UNIT II:

Project Planning -Integration Management - Introduction - Project plan development – Plan Execution - Scope Management - Introduction - methods for selecting projects - project charter - scope statement - work breakdown structure - Stepwise Project Planning -Overview - Main steps in project planning. Project Scheduling-Time Management- Importance of project schedules- Schedules and activities - Sequencing and scheduling activity - Project Network Diagrams -Network planning models- Duration Estimating and schedule development- Critical path analysis- Program evaluation and review Techniques

2.1.Project planning

Project planning is part of project management, which relates to the use of schedules such as Gantt charts to plan and subsequently report progress within the project environment.

Initially, the project scope is defined and the appropriate methods for completing the project are determined. Following this step, the durations for the various tasksnecessary to complete the work are listed and grouped into a work breakdown structure. Project planning is often used to organize different areas of a project, including project plans, work loads and the management of teams and individuals.

Project planning can be done manually, but project management software is often used.

The purpose of the project planning phase is to:

Establish business requirements
Establish cost, schedule, list of deliverables, and delivery dates
Establish resources plans
Obtain management approval and proceed to the next phase

The basic processes of project planning are:

Scope planning – specifying the in-scope requirements for the project to facilitate creating the work breakdown structure
Preparation of the work breakdown structure – spelling out the breakdown of the project into tasks and sub-tasks
Project schedule development – listing the entire schedule of the activities and detailing their sequence of implementation

Resource planning – indicating who will do what work, at which time, and if any special skills are needed to accomplish the project tasks

Budget planning – specifying the budgeted cost to be incurred at the completion of the project

Procurement planning – focusing on vendors outside your company and subcontracting

Risk management – planning for possible risks and considering optional contingency plans and mitigation strategies

Quality planning – assessing quality criteria to be used for the project

Communication planning – designing the communication strategy with all project stakeholders

2.2.Integration Management:

Integration management is a collection of processes required to ensure that the various elements of the projects are properly coordinated. It involves making trade-offs among competing objectives and alternatives to meet or exceed stakeholder needs and expectations.

Comprised of:

Project plan development

Integrating and coordinating all project plans to create a consistent, coherent document

Project plan execution

Carrying out the project plan, according to the strategy, plan and activities as per the plan

Integrated change control

Coordinating changes across the project

Project plan development

Inputs Tools and techniques Outputs Other planning inputs Project planning methodology Project plan Historical information Stakeholder skills and knowledge Supporting details Organizational policies Project management information system Constraints Earned value management

What is Project Integration Management?

Project Integration management is mainly concerned with the processes required to ensure that the various activities of the project are co-ordinated properly.

In other words, Project Integration Management process comprise of activities like identifying, defining, combining, and coordinating various processes related to project.

Project Integration management includes following activities.

Process	Project Stage	Key Deliverables
Develop project charter	Initiating	Project Charter
Develop Project Management Plan	Planning	Project Management Plan
Direct and Manage Project Work	Execution	Deliverables
Monitor and Control Project Work	Monitoring and Control	Change Requests
Perform Integrated Change Control	Monitoring and Control	Change request status updates
Close Project or Phase	Project closure	Final product

Project Charter

The project charter is an integral part of Project Integration Management, without a project charter, a project cannot start. It formally authorizes and defines the objectives of the project. It includes name, description, and deliverables of the project, usually written by a higher authority than a project manager.

Inputs	Tools & Techniques	Outputs
Project statement of work	Expert Judgement	Project Charter
Business case		

Contract
Enterprise environmental factors
Organizational process assets

Project Management Plan

Project plan development uses the outputs of the other planning processes to produce a consistent, logical document that can be used to guide both project control and project execution. Project Management Plan is used to direct project execution, documenting project planning assumption, communicating among stakeholders, for better project control, etc.

Inputs	Tools & Techniques	Outputs
Project charter	Expert Judgement	Project Management Plan
Output from planning processes		
Enterprise environmental factors		
Organizational process assets		

Direct and Manage Project Work

It is a process where the work will be executed as defined in the project management plan and implementing changes with respect to project requirement.

Inputs	Tools & Techniques	Outputs
Project management plan	Expert Judgement	Deliverables

Approved change requests	Project management information system	Work performance information
Enterprise environmental factors		Change Requests
Organizational process assets		Project management plans updates
		Project document updates

Monitor and Control Project Work

This stage includes tracking, reviewing and reporting the progress of the project in order to meet the performance objectives defined in the project management plan.

Inputs	**Tools & Techniques**	**Outputs**
Project management plan	Expert Judgement	Change Requests
Performance reports		Project management plans updates
Enterprise environmental factors		Project document updates
Organizational process assets		

Perform Integrated Change Control

It is the phase where the impact of any change is assessed against the project. It requires to be assessed across the whole of the project. In this process, the actual work is analyzed against the projected plan and makes an adjustment if they are not inline or in sync.

The difference between the "monitor & control project work" and "integrated change control" is that Perform Integrated Change Control emphasis on managing any change to project scope while the former one focuses on managing the way that such scope is executed.

Inputs	Tools & Techniques	Outputs
Project management plan	Expert Judgement	Change requests status updates
Work performance information	Change Control Meetings	Project management plan updates
Change Requests		Project document updates
Enterprise environmental factors		
Organizational process assets		

Close Project or Phase

It is the phase of formal completion of the project related activities.

Inputs	Tools & Techniques	Outputs

Project management plan	Expert Judgement	Final product, service or result transition
Accepted deliverables		Organizational process assets updates

2.2.1.Project plan development:

Project plan development is one of the most critical activities within the project management lifecycle. It is the main part of the Planning Stage. The project manager takes the ultimate responsibility for creating a plan, which is a formal document showing the basis upon which to assess performance of the project and measure its results. Let's review the major steps to develop a project plan in detail.

Step#1: Decompose And Structure Work

In order to create a project plan, you will need to decompose the overall amount of project work into smaller, more manageable pieces. For example, you can develop the *Work Breakdown Structure* (the acronym "WBS"). The WBS is a detailed list of all phases, activities and jobs required for successful project completion. The WBS becomes a foundation for your project plan as you can use it to identify the resources required to deliver each activity or task listed. The WBS allows you to design simple to-do lists and task lists and then assign them to members of your team.

When developing a project plan, you should remember that the WBS also depicts dependencies and relationships between work items (procedures, tasks). You will need to identify how each WBS element is associated with other elements and what (internal or external) dependencies can be established. Project plan development requires setting clear milestones and time checkpoints, so be sure you have added milestones to your WBS.

Step#2: Define Resources Required

Once the tasks and activities required to deliver your project are defined and structured, your next step in creating a project plan is to define the resources required to do each task and activity. In your WBS showing the project scope you should add a section that describes which resources are required and in which quantities and measures. In this step of project plan development, the resource base will be defined and types of resources required will be identified.

Your project may require such resources as the following:

Full-time and part-time employees

Equipment and materials

Technology and knowledge

Your goal is to calculate how many human resources and materials you should acquire to do your project and then define suppliers who will provide equipment and materials. In your WBS you need to specify this information.

