. Data Representation
	   o Stakeholder
		1. Communications Management Plan
		2. Project ManagementPlan Updates
		   o Stakeholder Engagemen tPlan
		3. Project Documents Updates
		   o Project Schedul e
		   o Stakeholde rRegister

	Engagement Assessment Matrix 8. Meetings	

2. Manage Communications

The second process of project communication management is Manage Communications which mainly aims to collect, create, distribute, store, retrieve, manage, monitor and finally dispose of the project information in an appropriate and timely manner. It is performed throughout the project lifecycle in order to provide an effortless and efficient flow of information from the project team to stakeholders and vice-versa. This process also helps in identifying different aspects of effective communication along with the most suitable methodologies, technologies, and techniques. Furthermore, it allows the entire communication system to be more flexible by providing space for any adjustments in methods and techniques. It helps in accommodating the changing demands and needs of the stakeholders without disrupting the communication flow.

In the below table I have listed down the complete list of inputs, tools & techniques and

outputs involved in the process of Manage Communications:

Inputs	Tools & Techniques	Outputs

1. Project Management Plan
    o Resource Management Plan
    o Communications Management Plan
    o Stakeholder Engagement Plan
2. Project Documents
    o Change Log
    o Issue Log
    o Lessons Learned Register
    o Quality Report
    o Risk Report
    o Stakeholder Register
	Communication Technology
	
	1. Communication Methods
	2. Communication Skills
	    o Communication
	    o Competence
	    o Feedback
	    o Nonverbal
	    o Presentations
	3. Project Management Information System
	4. Project Reporting
	5. Interpersonal and Team Skills
	    o Active Listening
	    o Conflict
		Project Communications
		Project Management Plan Updates
		Communication Management Plans
		Stakeholder Engagement Plan
		Project Document Updates
		Issue Log
		Lessons Learned Register
		Project Schedule
		Risk Register
		Stakeholder Register
		Organizational Process

	Management	Assets Updates
3. Work Performance Reports 4. Enterprise Environmental Factors 5. Organizational Process Assets	o Cultural Awareness o Meeting Management o Networking o Political Awareness 6. Meetings	

3. Monitor Communications

Monitor Communications is the final process of the communication management knowledge area. This process ensures that all the information needs and requirements of the project and the involved stakeholders are met by its completion. It is performed throughout the project lifecycle and helps in optimizing the flow of the information as per the communication management and stakeholder engagement plan.

Below table contains the list of various inputs, tools & techniques and outputs involved in the final process of project communication management:

Inputs	Tools & Techniques	Outputs
Project Management Plan Resource Management Plan Communications Management Plan Issue Log Lessons Learned Register Project Communications Work Performance Reports Enterprise Environmental Factors Organizational Process Assets	Expert Judgement Project Management Information System Data Analysis Stakeholder Engagement Assessment Matrix Interpersonal & Team Skills Observation/Conversation Meetings	Work Performance Information Change Requests Project Management Plan Updates Communication Management Plans Stakeholder Engagement Plan Project Document Updates Issue Log Lessons Learned Register Stakeholder Register

Manage Communications: Tools and Techniques

1. **Communication Technology** : This is also considered in making the Communications Management Plan. The factors that influence the choice of communications technology are:

- Urgency of the information–this will affect the frequency and the format of the information.

- Availability and reliability of technology–this is important when choosing any type of technology.

- Ease of use–if communications technology is unfamiliar to people, there should be training events planned in order to get them up to speed so that.

- Project environment–This will determine whether meetings are face-to-face or in a virtual environment.

- Confidentiality of information–There may be some proprietary information which should not be shared with certain outside groups, for example, when communicating with vendors or with contract employees who are not directly employed by the organization.

- Organizational culture–many of the ground rules for communication on the project will be ones that are set by the organization that is doing the project.

2. **Communications Methods**

There are three basic communications methods used to share information among project team members and project stakeholders.These can be broadly classified as follows:

- Interactive communication (one-on-one or many-to-many)–this is a multi-directional exchange of information. Examples: meetings, phone calls, instant messaging, some forms of social media, and video-conferences.

- Push communication (one-to-many)–this is information sent to specific recipients who need to receive it. Examples: letters, memos, reports, faxes, voice mails, blogs, press releases.

- Pull communication (many-to-one)–requires the recipients to access content at their own discretion subject to security procedures; usually reserved for large complex information sets, or for large audiences. Examples: E-learning, web portals, intranet sites, lessons learned databases, knowledge repositories.

3. **Communication Skills**: There are many sets of skills needed in communication. Here are some of them:

- Communication competence–this is mainly dealing with interactive (one-on-one) communication.
- Feedback–In your role as project manager, you will need to give feedback to your members to correct behavior that does not conform to the ground rules set at the beginning of the project or that addresses a conflict that has arisen between members.
- Nonverbal–when you are speaking, learn to use vocal variety (varying the tone and pitch of your voice, using pauses for emphasis), gestures to punctuate the meaning of what you are saying, and facial expressions (even exaggerated ones) again to emphasize your point.
- Presentations–clear and effective presentations are important. You need to get across the four categories of preferences people have in communication.
  - Ideas
  - Action
  - People
  - Process

4. **Project Management Information System (PMIS)**

This is a software tool like Microsoft Project which can be use to help manage the following:

- Project management–this can help you establish a schedule, and create a dashboard to help monitor progress in maintaining that schedule
- Electronic communications–this can help you with various forms of communication with project team members and stakeholders on the project
- Social media–helps form online communities that can engage stakeholders with what's going on in the project

5. **Project Reporting**

This is a matter of taking work performance information (the comparison of the actual work with the work as projected in the plan) and putting it in a useful form as work performance reports that go out to the stakeholders. The most important information should be sent out to

relevant stakeholders on a regular basis, although you should also be prepared to send out information as requested by key stakeholders.

6.   Interpersonal and Team Skills

These are skills that are used in working one-on-one with project team members (interpersonal skills) and the project team as a whole in meetings (team skills).

- Active listening
- Conflict management
- Cultural awareness
- Meeting management–project meetings are the bane of every project manager's existence.
- Networking–This is either personal, face-to-face networking or virtual in the form of e-mails and/or social media. This is done to
    - Solve problems
    - Influence actions of stakeholders
    - Increase stakeholder support
- Political awareness–this helps with influencing actions of stakeholders and increasing their support for the project. It includes:
    - Recognition of power and influence relationships within the organization (which are the stakeholders who have influence on the project)
    - Understanding the strategies of the organization (which are the stakeholders who are influenced by the project and will therefore be interested in its outcome)

7 . Meetings

These are a tool where communication management is vital in order that they be efficient (not take too much time of the participants) and effective (they help move the project objectives forward).

These are the tools and techniques used in managing communications on the project.

