
CHAPTER FOUR: INTRODUCTION TO PROJECT PLANNING

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Objectives

After completing this chapter you should be able to:

- Identify the purpose of project planning and identify the six key questions project planning answers;
- Describe the project planning processes;
- Distinguish between a core and facilitating project planning processes;
- Describe the benefits of a project plan;
- List and describe each components of a complete project plan.
- Identify the main elements of risk management planning;
- Describe the purposes of communication plan;
- Develop the various reporting techniques; and
- Develop a change control management plan.

Introduction

This chapter will introduce you with the background information of the project-planning phase, which is the second stage in the project life cycle. The chapter is divided into two parts. The first part deals with the purpose and the processes of project planning. The second part deals with the project plan and its components. Hoping that you have grasped the core planning processes and project plan components, I will now proceed to the discussion of facilitating planning processes.

In this chapter we will develop the additional management procedures and plans required to prepare a complete project plan. All the documents created in the planning phase are then compiled and included in the project plan to be utilized in project implementation.

The Facilitating Processes are performed intermittently during the Project Planning Phase on an as needed basis. However, Facilitating Processes are **not optional**. These processes will frequently affect components of the plans developed from the Core Processes.

The three planning documents resulting from the facilitating processes are:

- Risk Management Plan
- Communications Plan
- Change control Management Plan

Now in this Unit we will discuss the procedures and elements of each plan components in more detail.

4.1 Planning Phase

Project planning phase is; where the project manager organizes the project's activities and resources within a specified time frame and prepares the project for successful implementation.

Project-planning phase builds on the work done in project initiation. The project initiation defines all parameters of the project such as scope, cost and schedule. In the planning phase the Initiation definition are further developed, enhanced, and refined, until they form a definitive plan for the rest of the project.

Project Planning is an opportunity to identify and resolve any remaining issues and answer outstanding questions that may undermine the goals of the project or threaten its success. It is an opportunity to plan and prepare, as opposed to react and catch up.

Project planning is the process of defining an orderly arrangement of activities and resources to deliver a unique product or service. The project-planning phase organizes the project's deliverables and resources within realistic time frames. The planning phase prepares the project for successful implementation. It links the resources to the project's activities. The purpose of project planning is therefore to define the exact parameters of a project and ensure that all the pre-requisites for project execution are in place.

Planning a project involves answering key questions such as:

- What work to be performed?
- Who will be responsible for each piece of work?
- In what order should the work be completed?
- How long will it take to complete each item of the work?
- What resources are needed to complete each item of the work?
- How can the work be scheduled to meet the requested deadline?

Project planning develops management procedures and plans. All documents created during project planning are compiled into the **Project Plan** to be utilized in project execution phase of the project.

Time spent developing the appropriate structure for organizing and managing project activities improves performance in the project execution phase. The project-planning

phase begins after approval of the project charter and concludes with approval of the project plan.

4.1.1 Planning Processes

The project planning consists of two sets of interrelated processes. These are:

- Core processes and
- Facilitating processes.

Now let's briefly describe the **core planning** and **facilitating processes** cycle, and the resulting plan deliverables. For each plan deliverable, a more detailed description is provided in next units.

- ❖ **Core planning processes** represent a set of critical activities that are dependent on each other and are executed in an explicit order. Execution of the core planning process begins with the review and refinement of the **project scope and objectives** formulated in the initiation phase. From the refined project scope and objectives, the **work breakdown structure (WBS)** is built. The WBS is a deliverable-oriented grouping of project components that organizes and defines the total scope of the project. The WBS becomes the foundation for development of the **organizational breakdown structure (OBS)**, the **sequencing of activities**, and the development of the **resource plan**. Development of the resource plan also requires input from the OBS. The OBS defines the organizational units responsible for a specific project component or task, and the resource plan identifies the specific resources, which will be allocated to the project component or task. And then a **project schedule** is developed.

Project schedule development is dependent on input from the resource plan and activity sequencing processes. The project schedule provides a representation of predicted tasks, milestones, dependencies, resource requirements, task durations, and deadlines. The project schedule and resource plan provide input to the **budget planning** process. The budget plan identifies the available funding and costs associated with a defined set of activities during a specified time period. Finally, the **performance planning** is developed

with input from the refined scope and objectives and the budget plan. The performance plan defines how the project success or failure is measured.

The project plan component documents that result from execution of the core planning process are:

- Work Breakdown Structure
- Resource Plan
- Project Schedule
- Project Budget
- Performance Plan

❖ **Facilitating-planning processes** represent planning activities that are not dependent on other processes. The facilitating planning processes are performed intermittently during the project-planning phase on an as needed basis. However, facilitating processes are not **optional**. These processes will frequently affect components of the plans developed from the core planning process.

The key planning documents resulting from the facilitating planning processes are:

- Risk Management Plan
- Communications Plan
- Change control Management

4.2 Project Plan

The project plan is used to guide execution and control of the project. It forms the basis for all management efforts associated with the project. The project plan can also be used to communicate with project stakeholders and gain support and understanding of the project.

The project manager and project team develop the project plan through execution of the project planning processes and present the plan to management for approval. A project plan is a formal approved document that is used to guide both project execution and project control.

Information documented in the project plan evolves as the project moves through multiple iterations of the planning process. Changes made to any component of the project plan can affect other plan components and thus requires the review of all planning documents. The project plan is actually a combination of numerous component plans that are developed during the Project Planning Phase.

The project plan usually contains these elements:

➤ **General Project Information**

This will contain, among other things, a record of the project objectives and project scope and outline of the costs, timing and specifications of the work to be done.

➤ **Performance Plan**

List the project objectives, performance goal for each objective, and briefly describe the methodology for how the performance goal is measured.

➤ **Work Breakdown Structure**

This is a detailed WBS, drawn up to a level at which control will be exercised during implementation phase of a project. It should give specifications for all tasks.

➤ **Resource Plan**

Provide a detailed breakdown of resources, other than funds, required to execute the project. Identify the skill level, associated task, duration required, available time period, cost, unit of cost and the level of risk associated with that resource.

➤ **Project Schedule**

Schedule starting finishing dates of all activities on the WBS are needed. major milestones should also be identified.

➤ **Project Budget**

This section provides the expenditures and source of funding for the project during the life of the project. Identify and explain deviations from the approved funding outlined in the Project Charter. This budget does not include expenditures and funding for the life of the asset produced. Lifecycle cost for the asset is addressed in Project Initiation.

➤ **Risk Plan**

This should describe the process for identification of risk, evaluation and prioritization of risk, identification of options for mitigating risk, the process for maintaining the risk plan and risk monitoring, and the responsibilities of individuals.

➤ **Communications Plan**

This section documents the information requirements of stakeholders and defines the procedures to meet those requirements. The plan details what, when, and how information is collected and reported.

➤ **Change control Management Plan**

This part provides the means to control and manage change during the execution of the project plan.

All these components of the plan will be discussed in detail in unit two and three of this module.

4.3 Core Planning Process Tools and Techniques

As seen in the last Section, the project-planning phase consists of two sets of interrelated processes. These are **core planning processes** and **facilitating planning processes**. As you remember we have briefly outlined the processes of the core planning cycle and facilitating planning.

