2024

LECTURE NOTES

PROJECT MANAGEMENT

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PREFACE

This lecture notes are made for the undergraduate students in Business Information Systems (BIS) Program. It contains all related topics for Project Management (PM) lectures. It has been collected from and made using different references, which have been edited, summarized, and explained according to familiar scientific methods. Its only purpose is to help the students to follow what will be explained in the lectures. And to help them find these explained topics in one material. And present it in an easy and suitable way.

Dr. Ahmed Abd-Elwahab.

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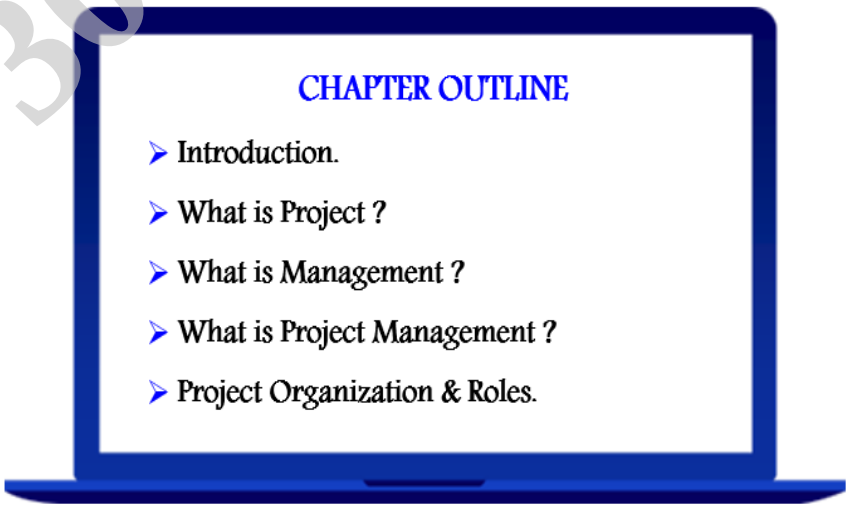


CHAPTER 1

INTRODUCTION TO PROJECT MANAGEMENT

1.1 Introduction

Project Management in recent years has **Proliferated**, **Reaching new heights** of **Sophistication**. It has **Emerged** as a **Distinct Area of Management Practices** to meet the **Challenges** of :

- **New Economic Environment**,
- **Globalization Process**,
- **Rapid Technological Advancement**, and
- **Quality Concerns of the Stakeholders** (**e.g.,** suppliers, users, general public, etc.).

1.2 What is a Project ?

To **understand** **Project Management**, one must begin with the definition of a **Project**.

- A **project** can be **any series of activities and tasks** that:
  - **Have** a **Specific Objective** to be **completed within Certain Specifications** (**Unique Specifications**).
  - **Have** defined **Start** and **End** **dates** (**Specific Timeframe**) = **Schedule**.
  - **Have Funding limits** (if applicable) = **budget** = **Cost**.
  - **Consume Human** and **Nonhuman Resources** (i.e., **people**, **money**, **equipment**, **materials**, **facilities**, **IT**).
  - **Are Multifunctional** (i.e., **cut across several functional lines**).
  - **Working across Organizational Boundaries.**

- A **Project** is defined as **a Sequence of activities or tasks** that **must be Completed** to attain a **Certain Outcome**.

- A **Project** is " a **Temporary Endeavor** undertaken to **Produce** a **Unique product**, **service**, or **result** ".
- A **Project** is " a **Unique Endeavor** to **Produce a set of Deliverables** within **clearly specified scope**, **time**, **cost** and **quality Constraints** ".
- A **Project** is " a **Problem Scheduled** for **Solution** ".

(**Every Project is Conducted to Solve some kind of Problem for a Company**).

1.2.1 Project Performance Dimensions

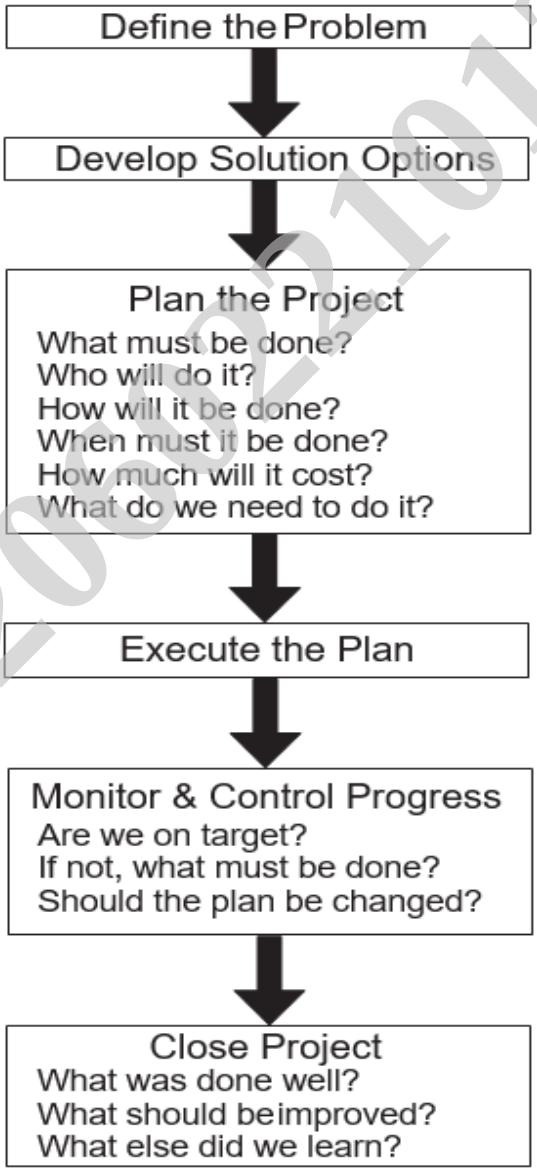
Three major dimensions that define the **Project Performance** are (**Scope**, **Budget/Cost** and **Time**).

These parameters are **interrelated** and **interactive**. The relationship is generally represented as an **equilateral triangle**.

Mathematically

Performance = f(Scope, Cost, Time)

1.2.2 The Steps in Managing a Project



1. Define the Problem

We need to **identify the problem** to be solved by the project. It helps to **visualize the desired end result**.

2. Develop Solution Options

How many **different ways** might solve the problem? **Brainstorm solution alternatives** (you can do this *alone* or as a *group*). Of the available alternatives, which **is the best to solve the problem**? Is it more or less costly than other suitable choices? Will it result in a complete or only a partial fix?

3. Plan the Project

How to do the work. There are three components to the plan: **strategy**, **tactics**, and **logistics**. **Planning** is answering questions: what must be done, who, how much, when how and so on.

4. Execute the Plan

Once the plan has been developed and approved, **the team can begin to implement the work**. Interestingly, we sometimes find people going to great effort to put together a plan, then failing to follow it. If a plan is not followed, there is not much point in planning, is there?

5. Monitor and Control Progress

To ensure that the work is **progressing according to the plan**. When **deviations** from the plan occur, corrective action is taken to get the project back on track, or, if this is not possible, the plan is changed and approved.

6. Close the Project

When all the work has been completed, the closeout phase requires that a **review of the project be conducted**. The **purpose** is to learn lessons from this job that can be applied to future ones. Two questions are asked:

"*What did we do well*?" and "*What do we want to improve next time*?"

Notice that we don't ask what was done wrong. This question tends to make people defensive, and they try to hide things that may result in their being punished.

1.2.3 Boundaries of a Project

Every Project operates within certain Boundaries called Constraints :

1.2.4 Project Life Cycle – 5 Stages

1. Initiating

Once a decision has been made to do a project, it must be initiated or launched. There are a number of activities associated with this. One is for the project sponsor to create a project **charter**, which defines *what is to be done to meet the requirements of project customers*. The charter should be used to authorize work on the project; define the **authority**, **responsibility**, and **accountability** of the project team; and **establish** scope boundaries for the job. When such a document is not produced, the team members may misinterpret what is required of them, and this can be very costly.

2. Planning

One of the major causes of project failures is poor planning because the team tries to do the work without doing any planning at all and failing to develop a plan means that there can be no actual control of the project.

3. Executing

There are two aspects to the process of project execution. One is to execute the work that must be done to create the product of the project. This is called **technical work**, and a project is **conducted** to produce a product. Executing also refers to **implementing the project plan**.

4. Monitoring and Controlling

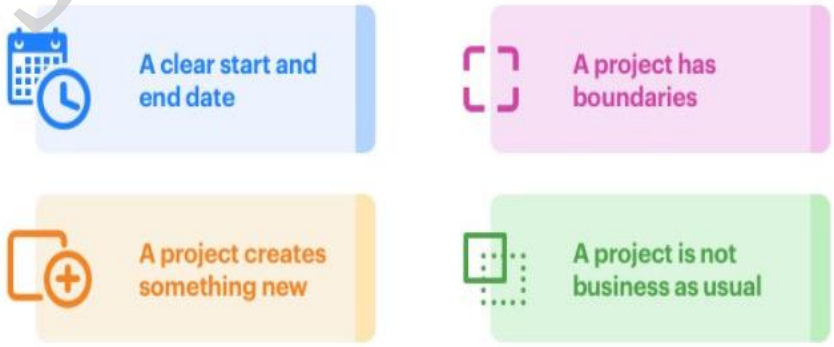
Monitoring and controlling can actually be thought of as two separate processes, **but** because they go hand in hand, they are considered one activity. **Control** is exercised by comparing where project work is to where it is supposed to be, then taking action to correct for any deviations from target.

5. Closing

Once the product is produced to the customer's satisfaction, the project is considered finished, or closed.

1.2.5 Characteristics of a Project

A **project** is a set of **interdependent tasks** that have a **common goal**. **Projects** have the following **Characteristics**:



1.2.6 Difference Between Projects and Operations

There are many differences between **projects** and standard business **operational** activities. Some differences are as follows:

- **Projects** are **unique** and **temporary**, while **Operations** are **ongoing** and **permanent** with a **repetitive output**.
- **Projects** have a **fixed budget**, while **Operations** have to **earn a profit** to run the business.
- **Projects** are executed to **start a new business objective** and **terminated when it is achieved**, while **Operational** work **does not produce anything new** and is **ongoing**.
- **Projects** create a **unique product**, **service**, or **result**, while **Operations** produce the **same product**, aim to **earn a profit** and **keep the system running**.
- There are **more risks** in **projects** as they are usually done for the first time, while in **Operations** there are **fewer risks** as they are **repeated many times**.

- **Projects** are **performance intensive** while **Operations** are **efficiency intensive**.
- **Projects** are **managed through project management** and **Operations** require **business process management**.

1.3 What is Management ?

Management is the **Process** of reaching **Organizational Goals** by working with and through **People** and **Other Organizational Resources**.

Management has the following **3 Characteristics**:

- It is a **process** or **series** of **continuing** and **related activities**.
- It **involves** and **concentrates** on **reaching organizational goals**.
- It **reaches** these goals by working with and through **people** and **other organizational resources**.

1.3.2 Management Functions

Management is the **Planning**, **Organizing**, **Leading**, and **Controlling** of **human** and **other resources** to achieve **Organizational Goals** **efficiently** and **effectively**.

1. Planning:

Planning is a method that managers utilize to define and choose acceptable targets and courses of action. Planning includes determining tasks that must be accomplished in order to achieve organizational objectives, setting out how the tasks must be completed, and indicating when they should be completed.

- **Determining** which targets the company would follow.
- **Choosing** which courses of action to take in order to achieve those objectives.
- **Deciding** how to allocate organizational resources to reach these objectives.

The goal-oriented planning practice focuses on achieving objectives. Managers lay out exactly what companies must do to succeed. Planning is concerned with the organization's short- and long-term performance and achievement. In the planning phase, **there are three steps**:

- **Deciding** which objectives that the organization will follow.
- **Deciding** what courses of actions to take in order to achieve those objectives.
- **Deciding** how to allocate organizational in order to achieve those objectives.

2. Organizing:

Organizing entails structuring working relationships in such a fashion that members of an organization can collaborate and work together to achieve organizational objectives.

Organizing means categorizing individuals into departments based on the types of activities they perform. Organizing can be described as the process of allocating tasks established during the planning stages to various individuals or groups within an organization. The aim of **Organizing** is to build a system for putting plans into motion. People in the organization are handed job assignments that help the institution achieve its objectives. Tasks are structured so that each person's performance contributes to the success of departments, which, in turn, contributes to the success of divisions, which, in turn, contributes to the overall success of the business.

3. Leading:

Leading involves setting a clear vision as well as motivating and empowering the working members to recognize their position in achieving organizational objectives.

4. Controlling:

Controlling means assessing how well an organization is meeting its objectives and taking steps to sustain or increase efficiency. The ability to reliably assess performance and regulate organizational productivity and effectiveness is the result of the control process.

1.4 What is Project Management

- **Project Management** is **the application of Knowledge**, **Skills**, **Tools**, **Methods** and **Techniques** to **execute projects efficiently** and **effectively** to **achieve Specific Goals** in order to **meet** or **exceed Stakeholder needs** and **expectations** ".
- **Project Management** is the **Skills**, **Tools** and **Management Processes** required to **undertake a project successfully**.

- **Project Management Comprises:**

1) **A set of Skills** - Specialist **Knowledge**, **Skills** and **Experience** to **reduce** the **level of risks** within a project **&** **enhance** likelihood of success.

2) **A suite of Tools** - Various types of tools include **Document Templates**, **Document Registers**, **Planning Software**, **Modeling Software**, **Audit Checklists** and **Review Forms**.

3) **A series of Processes** - Various management **techniques & processes** are used to **monitor** and **control** **time**, **cost**, **quality**, and **scope**. **Examples** include **Time Management**, **Cost Management**, **Quality Management**, **Change Management**, **Risk Management** and **Issue Management**.

1.4.1 What Skills do Project Managers need ?

Project Manager: **Systems Analyst** with **Management** and **Leadership** **Skills** responsible for **leading Project Initiation**, **Planning**, **Execution**, and **Closedown**.

1.4.2 Why Projects Fail ?

- **Failure to align Project** with **Organizational Objectives.**
- **Poor/Creep Scope.**
- **Poor Communication.**
- **Unrealistic Expectations.**
- **Lack of Executive Sponsorship.**
- **Lack of Project Managerial Skills.**
- **Inability to move beyond Individual** and **Personality Conflicts.**
- **Politics**.

1.4.3 Why Projects SUCCEED ?

- Good Project Charter.
- Good Communication.
- Good Decision-Making Structure.
- Strong Project Management.
- Project Sponsorship at Executive Level.
- The Right Mix of Team Players.
- Team members are working toward Common Goals.

1.4.4 Defining Projects Succeed

The definition of project success has been modified to include completion:

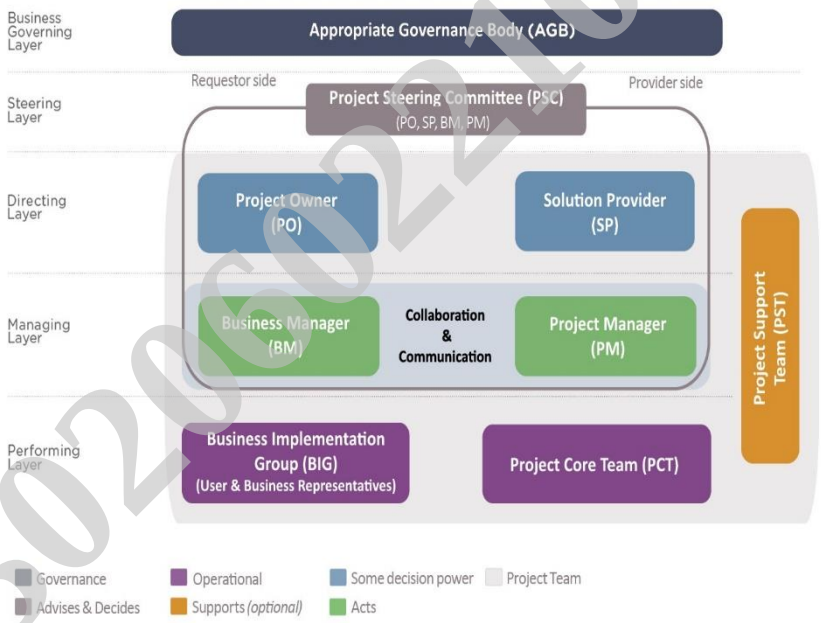
- **Within** the **allocated time period**.
- **Within** the **budgeted cost**.
- **At the proper performance** or **specification level**.
- **With acceptance** by the **customer/user**.
- **With minimum** or **mutually** agreed upon **scope changes**.
- **Without disturbing** the main **workflow of the organization**.
- **Without changing** the **corporate culture** International Campus.