Project Management

UNIT V: Project Quality, Risk, and Procurement

Project Quality Management: Planning Quality Management - Tools and Techniques Used for Quality Planning - Managing and Controlling Quality - Tools and Techniques for Quality Control - Project Risk Management: Planning and Developing the Risk Management Plan - Identifying - Analyzing Risks (Qualitative and Quantitative) - Risk Response Plan - Tools and Techniques - Implementing Risk Responses - Monitoring Risks - Project Procurement Management : Procuring the Project Resources - Procurement Planning, methods and management – Conducting and controlling procurements.

Project quality management

Product quality management is a set of methods and strategies for evaluating the quality of all workflows, tasks, personnel and deliverables for a project. With project quality management, professionals can ensure that all the processes and responsibilities related to their projects operate with optimized efficiency. Project quality management may also help companies reduce operational costs, boost productivity, increase interdepartmental collaboration efforts and improve customer satisfaction.

Elements of quality

There are four components of quality. There are as follows -

- *Quality Control Planning*

The process of planning quality control is a vital step in the production of goods or services. It involves identifying your quality goals, standards, and requirements and creating a plan to meet those goals. The strategy should also include procedures for checking whether the criteria have been met.

- *Quality Control*

The next step in the process is quality control, where you physically inspect and test what you laid out in the planning stage to ensure it's obtainable. It should include checking that all materials are suitable for their intended use and that any instruments used are functioning correctly.

- *Quality Assurance*

Quality assurance refers to reviewing the delivery process of services or the quality management of goods manufacturing. It involves looking at how things have been done and seeing if any issues need to be addressed before going forward with production or shipping.

- *Quality Improvement*

Finally, we come to quality improvement! If you've followed these steps before (and hopefully you have!), then now is when it gets interesting: thoroughly review your findings from the last three components above and come up with a way to improve your methods going forward.

Planning Quality Management

Quality management ensures that project objectives are fulfilled with high-quality products, services, and processes. Quality Management Plans (QMPs) explain how the contractor will manage and implement project quality assurance and management activities. The contractor developed the QMP, reviewed by the customer, and approved by both parties.

The QMP describes how a project manager will implement quality management by defining quality methodology, standards, criteria, activities, expectations, tools, and resources needed for successful project execution. It also describes how the project manager will conduct reporting and corrective actions throughout the life cycle of an activity or product associated with a particular project or program.

Quality management planning should have the following attributes

1. Deliverables and processes.

2. Quality standards of deliverables.

3. Customer satisfaction.

4. Quality control.

5. Process quality standards.

6. Stakeholder expectations.

7. Quality assurance.

You can use the following steps to create a quality plan.

1. Create a document to understand the quality of the project.

2. Divide the responsibilities for quality management.

3. Determine the customer needs

4. Document acceptance criteria.

5. Create a product deployment pipeline.

6. Implement quality control

7. Take corrective actions

8. Automate

Importance of quality planning

An ideal product should have no defects or significant differences between the customer's and buyer's purchases. It ensures that the best outcome is being developed and delivered to your customers. To achieve uniformity of output that meets specific customer or user requirements, measurable and verifiable standards must be strictly followed and consistently applied.

Quality can be achieved using modern tools like Six Sigma, Lean Manufacturing, TQM (Total Quality Management), HACCP (Hazard Analysis Critical Control Points), ISO 9000, and many others. These tools help companies improve their quality management systems, improving customer satisfaction through better products and services.

Objectives of quality planning

The Quality Management Plan (QMP) defines quality procedures for the project, determines how the project manager will manage quality throughout the project lifecycle, identifies project deliverables and processes to be managed using those policies, and delegates responsibilities for quality assurance.

The QMP should include:

- A description of the quality management system used in your organization.

- Quality objectives for each deliverable.

• Quality metrics will measure performance against those objectives, including a measurement baseline.

- Quality assurance activities during development.

- Quality assurance activities during production.

QUALITY PLANNING TOOLS

you can use seven essential quality tools to improve the quality of a product or service. They are known as Ishikawa's seven critical tools in quality. These tools are also referred to as 7QC

- **Cause-and-Effect Diagrams**

Cause-and-effect diagrams are called fish bone diagrams because they resemble a fish's skeleton. The head of the fish is the effect, and each bone of the fish is a cause that leads to that effect. The bones can branch into smaller bones as you determine the lower-level cause-effect relationships. When all the bones are filled in, the diagram lets you look at all the possible causes of the effect so that you can develop a solution to mitigate that effect. The diagram allows organized thought and encourages consideration of the factors that result in a particular outcome.

example: Diagramming Quality Problems

CAUSE AND EFFECT DIAGRAM
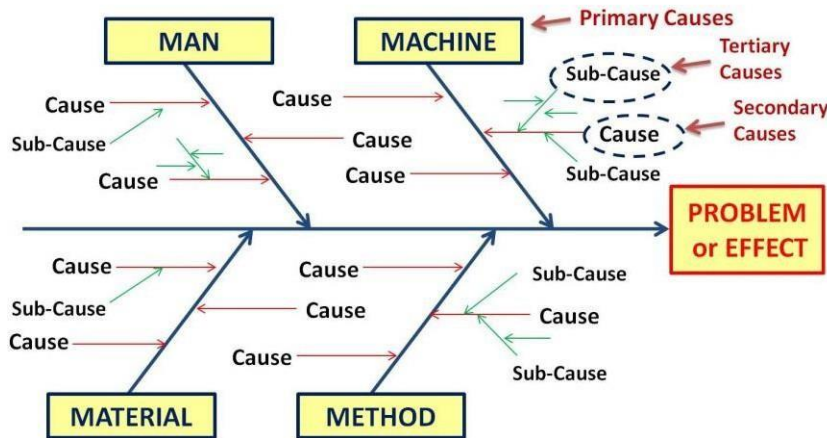
- A cause-and-effect diagram is one example of a visual tool that can help you organize your thoughts and consider multiple factors more than if you were writing out sentences or paragraphs on paper. Visual tools like this allow you to see relationships between different things quickly and clearly, making it easier to solve problems by seeing where things connect.

- **Flowcharts**

Flowcharts help logical document steps within a process or system. When it comes to quality planning and control, flowcharts are a powerful tool. They can help you determine and analyze potential problems in your system and identify how to manage them.

The system flowchart is the most common type, which outlines the logical steps to complete a process. By documenting these logical steps, teams can identify where quality problems might occur and develop approaches to manage them. Flowcharts also help create a repeatable process.

- **Check Sheets**

A check sheet is a simple method of organizing information that makes it easy to gather data for inspection purposes. Check sheets can be practical for inspections because they enable you to focus on specific attributes that you are looking for and not get distracted by extraneous details.

- **Pareto Diagrams**

Pareto charts, also known as Pareto diagrams, are a specific type of histogram based on Pareto's principle, which states that a small number causes many defects or problems.

A Pareto diagram is an ordered bar graph showing the number of defects and their causes. The charts' bars individually show the number and percentage of reasons, and the line shows the cumulative value.Pareto charts help focus attention on the most critical issues to get the most benefit.