Now in this Section we will discuss the tools and techniques used in the core planning processes and the resulting plan deliverables in more detail.

We noted that the core processes represent a set of critical activities that are dependant on each other and are executed in an explicit order. We also outlined the steps:

- Defining the Activities or Tasks: Work Breakdown Structure
- Activity Sequencing
- Estimating Activity Durations
- Estimating the Resource Requirements
- Developing the Schedule
- Budgeting and Performance planning

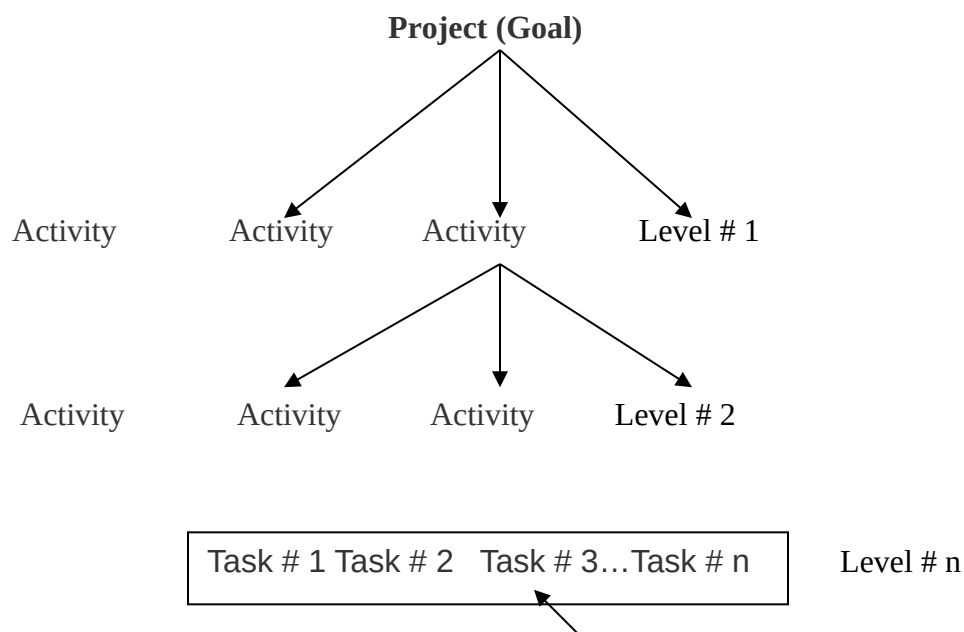
4.3.1. Work Breakdown Structure (WBS)

The work breakdown structure (WBS) is a project management tool that can be used to describe all the work that needs to be completed in a project and how it should be organized. It provides a clear picture of the entire project. This is based on the idea of a project being comprised of a set of major deliverables.

The WBS can be defined as:

The work breakdown structure (WBS) is a hierarchical description of all the work that must be done to complete the project.

Several processes can be used to create this hierarchy, which we will discuss in this section later on. An example of the WBS is shown below in figure 4.1.



Work Package

Fig 4.1: Hierarchal visualization of the work breakdown structure

Where:

- An activity is simply a chunk of work.
- A task is a smaller chunk of work.

While these definitions seem a bit informal, the difference between an activity and a task will become clearer shortly. The terms activity and task have been used interchangeably. Some would use the convention that activities are made up of tasks, while others would say that tasks are made up of activities. In this Course, we refer to higher-level work as activities which are made up of tasks. A work package is a complete description of how the tasks that make up an activity will actually be done.

The work package includes a description of the what, who, when, and how of the work. In this course we also refer tasks a distinct or unit of work packages. Breaking down work into a hierarchy of activities, tasks, and work packages is called **decomposition**. For example, take a look at the top of the WBS in figure 4.1. Notice that the project or its goal defined as a *level 0* activity in the WBS. The next level, *level 1*, is the decomposition of the *level 0* activity into a set of activities defined as *level 1* activities. These *level 1* activities are major chunks of work. When the work associated with each *level 1* activity is complete, the *level 0* activity is complete. For this example, that means the project is complete.

As a general rule when an activity at level n is decomposed into a set of activities at level $n+1$ and the work associated with those activities is complete, the activity at level n from which they were defined, is complete.

Decomposition is important to the over all project plans because it allows you to estimate the duration of the project, determine the required resources, and schedule the work. The complete decomposition will be developed by using the completeness criteria discussed later in this section by following those criteria; the activities at the lowest levels of

decomposition will possess known properties that allow us to meet planning and scheduling.

- **Steps in WBS Development**

- 1. Develop Level 1 of the WBS.**

The first step in constructing a WBS is to identify the major project activities. Typically, the scope described in the project charter is the basis for defining the first level of activities in a WBS. Level 1 activities are the major project activities identified as deliverables in the project scope. Level 1 represents the highest level of the WBS.

Example: For instance, consider a house project. In this project we may have different levels of activities.

- 2. Decompose WBS: List the sub activities or tasks for major activities**

Once the main activities of the project have been established, the second step is sub divide the items on the WBS into separate activities or tasks. The WBS is decomposed into discrete tasks or work packages to be accomplished during the project.

A project WBS normally is decomposed to at least three or four levels. Projects are decomposed to a level that represents a distinct package of work.

- 3. Assign Responsibility**

After the WBS is decomposed to the lowest level (the work package), responsibility is assigned for each element. Individuals assigned to an element are responsible for planning, controlling, and executing the specific task. Responsibility assignment is done using organizational breakdown structure which we will discuss later in this section.

- 4. Define WBS Elements**

A collection of activity and task descriptions is referred to as a **WBS dictionary**. The purpose of the WBS dictionary is to clearly describe each element of the WBS to facilitate planning and management of the element. The description includes what is to be delivered, attributes of the product or service delivered, and, in some cases, what is not included within the element. Defining what is not included ensures that the responsible individual does not allow additional scope to be added to the project. The WBS dictionary can be used to communicate scope to contractors or subcontractors, often forming the basis for a statement of work.

At this point in the planning process we generated a WBS.

- **Criteria to test completeness in the WBS**

Developing the WBS is the most critical part of planning. If we do this part right, the rest is comparatively easy. Each unit of the work package must possess three characteristics to be considered complete - that is completely decomposed. The three characteristics are as follows:

- They must be measurable in terms of cost, effort, resources and time.
- They must result in a single end product which can be checked
- They must be the responsibility of a single individual or functional group.

If the activity does not possess these characteristics, decompose the activity and ask the questions again. As soon as an activity possesses the three characteristics, there is no need to further decompose it. As soon as every activity in the WBS possesses the three characteristics, the WBS is defined as complete. The activities that satisfy these three characteristics are called tasks or unit of work package.