The Potential Benefits from Project Management

- **Identification of functional responsibilities** to ensure that all activities are accounted for, regardless of personnel turnover.
- **Minimizing the need for continuous reporting**.
- **Identification of time limits for scheduling**.
- **Identification of a methodology for trade-off analysis**.
- **Measurement of accomplishment** against **plans**.
- **Early identification of problems** so that **corrective action** may follow.
- **Improved estimating capability** for **future planning**.
- **Knowing** when **objectives** cannot be **met** or will be **exceeded**.

1.5 Project Organization & Roles

The following diagram gives an overview of the **main Roles** in the **Project Organization**, from a **Project Management** point of view.



1.5.1 Business Governing Layer:

The **Business Governing Layer** **determines** the **Vision** and **Strategy** for ***the entire organization***. It consists of **one** or **more** **management committees** operating at **Director level**. It is here that **Priorities** are defined, **Investment decisions** are made, and **Resources** are allocated.

1.5.2 Steering Layer:

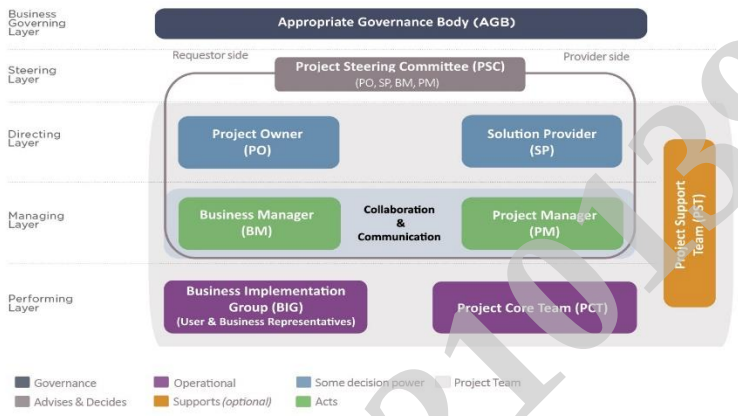
The **Steering Layer** provides **General Project Direction** and **Guidance**, keeping the ***Project Focused on its Objectives***. It reports to the **Appropriate Governance Body** (**AGB**). The Steering Layer is **Composed** of the Roles defined in the **Directing** and **Management** **Layers**, and other **Optional Roles**.

1.5.3 Directing Layer:

The **Directing Layer** champions the **Project** and owns **its Business Case**. It mobilizes the **Necessary Resources** and monitors **the Project's Performance** in order to ***realize the project's objectives***. The **Directing Layer** **Comprises** the Roles of **Project Owner** (PO) and **Solution Provider** (SP).

1.5.4 Managing Layer:

The **Managing Layer** focuses on **day-to-day Project Operations** by **Organizing**, **Monitoring**, and **Controlling** work to produce the **intended deliverables** and **implement** them in the business organization. Members of the **Managing Layer** report to the **Directing Layer**. The Managing Layer **Comprises** the Roles of **Business Manager** and **Project Manager**. It is importance for the success of the project that there is a collaboration and communication between the **Business Manager** and the **Project Manager**.



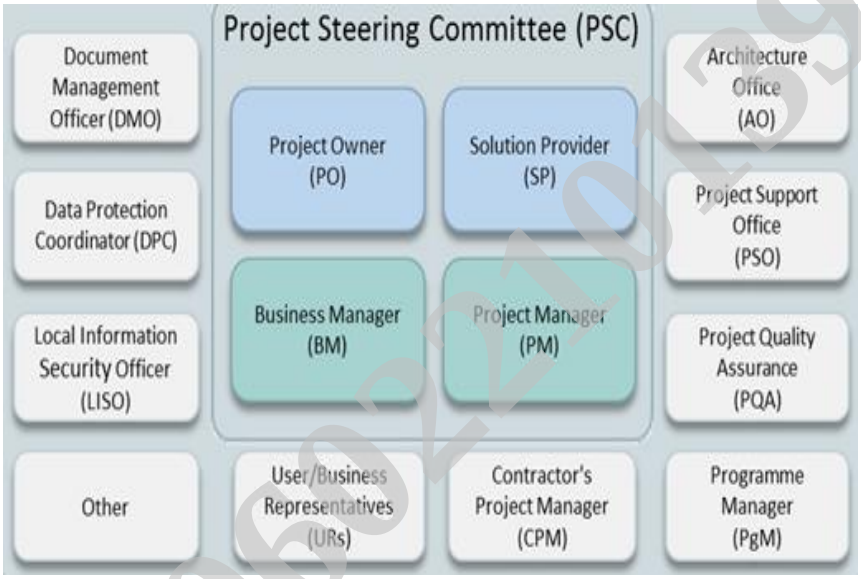
1. Appropriate Governance Body (AGB):

Role	Requestor or Provider	Group or Individual Role	Role Type
AppropriateGovernanceBody(AGB)	Both	Group	Key decision body

➢ Responsibilities:

- Define the corporate and business domain strategy.
- Agree and implement a portfolio management framework to realize the strategic objectives.
- Plan the strategy implementation by identifying, evaluating and authorizing programs and projects for implementation.
- Monitor and control portfolio delivery performance, keeping each portfolio focused on its objectives.
- Optimize and manage portfolio resources and benefits.

2. Project Steering Committee (PSC):



Role	Requestor or Provider	Group or Individual Role	Role Type
ProjectSteeringCommittee(PSC)	Both	Group	Main decision body

Composition (Permanent Members):

Roles	Description
Project Owner (PO)	Heads the Project Steering Committee (PSC), and is responsible for the project's progress as well as making important decisions. (PSC) is also held accountable for the whole process success.
Business Manager (BM)	The Business Manager is responsible for managing the project's business activities as a delegate of the Project Owner (PO). It is important to collaborate with the Project Manager (PM).
Solution Provider (SP)	Takes ultimate responsibility for the project's deliverables.
Project Manager (PM)	Is in charge of the whole project and all of its deliverables.

➢ Responsibilities:

- Guides and promotes the successful execution of the project at a strategic level, keeping the project focused on its objectives.
- Provides high-level monitoring and control of the project.
- At the end of the Initiating Phase, authorizes the project based on the project's Business Case and Project Charter, unless this is performed by the Appropriate Governance Body (AGB).
- At the end of the Planning Phase, authorizes the project to continue on to the Executing Phase, based on the Project Handbook and Project Work Plan.
- Authorizes plan deviations and scope changes with high project impact and decides on recommendations.
- Drives and manages organizational change caused by the project.
- Approves and signs-off all key management milestone artefacts (i.e., Business Case, Project Charter, Project Work Plan, etc.).

3. Project Owner (PO):

Role	Requestor or Provider	Group or Individual Role	Role Type	PSC Participation
Project Owner (PO)	Requestor	Individual	Key role	Chairman

Roles	Description
User Representatives (UR)	Represents the project's users' needs, ensuring the project deliverables are relevant.
Contractor's Project Manager (CPM)	Is in charge of the project's outsourced components.
Architecture Office (AO)	Plays a part in architectural aspects as a consultant.
Project Support Office(PSO)	Administers Project Steering Committee(PSC) meetings and project documentation, produces consolidated reports for large projects.
Project Quality Assurance (PQA)	Oversees quality control and auditing
Document Management Officer (DMO)	Ensures the record processing functions are performed in a transparent way.
Data Protection Coordinator (DPC)	Provides data protection consultation and advice.
Local Information Security Officer (LISO)	Provides security consulting and advice.

Description: The Project Owner (PO) is the key project decision maker and is accountable for the project's success.

➢ Responsibilities:

- Acts as the project champion, promoting the project's success.
- Chairs the Project Steering Committee (PSC).
- Provides leadership and strategic direction to the Business Manager (BM) and Project Manager (PM).
- Coordinates the resolution of issues and conflicts.

- Sets the business objectives and defines the Business Case for the project.
- Owns the project risks and ensures that project outcomes are in line with business objectives and priorities.
- Mobilizes the resources necessary for the project, in accordance with the agreed budget.
- Regularly monitors project progress.
- Ensures that the project's outcome meets business expectations.
- Drives organizational change and monitors proper evolution and change implementation.
- Approves and signs-off on all key management milestone artefacts (Project Handbook, Project Management Plans, Business Implementation Plan, etc.).

4. Solution Provider (SP):

Role	Requestor or Provider	Group or Individual Role	Role Type	PSC Participation
Solution Provider (SP)	Provider	Individual	Key role	Key member

Description: The Solution Provider (SP) assumes overall accountability for project deliverables.

➢ **Responsibilities**:

- Represents the interests of those who design, deliver, procure, and implement the project's deliverables.
- May help the Project Owner (PO) to define the project's Business Case and objectives.
- Agrees on objectives for supplier activities and approves the contractor's deliverables for the project (if applicable).
- Assumes overall accountability for project deliverables and services requested by the Project Owner (PO).
- Mobilizes the required resources from the supplier side and appoints the Project Manager (PM).

5. Business Manager (BM):

Role	Requestor or Provider	Group or Individual Role	Role Type	PSC Participation
Business Manager (BM)	Requestor	Individual	Key role	Key member

Description: The Business Manager (BM) represents the Project Owner (PO) on a daily basis within the project and collaborates closely with the Project Manager (PM).

➢ Responsibilities:

- Assists the Project Owner (PO) in defining the project's details and main business objectives.
- Sets up and guarantees an efficient cooperation and communication channel with the Project Manager (PM).
- Coordinates the Business Implementation Group (BIG) and acts as a liaison between the User Representatives (UR) and the provider organization.
- Ensures that the products delivered by the project fulfil the user's needs.
- Manages the activities on the business side of the project and ensures that the required business resources are made available.
- Decides on the best way to introduce business change or reengineering actions, when needed.
- Leads to the implementation of the business changes within the user DG.
- Ensures that the business organization is ready to accommodate the project's deliverables when these are made available by the provider organization.
- Coordinates the schedule and delivery of user training (and production of necessary user support material).

6. Project Manager (PM):

Role	Requestor or Provider	Group or Individual Role	Role Type	PSC Participation
Project Manager (PM)	Provider	Individual	Key role	Key member

Description: The Project Manager (PM) manages the project on a daily basis and is responsible for the qualitative product delivery within the imposed constraints.

➢ Responsibilities:

- Proposes and executes the project plans as approved by the Project Steering Committee (PSC).
- Manages and coordinates the Project Core Team's (PCT) daily activities, making optimal use of the allocated resources.
- Ensures that project objectives are achieved within the quality, time, and cost objectives, taking preventive or corrective measures where necessary.
- Manages stakeholder expectations.
- Is responsible for creating all management artefacts (except the Project Initiation Request, Business Case and Business Implementation Plan) and proposes them for approval to the Project Owner (PO) or the Project Steering Committee (PSC).

- Ensures the products'-controlled evolution, by implementing the Project Change Management Plan.
- Compares project the project status to the plan, and reports to the Project Steering Committee (PSC) on project progress.
- Performs risk management for project-related risks.
- Escalates unresolvable project issues to the Project Steering Committee (PSC).
- Liaises between the Directing and Performing Layers of the project.

7. Business Implementation Group (BIG):

Role	Requestor or Provider	Group or Individual Role	Role Type	PSC Participation
Business Implementation Group (BIG)	Requestor	Group	Key role	On Request

Description: The Business Implementation Group (BIG) consists of representatives of business and user groups. It is responsible for implementing the business changes that need to be in place for the organization to be able to effectively integrate the project deliverables into everyday work.

➢ Responsibilities:

- Under the coordination of the Business Manager (BM), the Business Implementation Group (BIG) plans and implements the activities needed to achieve the desired business changes as described in the Business Case and the Business Implementation Plan.
- Analyses the impact of the project's implementation on ongoing operations and existing business processes, and on the organization's people and culture.
- Participates in the design and updating of any affected business processes.
- Prepares the affected business area for the upcoming change.
- Advises the Business Manager (BM) on the organization's readiness to change.
- Embeds the project deliverables into business operations and implements the organizational change activities that fall under the project's scope.

User Representatives (URs):

Role	Requestor or Provider	Group or Individual Role	Role Type	PSC Participation
User Representatives	Requestor	Individual/Group	Key role	On request

Description: User Representatives represent the interests of the project's end-users. They are part of the Business Implementation Group (BIG). Involving User Representatives (URs) throughout the project's duration is important. It ensures that they know what's happening within the project, have a sense of ownership and motivation, and validate requirements in regular intervals, which ensures that the deliverables are fit for business purpose.

➢ Responsibilities:

- Helps define business needs and requirements.
- Ensures that the project specifications and deliverables meet the needs of all users.
- Approves the project specification and acceptance criteria on behalf of the users.
- Communicates and prioritizes user opinions in the Project Steering Committee (PSC) and ensure that they are taken into account in decisions on whether to implement recommendations on proposed changes.

- Participates in demonstrations and pilot phases as needed.
- Performs user acceptance tests.
- Signs off on documents related to users (documentation, requirements, etc.).
- Guarantees business stability during the transition towards the new operational state.

8. Project Core Team (PCT):

Role	Requestor or Provider	Group or Individual Role	Role Type	PSC Participation
Project Core Team (PCT)	Provider	Group	Key role	On request

Description: The Project Core Team consists of the specialist roles responsible for creating the project deliverables. Its composition and structure depend on the project size and type (e.g., IT project, policy development project, etc.) and are defined by the Project Manager (PM).

➢ Responsibilities:

- Contributes to the development of the project scope and the planning of project activities.
- Carries out project activities based on the Project Work Plan and schedule.
- Produces project deliverables.

- Provides the Project Manager (PM) with information on the progress of activities.
- Participates in project meetings as needed and contributes to the resolution of issues.
- Participates in the Project-End Meeting to derive and document lessons learned that are useful for the organization.

Aside from the specialist roles that create the project deliverables, there are two specific Project Core Team (PCT) roles that deserve to be discussed in more detail from a project management point of view: the Contractor's Project Manager (CPM) and the Assistant Project Manager (APM).

9. Project Support Team (PST):

Role	Requestor or Provider	Group or Individual Role	Role Type	PSC Participation
Project Support Team (PST)	Provider	Group	Optional role	On request

Description: Consists of the people responsible for providing support to the project. Its composition and structure depend on the project size and are defined by the Project Manager (PM). The Project Support Team (PST) role may be assumed by team members or a specific team or may be a horizontal service provided by the organization.

➢ Responsibilities:

- Provides administrative support to the project.
- Defines requirements for reporting and communication.
- Administers the Project Steering Committee (PSC) meetings and drafts related reports.
- Supports the Project Manager (PM) in planning, monitoring and controlling the project.
- Advises on project management tools and administrative services.
- Manages the project's documentation (versioning, archiving, etc.).

Examples of roles included in the PST Project Support Team (PST) are the Project Support Office (PSO) and the Project Quality Assurance (PQA).

Project Support Office (PSO):

Role	Requestor or Provider	Group or Individual Role	Role Type	PSC Participation
Project Support Office (PSO)	Provider	Individual/Group	Optional role	Member

Description: Provides support to the Project Manager (PM) and the whole Project Team.