Step#3: Design Schedule

After the Work Breakdown Structure is completely outlined, your next step in creating a project plan is to schedule tasks and define durations for resources-dependent activities listed in the WBS. You will need to create a *schedule* that shows execution sequence and sets due dates per activity within your project. To build a project schedule the following information is necessary:

Identified tasks and activities and their dependencies (both internal and external)

Assignments made to team members(who will do which task)

Risk mitigation strategies and a contingency plan

Critical milestones

Allocated resources required for the project

During the two previous development steps this information has been identified, so you can design a project schedule.

2.2.2.Plan Execution:

The execution plan is the “how-to” for your venture. It is a necessary input to your **financial plan**, slide **pitch deck** and **business plan**. It should also be a tool that you use with your team on a regular basis to manage the business, to communicate your critical goals and timing of deliverables, and to celebrate your successes.

What are the elements of an execution plan?

A good execution plan covers milestones and tasks for your business to achieve as well as what resources will be required to make them happen.

Milestones

Milestones are the goals critical to the success of any new venture. In The Art of the Start, Guy Kawasaki provides this simple list which applies generically to all technology-oriented ventures:

prove your concept (both technical and business model)
complete design specifications
finish a prototype
raise capital
ship a testable version to customers
ship the final version to customers
achieve break-even

These milestones can vary significantly in time and scope from business to business and will be generally broken down into additional steps for your internal team. For example, in a biopharmaceutical life sciences company, it may take many years to complete the design and testing process for products that will be injected into or ingested by humans, while a mobile software application may only take several months of effort to rapidly prototype an early version of a product to send to friendly customers for testing.

For each milestone, you will need to determine the amount of resources (headcount and other expenses) required, and the approximate timing involved. This information will be used to develop your **financing plan** for the business and to determine the type of investor you should approach about funding the next investment round, based on your **development stage**.

Tasks

A list of tasks helps you appreciate everything that your organization needs to accomplish and is a means to ensuring that nothing slips through the cracks in the early days. Task lists might include:

incorporating your business
renting office space
finding and engaging key vendors
setting up accounting and payroll systems
securing employment agreements with key personnel
filing legal and taxation documents
purchasing insurance policies
setting up your website

2.3.Scope Management:

In project management, the term **scope** has two distinct uses: Project Scope and Product Scope.

Scope involves getting information required to start a project, and the features the product would have that would meet its stakeholders requirements.

Project Scope: "The work that needs to be accomplished to deliver a product, service, or result with the specified features and functions.

Product Scope: "The features and functions that characterize a product, service, or result.

Notice that Project Scope is more **work-oriented** (the hows), while Product Scope is more oriented toward **functional requirements** (the whats).

If requirements aren't completely defined and described and if there is no effective change control in a project, scope or requirement creep may ensue.

Scope Management is the listing of the items to be produced or tasks to be done to the required quantity, quality and variety, in the time and with the resources available and agreed upon, and the modification of those variable constraints by dynamic flexible juggling in the event of changed circumstance called as Scope creep.

2.4.Methods for selecting projects:

Introduction

One of the biggest decisions that any organization would have to make is related to the projects they would undertake. Once a proposal has been received, there are numerous factors that need to be considered before an organization decides to take it up.

The most viable option needs to be chosen, keeping in mind the goals and requirements of the organization. How is it then that you decide whether a project is viable? How do you decide if the project at hand is worth approving? This is where project selection methods come in use.

Choosing a project using the right method is therefore of utmost importance. This is what will ultimately define the way the project is to be carried out.

But the question then arises as to how you would go about finding the right methodology for your particular organization. At this instance, you would need careful guidance in the project selection criteria,

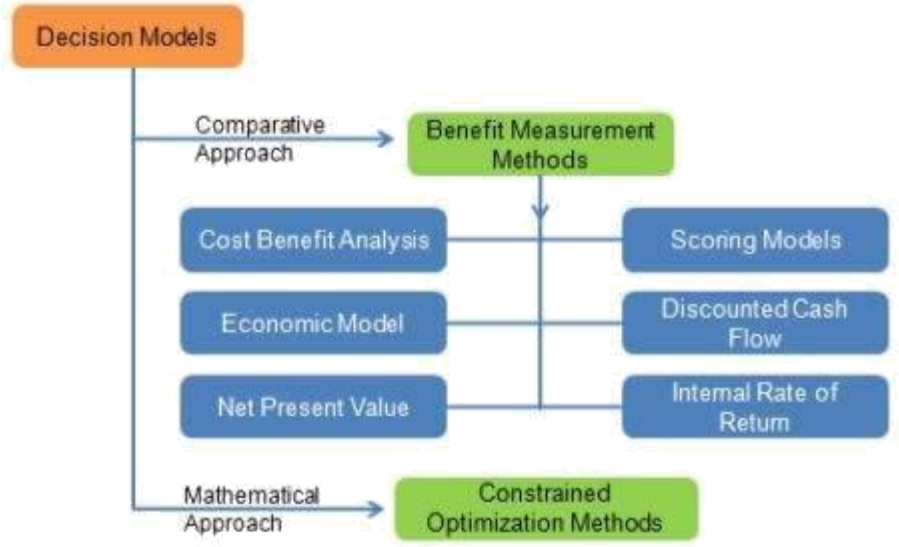
as a small mistake could be detrimental to your project as a whole, and in the long run, the organization as well.

Selection Methods

There are various project selection methods practised by the modern business organizations. These methods have different features and characteristics. Therefore, each selection method is best for different organizations.

Although there are many differences between these project selection methods, usually the underlying concepts and principles are the same.

Following is an illustration of two of such methods (Benefit Measurement and Constrained Optimization methods):



As the value of one project would need to be compared against the other projects, you could use the benefit measurement methods. This could include various techniques, of which the following are the most common:

You and your team could come up with certain criteria that you want your ideal project objectives to meet. You could then give each project scores based on how they rate in each of these criteria and then choose the project with the highest score.

When it comes to the Discounted Cash flow method, the future value of a project is ascertained by considering the present value and the interest earned on the money. The higher the present value of the project, the better it would be for your organization.

The rate of return received from the money is what is known as the IRR. Here again, you need to be looking for a high rate of return from the project.

The mathematical approach is commonly used for larger projects. The constrained optimization methods require several calculations in order to decide on whether or not a project should be rejected.

Cost-benefit analysis is used by several organizations to assist them to make their selections. Going by this method, you would have to consider all the positive aspects of the project which are the benefits and then deduct the negative aspects (or the costs) from the benefits. Based on the results you receive for different projects, you could choose which option would be the most viable and financially rewarding.

These benefits and costs need to be carefully considered and quantified in order to arrive at a proper conclusion. Questions that you may want to consider asking in the selection process are:

Would this decision help me to increase organizational value in the long run?

How long will the equipment last for?

Would I be able to cut down on costs as I go along?