- **Control Charts**

Most operations experience a degree of normal variation (or common cause variation); that is, most processes do not consistently achieve target performance. Control charts provide a mechanism for establishing an objective range of acceptable variation around the target performance, thereby focusing attention on particular cause variations. Control charts determine if processes are in or out of statistical control.

We can determine if our process is in statistical control by plotting data points over time and comparing them with an upper and lower control limit. If any issues fall outside the boundaries, something significant has happened that could impact quality or performance.

- **Histograms**

A histogram is a handy tool for identifying common causes. You can use it to analyze the frequency distribution of data.

The histogram is a bar chart showing the number or percentage of measurements in each s identify cause because it shows how often certain events occur.

Histograms can be ordered (like a Pareto chart) or unordered. They're also known as frequency polygons and box plots, which are different names for the same thing.

- **Scatter Diagrams.**

A scatter diagram is a graph that shows the relationship between two variables. It plots the independent variable (X) against the dependent variable (Y). The X-axis represents the measured characteristic, and the Y-axis measures the other.

For example, you could plot people's heights against their weights on a scatter diagram to show how they're related.

You can use these tools in the quality management plan and control quality processes. Using these tools, you can identify problems within your organization and find ways to fix them. You also can use them to help you better understand what changes need to be made to improve your company's processes and products.

QUALITY PLANNING TECHNIQUES

There are various techniques used in quality planning. Some of the most used methods are discussed below.

- **Cost-Benefit Analysis**

It is used to measure the trade offs of providing quality. It is like a cost-benefit ratio.

Ratios indicate how the benefits and costs of proposed projects are related. Ratios can be expressed in monetary or qualitative terms. Generally, a project with a BCR more significant than 1.0 is significantly suited to a positive net present value for investors and the firm.

BCR can be applied when evaluating investments in various assets and projects. For example, You can use it for estimating the return on investment for asset purchase or for determining whether to proceed with an investment in research and development (R&D).

- ### **Cost-of-Quality**

Cost of quality (COQ) is a term used in modern quality management to refer to the total costs associated with ensuring that a project meets its requirements, including the cost of conformance and non conformance.

COQ is vital because it's often more expensive to fix mistakes after they've been made than it would have been to prevent them from happening in the first place. For example, if you have a software program that has bugs and need to fix them by hiring new programmers, that will be far more expensive than if you had hired people who knew what they were doing first!

Businesses must consider the cost of quality when planning projects to ensure they're not wasting money on fixing mistakes later.

- ### **Brainstorming**

Brainstorming is a technique for gathering information, where multiple unfiltered inputs and ideas are solicited and captured for later analysis and decision making.

The objective of brainstorming is to produce as many ideas as possible. The more ideas there are, the better the chance of finding a good idea.

Brainstorming sessions should be relaxed and informal. The group should not be concerned with evaluating or criticizing any idea; instead, they should focus on generating as many ideas as possible.

Participants also need to feel free to contribute their thoughts without fear of ridicule or judgment by others. Brainstorming is an excellent way for teams to generate new ideas about products, services, processes, etc.

- ### **Force Field Analysis**

Force field analysis is a technique for analyzing ideas by grouping characteristics or factors pros and cons of the concept. In FFA, each aspect has a different strength: some are significant factors, others minor. The major ones significantly impact the idea, while the minor ones have a negligible effect.

The technique involves identifying the significant factors in favor of your idea, listing the minor ones in favor of it, then doing the same with elements against your view. Then you can compare how strong each of those groups has pros and cons and decide whether it's worth pursuing your idea further or not.

- **Nominal Group Technique**

Have you ever been in a group where you were dying to share an idea, but you didn't want to be the one to say it out loud? Or maybe you had an idea, and then someone else said it, and you wish you had said it first?

If this sounds familiar, you might want to try a process called nominal group technique (NGT). NGT is an enhancement of brainstorming that adds mechanisms for ranking ideas. It assumes that a minor group (one that has agreed to work as a team) will produce better results than a group engaging in traditional brainstorming.

NGT collects anonymous input from group members and encourages discussion of all information. Then each member prioritizes the input items. The items are further prioritized based on their cumulative score.

HOW TO MANAGE PROJECT QUALITY

Here are the steps to follow for managing project quality:

1. Perform quality planning

Identify the parameters, scope, requirements and compliance guidelines of the project. Creating a quality management plan helps you identify a logical goal for your project and delegate tasks to the

project's stakeholders. Include in your plan methods or metrics for tracking and evaluating the project while it's underway.

When creating your project quality management plan, evaluate all aspects related to quality, including:

- Validating that the deliverable meet the terms or needs agreed upon by stakeholders
- Adhering to compliance regulations
- Using precise metrics that ensure the project can repeatedly meet deliverable targets
- Calculating a range of acceptable results or targets for your deliverable

2. Conduct quality assurance

During the course of the project, use the techniques identified in your plan to continually assess the quality of the work flows related to your project. This process of evaluating the quality of the processes involved in your project is called quality assurance. If aspects of certain work flows indicate they may not lead to quality end results, analyze and optimize those aspects of the process.

3. Maintain quality control

As your project work flows produce results, evaluate the quality of these end materials, services, tasks or products. The process of quality control helps ensure that the output of each of your project work flows is of optimal quality. If your metrics suggest that you or your personnel could improve the quality of your deliverable further, adjust your project timeline or quality metrics to produce end results of a higher quality.

TOOLS TO MANAGE PROJECT QUALITY

Using quality management tools and software can help you perform detailed evaluations at various stages of your project. Here are some tools and programs you might consider incorporating into your approach toward project quality management:

- **Affinity diagrams:** Affinity diagrams are visualization tools that demonstrate connections or categorizations between a range of elements. An affinity diagram is a great way to organize subjective data, like opinions and ideas.

- **Prioritization matrix:** A prioritization matrix helps organizations compare a range of options using set criteria. Prioritization matrixes may also help you determine potential issues that could arise during your project quality management and how to resolve them before they become larger problems.
- **Network diagrams:** A network diagram visualizes your project's schedule and deadlines. Network diagrams can help you evaluate which tasks depend on the completion of other responsibilities and ensure that you remain on schedule.
- **Inter-relational diagrams:** Inter-relational diagrams focus on causal relationships, meaning how one aspect influences another. They depict how a range of project variables might impact other elements or outcomes of your processes or deliverables.
- **Matrix diagrams:** Matrix diagrams visualize the structure of your project. You can use a variety of types of matrix diagrams depending on how many objectives, variables and causes you want to depict.
- **Quality management software:** Quality management software (QMS) can help with quality planning, assurance and control for your project. QMS programs typically have tools to help you both identify areas for improvement and select the best methods for optimization.