➢ **Responsibilities**:

- Advises on project management tools, guidance and administrative services.
- Administers Project Steering Committee (PSC) meetings.
- Produces consolidated reports for the Project Steering Committee.
- Manages internal communication.
- Establishes standards, tools, procedures and methods for use in the project.
- Administers Project Management aspects such as document change control, baseline of plans, etc.
- Can play the role of custodian and guardian of all master copies of the project's products.

Project Quality Assurance (PQA):

Role	Requestor or Provider	Group or Individual Role	Role Type	PSC Participation
Project Quality Assurance (PQA)	Provider	Individual/Group	Optional role	Member

Description: Ensures the high quality of the project and its deliverables, independently from the Project Manager (PM).

➢ **Responsibilities**:

- Establishes quality assurance standards.
- Supports the Project Manager (PM) in planning, monitoring and controlling project quality.
- Reviews project management processes and artefacts (e.g., the Project Charter and Project Management Plans) as part of quality assurance.
- Reports to the Project Steering Committee (PSC) who is responsible for appointing them.

10. RAM (RASCI)-Documenting Responsibility Assignments

RASCI (pronounced 'rasky') is also known as the Responsibility Assignment Matrix (RAM) and is a way of representing and clarifying the roles and responsibilities for an activity.

RASCI		Description
R	Responsible	Performs the task. Others may be enlisted to help in as a supporting role.
A	Accountable	Ultimately, he or she is responsible for doing the job correctly and thoroughly. There is only one person who is held accountable.
S	Supports	As part of a team, they work with the person responsible. Unlike the consulted role, the support role helps complete the task.
C	Consulted	Those whose views are sought and with whom two-way contact is possible.
I	Informed	Those who are knowledgeable (kept updated).

Stakeholders should be reminded of their roles and responsibilities during the project. This PM² guide includes a RAM (RASCI) table for each artefact in the Initiating, Planning and Closing Phases and each of the activities in the Executing Phase and in Monitor & Control.

Example: The RAM for the Standard PM² roles involved in creating the Business Case document.

RAM (RASCI)	AGB	PSC	PO	BM	UR	SP	PM	PCT
Business Case	I	C	A	R	C	S	S	n.a.

Notes:

- **Accountable**: The Project Owner (PO) is accountable (they ensure that the work is done).
- **Responsible**: The Business Manager (BM) is responsible for creating the Business Case.
- **Supports**: The Solution Provider (SP) and the Project Manager (PM) work with the Business Manager (BM) to develop the Business Case. The final responsibility, however, lies with the Business Manager (BM).
- **Consulted**: The Project Steering Committee (PSC) and User Representative (UR) are consulted.
- **Informed**: The Appropriate Governance Body (AGB) will be informed about the outputs or status of the task (information will be made available).

CHAPTER 2

PROJECT MANAGEMENT KNOWLEDGE AREAS

CHAPTER 2 PROJECT MANAGEMENT KNOWLEDGE AREAS

2.1 Introduction

The **Project Management Institute** (**PMI**) defined the **10 Project Management Areas** in the **Project Management Body of Knowledge** (**PMBOK**) guide.

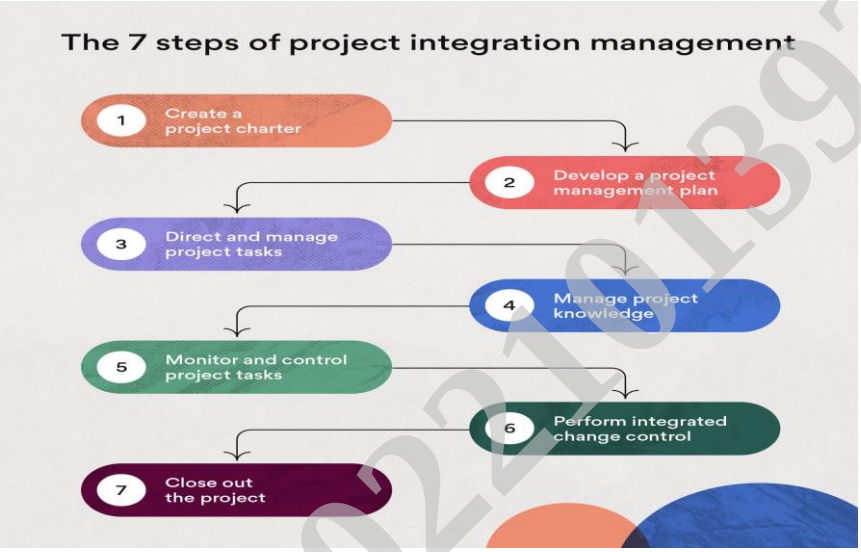
These Areas aim to Group **processes**, **tools**, and **techniques** Proven to be efficient in Project Management (PM) into **Categories** or **Groups** known as **Project Management Knowledge Areas.** The aim of these **Knowledge Areas** is to **better coordinate the various processes** and **group processes** that have similar characteristics together.

2.2 Key Areas of Project Management

- **Project Integration Management.**
- **Project Scope Management.**
- **Project Time Management.**
- **Project Cost Management.**
- **Project Communications Management.**
- **Project Quality Management.**
- **Project Human Resource Management.**
- **Project Risk Management.**
- **Project Procurement Management.**
- **Project Stakeholder Management.**

2.2.1 Project Integration Management

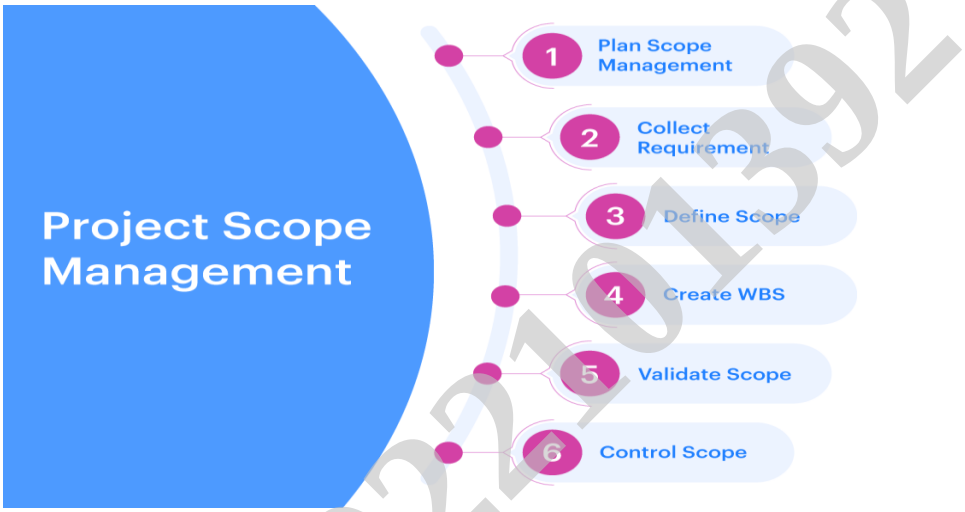
- **Project Integration Management** includes the **Processes** and **Activities needed** to **Identify**, **Define**, **Combine**, **Unify**, and **Coordinate** the **various processes** and **activities** with the **Project Management Process Groups**.
- **Good integration management** depends upon the **Project Team**. Is the team **Fully Staffed**, do they **Possess the necessary Skills**, are they at the **Right Place** at the **Right Time** ?



- **Integration Management Not Only involves taking decisions related to resource allocation, But also** about **making trade-offs** among **competing objectives** and **alternatives** in order to **Solve problems** and **Address minor issues** before they **turn into bigger problems**.

2.2.2 Project Scope Management

- **Scope** involves **getting Information required** to start a **project**, and **the Features the product** would have that would **meet** its **Stakeholder's Requirements**.
- **Project Scope**: "The **Work** that **needs to be accomplished** to **deliver** a **Product**, **Service**, or **Result** with the **Specified Features** and **Functions** ".
- It is **Primarily Concerned** with **Controlling what** "**is**" and **what** "**is not**" in the scope.

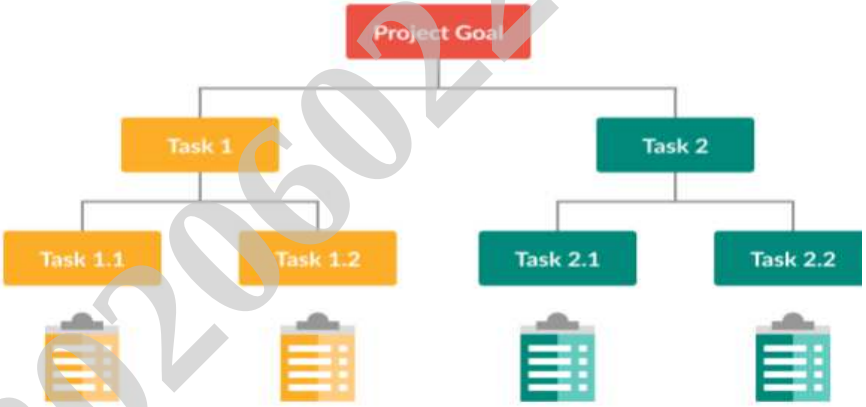


➢ **The Project Scope Management Processes include:**

1. **Plan Scope Management Process**: This **Sets out** how you will **Define**, **Manage**, **Validate**, and **Control** your **Project's Scope**.
2. **Collect Requirements Process**: Once you have **Outlined your Big-Idea**, you need to **Document** the **Requirements** and **Manage** your **Stakeholders' Expectations**. It includes:

- **Functional** and **Non-functional Requirements**.
- **Stakeholder Requirements** such as Reporting Requirements.
- **Support** and **Training Requirements**.
- **Business Requirements**.
- **Project Requirements** such as Levels of Service or Quality.

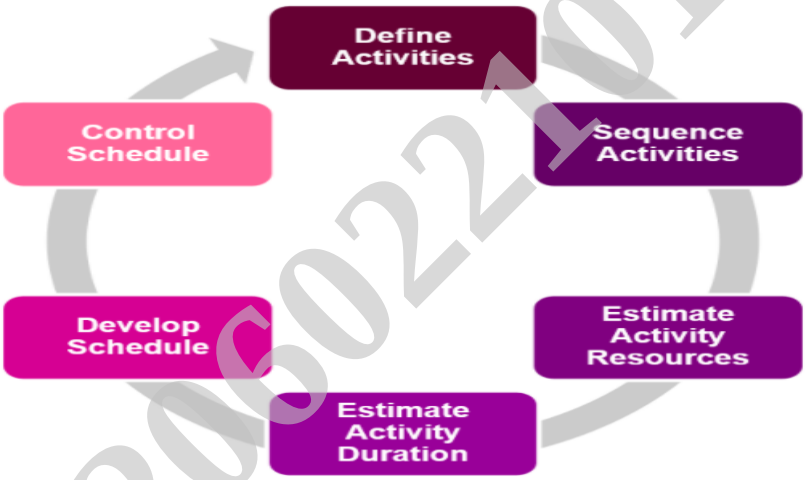
3. **Define Scope Process:** Here's where you take your **Requirements** and **turn them** into a **detailed description** of the **product** or **service** that your project is going to create.
4. **Create Work Breakdown Structure Process:** The main work here is **Breaking down Big tasks into Smaller, manageable chunks**. If you **don't think visually**, then you can achieve the same result by creating a **List**.



5. **Validate Scope Process**: The **Validate Scope process** is **getting business stakeholders** to **Sign-off your WBS**. It's about making sure that you have a **process** in place for **getting sign off** for your **deliverables when the time comes**.
6. **Control Scope Process**: It relates to **making sure that** there is **Effective Change Control** if the **scope** needs to **Change**.

2.2.1 Project Time Management

- **Time Management** is the **Process** of **Organizing** and **Planning** how to **divide** your **Time** between **Specific Activities**.



- **Processes of Project Time Management:**

1. **Define Activities**: It involves **identifying** the **Specific Activities** that must be **undertaken** to produce the approved deliverables for a project.
2. **Sequence Activities**: This involves **identification** and **documentation** **of relationships** between **Different Project Activities**.
3. **Estimate Activity Resources**: This involves **estimating** the **quality** and **quantities** of **material**, **manpower**, **machinery**, or **supplies** that would be **Required to Perform Each Activity**.

4. **Estimate Activity Durations**: This process is about **estimating** the **number of work periods needed** to **complete individual activities** with **the estimated number of resources available**.

5. **Develop Schedule**: This involves **analyzing** the **activity sequences**, **durations**, **resource requirements**, and **schedule Constraints** to **create a schedule for the project**.

6. **Control Schedule**: This is the process of **monitoring** the **progress of the project** to **update status** and **manage changes** to **the schedule baseline**.

➢ Time Management Benefits:

- ❑ **Greater Productivity** and **Efficiency**.
- ❑ **A better Professional Reputation**.
- ❑ **Less Stress**.
- ❑ **Increased Opportunities** for Advancement.
- ❑ **Greater Opportunities** to achieve important **life & career Goals**.

➢ Time Management Failure:

- ❑ **Missed Deadlines**.
- ❑ **Inefficient Workflow**.
- ❑ **Poor Work Quality**.
- ❑ **Poor Professional Reputation** and a **Stalled Career**.
- ❑ **Higher Stress Levels**.

Lessons to Become the Master of your Own Time

1. **Carry a Schedule** and **Record all your thoughts**, **conversations**, and **activities** for a week.
2. **Schedule Appointments** with **yourself** and **Create time blocks** for **high-priority thoughts**, **conversations**, and **actions**. **Schedule** when they will **start** and **end**.
3. **Plan to Spend at least 50% of your time** engaged in the **thoughts**, **activities** and **conversations** that produce most of your results.

4. **Schedule time for Interruptions**. Take, for instance, the concept of having "**Office Hours**".

5. **Take the first 30 minutes of every day to plan your day**. **Don't** start your day until you **Complete your Time Plan**.

6. **Take 5 minutes before every call** and **task** to decide **what result you want to attain** and **take 5 minutes after each call** and **activity** to determine **whether your desired result was achieved.**

7. **Put up a** "**Do Not Disturb**" sign when you **absolutely have to get work done**.

8. **Practice Not answering** the **Phone** just because it's ringing and **Emails** just because they show up.

9. **Block Out other Distractions** like **Facebook** and other forms of **social media** unless you use these tools to generate business.

10. **Remember** that it's **Impossible to get everything done**. Also, **Remember** that **odds are good** that **20%** of your **thoughts**, **conversations** and **activities produce 80%** of your **results**.

2.2.4 Project Cost Management

- **Cost Management** is the **Process** of **Managing Project Costs** through the Processes of **Planning**, **Estimating**, **Budgeting**, and **Controlling Costs** throughout the **Project Life Cycle** with the **Objectives** of keeping **Expenditures** within the **Approved Budget**. it's completed **within Budget**.

- **The Project Cost Management Processes are:**

Step1: Resource Planning: **WBS** and **historical information of comparable projects** can be used to **define** which **Physical Resources are needed**.

Step2: Cost Estimating: The **choice for** the **estimation method** depends on the **level of information available**.

Step3: Cost Budgeting: The **cost estimate forms** together with a **project schedule the input for cost budgeting**.

Step4: Cost Control: Cost control is **concerned** with **measuring variances** from the **cost baseline** and **taking effective corrective action** to achieve **minimum costs**.

2.2.5 Project Communications Management

- **Project Communications Management** is the **Systematic Planning**, **Implementing**, **Monitoring**, and **Revision** of all the **Channels of Communication** within an **Organization**, and between **Organizations**.

- **Project Communications Management Processes:**

1. **Identify Stakeholders.**
2. **Plan Communications.**
3. **Distribute Information.**
4. **Manage Stakeholder Expectations.**
5. **Report Performance.**

- **Aspects of Communications Management include:**

- **Developing Corporate Communication Strategies**,
- **Designing Internal** and **External Communications Directives**,
- **Managing** the **Flow of Information**, including **Online Communication**.