- **WBS Format**

There are two methods of presenting the WBS:

- Graphically in box
 - Text indents
- The WBS is a hierarchical structure, which is best presented by a **graphical** sub division of the scope of the work in the boxes. Consider the previous example of house project. The WBS can be graphically represented as follows:

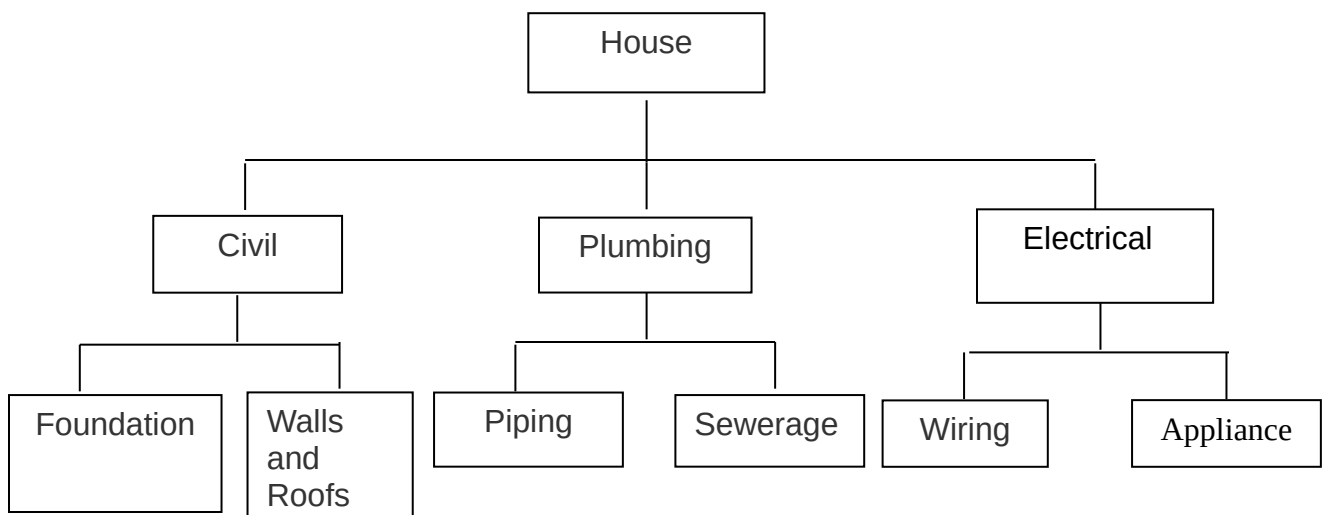


Fig 4.2: House project WBS sub divided into boxes

- The other method of presentation shows the scope of the work is **text indent**, where each level is tabbed to represent its level in the hierarchy. Now let's present the above figure as text indents.

1.0.0 House Project

1.1.0 Civil

1.1.1 Foundation

1.1.2 Walls and Roofs

1.2.0 Plumbing

1.2.1 Piping

1.2.2 Sewerage

1.3.0 Electrical

1.3.1 Wiring

1.3.2 Appliance

A WBS, because of its hierarchical nature, requires that a parent-child (hierarchical) relationship be established and captured for automated reporting. To achieve the parent-child relationship, a coding or numbering scheme is used to identify each element.

In other words, WBS elements are usually numbered, the numbering system may be arranged any way you choose. But, the simpler the coding scheme the better. The conventional numbering system is as shown in the simplified example above.

4.3.2. Activity Sequencing, Duration and Resource Estimation

Earlier we discussed the WBS. It provides a structure breakdown of the scope of the work into manageable work packages. The next process is to establish a logical relationship between the activities. Activity sequencing means creating logical flows of activities.

The process of sequencing activities and tasks represents a further refinement of the WBS. Activity sequencing involves:

- dividing the project into smaller, more manageable components,
- Specifying the order of completion, and
- Identifying the dependent relationships between activities and tasks.

A network diagram is used to create logical flows of activities. It is an excellent method to represent a logical relationship between activities. A network diagram may be defined as a graphical presentation of the project's activities showing the planned sequence of work.

The network diagram, also called precedence diagram method is a development of activity node concepts where each activity is represented in a node or a box.

In its simplest form only two items of information are required:

- List of activities
- Logical constraint, also called logical dependency or logical relationship between activities.

i. Defining Project Tasks

Use the WBS to identify the specific activities/tasks necessary to accomplish the project objective. The WBS definition of the activity and task description is usually a general description that should be further refined in this step of the project planning process. The accuracy of the project schedule will increase in proportion to the level of detail reflected in this process.

ii. Defining Logical Relationships

The network diagram shows the sequence of activities where these logical relationships can be either mandatory or discretionary.

Mandatory dependencies are those dependencies that are inherent to the type of work being done. They cannot and will not change, no matter how many individuals are working on a task or how many hours are allocated to a task.

Example: on a construction project the foundation **must** (hard logic) be built before the walls and roofs are erected, whereas scheduling the electrical work before the plumbing work is discretionary (soft logic).

The Project Manager must recognize mandatory dependencies since they will dictate the way certain pieces of the schedule will need to be structured.

Discretionary dependencies are those dependencies that are defined by the project team that force the project manager to schedule tasks in a certain way. For example, the Project Team may be required to use an in-house "best practice" to complete an activity that forces other activities to be completed in a specific sequence.

Before we can draw a network diagram we must define the logical relationship between all the activities. There are two basic relationships:

- Activities in **series**
- Activities in **parallel**

➤ **Activities in series:** when the activities are in series they are carried out one after the other. When the network diagram is first developed this would probably be the most common type of relationship.

Example: activities performed in series on a house project would be the foundation, followed by walls, followed by the roof.

➤ **Activities in Parallel:** when the activities are in parallel they can be performed at the same time, which is a more efficient use of time than activities in series.

Example: An example on a house project would be the installation of plumbing and electrical fitted simultaneously after the roof is fitted, followed by the painting.

Remember the term logical relationship; dependency and link are all used interchangeably to represent the lines drawn between activities nodes. Now let's establish a network diagram for activities performed in series on a house project. Read the network diagrams as you would a page of writing, the project starts on the (top) left side and moves to the right and down wards (See the figure below).

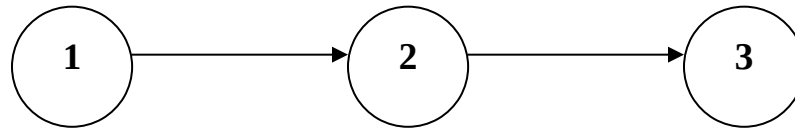


Fig 4.4: Activity Nodes

Event nodes at the end of the arrow mark the start and finish of the activity. The above diagram shows that activity 1 (start of activity) and activity 3 (the finish of activity). The node which ends one activity can also mark the start of another activity (activity 2 marks the start of activity 3).

Considering a house project activities performed in series would be the foundation (activity 1), followed by walls (activity 2), and followed by the roof (activity 3).

Using nodes like this, it is possible to construct a network which shows parallel dependencies between various activities.

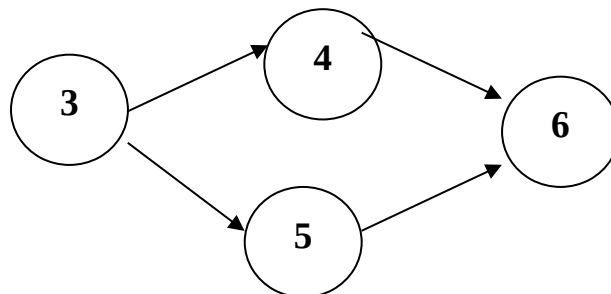


Fig 4.5: Activities in Parallel

5. The above network diagram shows the installation of plumbing (activity 4) and electrical (activity 5) fitted simultaneously after the roof (activity 3) is fitted, followed by the painting (activity 6).