QUALITY CONTROL

Quality control is about testing the deliverables to find any defects. If and when a defect is found you find the root cause of it and,

- fix the defect (which may need you to raise a change request),
- ensure that the root cause is addressed so such defects will not occur in future.

This project management activity is all about using statistical tools. The following concepts are something that the quality control team should be aware of.

Prevention versus Inspection

Prevention is about taking proactive action to ensure defects are not introduced in the product. Creating check-lists, training people in testing methods, creating effective test plan – these are all preventive acts.

Inspection is about examining deliverables with intent to find any defects, or deviations from documented requirements, so that customer gets the deliverables that implement given requirements. Quality control activities are conducted from this perspective.

Preventive activities are done **before** producing deliverables, and Inspection activities **after**.

Attribute Sampling versus Variables Sampling

First let us understand what is meant by „sampling".

Sampling is a statistical technique of assuring quality where a subset of large population is selected and certain characteristics are closely examined on that subset. If the characteristics meet specified standards then entire population is certified to be good, else entire population is rejected. Advantage of Sampling approach is that it reduces quality testing time and lowers quality assurance cost.

Now, **Attribute sampling** is the case of sampling where population is accepted if characteristics met specifications exactly; if they didn"t the population got rejected.

Variables sampling is the case where the degree to which characteristics matched specifications is measured. The population is accepted only if they matched to a certain degree of conformity. In other words, tolerance is introduced. In Attribute sampling tolerance is zero – characteristics either matched, or they did not.

Tolerances versus Control Limits

We saw the introduction of tolerance in previous paragraph. **Tolerance** indicates a range of deviation within which the results are accepted. **Control limits** are the thresholds of deviation beyond which the process is termed as „out of control".

TOOLS AND TECHNIQUES

- **Inspection**

Inspection is a non-intrusive way of verifying quality of a finished product by formal evaluation exercise against documented standards. This is mostly a manual exercise. Specific attributes to test and the method of inspection are understood from the Quality management plan.

Inspection is used to validate deliverables as well as defect repairs, which might come as a result of implementing change requests.

- **Data gathering tools**

Checklists

A checklist continuously gets refined as project progresses. A good quality checklist will help to verify quality of the product to a large extent. It is a structured list of predefined checks that help you to confirm that deliverables meet requirements. Certain industries have standard checklists.

Check sheets

Check sheets are also called tally sheets. These are good to use as a check list to collect information and group them together. While inspecting deliverables checklists are useful to make sure all attributes are verified.

Statistical sampling

Statistical sampling is a sampling technique where a representational sample is picked from the population and this sample is thoroughly tested using the designed tests. If number of defects found cross the acceptable limit in this sample, entire population is rejected.

For instance, out of 10,000 shirts (population) a lot of 100 shirts is randomly selected. Each of these shirts are tested for manufacturing defects. If the threshold is say 3 shirts, then 3 defective shirts at the most are allowed in this lot of 50 shirts. If more than 3 defective shirts are found, then entire population of 10,000 shirts are rejected.

Statistical sampling flow
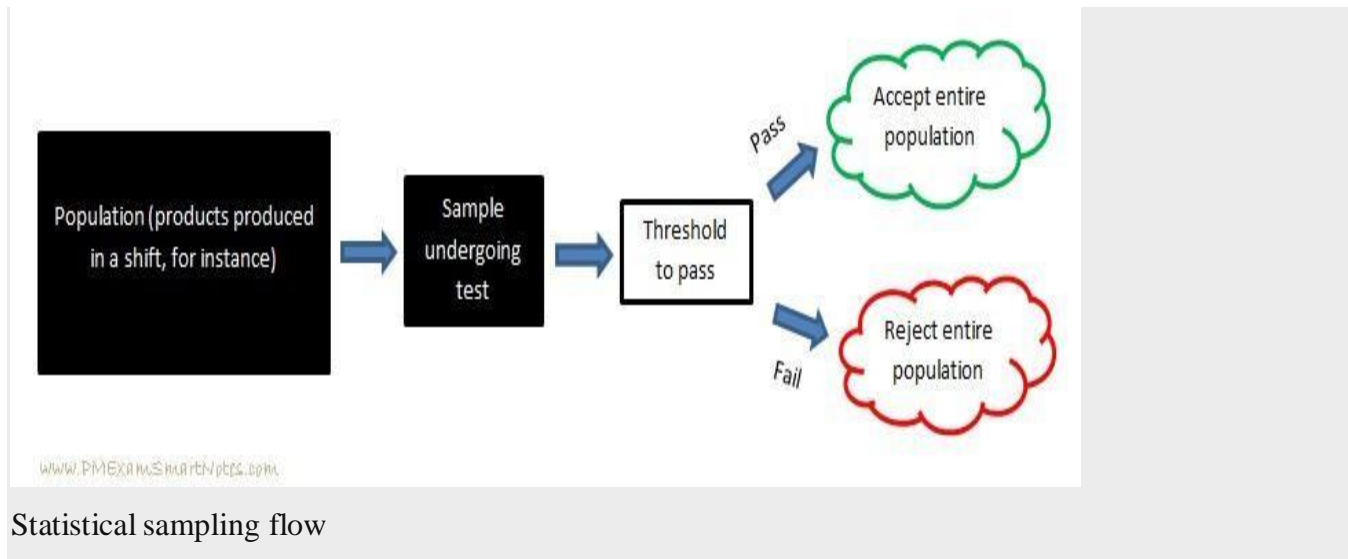
Data analysis tools such as root-cause analysis and performance reviews are used to collect relevant insights into how efficient quality activities are.

- **Data representation techniques**

such as..

Cause-and-effect diagram or Ishikawa diagram or fishbone diagram

These are also called **Ishikawa diagrams or fishbone diagrams**, as we saw in Identify Risks process. This is a popular root cause diagram, where a root of a cause of problem can be traced by continuously trying to answer „why" along each of the lines of symptoms.