2.2.6 Project Quality Management

- **Quality Management** is the **Process** to **Ensure** that the **Project** will **meet** or **exceed** **Stakeholder's needs** and **expectations**.
- **The Seven Quality Management Principles are:**

QMP 1 – Customer Focus.
QMP 2 – Leadership.
QMP 3 – Engagement of People.
QMP 4 – Process Approach.
QMP 5 – Improvement.
QMP 6 – Evidence-Based Decision Making.
QMP 7 – Relationship Management.

❑ QMP 1 – Customer Focus:

- **Statement:** The **Primary Focus** of **Quality Management** is to **Meet** **Customer Requirements** and to **Strive to exceed** **Customer Expectations**.
- **Rationale**: **Understanding** **Current** and **Future** **needs of Customers** and **other Interested Parties** **Contributes** to **Sustained Success** of the Organization.
- **Key Benefits**:

- **Increased Customer** "Value", "Satisfaction", "Loyalty", "Revenue and Market Share".
- **Enhanced** "Repeat Business " and "Reputation".

❑ QMP 2 – Leadership:

- **Statement: Leaders Establish Unity of Purpose** and **Direction** and **Create Conditions** in which people are engaged in achieving the **Organization's Quality Objectives**.
- **Rationale**: **enable** an **Organization** to **align** its **Strategies**, **Policies**, **Processes**, and **Resources** to **achieve its Objectives**.
- **Key Benefits**:
  - **Increased** Efficiency and Effectiveness.
  - **Better Coordination** of the Organization's Processes.
  - **Improved** Communication between Levels.
  - **Development** and **Improvement** of the Capability of the Organization and its People.

- **QMP 3 – Engagement of People:**

- **Statement: Competent**, **Empowered** and **Engaged People** at **all levels** throughout the **Organization** are **essential** to **enhance** its Capability to **Create** and **Deliver** Value.

- **Rationale**: **Recognition**, **Empowerment**, and **Enhancement of competence facilitates** the engagement of people in achieving the **Organization's Quality Objectives**.

- **Key Benefits**:

  - **Improved** understanding of the Organization's Quality Objectives.
  - **Enhanced** involvement of People in improvement activities.
  - **Enhanced** Personal Development, Initiatives, and Creativity.
  - **Enhanced** "People Satisfaction", "Trust and Collaboration".
  - **Increased** attention to shared Values and Culture.

❑ QMP 4 – Process Approach:

- **Statement: Consistent** and **Predictable** results are achieved more **Efficiently** and **Effectively** when activities are **Understood** and **Managed** as **Interrelated Processes**.
- **Rationale**: **Understanding** how **Results** are Produced by this System **enables** an Organization to **Optimize** the **System** and its **Performance**.
- **Key Benefits**:
  - **Enhanced ability** to focus effort on Key Processes and Opportunities for **Improvement**.
  - **Consistent** and **Predictable** Outcomes through a System of **aligned Processes**.
  - **Optimized Performance** through Effective process management, Efficient use of resources, and Reduced cross-functional barriers.

❑ QMP 5 – Improvement:

- **Statement: Successful Organizations** have an **Ongoing Focus** on **Improvement**.
- **Rationale**: **Improvement** is **essential** for an **Organization** to **Maintain** Current levels of Performance, to **React** to Changes in its internal and external Conditions and to **Create** New Opportunities.
- **Key Benefits**:

- **Improved Process** Performance, Organizational Capabilities, and Customer Satisfaction.
- **Enhanced focus** on Root-cause Investigation and Determination, followed by Prevention and Corrective actions.
- **Enhanced ability** to Anticipate and React to internal and external risks and Opportunities, Also, Drive for **Innovation**.

❑ QMP 6 – Evidence-Based Decision Making:

- **Statement: Decisions** based on the **Analysis** and **Evaluation** of **data** and **information** are more likely to **Produce Desired Results**.
- **Rationale**: **Understanding** how **Results** are Produced by this System **enables** an Organization to **Optimize** the **System** and its **Performance**. **Facts**, **Evidence**, and **Data Analysis lead** to greater **Objectivity** and **Confidence** in **Decision-Making**.
- **Key Benefits**:
  - **Improved** Decision-Making Processes.
  - **Improved** assessment of Performance and **ability** to achieve Objectives, and Operational efficiency and effectiveness.
  - **Increased ability** to review, **challenge** and **change** Opinions and Decisions.
  - **Ability** to demonstrate the effectiveness of **Past Decisions**.

❑ QMP 7 – Relationship Management:

- **Statement:** For **Sustained Success**, an Organization **Manages** its **Relationships** with **Interested Parties**, Such as: **Suppliers**.
- **Rationale**: **Interested Parties influence** the Performance of an Organization. **Sustained Success** is more likely to be **achieved**. when the Organization **manages** relationships with all its **Interested Parties** to Optimize their impact on its Performance.
- **Key Benefits**:

- **Responding** to the Opportunities and Constraints related to each **Interested Party**.
- **A well-managed** Supply Chain that provides a **Stable flow** of goods and services.
- **Increased Capability** to create Value for **Interested Parties** by Sharing Resources, Competence and Managing Quality-Risks.

2.2.7 Project Human Resource Management

- **Human Resource Management** (HRM) **Consists** of all the **Processes** that **assist** a **Project Manager** in **Organizing**, **Managing** and **Leading** the **Project Team**.
- **Human Resource Management** is all about "**Personnel Management**".
- **Project Human Resource Management Processes:**

1. **Develop Human Resource Plan**: (Roles & Responsibilities).
2. **Acquire Project Team**.
3. **Develop Project Team**: Improving the team dynamics and its Competency to perform better.
4. **Manage Project Team**.

Function of Human Resource Management

2.2.8 Project Risk Management

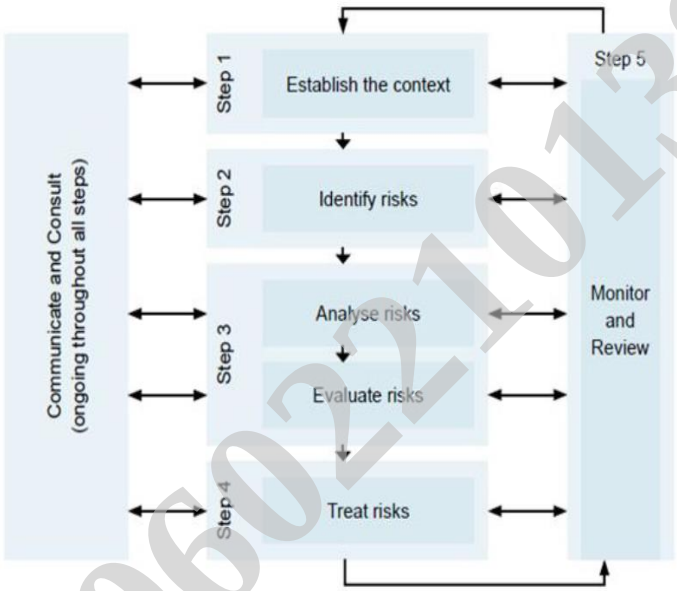
- **Risk** - is a **Probability** that some **adverse circumstance will occur.**
- **Risk Management** is the **Process** of **Defining**, **Evaluating**, and **Prioritizing Risks** and **Drawing up Plans** to **minimize their effect on a Project**.
  - **Project Risks affect Schedule** or **Resources**.
  - **Project Risks affect** the **Quality** or **Performance** of the software being developed.
- **Risk Management's Objective** is to **assure Uncertainty does not deflect** the **endeavor** from the **Business Goals**.
- **Risk can come from Various Sources including:**

1. **Uncertainty** in **Financial Markets**,
2. **Threats** from **Project Failures** (at any phase in **Design**, **Development**, **Production**, or **Sustainment** life cycles),
3. **Legal Liabilities**,
4. **Credit Risk**,
5. **Accidents**,
6. **Natural Causes** and **Disasters**,
7. **Any Events** of **Uncertain** or **Unpredictable** root-cause.

- **Principles of Risk Management** - The **International Organization for Standardization** (**ISO**) **identifies** the following **Principles of Risk Management**:

1. **Create Value** – resources expended to mitigate risk.
2. **Be** an **Integral Part of Organizational Processes**.
3. **Be** a **Part of Decision-Making Process**.
4. **Explicitly Address Uncertainty** and **Assumptions**.
5. **Be** a **Systematic** and **Structured Process**.
6. **Be based** on **the Best Available Information**.
7. **Be Tailorable**.
8. **Take Human Factors** into **account**.
9. **Be Transparent** and **Inclusive**.
10. **Be Dynamic**, **Iterative**, and **Responsive** to **Change**.
11. **Be Capable** of **Continual Improvement** and **Enhancement**.
12. **Be Continually** or **Periodically Re-assessed**.

➢ The Project Risk Management Processes:



Step 1 – Establish the Context:

- ❑ It is **important to understand** the **Context** in which it **exists**. You should **Define** the **Relationship** between your **Club** and the **Environment** that it operates in so that the **Boundaries** for dealing with **Risk** are **Clear**.
- ❑ **Establish the Content by Considering**:
  - The **Strategic Context** – the **Environment** within which the **Organization Operates**.
  - The **Organizational Context** – the **Objectives**, **Core activities** and **Operations** of the club.

Step 2 – Identify the Risk:

- The **Purpose** of this step is to **Identify** **What** could go **Wrong** (**Likelihood**) and **What** is the **Consequence** (**loss** or **damage**) of it occurring.

  Key Questions to ask include:

  - **What** can happen?
  - **How** and **Why** it can happen?
  - **What** is the likelihood of them happening?
  - **What** will be the consequences if they do happen?

- **Risks** can be **Physical**, **Financial**, **Ethical**, or **Legal**:

- **Physical Risks** are those involving **Personal Injuries**.
- **Financial Risks** involve the **assets of the Organization** and include **theft**, **fraud**, **loans**, **license fees**.
- **Ethical Risks** involve **actual** or **potential harm to the Reputation**.

Step 3 – Analyze & Evaluate the Risks:

- **Risk Analysis** involves **Analyzing** the **Likelihood** and **Consequences** of **each identified Risk** and **Deciding** **which Risk Factors will potentially have the greatest effect** and should, **therefore**, **Receive Priority** with regard to **how they will be managed.**

- **Risk Evaluation** involves **Comparing** the **level of risk** found during the analysis process with previously established risk criteria and **Deciding** whether risks can be **accepted**.
- If risks **do not fall into** the **low** or **acceptable category**, they should be **treated** using **one** or **more** of the **treatment options** considered in **Step 4**.

The Criteria for Evaluating the Risks:

1. **Likelihood Scale**: **Question – What** is the **likelihood** of the Risk event **occurring**?

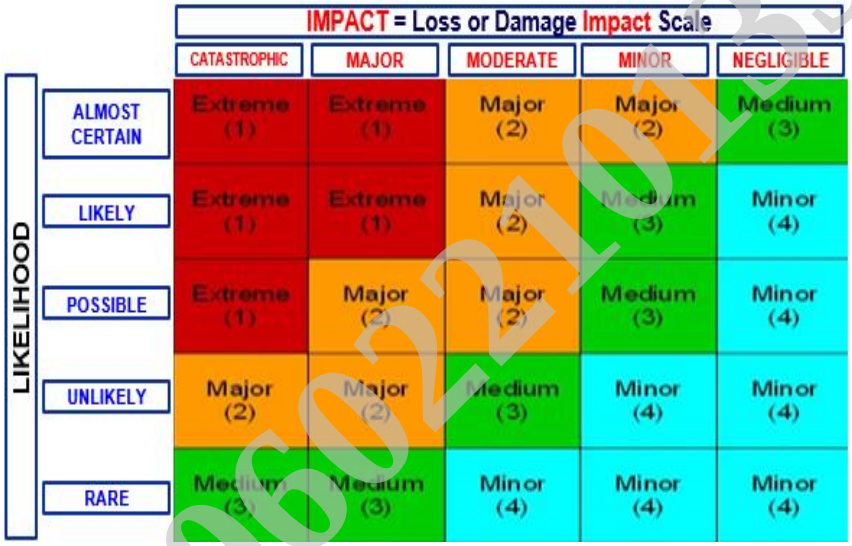
Rating	PROBABILITY The probability of issues arising within a year
5	ALMOST CERTAIN: will almost certainly occur, possibly multiple occasions a year
4	LIKELY: It's a high-probability case that'll happen once a year.
3	POSSIBLE: There's a fair chance it'll happen in the next five years.
2	UNLIKELY: probable, and could happen in the next five to ten years
1	RARE: Over a ten-year term, it's very unlikely but not impossible.

2. Loss or Damage impact Scale (Consequences): **Question – What** is the loss or damage **Impact** if the risk event occurred (**Severity**)?

Rating	POTENTIAL IMPACT
5	**CATASTROPHIC**: most objectives may not be achieved, or several severely affected
4	**MAJOR**: most objectives threatened, or one severely affected
3	**MODERATE:** some objectives affected, considerable effort to rectify i.e. sport injury – requires medical attention and has some impact on participation in sport and/or other activity
2	**MINOR:** easily remedied, with some effort the objectives can be achieved i.e. sport injury requires first aid treatment and prevents immediate participation in sport and/or other activity
1	**NEGLIGIBLE:** very small impact, rectified by normal processes i.e. sport injury but does not prevent participation

3. Risk Priority: The Risk Priority Scale **determines** the **nature of the risk** and the **action required**. They are **indicators** to assist in the decision making of what action is warranted for the risks. **Question – What** is the **Risk Priority**?

❑ The Criteria for Evaluating the Risks: (Risk Priority Scale)



LIKELIHOOD	IMPACT = Loss or Damage Impact Scale				
	CATASTROPHIC	MAJOR	MODERATE	MINOR	NEGLIGIBLE
ALMOST CERTAIN	Extreme (1)	Extreme (1)	Major (2)	Major (2)	Medium (3)
LIKELY	Extreme (1)	Extreme (1)	Major (2)	Medium (3)	Minor (4)
POSSIBLE	Extreme (1)	Major (2)	Major (2)	Medium (3)	Minor (4)
UNLIKELY	Major (2)	Major (2)	Medium (3)	Minor (4)	Minor (4)
RARE	Medium (3)	Medium (3)	Minor (4)	Minor (4)	Minor (4)

❑ The Criteria for Evaluating the Risks: Key of Risk Priority Scale

EXTREME	Extreme risks that are likely to arise and have potentially serious consequences requiring urgent attention
MAJOR	Major risks that are likely to arise and have potentially serious consequences requiring urgent attention or investigation
MEDIUM	Medium risks that are likely to arise or have serious consequences requiring attention
MINOR	Minor risks and low consequences that may be managed by routine procedures

Step 4 – Treat the Risks:

- **Risk Treatment** involves **Identifying** the range of Options for treating the risk, **Evaluating** those Options, **Preparing** the risk treatment Plans and **Implementing** those Plans.
- **According to the standard, treatment options include:**
  - **Accepting the Risk.**
  - **Avoiding the Risk.**
  - **Reducing the Risk.**
  - **Transferring the Risk.**
  - **Retaining the Risk.**
  - **Financing the Risk.**

Step 5 – Monitor and Review:

- **Monitoring** and **Review** is an **Ongoing Part of Risk Management** that is **integral** to **Every Step of the Process**.
- **Monitoring** and **Review** **Ensure** that the **important information generated by the Risk Management Process is Captured**, **Used** and **Maintained**.
- **Few Risks remain Static**. **Factors** that may affect the **Likelihood** and **Consequences** of an outcome may change, as may the factors that affect the **suitability** or **cost** of the various treatment options. **Review** is an **integral part of the risk management treatment plan**.

2.2.9 Project Procurement Management

- **Procurement Management** is the **Process** of **acquisition** of **goods** and/or **services**.

1. **Simple Procurements** however **doesn't** necessarily require **Contracts**, **Formal Agreements**, or **Purchase Orders**.
2. **Complex Procurements** should involve **looking for Vendors** or **Suppliers** who want to establish a long-term **Buyer/Seller Relationship**.