For ease of reading, logical information is often compiled in a **tabular form**, with each record (or line) defining a relationship.

Using the activity logic in table below walk through the following worked example (see figure 4.5) where activities and dependencies are labeled.

Activity number	Dependencies (preceding activities)
A	-
B	After a
C	After a
D	After b
E	After c
F	After d, e

Now lets draw a complete network diagram using the information provided in the table now See the figure below;

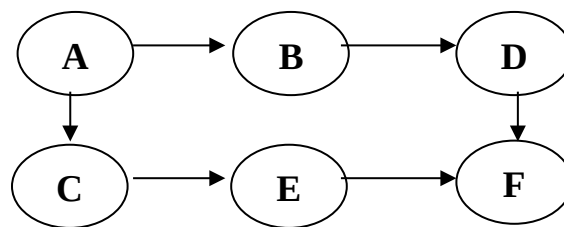


Fig 4.6: Network diagram

At this point in the planning process think only the sequence of the activities- as constraints of duration, resources, and costs will be introduced later. We will further discuss this in the next section in project scheduling.

4.3.3. Activity Duration

Accurate time estimation is a skill essential to good project management. It is important to get time estimates right for two main reasons:

1. Time estimates drive the setting of deadlines for delivery of projects, and hence peoples' assessments of your reliability
2. They often determine the pricing of contracts and hence their profitability.

Before we can estimate the duration of the listed activities, it is important to have a common definition. Duration is the amount of time required to complete the defined task.

Time units can be expressed as hours, days, weeks, months or years depending on the length of the activities and the project. An activity's duration will run from the start to the finish of the activity.

The estimated duration combined with resource planning information and task relationships will define the project schedule.

There are several techniques available to estimate task duration. These are:

- **Historical experience.** The most common technique relies on **historical experience**. Collected and archived historical project data can be used in this estimation. Historical records greatly enhance the accuracy of duration and cost estimates. Additionally, data based on staff skills are far more valuable than generalized industry estimates.
- **Expert advice.** If historical data do not exist, seek the **advice of experts** and others who have completed similar tasks. Obtain estimates from multiple sources, compare the results, and estimate the duration based on the multiple inputs.
- **Three point technique (or PERT).** PERT stands for Program Evaluation and Review Technique. PERT takes a slightly more skeptical view of time estimates made for each project stage or activities. PERT method can be used to estimate duration of projects when faced with high uncertainty.

To use PERT follow the following steps:

- ✿ Develop three time estimates. These are:

- the shortest possible time or the optimistic time
- the most likely length of time
- the longest time or the pessimistic time

In other words, to use PERT you need to first estimate the shortest possible time each activity will take, the most likely length of time, and the longest time that might be taken if the activity takes longer than expected.

✿ Use the formula below to calculate the time to use for each project stage:

$$\frac{\text{Shortest time} + 4 \times \text{likely time} + \text{longest time}}{6}$$

This helps to bias time estimates away from the unrealistically short time-scales normally assumed.

Before we wind up activity duration, let's briefly discuss the challenges faced in duration estimation.

You have to note that estimating task duration is one of the most challenging aspects of project planning. It is also a key input to cost estimation. Estimating task duration is an iterative process occurring throughout the planning phase and is directly affected by the results of resource planning.

Variables that impact task duration include:

- Staff availability,
- Complexity of the task,
- The skill level of the person assigned to the task,
- Unexpected events,
- Efficiency of work time, and
- Mistakes and misunderstandings during the execution of the project.

No staff resource is 100% productive every hour of the workday. If a time schedule assumes 100% productivity, the schedule rapidly falls apart. A successful time schedule developer incorporates these factors into the duration estimates.

4.3.4. Resource Planning

As you remember in the project initiation phase we developed a project proposal. The project proposal allocates resources (at a high level) to the project. Every project has a limited number of resources. One of the project manager's primary roles is to find a way to successfully execute a project within these resource constraints.

Now at this point in a planning phase a project manager prepare detailed resources requirements to execute a project with the limited resources.

There are several steps to planning for resource needs of a project:

- Determining the resource requirement
- Estimating the skill requirements or material quality
- Identification of duration of time that the resources are available
- Identification of resource costs
- Identification of risk associated with a particular resource

◆ Resource

Resource planning involves identifying a team that possesses the skills required to perform the work (labor resources) as well as identifying the tools, equipment, facilities and other resources needed by the team to complete the project.

Though the initiation phase allocates resources to the project, specific resources may not be identified. The first step is to determine the specific resources that are available to the project. Using the Work Breakdown Structure and the Organizational Breakdown

Structure, develop and provide a detailed breakdown of resources, other than funds, required to execute the project.

◆ Skill requirements and material quality

Identify the experience or skill level of people or the acceptable condition level of other resources.

Task completion time is directly related to the skill level of the person performing the task. The project manager must pragmatically assess the skills of the available resources. The skill level or quality of the allocated resource will drive both schedule and budget. (Less than optimal resources may slow the project and increase cost even if their rate is lower than an optimal resource.)

◆ Duration Required

Identify the duration of time (days, weeks, hours) that the resource is needed as well as when (dates) the required resource is available to the project.

◆ Costs

Identify what the resource will cost for the required period and the basis of cost. Cost may be based on an hourly, daily, weekly, or monthly calculation.

Identification of resource costs is essential information to development of the project budget. Resources required by the project can be charged to the project in a variety of ways. Some costs are hidden costs and are not easily identified. The cost for each resource and the unit of measure by which the cost is calculated needs to be recorded in the resource plan.

◆ Risk

There is risk associated with attaining and maintaining resources. Hence, it is important to identify the level of risk associated with each resource. The levels of risks are High, Medium, and Low. The Project Manager must determine the risks associated with the

available resources. Resource risk may include skill level availability and cost of the resource. Risks are inherently involved with scheduling resources.

Sound resource planning makes allowances for dealing with risks in one or more of the following ways:

- When significant resource risks are identified, add a WBS task for risk management/risk reduction and add financial reserves to the budget to cover potential schedule delays.
- Add time to those tasks where resources are known to be a problem. There is no rule of thumb for this multiplier; it depends on the degree of risk and the overall impact resource problems can have on the project.
- Apply an additional percentage of time to the schedule for specific individuals, particularly if new technology is being used or if the person providing the estimate is extremely optimistic
- When a skill shortage is identified, add time and resources for training. By recognizing resource shortfalls and providing the necessary training, a project manager mitigates some risk.

4.3.5. Project Developing Scheduling: CPA and Gantt Charts

The project schedule provides a graphical representation of predicted tasks, milestones, dependencies, resource requirements, task duration, and deadlines. The process of developing the project schedule follows sequencing of activities and resource planning.