Refer to the diagram below. Wrong measurements are one of the symptoms of Jogging track defects. And asking "why" has led to identifying that calibration of tools has been the root cause of this issue.
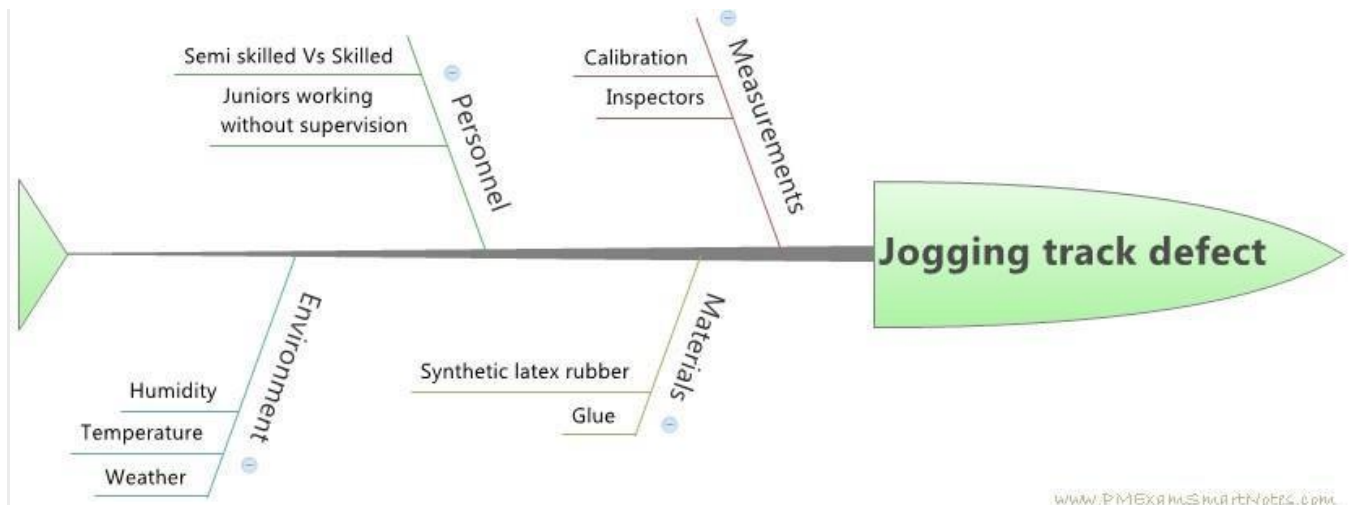
Fishbone diagram

Flowcharts

Flowcharts are used to show relationship between steps in a processes. Activities, decision points and order of processing are main constituents of flowchart. They can unearth potential problems in quality processes and help plug any gaps.
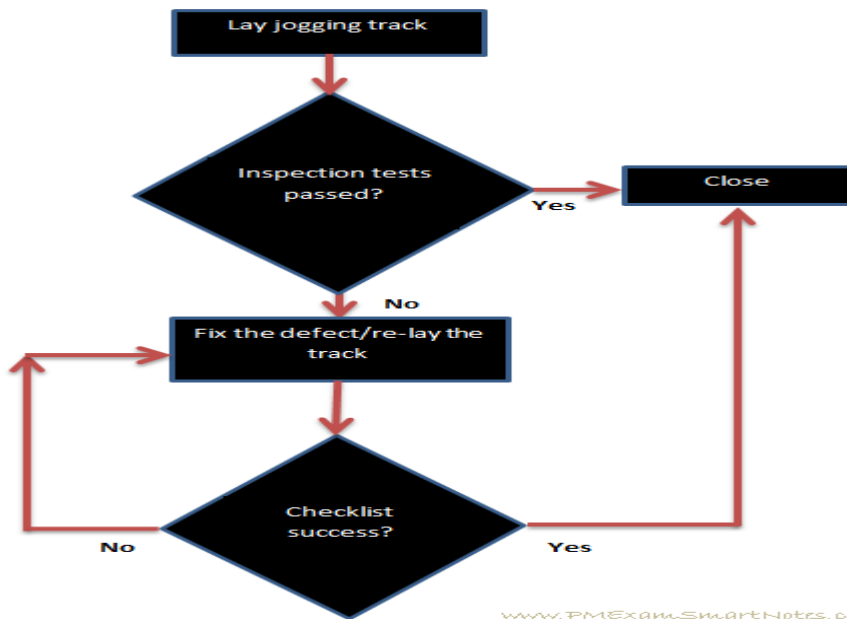
Simple flowchart

Histogram

This is a graphical representation of distribution of data, shown as vertical bars representing characteristics of problem. The y-axis can show probability of the characteristic happening during problem situation, or simply the number of times this characteristic materializes during the problem situation.

Scatter diagram

Also called Scatter Plot or Scatter graph is a type of mathematical diagram using Cartesian coordinates to display relation between two variables. One would be dependent variable and the other independent variable. Y-axis is used to plot the variable to be predicted (dependent variable) and X-axis is used for the variable to make prediction (independent variable).

Correlation refers to the degree of relationship between two variables. Degree of correlation can be found out looking at the plot. If the points are fairly random then correlation between variables is less (or „null"). If pattern of dots slope from lower left to upper right then it is called „positive" correlation, and if pattern of dots slope from upper left to lower right then it is called „negative" correlation.

An example of Scatter diagram is plot of two sets of variables, one representing height of an athlete (independent variable, on X-axis) and another representing weight (dependent variable, on Y-axis) – to find whether height has any correlation with weight of an athlete.
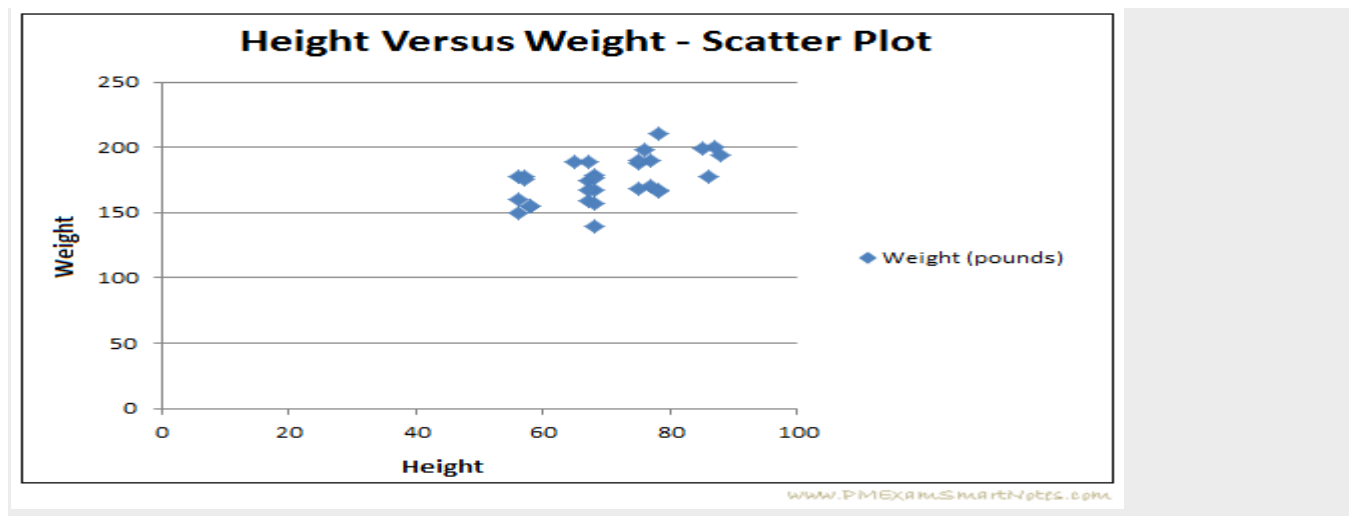
As you can see, there is a „positive" correlation between these variables. It appears that as height of an athlete increase she tends to weigh more.