- **Procurement** could also involve **Making Buying Decisions** based on **Economic Analysis Methods** like:

1. **Cost-Benefit Analysis**: This involves looking at the **Overall Costs** and **Benefits** of a decision, then evaluating the **pros** and **cons** to determine if the planned action is beneficial before making the decision.
2. **Cost-Utility Analysis**: Use a **Common Unit of Measure** (for example, quality of life in health care, or money). This method tends to **provide** a more detailed analysis of total benefits over cost-benefit analysis.
3. **Risk Analysis**: It can also help the project team in **identifying** the **Preventive measures needed** to mitigate the risk.

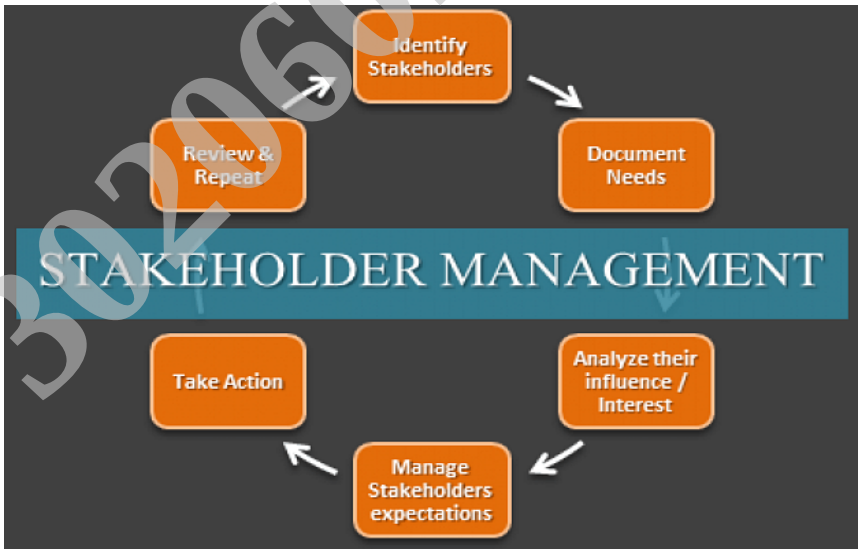
➢ **The Project Procurement Management Processes:**

1. **Plan Procurements**: **Documenting Procurement Decisions** on how Procurements will be **managed** and **deciding** the criteria for **seller selection on the project**.
2. **Conduct Procurements**: **Initiating the bidder selection process**, **Obtaining seller responses**, **Choosing a seller**, and **Ultimately awarding the contract**.
3. **Administer Procurements**: This involves **Maintaining the procurement relationship** with the **chosen vendor**. The process group is Monitoring and Controlling.
4. **Close Procurements**: This is the process of **Completing each project procurement transaction** and the **Contract Services at the end of the project.**

2.2.10 Project Stakeholder Management

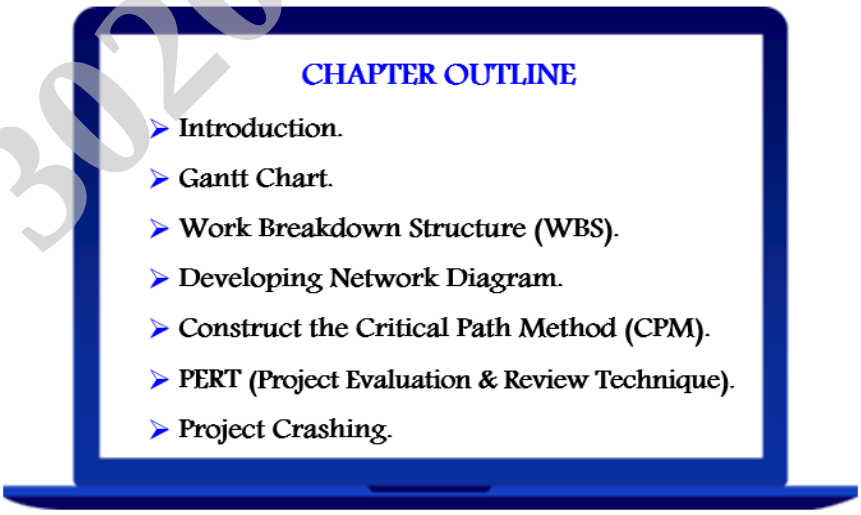
- A **stakeholder** is **anybody** who has **any interest** in your **Project**.
- **The different examples of Stakeholders are as follows:**
  - **Project Manager.**
  - **Project Team Members.**
  - **Senior Management.**
  - **Sponsors.**
  - **Suppliers.**
  - **Customers.**
  - **End Users.**
  - **Vendors.**
  - **People affected by Project's Output.**
  - **Competitors.**
  - **Social Groups.**
  - **Government and Political Leadership.**

- **Project Stakeholders** are **Individual**, **Group**, or **Organization** who may **affect**, or be **affected by** a **decision**(s), **activity**(s), or **outcome**(s) of a **Project**.
- **Stakeholder** can have a **Positive** or **Negative** **impact**. Therefore, it is necessary to **engage** and **involve** the stakeholders in the project to ensure project success.
- **Stakeholder Management** is a **Project Management Process** that consists in **Managing** the **Expectations** and **Requirements** of all the **Internal** and **External** **Stakeholders** that are involved with a project.



CHAPTER 3

PROJECT SCHEDULING



CHAPTER 3 PROJECT SCHEDULING

3.1 Introduction

Project scheduling or project planning in project management are the listings of milestones, activities, and deliverables with start and finish dates of the project.

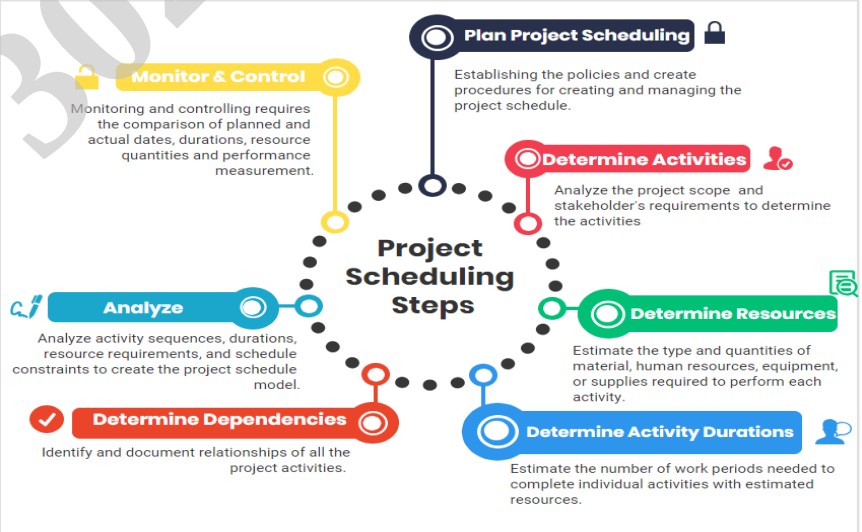
The estimation of resource allocation, budget and duration are directly linked with dependencies and scheduled events. In project management, project scheduling is used in project planning and project portfolio management. Project scheduling is just part of the project planning. Scheduling is determined by the timing and sequence of operations to give completion time, Work breakdown structure terminal elements, the statement of work or a contract data requirements list and on needed for completion of the project.

- **Project** is a **Problem Scheduled** for **Solution**.
- **Scheduling Project Activities** is a **Significant Part** of **Project** Preparation. It includes **determining which activities** (**tasks**) will be completed and **when**.

➢ Project Scheduling Processes & Techniques

A **Software Project Manager** needs to do the following:

1. **Identify** all the **activities** needed to complete the **Project**.
2. **Break-down Complex task into smaller activities**.
3. **Determine** the **Dependency** among **different activities**.
4. **Establish** the most likely estimates for the **time durations** necessary to **Complete the activities**.
5. **Allocate Resources** to **activities**.
6. **Plan** the **Starting** and **Ending dates** for **various activities**.
7. **Determine** the **Critical Path**.



All the **Techniques** comes with some **limitations** and can be used based on the requirements for **Project Scheduling** – The **first phase** in scheduling a programming project is to **define all of the tasks** that must be completed. **Executives** who have a thorough understanding of the project's complexities and implementation process are better able to recognize the project's most **critical tasks**. Following that, the massive tasks are **divided into** a rational series of small tasks that are delegated to various technicians. The **job breakdown structure methodology** assists the director in progressively breaking down the activities. The project manager must **determine the dependencies** among all the tasks after breaking down the tasks and creating the job breakdown structure. **The sequence** in which the various tasks are carried out is determined by the degree of dependency among them.

If the outcomes of activity A are required by another activity – activity B, activity A must be arranged after activity B. Task dependencies, in particular, identify a limited sequence among tasks, — in other words, each task may precede a subsection of other tasks, but certain tasks may not have any priority ordering specified among them (called concurrent task). An activity network is used to illustrate the interdependence of the tasks.

Following the completion of the **activity network representation**, resources are assigned to every task. A **Gantt** map is often used to allocate resources. After the assets have been allocated, a **PERT** chart is created. The PERT chart is a useful tool for tracking and controlling programs.

The **project manager** must **disintegrate** the project tasks into a chain of steps in order to schedule them. It is important to decide the **time** in which each operation should be completed. Each activity's conclusion is referred to as a milestone. The **project manager monitors** the effective delivery of milestones to document the work performance. If he finds that the goals are **falling behind** schedule, he must **closely track** the events to **ensure** that the project is delivered on time.

3.2 Gantt Chart

A Gantt chart is a project management tool assisting in the planning and scheduling of projects of all sizes; they are particularly useful for visualizing projects. A Gantt chart is defined as a graphical representation of activity against time; it helps project professionals monitor progress.

This chart lists the tasks to be performed on the vertical axis, and time intervals on the horizontal axis. The width of the horizontal bars in the graph shows the duration of each activity.

- **Show task durations.**
- **Show time overlap.**
- **Show slack time in duration.**

Project schedule

Code	Work package designation	Responsibility	Start	End
1	**IT-CONCEPT**		**15.05.2020**	**29.11.2020**
1.2	**As-is analysis**		11.06.2020	31.07.2020
1.2.1	As-is analysis Software		11.06.2020	08.07.2020
1.2.2	As-is analysis Hardware		25.06.2020	15.07.2020
1.2.3	As-is analysis Infrastructure		01.07.2020	26.07.2020
1.2.4	Documentation as-is analysis		12.06.2020	31.07.2020
1.3	**Description variants**		**01.08.2020**	**04.09.2020**
1.3.1	Definition variants		01.08.2020	07.08.2020
1.3.2	Description variant 1		09.08.2020	21.08.2020
1.3.3	Description variant 2		09.08.2020	21.08.2020
1.3.4	Description variant 3		22.08.2020	04.09.2020
1.4	**Market research software**		**05.09.2020**	**14.10.2020**
1.4.1	Listing Application Software		05.09.2020	11.09.2020
1.4.2	Analysis Application Software		11.09.2020	01.10.2020
1.4.3	Collecting additional information		01.10.2020	07.10.2020
1.4.4	Rating Application Software		08.10.2020	14.10.2020

3.3 Work Breakdown Structure (WBS)

A work-breakdown structure (WBS) in project management and systems engineering is a deliverable-oriented breakdown of a project into smaller components. A work breakdown structure is a key project management element that organizes the team's work into manageable sections.

It is a procedure for evaluating the complexity of a project by dividing the overall objective into a logical sequence of sequential, progressively particular tasks. The outcome is a detailed document that reflects all of the hard work that went into it. It identifies the various components that will make up the project. Consider it as a tool for splitting down a project into "small-sized" parts, each depicting a move required to finish the final business plan.

It may be difficult to imagine all of the components or task element necessary to ensure the quality of the project at the initial phase, however, the attempt to "dig deep" into the different activities at the task level will actually strengthen the project's whole image.

For example, Presume the case of a group of students collaborating on a college essay and final presentation for an academic seminar. splitting the roles down into a set of assignments, all of which can be assigned to a one or more than one of the team, is among the initial stages along the way of finishing the project. By splitting down the entire project into smaller parts, including a final essay and slideshow, it becomes even more doable, such as:

Task 1: Improve Subject.

Task 2: Designate roles for literature review.

Task 3: Create a basic description for your essay and slideshow.

Task 4: Appoint teammates to start finalizing the slideshow.

Task 5: Make drafts.

Task 6: Drafts should be reviewed and revised.

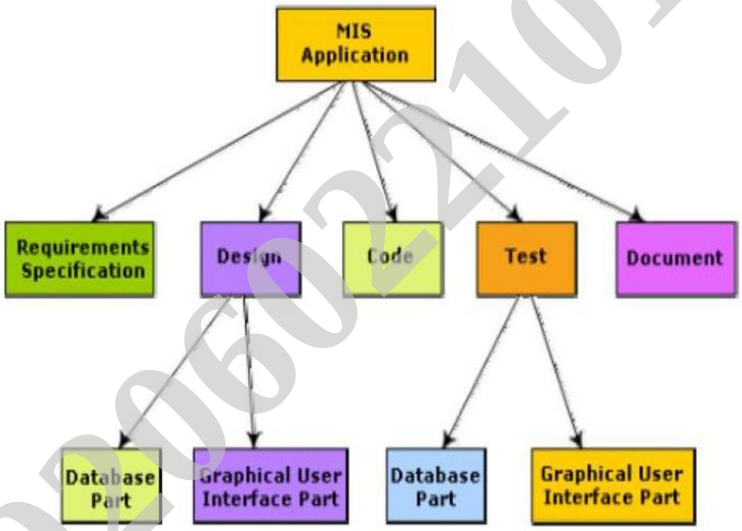
Task 7: Develop and the slideshow and check the class visual aids.

Task 8: Hand in your essay and demonstrate the slideshow.

The (WBS) is a method for successively decomposing a task structure into small parts. It is a term that can be used to reflect the main tasks that must be completed in order to resolve a problem. The problem name is written at the basis of the tree. Each node of the tree is cut into even smaller activities, which are referred to as the node's children. Each task is decomposed into smaller sub-activities in a cyclical fashion until it reaches the leaves level.

Work Breakdown Structure of an MIS Problem

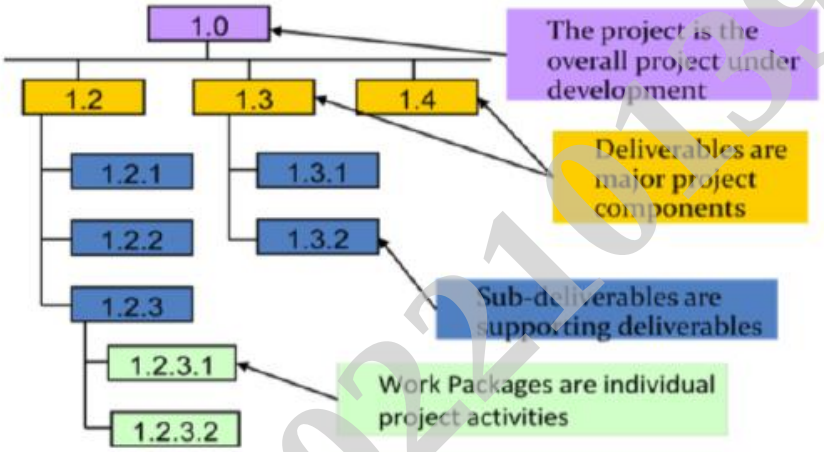
- Show task dependencies.
- Do not show time overlap, but show parallelism.
- Show slack time in boxes.