The project schedule should be detailed enough to show:

- Each WBS element to be performed
- Resources scheduled for each task
- Start and end date of each task

- Expected duration of each task
- Required predecessor task(s)

During the life of the project, actual progress is measured against the approved schedule baseline. A schedule baseline is defined as the original approved Schedule Plus or minus approved changes. Changes to the schedule baseline are controlled through a defined change control process addressed later in the methodology. Schedule development and maintenance have the following objectives:

- Developing a project schedule that displays a logical sequence of tasks to deliver the project
- Providing an accurate status of the project to control the project work effort
- Providing a means for understanding the impact of change on the schedule baseline

I. Scheduling Steps (or how do you do this?)

A project schedule is developed in steps. Figure 4.7 depicts the process to develop schedule during the life of the project.

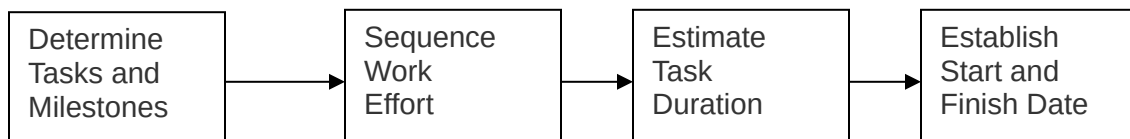


Fig 4.7: Schedule Development Process

1. Determine Tasks and Milestones

Tasks are focused on work effort to produce a product. Milestones are a point in time used as management checkpoints to measure accomplishment. The number of tasks and milestones identified result from the specific product, the level of risk, and the level of detail required by management. The result is a listing of tasks and milestones required to deliver the product.

Milestones denote the completion of key project activities. A milestone has no duration. A deliverable is often represented as a milestone, while the effort to produce the deliverable is identified as a task. Milestones can occur at the end of each work package in the work breakdown structure and serve as measurable items on which to evaluate success of a task.

2. Sequence Work Effort

Logically sequencing tasks and milestones to deliver a product is critical to development of a project schedule. Sequencing establishes dependencies among tasks and milestones, which must be incorporated into the project schedule. Sequencing of WBS activities and tasks is performed during activity sequencing discussed in the previous section.

3. Estimate Task Duration

Earlier we noted that estimating task duration is one of the most challenging aspects of project planning. It is also a key input to cost estimation. Estimating task duration is an iterative process occurring throughout the planning phase and is directly affected by the results of resource planning.

4. Establish Start Date and Finish Date

After the tasks and milestones are identified, sequenced, and estimated, the start and finish dates for each task must be specified.

The date a task may start is impacted by the availability of resources to perform the task and the task's dependency on other tasks. The **start date** of a task is derived from the date resources required to execute the task are available and the **finish date(s)** of predecessor task(s). The finish date of a task is determined by adding the estimated task duration to the start date.

II. Schedule Format

There are two types of schedule format. These are:

1. Gantt chart and
2. Critical Path Analysis chart (CPA)

A. Gantt Charts

A Gantt chart is frequently used method to display a schedule. The Gantt chart (or bar graph, named after Henry Gantt) is a two-dimensional representation showing tasks and the time frame for completion.

Gantt Charts are useful tools for analyzing and planning more complex projects. They:

- ◆ Help you to lay out the tasks that need to be completed
- ◆ Give you a basis for scheduling when these tasks will be carried out
- ◆ Allow you to plan the allocation of resources needed to complete the project, and
- ◆ Help you to work out the critical path for a project where you must complete it by a particular date.

When a project is under way, Gantt charts help you to monitor whether the project is on schedule. If it is not, it allows you to pinpoint the remedial action necessary to put it back on schedule.

Example: The example is related to computer project. We will use this same example for both this section and the section on [Critical Path Analysis](#). This will allow you to compare the results of the two approaches.

To draw up a Gantt chart for a computer project, follow these steps:

1. List all activities in the plan

For each task, **show the earliest start date, [estimated length of time](#) it will take, and whether it is parallel or sequential**. If tasks are sequential, show which stages they depend on. You will end up with a task list like the one in Table 2.2. This example shows the task list for a custom-written computer project.

	Possible start	Duration	Type	Dependent on...
1. High level analysis	week 1	5 days	sequential	
2. Selection of hardware platform	week 1	1 day	sequential	1
3. Installation and commissioning of hardware	week 3	2 weeks	parallel	2
4. Detailed analysis of core modules	week 1	2 weeks	sequential	1
5. Detailed analysis of supporting utilities	of week 1	2 weeks	sequential	4
6. Programming of core modules	week 4	3 weeks	sequential	4
7. Programming of supporting modules	of week 4	3 weeks	sequential	5
8. Quality assurance of core modules	week 5	1 week	sequential	6
9. Quality assurance of	week 5	1 week	sequential	7

supporting modules				
10.Core module training	week 7	1 day	parallel	6
11.Development accounting reporting	of week 6	1 week	parallel	5
12.Development management reporting	of week 6	1 week	parallel	5
13.Development management analysis	of week 6	2 weeks	sequential	5
14.Detailed training	week 7	1 week	sequential	1-13
15.Documentation	week 4	2 weeks	parallel	13

Fig 4.8 Gantt Chart Example: Planning a computer project

You have to note that the start week shows when resources become available. Whether a task is parallel or sequential depends largely on context.

2. Plot the tasks onto the graph paper

Plot each task on the graph paper, showing it starting on the earliest possible date. Draw it as a bar, with the length of the bar being the length of the task. Above the task bars, mark the time taken to complete them. Do not worry about task scheduling yet - all you are doing is setting up the first draft of the analysis.