Review of approved change requests

Just as deliverables, approved change requests too are verified for intended quality as per the guidelines from Quality management plan.

For Agile projects the **retrospective meetings** help identify lessons learned, and the whole iteration activities are analyzed to understand,

- what went right,
- what did not go well, and
- what needs to be improved

PROJECT RISK MANAGEMENT

Definition of Project risk

According to PMI, the project risk may be defined as the chance of certain occurrences adversely affecting project objectives, the degree of exposure to negative events, and their probable consequences.

3 Common Types of Project Risks

Each project has its own risks that depend on the project's current environment and each of them needs to have its own project risk management plan. We can split risks into two groups - external and internal. External risks cannot be controlled by an organisation and include political, economic, and

natural risks. Internal risks are the ones that a project manager or a risk management team can manage, and they are the most common project risks.

- **Cost risk**

Cost risk is the growth of project costs that were not calculated. In other words, it is the risk that the project will cost more than its allocated budget. This is perhaps the most common of all the project risks, and it happens due to poor budget planning, not managing resources correctly, inaccurate cost estimation, and scope creep. Cost risk can often lead to the other two common risks - schedule risk and performance risk.

- **Schedule risk**

Schedule risk is the risk of activities taking longer than expected. Typically this risk is also due to poor planning. Schedule risk is closely related to cost risk because an inaccurately planned schedule often leads to increases in cost since longer projects simply cost more. Schedule risk also leads to delays and that results in missed timelines and a possible loss of competitive advantage. Schedule risk can also lead to performance risk - missing the timeline to perform its intended mission.

- **Performance risk**

Performance risk is essentially the danger of the project failing to deliver results that meet the project's specifications. The source of this risk is difficult to identify because it might be attributed to a variety of circumstances.

What is a risk management in project management?

Risk cannot be managed, per se. Risk has to do with uncertainty, probability or unpredictability, hence the term risk management tends to be misleading. There is no way to truly have control over events happening during the project. Risk management must be seen as preparation for possible events in advance, rather than responding to them as they are happening.

6 KEY STEPS IN THE RISK MANAGEMENT PROCESS

For handling project risk, you need to have an effective risk management plan. The process of making one usually consists of these six steps:

6 Key Steps in the Risk Management Process

01 Identify the Risk

Analyse the Risk **02**

03 Prioritise the Risk

Assign a Risk Owner for Each Risk **04**

05 Respond to the Risk

Monitor the Risk **06**

1.   Identify the Risk

This is the first step in the risk management process because you cannot resolve a risk if you do not know what it is. There are many ways you can get the project risk identified but one of the most common ways is by brainstorming together with your team and stakeholders. You can also find people with relevant experience to your project and schedule a meeting with them.

When thinking of all the ways things can go wrong, note them. List all the ways a potential project risk can grow and even check past projects' data. It is important to keep all of the collected data in a risk register so you can reflect on the past in order to improve future projects.

2.   Analyse the Risk

Risk analysis is a process that is used to identify and analyse potential problems that could negatively impact the project. Once you identify risks, you can begin to analyse them. Many implications, such as avoiding future lawsuits, addressing regulatory difficulties, complying with new legislation, lowering project risk, and minimising its impact, can be proactively addressed. This can be determined using qualitative and quantitative risk analysis.

Risk analysis includes analysing the likelihood, severity, and response plan for each risk you have found. While determining the project risk's severity, it is important to consider how the risk will affect the project's goals; can it cause a delay in its completion, undermine the budget or other resources, etc. For that reason, the best option is to include the opinions of a project team or key stakeholders in this step. The response plan you come up with for each risk is what the project team will use when the risk arises to quickly address it.

- **Prioritise the Risk**

Because not all project risks are equal, an evaluation is needed so project managers know what resources they can gather towards the risk's resolvement. By categorising your list of risks as high, medium, and low, you can know which ones deserve to be more thoroughly investigated and which ones are not that serious. With a clear perspective like this, you can begin to plan for how and when these risks will be addressed. Some of them require immediate action because they can derail the entire project, while other risks, though still important, do not threaten the successful completion of the project.

- **Assign a Risk Owner for Each Risk**

This step in the risk management process is key. All the hard work done identifying, analysing, and prioritising risks would be for nothing if you don't assign the task of overseeing it to someone. A risk owner can be anyone - often it is a team member who is the most suited to monitor the risk. Then that person is responsible for identifying risk as well as leading the work towards its resolvement. Every

risk should have a person responsible for it. That way, every potential threat to the project's success is covered.

- **Respond to the Risk**

In this step, you can put to use everything you have prepared so far. But first, you need to identify if the risk is positive or negative. A lot of the time, people think of all the potential events that can occur as a threat - something that will impact the project negatively. However, that is not always the case. Sometimes events that take place can be good for your project. Those opportunities are then called positive risks and you should seize them to the best of your ability.

For each identified risk there should be a strategy for its management and mitigation. Once the strategy (preventative or contingency plan) is developed, the next step is to manage risk according to its priority. The manager communicates with the risk owner and together they decide which action plan to use to resolve the problem.

- **Monitor the Risk**

This step is tracking the progress of the initiative chosen for risk resolvement. Whoever is in charge of the risk will also be responsible to monitor and report its progress towards resolution. Project managers have to stay updated and have an accurate picture of the project"s overall progress. This enables them to identify and monitor new risks. Updating is achieved with a series of meetings set up to manage the risks.

While managing risks, it is important to always be transparent. Everyone involved in a project should know what is going on so that they can know what to pay attention to and help prevent and manage any risks that may arise in the future.

RISK MANAGEMENT TOOLS & TECHNIQUES

Risk is inherent in project management and so is the need to create a risk management plan to control it. That methodology is called risk management, which is as important as planning to make sure a project comes in on time, within budget and of quality.

Risk Management Tools & Techniques

The following are some of the best risk management tools and techniques that professional project managers use to build risk management plans and guard against inevitable risks, issues and changes.

1. Risk Register

The fundamental risk management tool is the risk register. Basically, what a risk register does is identify and describe the risk. It then will provide space to explain the potential impact on the project and what the planned response is for dealing with the risk if it occurs. Furthermore, the risk register allows a project manager to prioritize the risk, assign an owner responsible for resolving it and gives a place to add notes as needed.

The risk register is a strategic tool to control risk in a project. It works to gather the data on what risks the team expects and then the way to respond proactively if they do show up in the project. It has already mapped out a path forward to keep the project from falling behind schedule or going over budget.