Overall, for a generic project, the logic of hierarchy for WBS follows this form, which can be mapped as follows:

Level	WBS Term	Description
Level 1 (Highest)	Project	The overall project under development
Level 2	Deliverable	The major project components
Level 3	Subdeliverable	Supporting deliverables
Level 4 (Lowest)	Work package	Individual project activities

Work Breakdown Structure Deliverables



Example of WBS for a Project

Breakdown	Description	WBS	Code
IT Installation Project			**1.0**
Deliverable 1	**Match IT to organizational tasks and problems**		**1.1**
WP 1	Conduct problem analysis	1.1.1	
WP 2	Develop information on IT technology	1.1.2	
Deliverable 2	**Identify IT user needs**		**1.2**
WP 1	Interview potential users	1.2.1	
WP 2	Develop presentation of IT benefits	1.2.2	
WP 3	Gain user "buy-in" to system	1.2.3	
Deliverable 3	**Prepare informal proposal**		**1.3**
WP 1	Develop cost/benefit information	1.3.1	
WP 2	Gain top management support	1.3.2	
Deliverable 4	**Seek and hire IT consultant**		**1.4**
WP 1	Delegate members as search committee	1.4.1	
WP 2	Develop selection criteria	1.4.2	
WP 3	Interview and select consultant	1.4.3	
Deliverable 5	**Seek staff and departmental support for IT**		**1.5**
Deliverable 6	**Identify the appropriate location for IT**		**1.6**
WP 1	Consult with physical plant engineers	1.6.1	
WP 2	Identify possible alternative sites	1.6.2	
WP 3	Secure site approval	1.6.3	
Deliverable 7	**Prepare a formal proposal for IT introduction**		**1.7**
Deliverable 8	**Solicit RFPs from vendors**		**1.8**
WP 1	Develop criteria for decision	1.8.1	
WP 2	Contact appropriate vendors	1.8.2	
WP 3	Select winner(s) and inform losers	1.8.3	
Deliverable 9	**Conduct a pilot project (or series of projects)**		**1.9**
Deliverable 10	**Enter a contract for purchase**		**1.10**
Deliverable 11	**Adopt and use IT technology**		**1.11**
WP 1	Initiate employee training sessions	1.11.1	
WP 2	Develop monitoring system for technical problems	1.11.2	

3.4 Developing Network Diagram

In the scenario of the students planning a presentation that specifying all of the steps needed to execute the task is an essential initial step in project scheduling because it gives the tasks a successive nature and helps you form a realistic project schedule from the beginning to the end. Presume you want to make the best use of your time and availability by developing a system of the tasks mentioned previously.

- **Assuming** the **Students** are **Preparing a Seminar**, to **ensure the best use** of your **time** and **availability**, it would be necessary to determine a **Reasonable (Logical) Sequence**.

  1. **Preceding activities** (are those that **must occur before others** can be done).
  2. **Subsequent** or **Successor activity** (are those that **must follow** others).

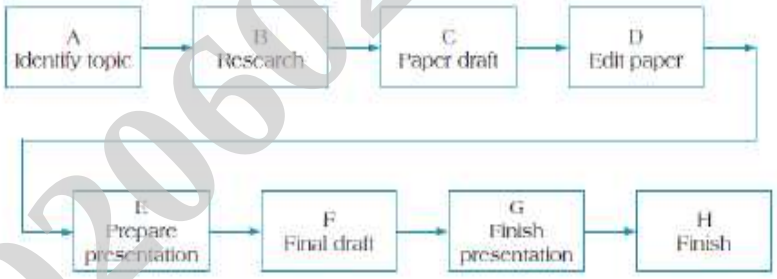
- **For example**, it would be necessary to first **Identify** the **term paper topic before beginning** to **Conduct research on it.**

- **Therefore**, **Activity1**, **Identify topic**, is a **Preceding activity**; and **Activity2**, **Research topic**, is referred to as **Successor activity**.

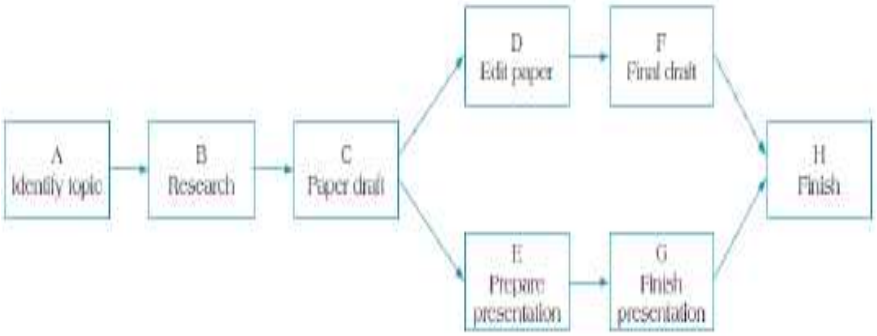
- **Once** you have **Identified** a **Reasonable Sequential Logic** for the **Network**, you can **Construct** a **Network Diagram**.
- **Network Diagram** is a **Schematic display** of the **Project's Sequential Activities** and the **Logical Relationships** **between them.**

Alternative Activity Networks for Term Paper Assignment

Option A: Serial Sequential Logic



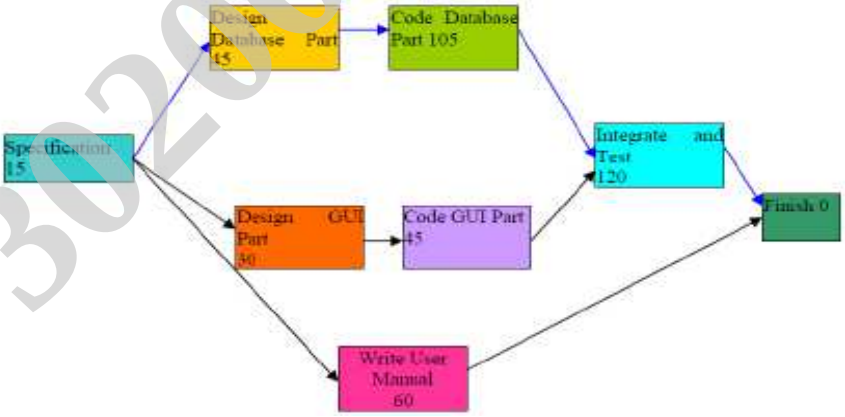
Option B: Non-Serial Sequential Logic



By presenting the activities defined in WBS alongside their interdependencies, the WBS for MIS example shown above could be converted into an activity network. As shown as follows, an activity network depicts the various activities that make up a project, their approximate timeframes, and interdependencies. A rectangle node defines each task, and the length of the assignment is displayed next to it.

Network Diagram

Activity Network Representation of the MIS Problem



Managers may predict the timeframes of various activities in a number of ways. They might, for instance, experientially assign timeframes to various tasks. This isn't a smart option, though, since software developers often dislike such arbitrary decisions.

Allowing the technician to determine the duration for an operation he can be appointed to is another choice. Some executives, on the other hand, tend to predict the length of different operations themselves. Numerous executives claim that a tight deadline encourages technicians to work harder and better. Studies have already shown, nevertheless, that overly demanding deadlines not only compel technicians to compromise on essential quality attributes, but also trigger delays. Allowing individuals to open their own deadlines is a great way to improve accuracy in task period determination without putting unnecessary deadline burden on them.

There are many explanations why project networks and schedules must be performed correctly. The below are some of the reasons:

- The interdependence of all activities and work packages is strongly illustrated by a network. Making a mistake early in the project may have serious consequences for later activities.

- A network promotes information flows by illustrating the interconnections between tasks and project participants. Individuals become much more knowledgeable of the work that occurred prior to their participation, and they gain a greater understanding of the needs of those that will assume charge later.

- Since it indicates periods of time when different employees must be completely dedicated to project tasks, a network aids in master scheduling of corporate assets. Employees can be allocated to several tasks at a time when they are most required on the project without a deep comprehension of where the project falls into the overall organizational framework.

- A network distinguishes the most important activities and separates them from the less important ones. The network determines the tasks that must be done on time in order for the entire project to be completed on time; it also identifies tasks that have some "wobble room."

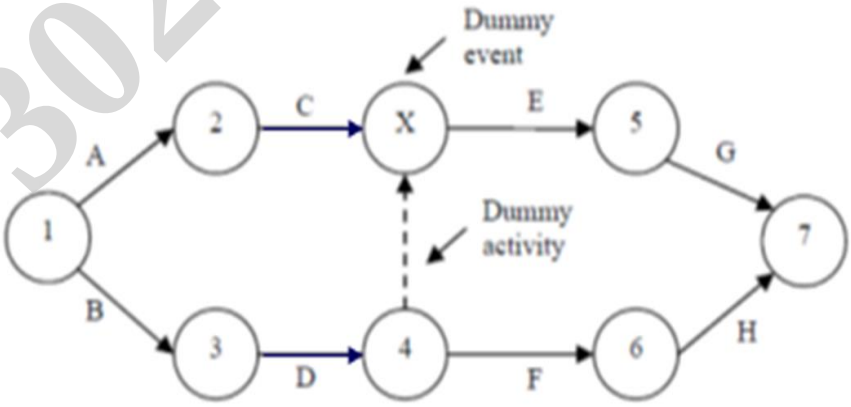
- Networks decide when projects are supposed to be finished.

- A network is used to define the dates on which different project tasks must begin and end in order to remain on track with the overall schedule.

- A network indicates which activities are based on which other activities. You will also be aware of the tasks that must be closely planned in order for the project to proceed smoothly.

Network

- **Network - Graphical Portrayal** of **activities** and **events**.
- **Shows Dependency Relationships** between **activities** or **tasks** in a Project.
- **Clearly shows tasks** that must **Precede** (**Precedence**) or **Follow** (**Succeeding**) **other tasks**. in a **logical manner** (**Reasonable Sequence**).
- **Clear Representation** of **Plan** – a **Powerful tool** for **Planning & Controlling Project**.
- **Combination** of all **Project activities** and the **Events**.

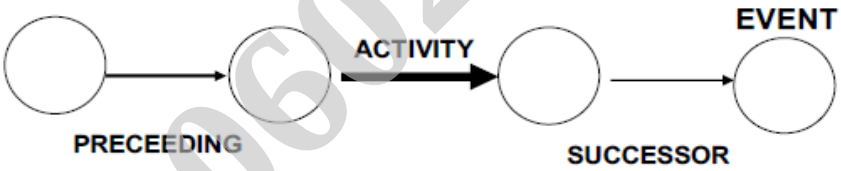


Rules for Constructing a Network Diagram

1. Some determination of activity **Precedence Ordering** **must be done before** **Creating the Network**. That is, all activities **must be** **logically linked to each other** - those that precede others, as well as **Successor Activities** (those that must follow others).
2. **Network diagrams** usually **flow** from **left** **to** **right**.
3. An **activity** **Cannot** begin **until** **all** **Preceding connected activities have been Completed**.
4. **Arrows** (**Arcs**) on **Networks** indicate **Precedence** and **Logical Flow**.
5. Each **activity** should have a **Unique Identifier** associated with it (**number**, **letter**, **code**, etc.). For **simplicity**, these identifiers should occur in **Ascending Order**; each one should be larger than the identifiers of **Preceding activities**.
6. **Looping**, or **Recycling** through activities, is **Not Permitted**.
7. Although not required, it is **common** to **Start** a Project from a **Single beginning node**, even in the case when multiple start points are possible. A single node point also is typically used as a project **End** indicator.

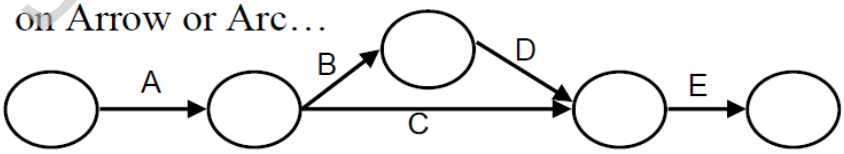
Definition of Terms in a Network

- **Activity**: any **Portions** of Project (**tasks**) which required by Project, uses up **resource**, and **consumes time** – may involve (labor, paperwork, contractual negotiations, machinery operations).
- **Event: Starting** or **Ending** Points of one or more **activities**, instantaneous point in time, also called '**Nodes**'

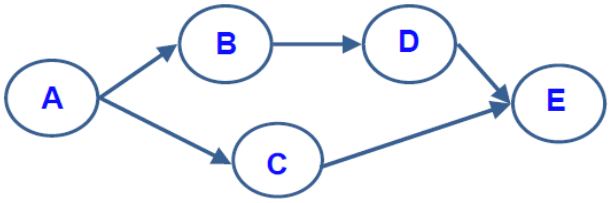


AOA Versus AON

The same mini-project is shown with Activities on Arrow or Arc…



… and Activities on Node.

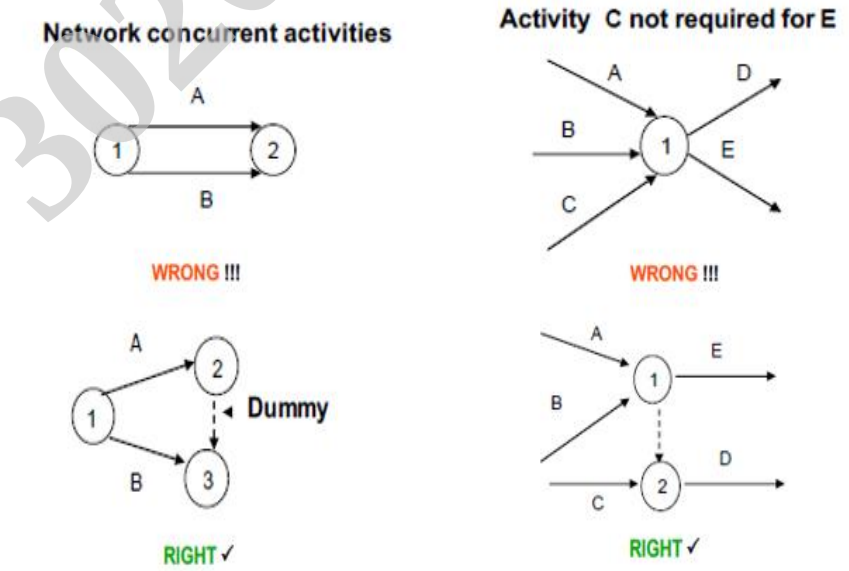


Rules for Constructing a Network Diagram

Construction of **Network** should be based on **logical** or **technical dependencies** among **activities**.

1. **Each activity** is represented by **One** and **Only One Arrow** (**Arc**) in the **Network** = (**Unique Node**);
2. **No two activities** can be identified **by the same head** and **tail** events (a **dummy** activity is introduced in such situations);

Example of the Use of Dummy Activity



Example 1 - A Simple Network

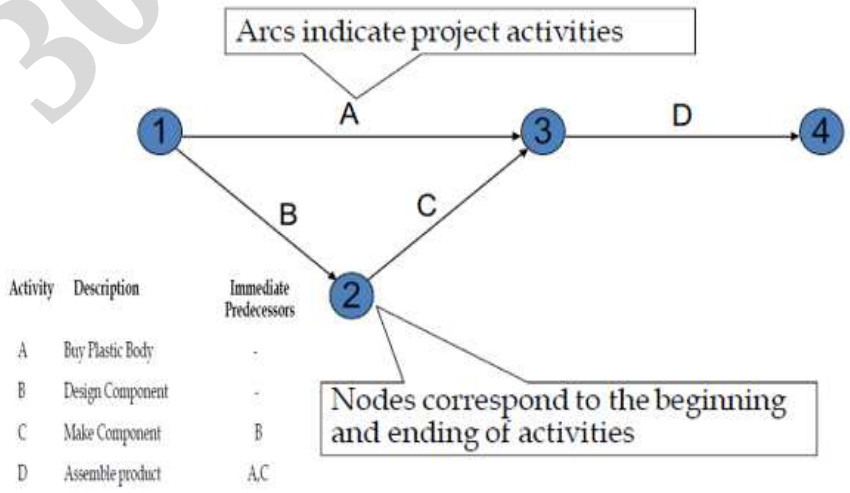
- **Consider the list of four activities for Making a Simple Product:**

Activity	Description	Immediate Predecessors
A	Buy Plastic Body	-
B	Design Component	-
C	Make Component	B
D	Assemble product	A,C

Immediate Predecessors for a particular activity are the activities that, when completed, enable the start of the activity in question.