In addition to these methods, you could also consider choosing based on opportunity cost - When choosing any project, you would need to keep in mind the profits that you would make if you decide to go ahead with the project.

Profit optimization is therefore the ultimate goal. You need to consider the difference between the profits of the project you are primarily interested in and the next best alternative.

2.5.Project Charter:

Project Charter refers to a statement of objectives in a project. This statement also sets out detailed project goals, roles and responsibilities, identifies the main stakeholders, and the level of authority of a project manager.

It acts as a guideline for future projects as well as an important material in the organization's knowledge management system.

The project charter is a short document that would consist of new offering request or a request for proposal. This document is a part of the project management process, which is required by Initiative for Policy Dialogue (IPD) and Customer Relationship Management (CRM).

The Role of Project Charter

Following are the roles of a Project Charter:

It documents the reasons for undertaking the project.

Outlines the objectives and the constraints faced by the project.

Provides solutions to the problem in hand.

Identifies the main stakeholders of the project.

Benefits of Project Charter

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

It improves and paves way for good customer relationships.

Project Charter also works as a tool that improves project management processes.

Regional and headquarter communications can also be improved to a greater extent.

By having a project charter, project sponsorship can also be gained.

Project Charter recognizes senior management roles.

Allows progression, which is aimed at attaining industry best practices.

Elements in Project Charter

Since project charter is a project planning tool, which is aimed at resolving an issue or an opportunity, the below elements are essential for a good charter project.

For an effective charter project, it needs to address these key elements:

Identity of the project.

Time: the start date and the deadline for the project.

People involved in the project.

Outlined objectives and set targets.

The reason for a project charter to be carried out, often referred to as 'business case'.

Detailed description of a problem or an opportunity.

The return expected from the project.

Results that could be expected in terms of performance.

The expected date that the objectives is to be achieved.

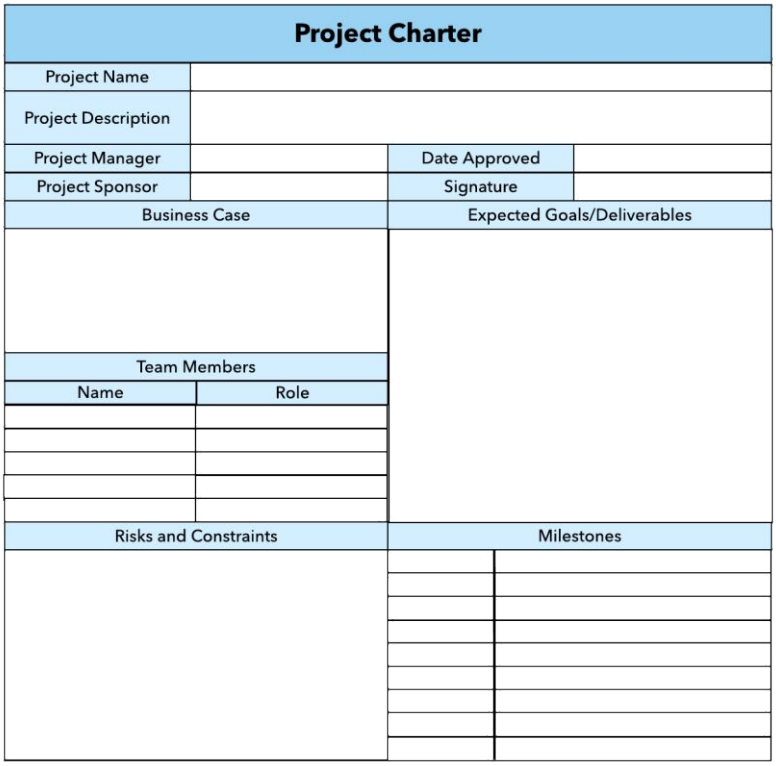
Clearly defined roles and responsibilities of the participants involved.

Requirement of resources that will be needed for the objectives to be achieved.

Barriers and the risks involved with the project.

Informed and effective communication plan.

Out of all above elements, there are three most important and essential elements that need further elaboration



Project Charter			
Project Name			
Project Description			
Project Manager		Date Approved	
Project Sponsor		Signature	
Business Case		Expected Goals/Deliverables	
Team Members			
Name	Role		
Risks and Constraints		Milestones	

2.6.Scope statement:

The purpose of the Project Scope Statement is to provide a baseline understanding of the scope of a project to include the project's scope and deliverables, the work required to complete the deliverables, and ensure a common understanding of the project's scope among all stakeholders. The Project Scope Statement defines the following:

Purpose and Justification of the Project

Scope Description

High Level Project Requirements

Project Boundaries

Project Strategy

Project Deliverables

Acceptance Criteria

Project Constraints

Project Assumptions

Cost Estimates

Cost Benefit Analysis

This Project Scope Statement serves as a baseline document for defining the scope of the Acme Consulting Portfolio Management Database (PMD) Project, project deliverables, work which is needed to accomplish the deliverables, and ensuring a common understanding of the project's scope among all stakeholders. All project work should occur within the framework of the project scope statement and directly support the project deliverables. Any changes to the scope statement must be vetted through the approved Project Change Management Process prior to implementation.

2.7.Work breakdown structure:

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

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

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

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

Accurate and readable project organization.

Accurate assignment of responsibilities to the project team.

Indicates the project milestones and control points.

Helps to estimate the cost, time and risk.

Illustrate the project scope, so the stakeholders can have a better understanding of the same.

Construction of a WBS

Identifying the main deliverables of a project is the starting point for deriving a work breakdown structure.

This important step is usually done by the project managers and the subject matter experts (SMEs) involved in the project. Once this step is completed, the subject matter experts start breaking down the high-level tasks into smaller chunks of work.

In the process of breaking down the tasks, one can break them down into different levels of detail. One can detail a high-level task into ten sub-tasks while another can detail the same high-level task into 20 sub-tasks.

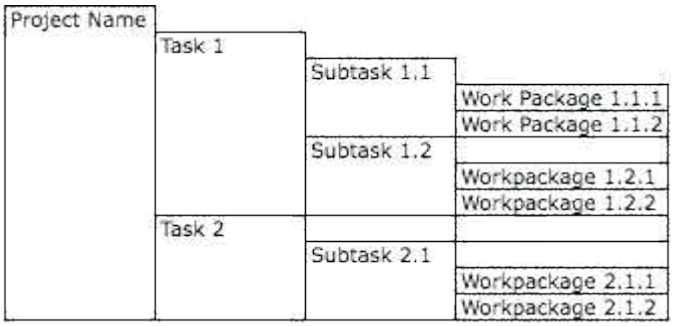
Therefore, there is no hard and fast rule on how you should breakdown a task in WBS. Rather, the level of breakdown is a matter of the project type and the management style followed for the project.

In general, there are a few "rules" used for determining the smallest task chunk. In "two weeks" rule, nothing is broken down smaller than two weeks worth of work.

This means, the smallest task of the WBS is at least two-week long. 8/80 is another rule used when creating a WBS. This rule implies that no task should be smaller than 8 hours of work and should not be larger than 80 hours of work.