Figure 2: Draft Gantt Chart: Example Computer Project

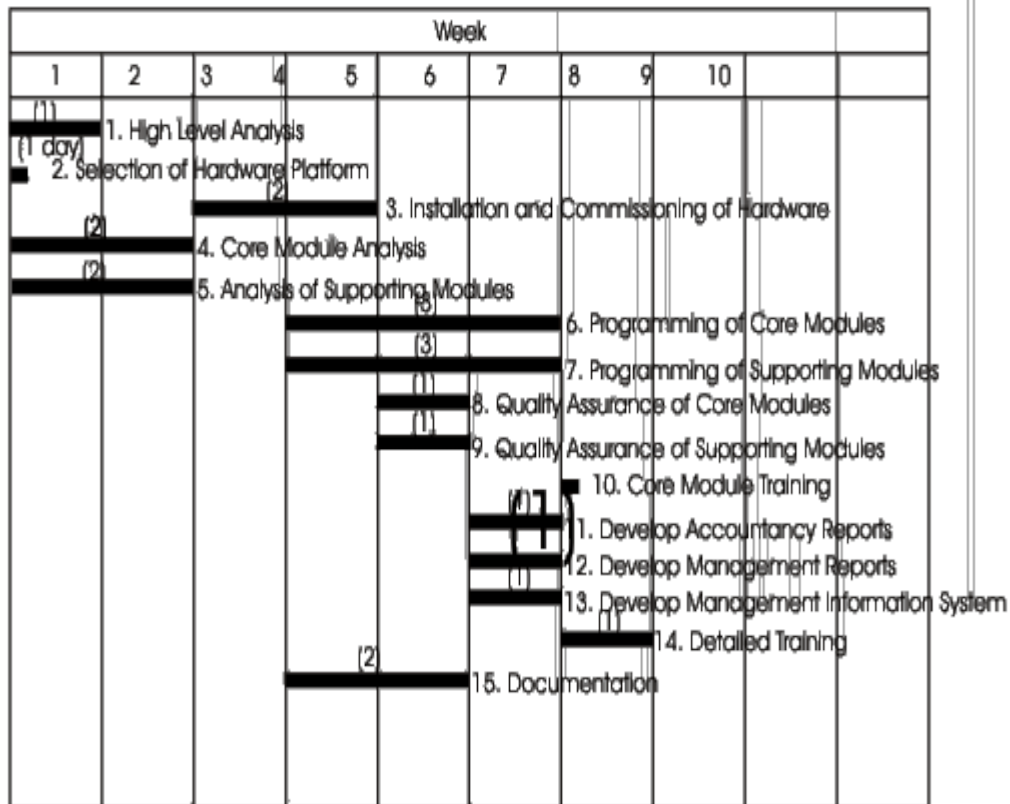


Fig 4.9 Draft Gant Chart: Example Computer Project

3. Schedule Activities

Now take the draft Gantt chart, and use it to schedule actions. Schedule them in such a way that sequential actions are carried out in the required sequence. Ensure that dependent activities do not start until the activities they depend on have been completed. While scheduling, ensure that you make best use of the resources you have available, and do not over-commit resource. Also allow some slack time in the schedule for holdups, overruns, quality rejections, failures in delivery, etc.

4. Presenting the Analysis

The final stage in this process is to prepare a final version of the Gantt chart. This should combine the draft analysis (see above) with your scheduling and analysis of resources. This chart will show when you anticipate that jobs should start and finish.

By drawing this example Gantt chart, you can see that:

- If all goes well, the project can be completed in 10 weeks
- If you want to complete the task as rapidly as possible, you need:
 - 1 analyst for the first 5 weeks
 - 1 programmer for 6 weeks starting week 4
 - 1 programmer for 3 weeks starting week 6
 - Quality assurance resource for weeks 7 and 9
 - Hardware to be installed by the end of week 7
- Analysis, and development and installation of supporting modules are essential activities that must be completed on time.

- Hardware installation is a low priority task as long as it is completed by the end of week 7

While this section describes how to draw a Gantt chart manually, in practice project managers tend to use software tools like [Microsoft Project](#) to create Gantt Charts. Not only do these ease the drawing of Gantt Charts, they also make modification of plans easier and provide facilities for monitoring progress against plans.

a. Critical Path Analysis Chart

Critical Path Analysis chart is a powerful tool that helps you to schedule and manage complex projects. They were developed in the 1950s to control large defense projects, and have been used routinely since then.

As with [Gantt Charts](#), Critical Path Analysis (CPA) chart:

- ◇ Helps you to lay out all tasks that must be completed as part of a project.
- ◇ Act as the basis both for preparation of a schedule, and of resource planning.
- ◇ Allow you to monitor achievement of project goals during management of a project.
- ◇ Helps you to see where remedial action needs to be taken to get a project back on course.

The benefit of using CPA over Gantt Charts is that CPA formally identifies tasks which must be completed on time for the whole project to be completed on time, and also identifies which tasks can be delayed for a while if resource needs to be reallocated to catch up on missed tasks. The disadvantage of CPA is that the relation of tasks to time is not as immediately obvious as with Gantt Charts. This can make them more difficult to understand for someone who is not familiar with the technique. A further benefit of CPA is that it helps you to identify the minimum length of time needed to complete a project. Where you need to run an accelerated project, it helps you to identify which project steps you should accelerate to complete the project within the available time. This helps you to minimize cost while still achieving your objective. Now let us draw a Critical Path Analysis Chart using a computer project example used previously.

- **Steps to draw a CPA Chart:**

- 1. List all activities in the plan**

For each activity, show the earliest start date, estimated length of time it will take, and whether it is parallel or sequential. If tasks are sequential, show which stage they depend on. For the project example used here, you will end up with the same task list as explained in the article on Gantt Charts (we will use the same example as with Gantt Charts to compare the two techniques). The chart is repeated in table 2.2 below:

Task	Possible start	Duration	Type	Dependent on...
1. High level analysis	week 1	5 days	sequential	
2. Selection of hardware platform	week 1	1 day	sequential	1
3. Installation and commissioning of hardware	week 3	2 weeks	parallel	2
4. Detailed analysis of core modules	week 1	2 weeks	sequential	1
5. Detailed analysis of supporting utilities	week 1	2 weeks	sequential	4
6. Programming of core modules	week 4	3 weeks	sequential	4
7. Programming of supporting modules	week 4	3 weeks	sequential	5
8. Quality assurance of core modules	week 5	1 week	sequential	6
9. Quality assurance of supporting modules	week 5	1 week	sequential	7
10. Core module training	week 7	1 day	parallel	6
11. Development of accounting reporting	week 6	1 week	parallel	5
12. Development of management reporting	week 6	1 week	parallel	5
13. Development of management analysis	week 6	2 weeks	sequential	5
14. Detailed training	week 7	1 week	sequential	1-13

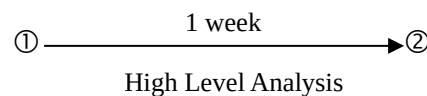
Fig 4.11 Task List: Planning a custom-written computer project**2. Plot the activities as a circle and arrow diagram**

Critical Path Analyses are presented using network diagrams, which we have discussed in the previous section.

In these, nodes show events within the project, such as the start and finish of tasks. Circles are normally numbered to allow you to identify them.

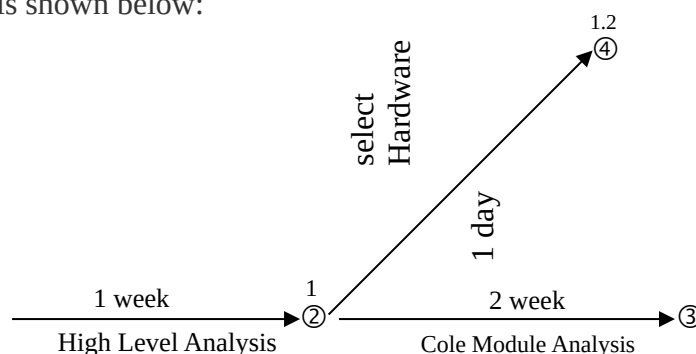
An arrow running between two event circles shows the activity needed to complete that task. A description of the task is written underneath the arrow. The length of the task is shown above it. By convention, all arrows run left to right.

An example of a very simple diagram is shown below:



This shows the start event (circle 1), and the completion of the 'High Level Analysis' task (circle 2). The arrow between them shows the activity of carrying out the High Level Analysis. This activity should take 1 week.