Answer for Example 1 - A Simple Network

NETWORK OF FOUR ACTIVITIES

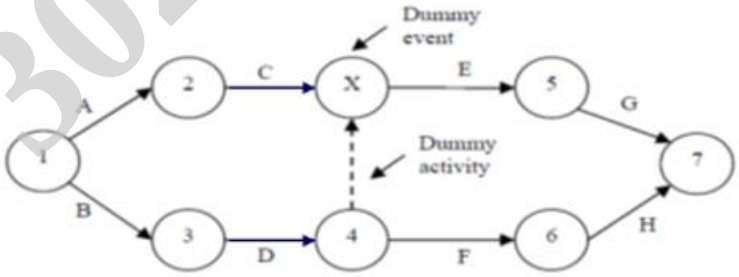


Example 2

- **Develop the Network for a Project with the table below:**

Activity	Immediate Predecessors
A	-
B	-
C	A
D	B
E	C, D
F	D
G	E
H	F

Answer for Example 2



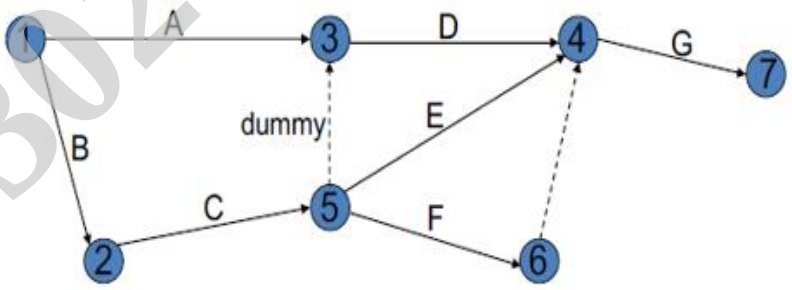
Activity	Immediate Predecessors
A	-
B	-
C	A
D	B
E	C, D
F	D
G	E
H	F

Example 3

- **Develop the Network for a Project with the table below:**

Activity	Immediate Predecessors
A	-
B	-
C	B
D	A, C
E	C
F	C
G	D,E,F

Answer for Example 3

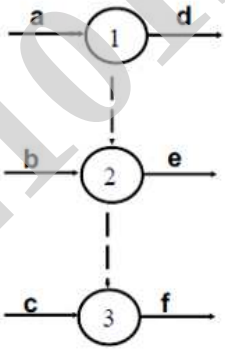


- **Note** how the **Network** correctly identifies **D**, **E**, and **F** as the **Immediate Predecessors** for **G**.
- **Dummy activity** is used to identify **Precedence Relationships** correctly and to **Eliminate Possible Confusion** of **two** or **more** activities having **the same** starting and ending nodes.

➢ **Dummy activities** have **No Resources** (time, labor, machinery, etc.) – Purpose is to **PRESERVE LOGIC** of the Network.

Example of Dummy Activity

a precedes **d.**
a and **b** precede **e.**
b and **c** precede **f.**

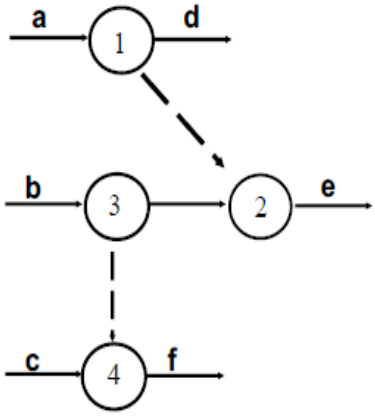


WRONG !!!

(a does not Precede f).

Answer for Example of Dummy Activity

a precedes **d.**
a and **b** precede **e.**
b and **c** precede **f.**



Exercise

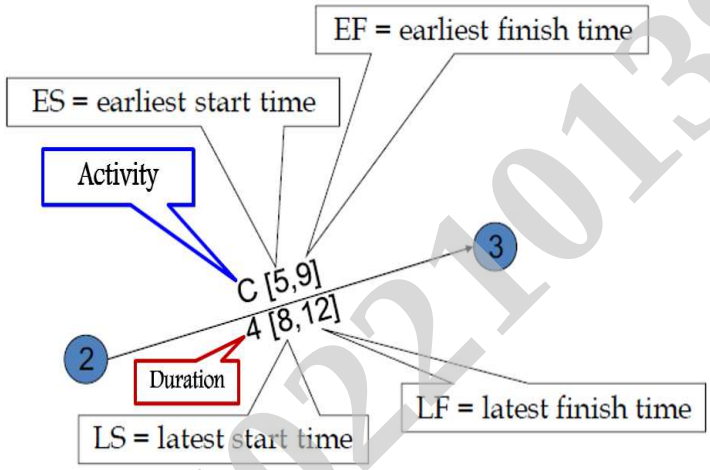
- **Develop the Network for a Project with the table below:**

Activity	Preceding Activity
A	-
B	-
C	A
D	A
E	A
F	C
G	C
H	C
J	B, D
K	F, J
L	E,H,G,K
M	E,H
N	L,M

3.5 Construct the CPM & Identify Activity Float

- **Following the Completion** of the **Project Network Plan** and the **Understanding** of activity times, we **think** about **How Long** the Project will take to be Finished and **When** the tasks will be Planned. This can be **addressed** by **determining** the **Network's Critical Path Method** (**CPM**).
- **For this**, we need an **Arrow Graph** and the **Timeframe** of all the **activities**.
- These Calculations **integrate** a **Forward** (**ES**, **LS**) and a **Backward** (**EF**, **LF**) Crossing in the Network.
- The **Forward** Crossing estimations harvest the **First Start** and the **First Finish** durations for each activity.
- The **Backward** Crossing estimations render the **Latest allowable Start** and the **Latest Finish** durations for every activity.
- With the aid of the **Examples** given, we will illustrate how to calculate the **Earliest Start**, **Earliest Finish**, **Latest Start**, and **Latest Finish** times of different project activities.

Activity, duration, ES, EF, LS, LF



Scheduling with activity time

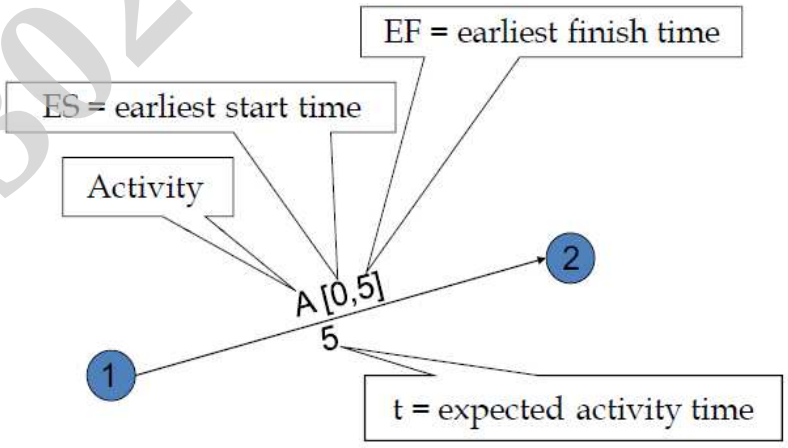
Activity	Immediate predecessors	Completion Time (week)
A	-	5
B	-	6
C	A	4
D	A	3
E	A	1
F	E	4
G	D,F	14
H	B,C	12
I	G,H	2
	Total ...	51

This information indicates that the **total** time required to complete **activities** is **51 weeks**. **However**, we can see from the network that **Several of the activities can be Conducted simultaneously** (**A** and **B**, for **example**).

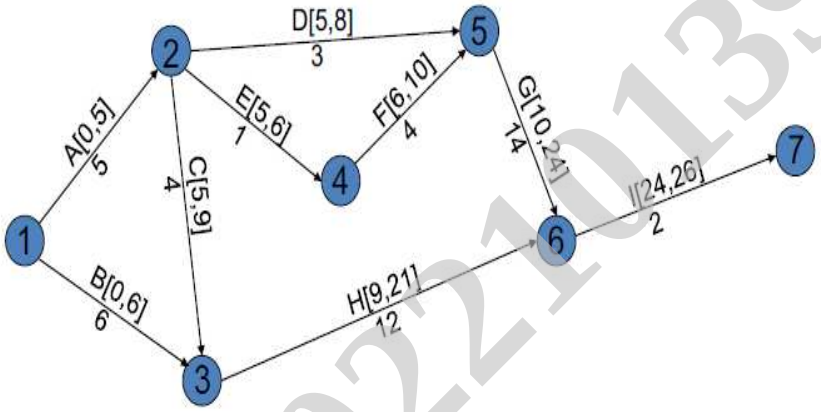
Earliest Start & Earliest Finish Time

- We are interested in the **Longest Path** through the **Network**, i.e., the **Critical Path**.
- **Starting** at the Network's Origin (**Node1**) and using a **starting time** of **0**, we **Compute** an **Earliest Start** (ES) and **Earliest Finish** (EF) time for each activity in the network.
- The **Expression EF= ES + t** can be used to find the **earliest finish time** for a given activity.
- **For Example**, for activity **A**, **ES=0** and **t=5**; **thus**, the **earliest finish time** for activity **A** is **EF = 0 + 5 = 5**

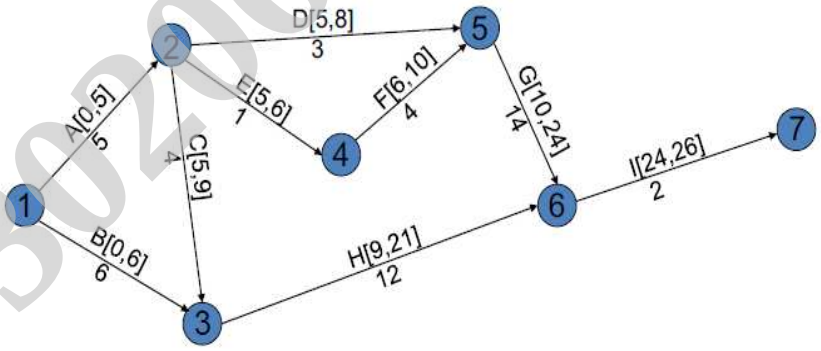
Time Arc with ES & EF time



Network with ES & EF time for all activities



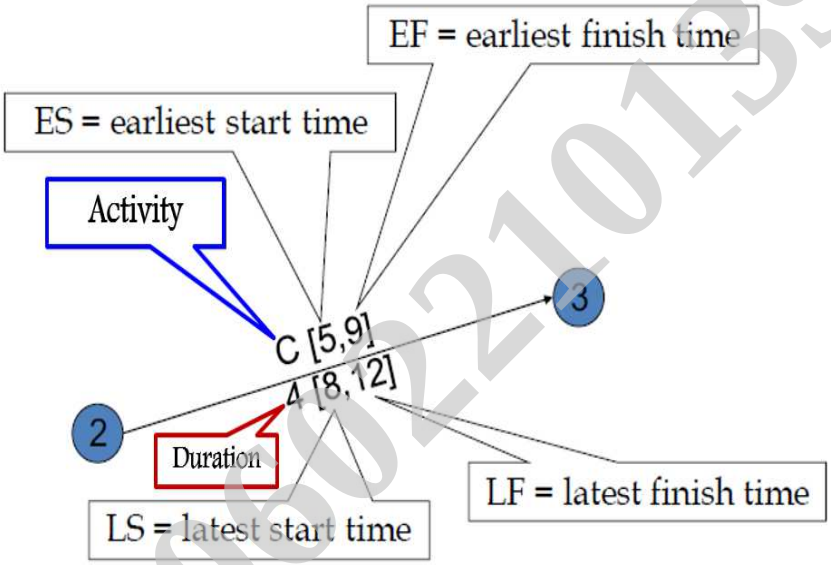
Network with ES & EF time



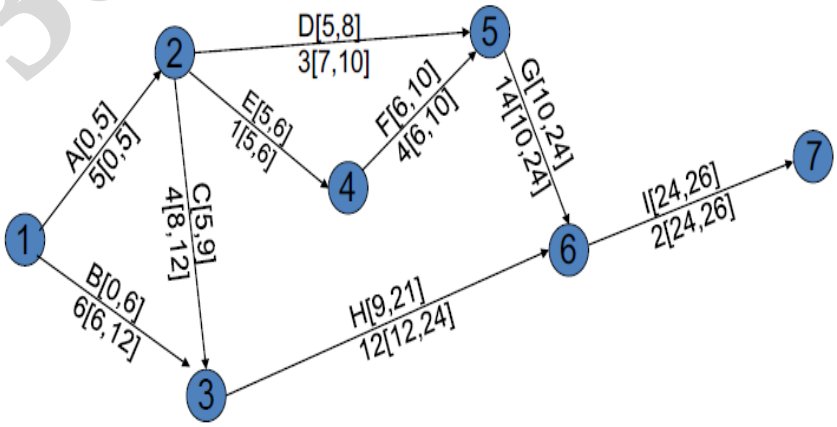
Earliest Start Time Rule:

The **Earliest Start** time for an activity leaving a particular node is equal to the **Largest** of the **Earliest Finish times** for all activities entering the node.

Activity, duration, ES, EF, LS, LF



Network with LS & LF time for all activities



Latest Finish Time Rule:

The **Latest Finish** time for an activity entering a particular node is equal to the **Smallest** of the **Latest Start times** for all activities leaving the node.

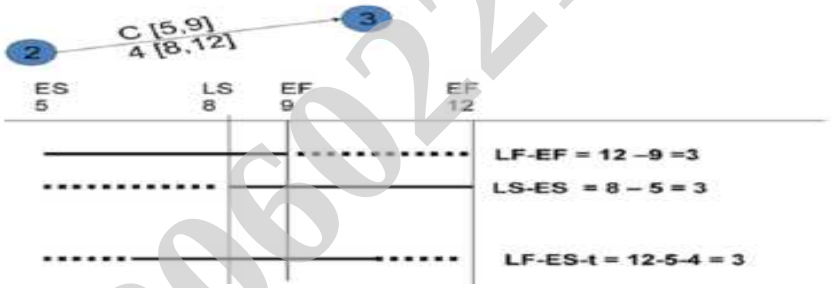
Latest Start & Latest Finish Time

- To find **Critical Path** we need a **Backward Pass** calculation.
- **Starting** at the **Completion Point** (**Node7**) and using a ***latest finish*** time (LF) of **26** for activity I, we trace **back** through the network computing a **Latest Start** (LS) and **Latest Finish** time for each activity.
- The **Expression LS = LF – t** can be used to calculate **latest start time** for each activity.
- **For Example**, for activity **I**, **LF=26** and **t=2**; **thus**, the **latest start time** for activity **I** is **LS = 26 – 2 = 24**

Slack or Free Time or Float

Slack/Float refers to **the amount of time an operation may be Postponed Without Changing the Project's Overall End Date**. **Slack** for **C= 3** weeks.

For Example, Activity C can be postponed for up to **3** weeks (**Starting somewhere between week 5 and 8**).



Activity Schedule for our Example

Activity	Earliest Start (ES)	Latest Start (LS)	Earliest Finish (EF)	Latest Finish (LF)	Slack (LS-ES)	Critical Path
A	0	0	5	5	0	Yes
B	0	6	6	12	6	
C	5	8	9	12	3	
D	5	7	8	10	2	
E	5	5	6	6	0	Yes
F	6	6	10	10	0	Yes
G	10	10	24	24	0	Yes
H	9	12	21	24	3	
I	24	24	26	26	0	Yes

Critical Path identifies the minimum time to Complete Project

Critical Path (CP)

What is the total time to Complete the Project (Critical Path)?