One can use many forms to display their WBS. Some use tree structure to illustrate the WBS, while others use lists and tables. Outlining is one of the easiest ways of representing a WBS.

Following example is an outlined WBS:



There are many design goals for WBS. Some important goals are as follows:

Giving visibility to important work efforts.

Giving visibility to risky work efforts.

Illustrate the correlation between the activities and deliverables.

Show clear ownership by task leaders.

In a WBS diagram, the project scope is graphically expressed. Usually the diagram starts with a graphic object or a box at the top, which represents the entire project. Then, there are sub-components under the box.

These boxes represent the deliverables of the project. Under each deliverable, there are sub-elements listed. These sub-elements are the activities that should be performed in order to achieve the deliverables.

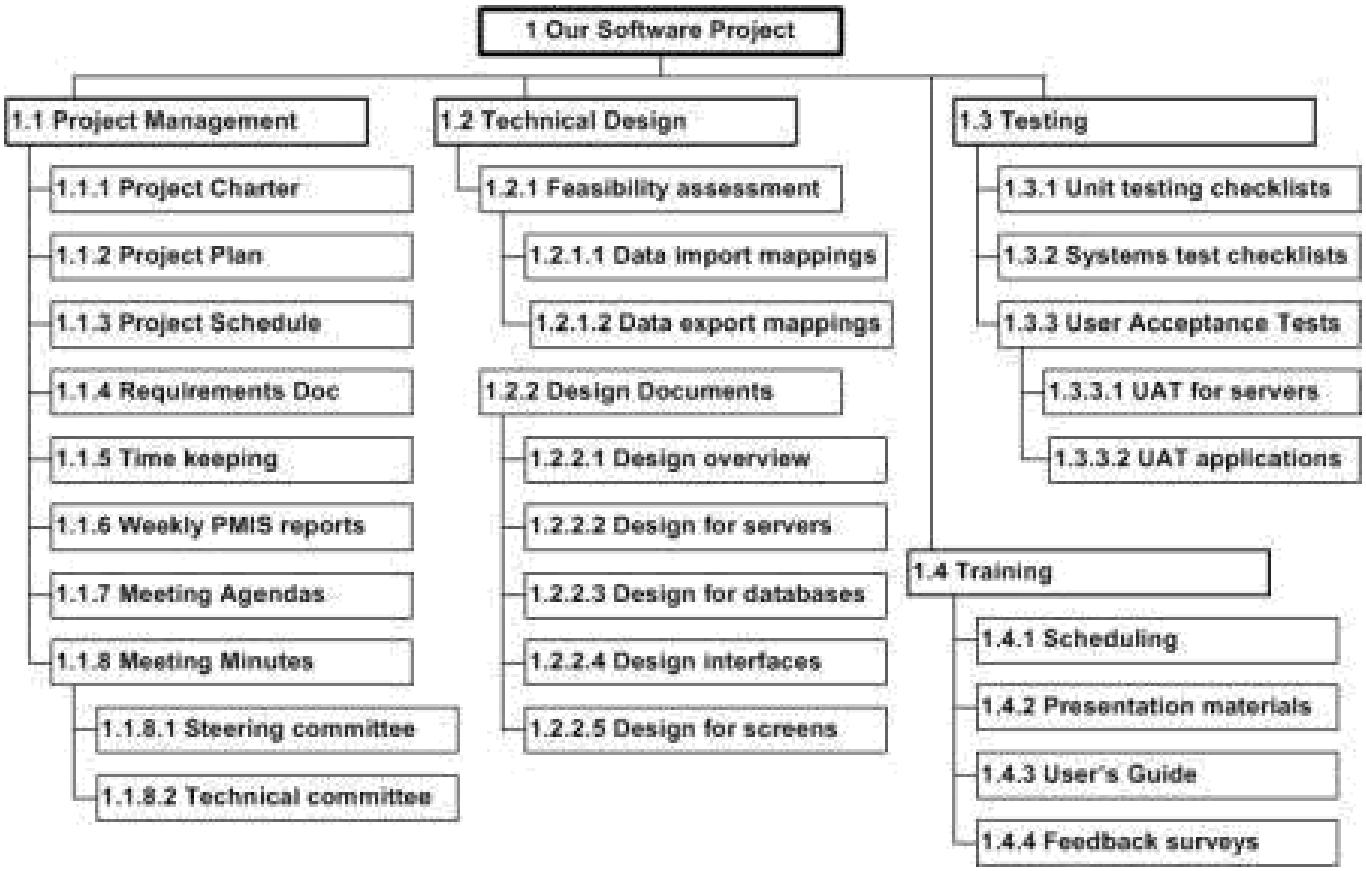
Although most of the WBS diagrams are designed based on the deliveries, some WBS are created based on the project phases. Usually, information technology projects are perfectly fit into WBS model.

Therefore, almost all information technology projects make use of WBS.

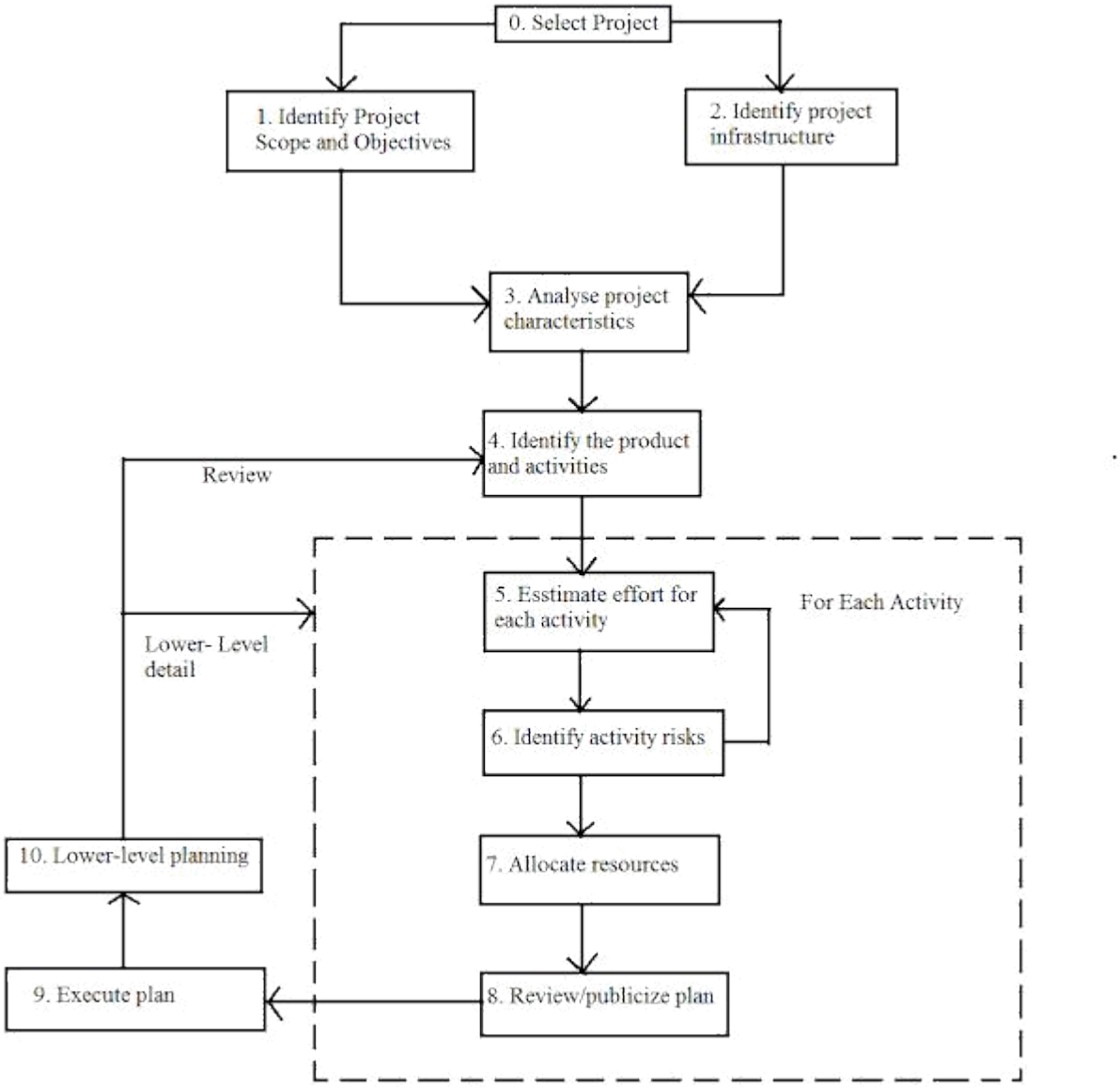
In addition to the general use of WBS, there is specific objective for deriving a WBS as well. WBS is the input for Gantt charts, a tool that is used for project management purpose.