Risk Tracking Template

Date of last review:

(PM) ProjectManager

ID	Description of Risk	Impact	Risk Reponse	Risk Level	Risk owner	Notes
1	Equipment malfunction	Assembly line stops	Have back-up equipment in the production facility	High	John Smith, Fred Jones	SAMPLE
2	Supplier delay	Delays production schedule	Confirm delivery dates by Phase 2	High	Clarissa	SAMPLE
3	Factory availability	Cost overruns	Stakeholder trip to China	High	Dave, Rajesh & Nina	SAMPLE
4	Steering committee unavailable	Delay launch marketing	Define marketing plans in March	Low	Tyrell	SAMPLE

2. Root Cause Analysis

The root cause is another way to say the essence of something. Therefore, root cause analysis is a systematic process used to identify the fundamental risks that are embedded in the project. This is a tool that says good management is not only responsive but preventative.
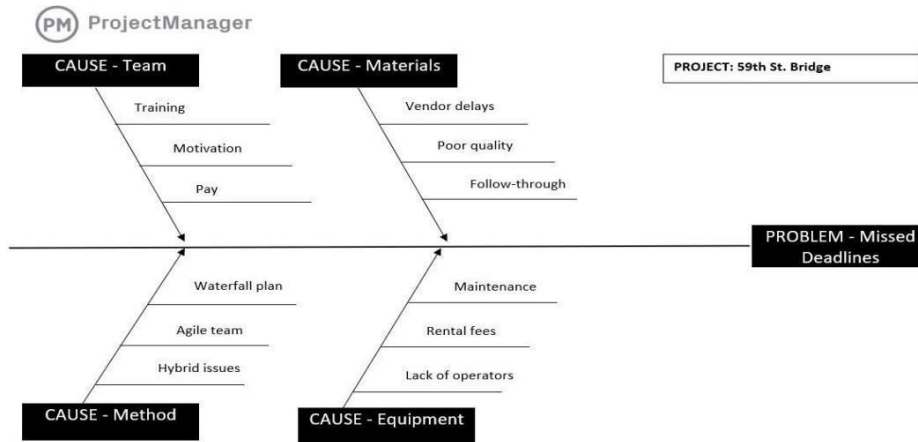
Often <u>root cause analysis</u> is used after a problem has already come up. It seeks to address causes rather than symptoms. But it can be applied to assessing risk by going through the goals of any root cause analysis, which asks the following questions:

- What happened?

- How did it happen?

- Why did it happen?

Once those questions are addressed, develop a plan of action to prevent it from happening again.

3. SWOT

SWOT, or strengths, weaknesses, opportunities, threats, is another tool to help with identifying risks.

SWOT Analysis

Project Manager/Executive: _____   Date: _____

Project Name: _____

Purpose: _____

	POSITIVE	NEGATIVE
INTERNAL	**Strengths** 1. *Internal strength* 2. *Internal strength* 3. *Internal strength*	**Weaknesses** 1. *Internal weakness* 2. *Internal weakness* 3. *Internal weakness*
EXTERNAL	**Opportunities** 1. *External opportunity* 2. *External opportunity* 3. *External opportunity*	**Threats** 1. *External Threat* 2. *External Threat* 3. *External Threat*

Begin with strengths and determine which aspects of the project are secure and well-positioned. Next, list the weaknesses or things that could be improved or are missing from the project. This is where the likelihood of negative risk will raise its head, while positive risk comes from the identification of strengths. Opportunities are another way of referring to positive risks and threats are negative risks.

When collecting SWOT, illustrate your findings in a four-square grid. The top of the square has strengths to the left and weaknesses to the right. Below that are opportunities to the left and threats to the right. The left-hand side is helpful to achieving the objective of the project and those on the right-hand side are harmful to achieving the objective of the project. This allows for analysis and cross-reference.

4. Risk Assessment Template for IT

While this tool was developed for IT projects, it can be expanded to speak to any project. What <u>an IT risk assessment template</u> offers is a numbered listing of the risks, along with the control environment, control activities and any additional pertinent information.

PM ProjectManager

Project Name:

					IT RISK ASSESSMENT TEMPLATE							
ITEM #	TOPIC	RISK	CONTROL ENVIRONMENT	RISK ASSESSMENT	CONTROL ACTIVITIES	MONITORING	INFORMATION AND	CONTROLS PRESENT	RISK JUDGEMENT	LIKLELIHOOD	IMPACT	RISK LEVEL
										1	100	100
												0
												0

One of the most unique aspects of the risk assessment template is that the spreadsheet has a built-in calculator that figures out the likelihood of a risk in fact occurring and then multiples that against the impact it would have on the project or the organization. This way, a project manager knows the potential harm of the risk and so can prioritize their response to it if or when the risk happens.

5. Probability and Impact Matrix

Another tool for project managers is the probability and impact matrix. It helps prioritize risk, which is important, as you don‟t want to waste time chasing a small risk and exhaust your resources. This technique combines the probability and impact scores of individual risks and then ranks them in terms of their severity. This way each risk is understood in context to the larger project, so if one does occur, there‟s a plan in place to respond or not.

ProjectManager

Project Name:	Project Manager	Date

Risk Matrix		Severity				
		Insignificant	Minor	Moderate	Major	Severe
Likelihood	Almost Certain	Medium	High	Very High	Very High	Very High
	Likely	Medium	High	High	Very High	Very High
	Possible	Low	Medium	High	High	Very High
	Unlikelyh	Low	Low	Medium	Medium	High
	Rare	Low	Low	Low	Low	Medium

6. Risk Data Quality Assessment

With a risk data quality assessment technique, project managers use data that has been collated for the risks they"ve identified. This is used to then find the level to which information about the risk is relevant to the project manager. It helps the project manager understand the accuracy, reliability, quality and integrity of the risk as related to the collected data about it.

For each risk listed, the risk data quality assessment requires that the project manager determine the extent of the understanding of the risk, collect what data is available, what the quality and reliability are of that data and its integrity. It is only by examining these parameters of the risk can an accurate assessment be reached.

7. Brainstorming

To begin the brainstorming process, you must assess the risks that could impact your project. This starts with reviewing the project documentation, looking over historic data and lessons learned from similar

projects, and reading over articles and organizational process assets. Anything that can provide insight into issues that might occur during the execution of the project. Once you"ve done your research, start brainstorming with anyone who might have insight.

A variant of this is the Delphi technique, which is when a request is sent to experts and they reply anonymously. Or the project manager can interview experts, team members, stakeholders and others with experience in similar projects.

PROJECT PROCUREMENT MANAGEMENT

Project procurement management is a process to *obtain all the resources you need* and *manage them effectively* throughout the term of the project.

Procurement management refers to all the actions and strategies related to the cycle of identifying, evaluating and selecting suppliers of production inputs. This involves creating a procurement management plan, testing quality, managing procurement contracts, executing purchases and any other activity that"s needed to control how purchases are made in your organization.

Procurement of resources

There are several documents that are needed for the procurement process. Here are some of the most important ones.

- **Request for Information (RFI)**

This document is used for a formal information-gathering process. It"s directed towards those suppliers of goods and services with which you might want to contract. The RFI helps procurement managers find the supplier who"ll deliver what they need and when they need it for a price with which they"re comfortable.