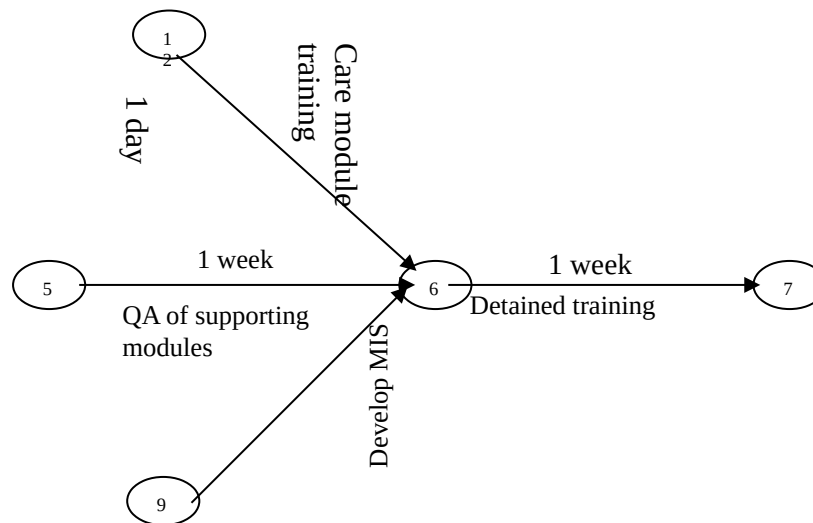
Where one activity cannot start until another has been completed, we start the arrow for the dependent activity at the completion event circle of the previous activity. An example of this is shown below:



Here the activities of 'Selecting Hardware' and 'Core Module Analysis' cannot be started until 'High Level Analysis' has been completed. This diagram also brings out a number of other important points:

- Within Critical Path Analysis, we refer to activities by the numbers in the circles at each end. For example, the task 'Core Module Analysis' would be called 'activity 2 to 3'. 'Select Hardware' would be 'activity 2 to 4'.
- Activities are not drawn to scale. In the diagram above, activities are 1 week long, 2 weeks long, and 1 day long. Arrows in this case are all the same length.
- In the example above, you can see numbers above the circles. These show the earliest possible time that this stage in the project will be reached. Here units are whole weeks.

A different case is shown below:



Here activity 6 to 7 cannot start until the other three activities (12 to 6, 5 to 6 and 9 to 6) have been completed.

All the activities above will take place as part of the project. Notice that each event circle has a figure below it as well as a figure above. This shows the latest time that it can be

reached with the project still being completed in the minimum time possible. You can calculate this by starting at the last event (in this case number 7), and working backwards.

You can see that event 4 can be completed any time between 1.2 weeks in and 7.8 weeks in. The timing of this event is not critical. Events 1 to 2, 2 to 3, 3 to 4, 4 to 5, 5 to 6 and 6 to 7 must be started and completed on time if the project is to be completed in 10 weeks. This is the 'critical path' - these activities must be very closely managed to ensure that activities are completed on time.

If jobs on the critical path slip, immediate action should be taken to get the project back on schedule. Otherwise completion of the whole project will slip.

You may find that you need to complete a project earlier than your Critical Path Analysis says is possible. In this case you need to take action to reduce the length of time spent on project stages.

You could pile resources into every project activity to bring down time spent on each. This would probably consume huge additional resources.

A more efficient way of doing this would be to look only at activities on the critical path. **Example:** As an example, it may be necessary to complete the computer project in figure 5 in 8 weeks rather than 10 weeks. In this case you could look at using two analysts in steps '2 to 3' and '3 to 4', and two programmers instead of one in step '4 to 5'. This would shorten the project by two weeks, but would raise the project cost - doubling resources at any stage often only improves productivity by, say, 50%. This occurs as time spent on coordinating the project consumes time gained by increasing resource.

Note that in this example, shortening the project by two weeks would bring activities '3 to 11', '11 to 12' and '12 to 6' onto the critical path as well.

An effective Critical Path Analysis can make the difference between success and failure on complex projects. It can be very useful for assessing the importance of problems faced during the implementation of the plan. Now you have established a project schedule that

meets the project completion date. The final step is to develop a budget plan and performance plan to complete the core process cycle.

4.3.6. Project Budget and Performance Planning

1. Project Budget

Initial budgetary estimates from the project proposal and project charter are based on availability of funds and gross estimates of project costs derived from historical data or experience. The availability of funds may or may not coincide with the actual funds needed to execute the project. For this reason, budget estimates are refined in the Project Planning Phase and base lined with approval of the project plan.

Budget planning is the determination of available funding and costs associated with a defined set of activities during a specified time period. The steps associated with budget planning are highly dependent on both the estimated duration of tasks and the resources assigned to the project.

The budget plan is dependant upon the project schedule, the resource plan, and the risk management plan. Budgeting serves as a control mechanism where actual costs can be compared with and measured against the baseline budget. When a project schedule begins to slip, cost is affected. When project costs begin to escalate, the project manager should revisit the Project Plan to determine, whether the scope, budget, or schedule needs adjusting.

◇ Estimate cost for WBS Elements

To develop the budget, the applicable cost factors for each WBS element must be estimated. The cost factors are: labor resources, facilities, equipment and other tools. A cost for each factor can be determined from information contained in the project schedule and resource plan. The cost for each factor should be totaled by fiscal year as well as the costs of all factors associated with a WBS element.

◇ Contingency Cost

Identifying and quantifying project risk is critical to the development of a project budget. Good budgeting practices make allowances for handling risk. The risk management plan described in the unit provides an area to estimate contingency cost for risk. Risk funding or contingency cost is forecast for each fiscal year and allocations made according to the needs identified in the risk management plan.

◇ Spend Plan

The project spend plan is a part of the project budget and allocates funding against the identified cost factors for a particular time period. Normally spend plans forecast the spending using the WBS as the basis for the forecast. Monitoring the spend plan against actual spending provides a metric that readily identifies deviation of a project from its budget.

2. Performance Planning

The project performance plan defines how project success or failure is measured. Project success is achieved by meeting the stated business objectives for the project and by satisfying customer needs. The performance plan identifies the relationship of the agency's business objectives to performance goals and specifies:

- Who will measure the performance;
- How and when performance is measured; and,

- How performance is reported.

The performance plan also identifies and defines the project deliverables and acceptance criteria for each deliverable.

The performance plan is a result of the complete planning process that begins with the project scope and objectives defined by the project charter. All of the plans developed through execution of the core and facilitating processes provide information that is used in development of the performance plan.

4.3.7. Project Risk Management

In this Section we will discuss the project risk management plan, which is the major deliverable of the facilitating planning processes. Risks require continual review and assessment throughout the project management lifecycle. The goals of risk management planning are to predict the likelihood that a risk will occur, to quantify its potential impact on the project, and to develop plans for risk management. Risks documented during Project Initiation should be reassessed during Project Planning.

1. Risk Concept

Risk is a combination of the probability of a negative event and its consequences. If an event is inevitable but inconsequential, it does not represent a risk, because it has no impact. Alternatively, an improbable event with significant consequences may not be a high risk. These two factors are combined in what we experience as the possibility of loss, failure, danger, or peril. Therefore,

$$\text{Project Risk} = \sum (\text{Events} * \text{Probabilities} * \text{Consequences})$$

A project risk can be defined as: any even that prevents or limits the achievement your objectives a defined at the outset of the project.

What may look like an unacceptable risk to one person might rightly appear as an attractive opportunity to another. The difference is vision.