Gantt chart is used for tracking the progression of the tasks derived by WBS.

Following is a sample WBS diagram:



2.8.Stepwise project planning:



Planning is the most difficult process in project management. The framework described is called the Stepwise method to help to distinguish it from other methods.

Step 0: Select Project

Step 1: Identify project scope and objectives

Step 1.1 : Identify objectives and practical measures of the effectiveness in meeting those objectives

Step 1.2 : Establish a project authority

Step 1.3 : Stakeholder analysis - identify all stakeholders in the project and their interests.

Step 1.4 : Modify objectives in the light of stakeholder analysis.

Step 1.5 : Establish methods of communication with all parties.

Step 2 : Identify project infrastructure

Step 2.2 : Identify installation standard and procedures

Step 2.3 : Identify project team organization

Step 3 : Analyse project characteristics

Step 3.1 : Distinguish the project as either objectives- or product-driven.

Step 3.2 : Analyse other project characteristics

Step 3.3 : Identify high-level project risks

Step 3.4 : Take into account use requirements concerning implementation

Step 3.5 : Select development methodology and life-cycle approach

Step 3.6 : Review overall resource estimates

Step 4 : Identify project products and activities

Step 4.1 : Identify and describe project products

Step 4.2 : Document generic product flows

Step 4.3 : Recognize product instances

Step 4.4 : Produce ideal activity network

Step 4.5 : Modify the ideal to take into account need for stages and checkpoints

Step 5 : Estimate effort for each activity

Step 5.1 : Carry out bottom-up estimates

- distinguish carefully between effort and elapsed

time Step 5.2 : Revise plan to create ontrollable activities

- breakup very long activities into a series of smaller ones
- bundle up very short activities

Step 6 : Identify activity risks

Step 6.1 : Identify and quantify activity based risks

- damage if risk occurs

- likelihood if risk occuring

Step 6.2 : Plan risk reduction and contingency measures

- risk reduction : activity to stop risk occuring
- contingency : action if risk does occurs

Step 6.3 : Adjust overall plans and estimates to take account of risks

Step 7 : Allocate resources

Step 7.1 : Identify and allocate resources

Step 7.2 : Revise plans and estimates to take into account resource constraints

Step 8 : Review/ Publicize plans

Step 8.1 : Review quality aspects of the project plan

Step 8.2 : Documentr plans and obtain agreement

Step 9 and 10 : Execute plan. Lower levels of planning

2.9.Main Steps in Project Planning:

Project planning is one of the main project management processes. If the project management team gets this step wrong, there could be heavy negative consequences during the next phases of the project.

Therefore, the project management team will have to pay detailed attention to this process of the project.

In this process, the project plan is derived in order to address the project requirements such as, requirements scope, budget and timelines. Once the project plan is derived, then the project schedule is developed.

Depending on the budget and the schedule, the resources are then allocated to the project. This phase is the most important phase when it comes to project cost and effort.

2.10.Project Scheduling:

Project Scheduling in a project refers to roadmap of all activities to be done with specified order and within time slot allotted to each activity. Project managers tend to define various tasks, and project milestones and them arrange them keeping various factors in mind. They look for tasks lie in critical path in the schedule, which are necessary to complete in specific manner (because of task interdependency) and strictly within the time allocated. Arrangement of tasks which lies out of critical path are less likely to impact over all schedule of the project.

For scheduling a project, it is necessary to -

Break down the project tasks into smaller, manageable form

Find out various tasks and correlate them

Estimate time frame required for each task

Divide time into work-units

Assign adequate number of work-units for each task

Calculate total time required for the project from start to finish

2.11.Time management:

Time is a terrible resource to waste. This is the most valuable resource in a project.

Every delivery that you are supposed to make is time-bound. Therefore, without proper time management, a project can head towards a disaster.

When it comes to project time management, it is not just the time of the project manager, but it is the time management of the project team.

Scheduling is the easiest way of managing project time. In this approach, the activities of the project are estimated and the durations are determined based on the resource utilization for each activity.

In addition to the estimate and resource allocation, cost always plays a vital role in time management. This is due to the fact that schedule over-runs are quite expensive.

The Steps of the Time Management Process

Following are the main steps in the project time management process. Each addresses a distinct area of time management in a project.

1. Defining Activities

When it comes to a project, there are a few levels for identifying activities. First of all, the high-level requirements are broken down into high-level tasks or deliverables.

Then, based on the task granularity, the high-level tasks/deliverables are broken down into activities and presented in the form of WBS (Work Breakdown Structure).

2. Sequencing Activities

In order to manage the project time, it is critical to identify the activity sequence. The activities identified in the previous step should be sequenced based on the execution order.

When sequencing, the activity interdependencies should be considered.

3. Resource Estimating for Activities

The estimation of amount and the types of resources required for activities is done in this step. Depending on the number of resources allocated for an activity, its duration varies.

Therefore, the project management team should have a clear understanding about the resources allocation in order to accurately manage the project time.

4. Duration and Effort Estimation

This is one of the key steps in the project planning process. Since estimates are all about the time (duration), this step should be completed with a higher accuracy.

For this step, there are many estimation mechanisms in place, so your project should select an appropriate one.