- **Request for Proposal (RFP)**

When an organization is looking to contract with a vendor or contractor, it"ll send out an RFP that explains what they want to be done. The document then captures the description and price of doing that work by a variety of entities, where one can be chosen as they offer the best all-around deal.

- **<u>Request for Quotation (RFQ)</u>**

This process is used to ask a vendor or vendors to submit their price quotes for items that will be used in a project or other venture. This allows the sender to compare prices with other potential vendors who are vying for the job. It"s an essential part of making the right decision about who to contract with.

<u>Process of Project Procurement Management</u>

There are four key stages involved in project procurement management:

1. Plan Procurement

In this phase, you need to make a detailed plan for the following:

- The materials and services you will require for the project
- What you already have and what you"ll need to outsource (Make vs Buy)
- Important project milestones and their deadlines
- Contract requirements for outsourcing purchases
- The process that you"ll undertake to search for the suppliers or contractors
- Any legal terms or conditions that must be met
- The criteria for bidding and selection
- The factors that will affect the budget
- Important details like project schedule, activity cost estimates, and more

The output at this stage will be a *project procurement plan* and *statement of work (SOW)*.

The more specific you are with your plan, the more equipped you"ll be to select the right contractor or supplier.

You can make use of a project management tool like SmartTask to make a detailed procurement plan along with the project schedule.

2. Conduct Procurement

You study all the bids that you received and analyze them on different criteria already set such as budget, quality, the scope of the project, and so on.

Vendor negotiations also take place at this stage and the final decision is then made. After that, the agreed-upon contract is signed and the procurement plan is updated if necessary.

Some projects also require a thorough quality check of materials before finalization which occurs at this stage.

You may also need to make amendments to the project schedule and timeline with resource information such as when resources will be available when the respective work will be carried out, and for how long.

Risk factors should also be considered and their impact on the timeline and budget should be noted. For example, if one part of the construction equipment gets delayed by a week, what impact will it have?

3. Control Procurement

What if the resources you procured for your construction project were sub-par.

Would this impact your budget and project timeline?

Definitely! A reason why controlling your procurement is as important as the above two phases.

As a project manager, you should set up regular check-ins with your vendors to make sure everything is going smoothly.

This could involve *reviewing requirements*, *conducting audits*, getting *delivery and performance updates*, making sure everything is *going as noted in the agreements*, and so on.

At this stage, you may also need to make some important decisions.

For example, you require construction equipment to get delivered more quickly than what you planned. The vendor asks for a 10% additional fee for that.

What do you do next?

Do you let the budget go up with that fee?

Would you allow for a delay? Or

Would you look for another supplier?

Instead of spending a lot of time conversing with people on calls, WhatsApp or worse, Email - invite guest users to SmartTask''s task management software, share some data points in real-time and continue decision making on instant chat to reach the conclusion faster.

some data points in real-time and continue decision making on instant chat to reach the conclusion faster.

4. Close Procurement

Just as you needed a process to start the procurement, you need one to finalize and close it as well.

Here''s what that process could look like:

- Reviewing the work and services completed
- Making any changes to the original contract if needed
- Filing a formal release of liability
- Calculating final contract costs
- Filing documentation such as performance reviews, audits, contract dispute documents, and other reports can act as a guide for future projects.

Instead of storing all this information in silos, you can store it in a tool such as SmartTask.

This makes sure that the project lead can always go back to past data and evaluate it once the project ends to find out where they could bring in improvements for similar projects in the future.

The Case for Digitizing Procurement Management

The era of paperwork is long gone. With so many different variables in projects like the number of people, multiple milestones and deadlines, and hundreds of documents, your team can go crazy if you don't digitize your entire project process.

One missed deadline or one delay in procurement can cost your company thousands of dollars.

This is where project management software can be your savior. Let's find out how.

Bird's Eye View

As all the important details like milestones, <u>project scope</u>, task details, assignees, and important documents are there in one single tool, your team can be on the same page and you can reduce procurement problems like off-contract purchasing and delays.

With the <u>Portfolio view</u>, you can also get a bird's eye view of your entire project or procurement management process.

Real-Time Tracking

You can easily keep a track of how your procurement process is progressing along with other details like budgets and timelines. You can also get access to different performance reports to make sure everything is going smoothly. This also helps the project lead be proactive by discovering potential problems before they arise and taking corrective actions.

Automated Workflows

You can automate your entire procurement process in project management software. For example, once the contractor sends their bid, you can attach it to the task and the system automatically assigns that task to the relevant person on your team with a set deadline. This has the added benefit of accountability and quickening the entire process.

Improved Team Collaboration

The better your team collaborates, the higher the chances of reaching success with your projects. A project management software helps your entire team stay on the same page by accessing the information they need from anywhere at any time. The tool also gives you the ability to comment, DM, and glance at real-time charts and schedules which limits miscommunication and false interpretation.

Final Thoughts

Project procurement management can be challenging but equally rewarding. With the right project management software, you"re all set to create an effective process.

With SmartTask"s robust functionalities and feature-rich platform, your project leads can keep a track of everything via real-time updates and progress notifications. Not only that, you can have all the information in one place so that your team can collaborate effectively and manage multiple stages of the procurement process easily.

Project manager responsibilities during procurement

Throughout project procurement, there are several responsibilities of project managers. These may vary depending on the project and its objectives, but there are five common duties of project procurement managers:

1. Project initiation

A project procurement manager may begin the procurement process during project initiation. They often communicate with management, executives and members of the team assigned to the project to discuss objectives and timelines. This may also include discussing the budget, internal capabilities and high-level expectations.

2. Procurement planning

A procurement plan is an important part of aligning expectations and organizing processes. During procurement planning, project managers often create lists and documents that outline necessary resources and materials, timelines and milestones and potential means of contacting vendors. They

may also advertise their need for contractors through classified ads, online networking sites and through their professional networks.

Project procurement managers may also work with management and executives to discuss vendor requirements and post-procurement activities.

3. Stakeholder coordination

Projects often involve several stakeholders, including business owners, management, executives, project teams, liability professionals and consultants. The project procurement manager is responsible for coordinating these teams and individuals to ensure mutual understanding of project goals and objectives. To do this, may they identify all important stakeholders and engage them at appropriate times throughout the project.

4. Vendor coordination

Often, multiple vendors may engage in a single project. It's important that project procurement managers effectively coordinate the efforts of multiple contractors. During this process, a project manager may create vendor schedules of collective meetings or demonstrations and facilitate communication between contractors when necessary.

5. Communication of progress

As a project evolves and progresses, a project procurement manager communicates these changes and advancements to all stakeholders involved. This can help to ensure that all teams and individuals working on the project remain informed on deadlines and schedule changes. Project procurement managers often determine which information is necessary to communicate, collect that information from stakeholders and vendors and circulate it to the appropriate parties. They may also send weekly email updates to inform all team members of current project statuses.