Generally, Items in the project plan that are important and that are uncertain of success should be considered risk areas and given special attention. Consider the following specific areas that result in or increase risk.

- Risk should be associated with areas where the scope is not well defined or is subject to change.
- An unproven or immature technical approach, or known technical difficulty or complexity will increase project risk.
- Ambitious goals always result in risk.
- Unfamiliarity with the process, or inexperienced personnel, constitutes project risks, if for no other reason than being unknowns.
- Exterior interfaces cause risks because they can change and, even if they don't change, their descriptions or specifications may be inaccurate. Exterior organizational dependencies create project risks.
- Incomplete planning or optimistic cost or schedule goals create risk.

To sum up, any area over which the project manager does not have control can be project risks. Anything that is not well understood anything that is not well documented and anything that can change these all create projects risks. Things that haven't been tested are always at risk.

2. Risk Management Process

The risk management process has four functional components. These are:

- Risk Identification
- Risk Quantification
- Risk Response and Monitoring
- Risk Mitigation Cost Estimation

- **Risk identification** requires the project team to identify risks associated with execution of the project as well as external risks to the project. Risks are identified throughout project planning and project execution. Risks are frequently associated with resource and schedule constraints.

One useful technique for expressing risk is to use an “if “and “then” statement.

For example, “If” X thing happens “then” the result will be Y.

- **Risk Quantification.** A risk is quantified by estimating the likelihood of occurrence of the risk event and, the effect the risk will have on the project. Probability of occurrence is the expression used to describe the likelihood of occurrence of the risk event. The probability of occurrence is expressed as a percentage. The higher the percentage, the more likely a particular risk event will occur.
- **Risk response and monitoring.** These are driven by the results of identification and quantification. Risk priorities are assigned based on the level of impact and the probability of occurrence. Risks that are most likely to occur and have the highest level of impact are prioritized above less likely, lower impact risks. Prioritization of risks is used to focus the risk management effort and resources on those risk events that pose the greatest threat to the project. Once identified, a risk event is assigned to a project team member for continuous monitoring and evaluation. The person assigned to monitor a risk should be the individual most likely to direct the mitigation activities if the risk event becomes a reality. Mitigation actions for all risks should be documented. Response triggers, that signal the project team that the risk event has or will soon occur, should also be identified and documented.
- **Risk mitigation costs.** This can be estimated, and funds planned for risk mitigation activities. The process requires the estimation of cost by budget category for the mitigation actions planned in risk response planning. It is not necessary to set aside all funding estimated to respond to any identified risk.

A contingency funding budget is based on the total cost identified to mitigate risk reduced by the probability that the risk event will not occur. This calculation requires the multiplication of the total mitigation cost by the probability of occurrence. The risk plan will change frequently throughout the planning and execution phases of a project. Risk identification and monitoring must be continuous. Regular reviews of the risk plan and reevaluation of project risks should be included in the project schedule.

4.3.8. Communication and Change Control Management Planning

Communication is the exchange of information between parties. Communications planning involves identifying and meeting the information needs of the project stakeholders. Specifically, identifying which people need what information, when the information is needed, and how the information is collected and communicated. Communications planning strives to simplify and document effective communications within the project organization. The Communications Plan is a document describing the means by which project communications will occur.

The communication process must be bi-directional. The Project Manager must receive input from Project Team members and Stakeholders about their information and communications requirements, determine the best and most cost effective way in which the requirements can be met, and record the information in a formal, approved document. Similarly, the Project Manager must provide details to the team and the Stakeholders regarding the communications he/ she expect to receive, and document these requirements in the plan.

A communication plan documents the information requirements of stakeholders and defines the procedures to meet those requirements. The plan details what, when, and how information is collected and reported. Information required in the communications plan includes:

- Identification of stakeholders with information needs
- Stakeholder information requirements
- Time frame or period the stakeholder needs the information
- Detailed description of the information need
- Description of when and how information is collected and who collects it
- Description of document distribution methods and frequency of distribution.

4.3.9. Performance Reporting

Performance reports are typically required by all projects. These reports provide information on resource utilization by the project. (There are various types of performance reports.)

The most common type of performance report is the **Project Status** Report. Project Status reports cover multiple areas, including scope, budget, schedule, and risk. In order to produce status reports, the project team members must manage and monitor their project responsibilities closely. This will be further discussed in the next module.

4.3.10. Changes Control Management

Every aspect of the project defined during Project Initiation and Planning has the potential to change. In fact, change should be expected to occur throughout every project phase; but if an effective change control process is defined and agreed upon during Project Planning, any change should be able to be handled without negative effect on the project outcome.

Project change is not defined simply as a change to the cost, schedule, or project scope. Change should be defined as ANY adjustment to ANY aspect of the Project Plan or to ANY already approved deliverable. Decision-Maker must agree on the change control process, which then must be formalized, documented, and included as a section in the Project Plan. Items that must be defined are:

The term change control will describe the management of change to the project. It provides the means to control and manage change during the execution of the project plan. Change control management identifies and manages change. Change control management does not prevent change.

Management of changes to the project includes:

- the administrative management (tracking, review, and assessment) of the proposed changes;
- the organized timely review and decision on recommended changes to controlled items; and
- The administrative process to ensure that the project team is informed of changes when they are approved.

Change control is therefore the process of controlling, documenting and storing the changes to control items. This includes proposing the change evaluating it approving or rejecting it scheduling it and tracking it.

Change control requires the following:

- All project plan items are baselined when the project plan is approved. Once the project plan items are baselined, changes to the baseline are managed through a formal change process.
- The integrity of the performance measurement baseline must be maintained. Only project scope changes can impact the performance measurement baseline.
- Changes are coordinated among all knowledge areas of the project. For example, a proposed schedule change may also impact the cost, risk, quality, and staffing of the project.

Summary

We can take into consideration project planning phase, which is the second stage in the project life cycle. The purpose of project planning is therefore to define the exact parameters of a project and ensure that all the pre-requisites for project execution are in place. A project plan is a formal approved document that is used to guide both project execution and project control.

The work break down structure (WBS) is hierarchical description of all the work that must be done to complete the project. A work package is a complete description of how the tasks that makes up on activity will actually be done. The lower levels of the work breakdown structure are called a unit of work package or task.

The planning phase is the heart of project management. It is here that the plans are constructed. The experience of the team is focused on the plan in an attempt to weed out problems and capitalize on opportunities. The planning work is strengthened by the work done in the definition phase and leads to the goal of all project management – successful project implementation. The planning phase sequences and schedules the terminal elements of the work breakdown structure so that the needed resources are delivered at the appropriate time.

Check In Progress 4

1. Describe the key factors than need to be considered when setting up a communication plan.

2. What is the purpose of change control management plan?

3. What are the four important benefits of developing a project plan? List down.

4. The project plan is the primary document developed during the planning phase and communicates project activities in terms of five key areas. What are they?

5. Describe the sequence of activities takes place in core planning processes.

6. Given the following information, draw a network diagram.

Activity number	Dependencies (Preceding activities)
A	-
B	-
C	A
D	B
E	B
F	C, D