Most of the companies follow either WBS based estimating or Function Points based estimates in this step.

Once the activity estimates are completed, critical path of the project should be identified in order to determine the total project duration. This is one of the key inputs for the project time management.

5. Development of the Schedule

In order to create an accurate schedule, a few parameters from the previous steps are required.

Activity sequence, duration of each activity and the resource requirements/allocation for each activity are the most important factors.

In case if you perform this step manually, you may end up wasting a lot of valuable project planning time. There are many software packages, such as Microsoft Project, that will assist you to develop reliable and accurate project schedule.

As part of the schedule, you will develop a Gantt chart in order to visually monitor the activities and the milestones.

6. Schedule Control

No project in the practical world can be executed without changes to the original schedule. Therefore, it is essential for you to update your project schedule with ongoing changes.

2.12.Importance of project schedules:

Scheduling is the way we actually manage a project. Without scheduling, nothing or nobody is managing the project and hence amounts to failure of a project. Scheduling describes guidance and pathway for a project to run. It defines certain milestones and deliverables which need to be achieved on a timely basis for successful completion of a project. Monitoring the schedule provides an idea of the impact the current problems are having on the project, and provides opportunities to enhance or reduce the scope of a milestone/phase in the project.

It also provides a medium for continuous feedback on how the project is progressing and if there are issues that need to be dealt with or if the client needs to be told about a delay in delivery.

2.13.Schedules and activities:

Creating a comprehensive schedule is one of the more difficult activities that project managers face. Schedule creation is often considered more art than science, and results often support this. What is often more frustrating is that team members often find themselves on one team with a project manager that creates and manages schedules a particular way and on another team with a project manager with a different approach.

I often hear from people on teams, "why can't all project managers do things the same way?"

If you have heard this on your team, perhaps it is time that you take a look at the way you and your team create your team schedules. Perhaps you are not taking a consistent step in developing team schedules that have been shown to work time and time again.

There are tons and tons of resources out there that claim the perfect answer to your scheduling problems. But, I believe that you can improve your chances for success just by following the six simple steps below.

Step 1: Define the Schedule Activities

Take your Work Breakdown Structure (WBS) work packages and decompose them further into schedule activities.

Take each WBS work package, and decide what activities are required to create that package. For example, if your work package is "configure new computer hardware," your schedule activities might include "set up network configuration," "install the video card," "install applications," and then "set up mail client."

Step 2: Sequence the Activities

Remember back in grade school where you were given a bunch of pictures and you had to figure out their order. You had to decide which picture represented the 1st activity, the 2nd activity and so on? Well, that is exactly what the second step is all about. In the second step we sequence the schedule activities by simply placing them in the order in which they need to happen. For example, perhaps we need to install the video card first, then set up the network configuration, install applications and then finally set up the mail client. In some cases two or more activities can be done simultaneously. Perhaps we can set up the mail client while other applications are being installed. This step is where we look at the different types of schedule dependencies such as finish-to-start, start-to-start, finish-to-finish, and start-to-finish to figure out how each of these activities relate to each other.

Step 3: Estimate the Resources Needed for the Activity

The third step involves estimating what resources will be required to accomplish each activity. This includes estimating needed team resources, financial resources, and equipment. These resource needs should be selected for each activity prior to estimating the duration of each activity which is the next step.

Step 4: Estimating the Duration of Each of the Activities

This step requires you and your team to analyse how long it will take to accomplish each of the activities. These estimates can be quantified through the following tools:

Expert Judgement: by conferring with someone who is familiar or experienced in what it takes to accomplish a particular activity.

Analogous Estimating: a top-down estimation approach is taken by looking at similar projects within your organisation for estimates on how long a particular activity should take.

Parametric Estimating: basically this is scaling an estimate. For example, perhaps you know it takes on average 10 minutes to install a software application. If the "install applications" activity includes the installation of 6 applications, you can use parametric estimation to estimate that it will take approximately 6 times 10 minutes, or 60 minutes to install all the applications.

Three point estimation: sometimes referred to as PERT analysis, is a great tool for estimating activity durations. You basically take a weighted average of a pessimistic, expected, and optimistic

estimate for the activity duration. This estimate is in the form of (Pessimistic + 4x (Expected) + Optimistic) / 6

Step 5: Schedule Development

This step is the process where the sequence of activities, resources needed for the activities, and the duration of each activity is used to optimise the overall project schedule. Tools used in this process include critical path method, schedule compression, what-if scenario analysis, resource levelling, and critical chain methods. Each of these topics could have one or more articles dedicated to it, so we will not go into the detail of each.

Once the schedule is developed, it should be baselined to provide a snapshot of the original schedule plan of the plan.

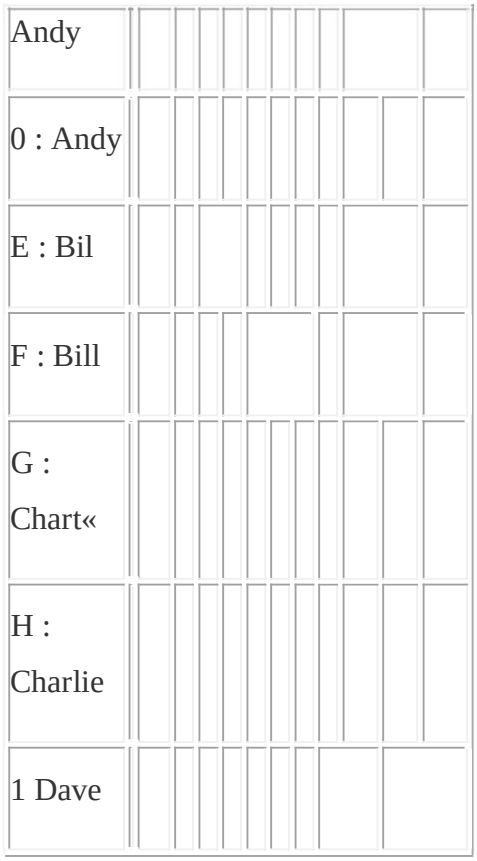
Step 6: Monitoring and Controlling the Schedule

The final step is monitoring and controlling the schedule. This step is performed throughout the life of the project and ensures that the work results lines up with the schedule plan. Schedule control requires the use of progress reporting, schedule change control systems, such as the use of project change requests, performance management, and variance analysis to determine if additional action is required to get the schedule back in line with the plan.

2.14.Sequencing and Scheduling activity:

Throughout a project, we will require a schedule that clearly indicates when each of the project's activities is planned to occur and what resources it will need. One way of presenting such a plan is to use a bar chart

Task Person 1	2	3	4	5	6	7	8	9	10	11	12 13
A Andy											
BAndy	M										
C :											



Activity key: A: Overall design F: Code module 3

B: Specify module I G: Code module 2 C: Specify module 2 H: Integration

testing Activity key: A: Overall design F: Code module 3

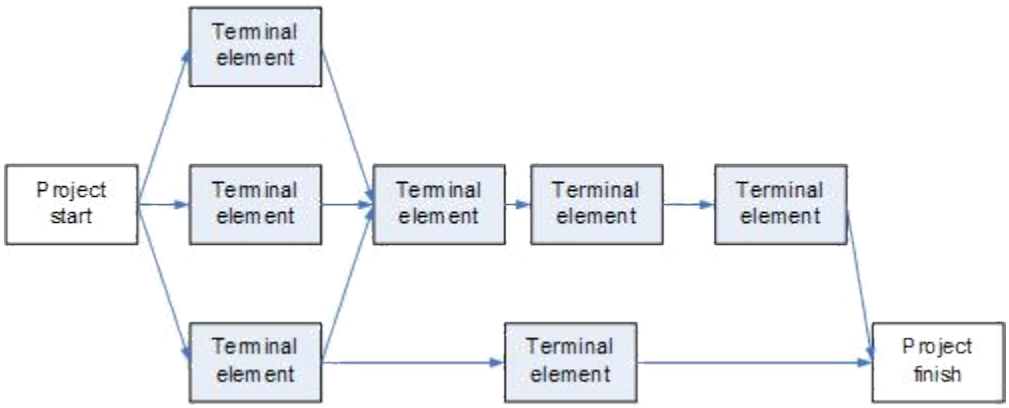
B: Specify module I G: Code module 2 C: Specify module 2 H: Integration testing

D: Specify module 3 I: System testing E: Code module I

In drawing up the chart, we have done two things:- Sequencing the tasks(i.e., identified the⎫ dependencies among activities dictated by the development process) Scheduled them(i.e., specified when they should ⎫ take place) • The scheduling has had to take account of availability of staff and the way in which the activities have been allocated to them.

2.15.Project Network Diagram:

A **project network** is a graph (weighted directed graph) depicting the sequence in which a project's terminal elements are to be completed by showing terminal elements and their dependencies. It is always drawn from left to right to reflect project chronology.[1]



The work breakdown structure or the product breakdown structure show the "part-whole" relations. In contrast, the project network shows the "before-after" relations.

The most popular form of project network is activity on node (AON)(as shown above), the other one is activity on arrow (AOA).

The condition for a valid project network is that it doesn't contain any circular references.

Project dependencies can also be depicted by a predecessor table. Although such a form is very inconvenient for human analysis, project management software often offers such a view for data entry.

2.16.Network planning models:

CPM was developed by the Du Pont Chemical Company who published the method in 1958, claiming that it had saved them $1 million in its first year of use.

These project scheduling techniques model the project's activities and their relationships as a network. In the network, time flows from left to right. These techniques were originally developed in the 1950s - the two best known being CPM (Critical Path Method) and PERT (Program Evaluation Review Technique). More recently a variation on these techniques, called precedence networks, has become popular and it is this method that is adopted in the majority of computer applications currently available. All three methods are very similar and it must be admitted that many people use the same name (particularly CPM) indiscriminately to refer to any or all of the methods.

A traditional network planning methodology in the context of business decisions involves five layers of planning, namely:

need assessment and resource assessment

short-term network planning

IT resource

long-term and medium-term network planning

operations and maintenance.[1]

Each of these layers incorporates plans for different time horizons, i.e. the business planning layer determines the planning that the operator must perform to ensure that the network will perform as required for its intended life-span. The Operations and Maintenance layer, however, examines how the network will run on a day-to-day basis.

The network planning process begins with the acquisition of external information. This includes:

forecasts of how the new network/service will operate;

the economic information concerning costs; and

the technical details of the network's capabilities.

Planning a new network/service involves implementing the new system across the first four layers of the OSI Reference Model. Choices must be made for the protocols and transmission technologies.

Network planning process involves three main steps:

Topological design: This stage involves determining where to place the components and how to connect them. The (topological) optimisation methods that can be used in this stage come from an area of mathematics called Graph Theory. These methods involve determining the costs of transmission and the cost of switching, and thereby determining the optimum connection matrix and location of switches and concentrators.

Network-synthesis: This stage involves determining the size of the components used, subject to performance criteria such as the Grade of Service (GOS). The method used is known as "Nonlinear Optimisation", and involves determining the topology, required GoS, cost of transmission, etc., and using this information to calculate a routing plan, and the size of the components.

Network realization: This stage involves determining how to meet capacity requirements, and ensure reliability within the network. The method used is known as "Multicommodity Flow Optimisation", and involves determining all information relating to demand, costs and reliability, and then using this information to calculate an actual physical circuit plan.

2.17.Duration Estimating and schedule development:

Estimating:

Some information is essential to creating a meaningful estimate:

A statement of scope or scope document that defines what the project is and is not (this includes vetting of underlying assumptions and constraints)

A task list in the form of a work breakdown structure (WBS)

The task details defined (not simply a list of task names)

Duration estimations provided by the team and with use of historical record

Task dependencies (schedule and risks) clarified

Schedule risks identified, such as:

- Critical Path? (longest consecutive, slack-less path)
- Task variations

Planned schedule risk mitigation

Schedule development:

The schedule essentially transforms the project from a vision to a time-based plan.

Schedules also help you do the following:

They provide a basis for you to monitor and control project activities.

They help you determine how best to allocate resources so you can achieve the project goal.

They help you assess how time delays will impact the project.

You can figure out where excess resources are available to allocate to other projects.

They provide a basis to help you track project progress.

2.18.Critical path analysis:

Critical path is the sequential activities from start to the end of a project. Although many projects have only one critical path, some projects may have more than one critical paths depending on the flow logic used in the project.

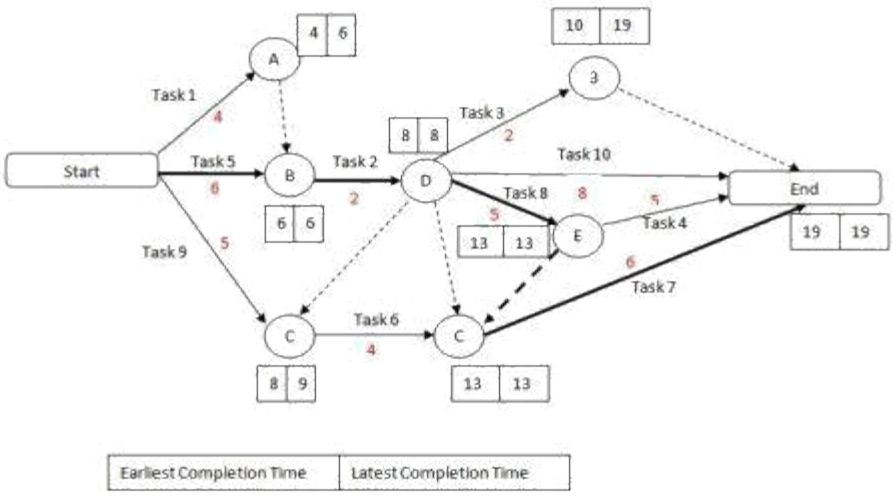
If there is a delay in any of the activities under the critical path, there will be a delay of the project deliverables.

Most of the times, if such delay is occurred, project acceleration or re-sequencing is done in order to achieve the deadlines.

Critical path method is based on mathematical calculations and it is used for scheduling project activities. This method was first introduced in 1950s as a joint venture between Remington Rand Corporation and DuPont Corporation.

The initial critical path method was used for managing plant maintenance projects. Although the original method was developed for construction work, this method can be used for any project where there are interdependent activities.

In the critical path method, the critical activities of a program or a project are identified. These are the activities that have a direct impact on the completion date of the project.



Key Steps in Critical Path Method

Let's have a look at how critical path method is used in practice. The process of using critical path method in project planning phase has six steps.

Step 1: Activity specification

You can use the Work Breakdown Structure (WBS) to identify the activities involved in the project. This is the main input for the critical path method.

In activity specification, only the higher-level activities are selected for critical path method.

When detailed activities are used, the critical path method may become too complex to manage and maintain.

Step 2: Activity sequence establishment

In this step, the correct activity sequence is established. For that, you need to ask three questions for each task of your list.

Which tasks should take place before this task happens.

Which tasks should be completed at the same time as this task.

Which tasks should happen immediately after this task.

Step 3: Network diagram

Once the activity sequence is correctly identified, the network diagram can be drawn (refer to the sample diagram above).

Although the early diagrams were drawn on paper, there are a number of computer softwares, such as Primavera, for this purpose nowadays.

Step 4: Estimates for each activity

This could be a direct input from the WBS based estimation sheet. Most of the companies use 3-point estimation method or COCOMO based (function points based) estimation methods for tasks estimation.

You can use such estimation information for this step of the process.

Step 5: Identification of the critical path

For this, you need to determine four parameters of each activity of the network.

Earliest start time (ES) - The earliest time an activity can start once the previous dependent activities are over.

Earliest finish time (EF) - ES + activity duration.

Latest finish time (LF) - The latest time an activity can finish without delaying the project.

Latest start time (LS) - LF - activity duration.

The float time for an activity is the time between the earliest (ES) and the latest (LS) start time or between the earliest (EF) and latest (LF) finish times.

During the float time, an activity can be delayed without delaying the project finish date.

The critical path is the longest path of the network diagram. The activities in the critical path have an effect on the deadline of the project. If an activity of this path is delayed, the project will be delayed.

In case if the project management needs to accelerate the project, the times for critical path activities should be reduced.

Step 6: Critical path diagram to show project progresses

Critical path diagram is a live artefact. Therefore, this diagram should be updated with actual values once the task is completed.

This gives more realistic figure for the deadline and the project management can know whether they are on track regarding the deliverables.

Advantages of Critical Path Method

Following are advantages of critical path methods:

Offers a visual representation of the project activities.

Presents the time to complete the tasks and the overall project.

Tracking of critical activities.

2.19.Program evaluation and review techniques:

Before any activity begins related to the work of a project, every project requires an advanced, accurate time estimate. Without an accurate estimate, no project can be completed within the budget and the target completion date.

Developing an estimate is a complex task. If the project is large and has many stakeholders, things can be more complex.

Therefore, there have been many initiatives to come up with different techniques for estimation phase of the project in order to make the estimation more accurate.

PERT (Program Evaluation and Review Technique) is one of the successful and proven methods among the many other techniques, such as, CPM, Function Point Counting, Top-Down Estimating, WAVE, etc.

PERT was initially created by the US Navy in the late 1950s. The pilot project was for developing Ballistic Missiles and there have been thousands of contractors involved.

After PERT methodology was employed for this project, it actually ended two years ahead of its initial schedule.

The PERT Basics

At the core, PERT is all about management probabilities. Therefore, PERT involves in many simple statistical methods as well.

Sometimes, people categorize and put PERT and CPM together. Although CPM (Critical Path Method) shares some characteristics with PERT, PERT has a different focus.

Same as most of other estimation techniques, PERT also breaks down the tasks into detailed activities.

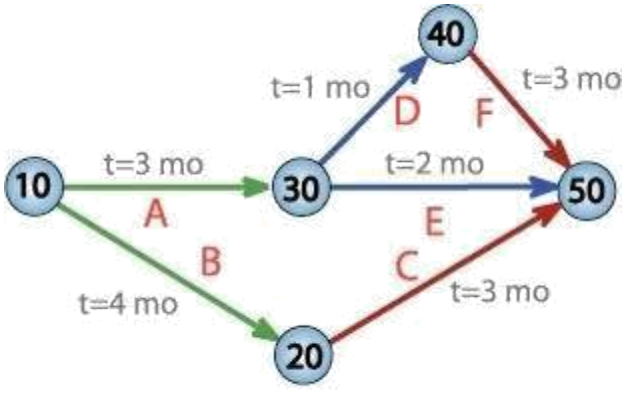
Then, a Gantt chart will be prepared illustrating the interdependencies among the activities. Then, a *network* of activities and their interdependencies are drawn in an illustrative manner.

In this map, a *node* represents each event. The activities are represented as arrows and they are drawn from one event to another, based on the sequence.

Next, the Earliest Time (TE) and the Latest Time (TL) are figured for each activity and identify the slack time for each activity.

When it comes to deriving the estimates, the PERT model takes a statistical route to do that. We will cover more on this in the next two sections.

Following is an example PERT chart:



PERT network chart for a seven-month project with five milestones (10 through 50) and six activities (A through F)

The Three Chances

There are three estimation times involved in PERT; Optimistic Time Estimate (TOPT), Most Likely Time Estimate (TLIKELY), and Pessimistic Time Estimate (TPESS).

In PERT, these three estimate times are derived for each activity. This way, a range of time is given for each activity with the most probable value, TLIKELY.

Following are further details on each estimate:

1. TOPT

This is the fastest time an activity can be completed. For this, the assumption is made that all the necessary resources are available and all predecessor activities are completed as planned.

2. TLIKELY

Most of the times, project managers are asked only to submit one estimate. In that case, this is the estimate that goes to the upper management.

3. TPESS

This is the maximum time required to complete an activity. In this case, it is assumed that many things go wrong related to the activity. A lot of rework and resource unavailability are assumed when this estimation is derived.

The PERT Mathematics

BETA probability distribution is what works behind PERT. The expected completion time (E) is calculated as below:

```
E = (TOPT + 4 x TLIEKLY + TPESS) / 6
```

At the same time, the possible variance (V) of the estimate is calculated as below:

```
V = (TPESS - TOPT)^2 / 6^2
```

Now, following is the process we follow with the two values:

For every activity in the critical path, E and V are calculated.

Then, the total of all Es are taken. This is the overall expected completion time for the project.

Now, the corresponding V is added to each activity of the critical path. This is the variance for the entire project. This is done only for the activities in the critical path as only the critical path activities can accelerate or delay the project duration.

Then, standard deviation of the project is calculated. This equals to the square root of the variance (V).

Now, the normal probability distribution is used for calculating the project completion time with the desired probability.