Activity	Immediate predecessors	Completion Time (week)
A	-	5
B	-	6
C	A	4
D	A	3
E	A	1
F	E	4
G	D,F	14
H	B,C	12
I	G,H	2
	Total ...	26

26 Weeks if the individual activities are Completed on Schedule.

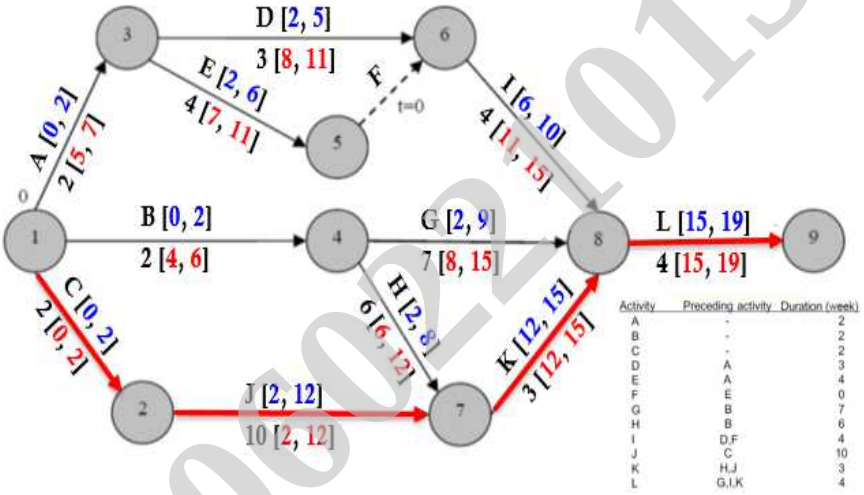
Exercise 1

Calculate the Critical Path

Activity	Preceding activity	Duration (week)
A	-	2
B	-	2
C	-	2
D	A	3
E	A	4
F	E	0
G	B	7
H	B	6
I	D,F	4
J	C	10
K	H,J	3
L	G,I,K	4

Answer for Exercise 1

Developing Network Diagram for all activities



Activity	Preceding activity	Duration (week)
A	-	2
B	-	2
C	-	2
D	A	3
E	A	4
F	E	0
G	B	7
H	B	6
I	D,F	4
J	C	10
K	H,J	3
L	G,I,K	4

Activity Schedule for our Exercise 1

Activity	Earliest Start ES	Latest Start LS	Earliest Finish EF	Latest Finish LF	Slack (LS-ES) or (LF-EF)	Activity on critical path
A	0	5	2	7	5	
B	0	4	2	6	4	
C	0	0	2	2	**0**	YES
D	2	8	5	11	6	
E	2	7	6	11	5	
F	Dummy Activity					
G	2	8	9	15	6	
H	2	6	8	12	4	
I	6	11	10	15	5	
J	2	2	12	12	**0**	YES
K	12	12	15	15	**0**	YES
L	15	15	19	19	**0**	YES

The Critical Path is C, J, K, L with a duration of 19 Weeks.

Exercise 2

Calculate the Critical Path

Activity	Preceding activity	Duration (month)
A	-	2
B	-	6
C	-	4
D	B	3
E	A	6
F	A	8
G	B	3
H	C, D	7
I	C, D	2
J	E	5
K	F, G, H	4
L	F, G, H	3
M	I	13
N	J, K	7

3.6 Project Evaluation & Review Technique (PERT)

Probabilistic aspects in managing projects have not been used throughout our review up to this point. The work hours are expected to be defined in CPM, but they can be changed by adjusting the resource level. Conversely, several operations are only carried out once in all research and development programs. Therefore, there is no previous familiarity of related events.

Since the overwhelming amount of project management software produces CPM networks, through use of PERT has declined significantly in recent years. Both approaches are somewhat common and are frequently merged for academic purposes. PERT was programmed with the duration factor of ventures in particular, and it relied on probabilistic operation duration estimates to help determine the likelihood that a project should be finished by a certain deadline.

CPM, on the other side, focused on deterministic activity duration time assessment and was developed to handle both the duration and expenses components of a project, particularly their trade-offs. Tasks in CPM may be "collapsed" (speeded up) at an added charge to reduce the duration.

NETWORK TECHNIQUES

CPM: Critical Path Method.

PERT: Program Evaluation and Review Technique.

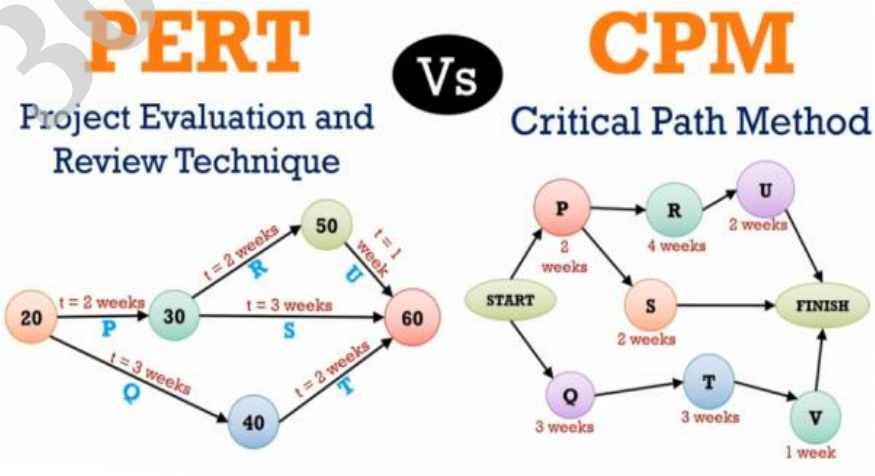
- **Both Use same Calculations**, almost **Similar**.
- **Identify Critical activities** that **Cannot** be delayed **without** delaying the **Project**.
- **Estimate** the amount of **Slack** associated with non-critical activities
- **Gantt Chart** also used in **Scheduling**.
- **Main difference** is (PERT) **Probabilistic** and (CPM) **deterministic** in time estimation.

Comparison Between CPM and PERT

	CPM	PERT
1	Uses Network, Calculate float or slack, identify Critical Path and activities, guides to monitor and Controlling Project	Same as CPM
2	Uses One Value of activity time	Requires 3 estimates of activity time Calculates mean and variance of time
3	Used where times can be estimated with Confidence, Familiar activities	Used where times cannot be estimated with confidence. Unfamiliar or New activities
4	Minimizing Cost is more important	Meeting Time target or estimating Percent Completion is more important
5	Example: construction projects, building one off machines, ships, etc...	Example: Involving new activities or products, research and development, etc ...

Benefits of CPM and PERT techniques

- **Shows** **interdependence** of all tasks, **work packages**, and **work units**.
- **Determines** **expected project completion date**.
- **Identifies** so-called **critical activities**, which can delay the project completion time.
- **Identified** **activities** with **slacks** that can be delayed for **specified periods** **without** **penalty**, or from which **resources** may be **temporarily borrowed**.
- **Shows** which **tasks** must be **coordinated** to **avoid** **resource** or **timing** **conflicts**.
- **Shows** which **tasks** may **run in parallel** to **meet** **project completion date.**



PERT (Project Evaluation and Review Technique)

- **So far**, **times** can be estimated with **relative certainty**, **confidence**.
- For many situations this is **Not Possible**, e.g., Research, development, new products and projects, etc.
- Use **3**-time estimates:

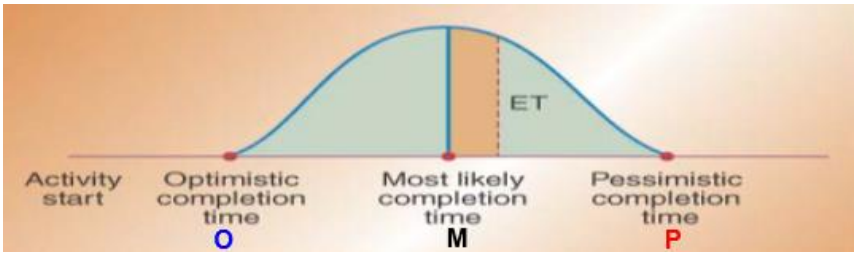
  O = Optimistic time estimate.

  M = most likely **time** estimate, mode.

  P = Pessimistic time estimate.

Using Beta Probability Distribution to Calculate Expected Time Durations

- A typical beta distribution is shown below, note that it has definite end points.
- The expected time for finishing each activity is a weighted average.



Dealing with Uncertainties

$$Exp.time = \frac{Optimistic + 4\,(most\ likely) + Pessimistic}{6}$$

Expected Value (TE) = (O + 4m + P) / 6

Variance (V) = ((P − O) / 6)²

Std. Deviation (δ) = (SQRT (V) = (P − O) / 6

Example for Probabilistic Time Estimates

Activity	Description	Optimistic time	Most likely time	Pessimistic time
A	Develop product specifications	2	4	6
B	Design manufacturing process	3	7	10
C	Source & purchase materials	2	3	5
D	Source & purchase tooling & equipment	4	7	9
E	Receive & install tooling & equipment	12	16	20
F	Receive materials	2	5	8
G	Pilot production run	2	2	2
H	Evaluate product design	2	3	4
I	Evaluate process performance	2	3	5
J	Write documentation report	2	4	6
K	Transition to manufacturing	2	2	2

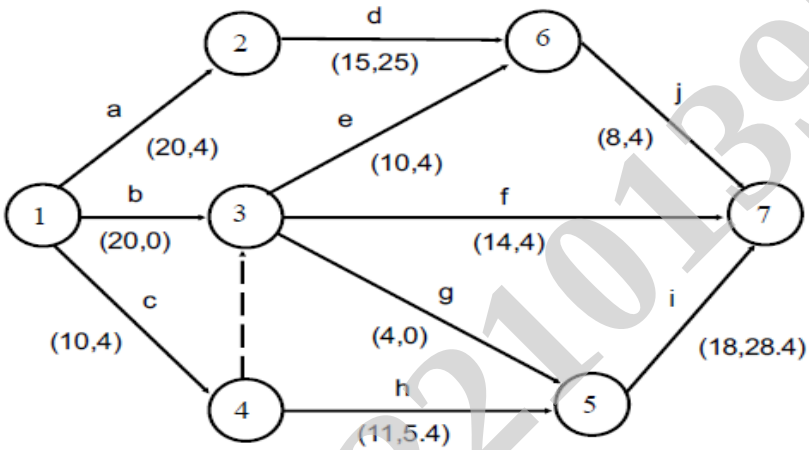
Calculating Expected Task Times

$$\text{Expected Value (TE)} = (O + 4m + P) / 6$$

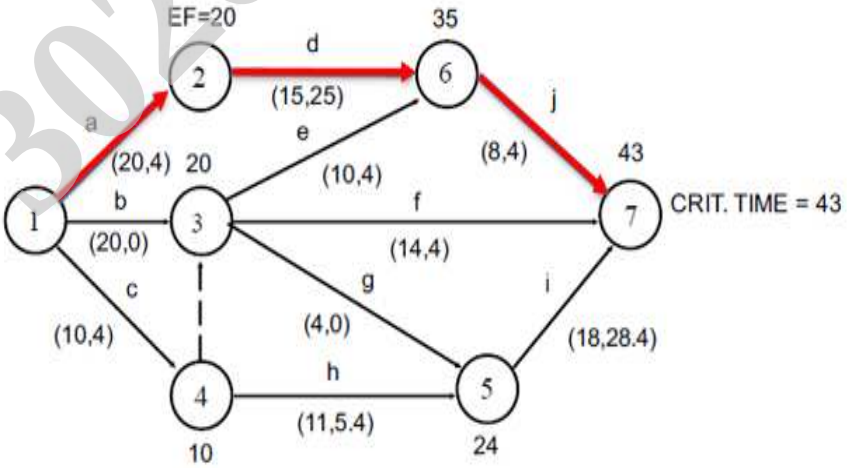
Activity	Optimistic time	Most likely time	Pessimistic time	Expected time
A	2	4	6	4
B	3	7	10	6.83
C	2	3	5	3.17
D	4	7	9	6.83
E	12	16	20	16
F	2	5	8	5
G	2	2	2	2
H	2	3	4	3
I	2	3	5	3.17
J	2	4	6	4
K	2	2	2	2

Example1: Calculating the Probability of Finishing the Project in 50 Days

Activity	Immediate Predecessor	Optimistic Time	Most Likely Time	Pessimistic Time	EXP TE	Var V	S.Dev σ
a	-	10	22	22	20	4	2
b	-	20	20	20	20	0	0
c	-	4	10	16	10	4	2
d	a	2	14	32	15	25	5
e	b,c	8	8	20	10	4	2
f	b,c	8	14	20	14	4	2
g	b,c	4	4	4	4	0	0
h	c	2	12	16	11	5.4	2.32
I	g,h	6	16	38	18	28.4	5.33
j	d,e	2	8	14	8	4	2



The Complete Network

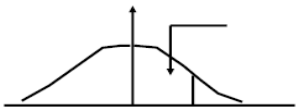


Calculate Critical Path

Assume, PM promised to complete the project in the 50 days
What are the chances of meeting that deadline?
Calculate Z, where

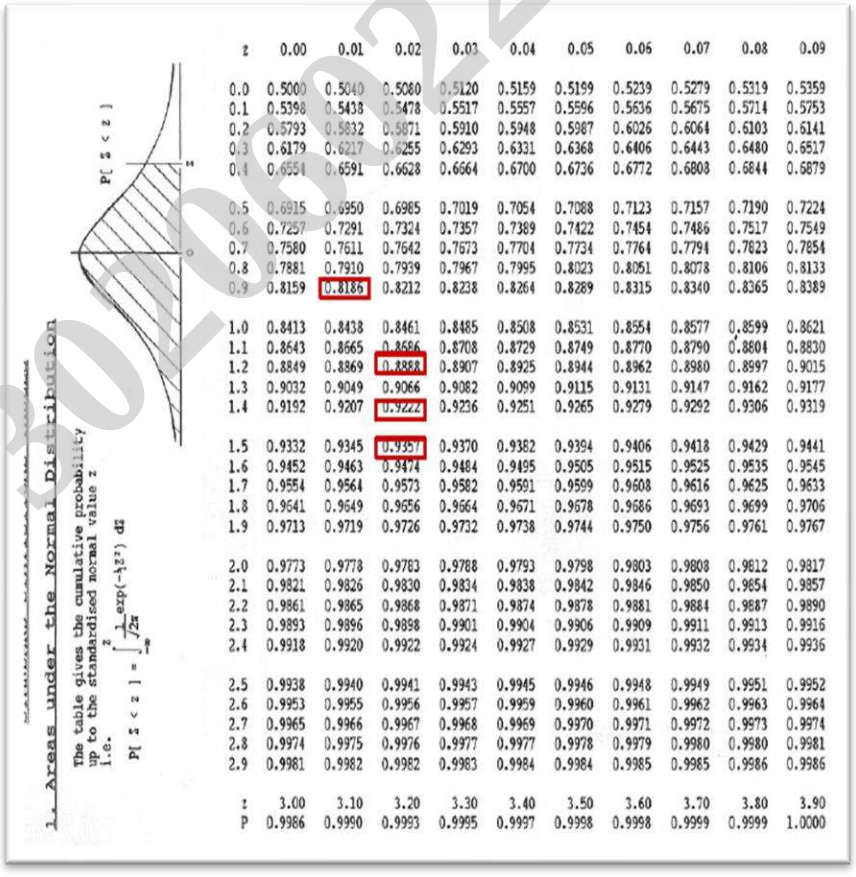
$$Z = (D-S)/\sqrt{V}$$

Example,



D = 50;
S (Scheduled date) = 20+15+8 =43;
V = (4+25+4) =33
Z = (50 – 43) / 5.745
= **1.22** standard deviations.
➔ 0.8888 = 89%

The probability of achieving the scheduled date of day 50 is 89%



1. Areas under the Normal Distribution

The table gives the cumulative probability up to the standardised normal value z i.e.

$$P[z < z_1] = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} \exp(-\tfrac{1}{2}z^2)\, dz$$

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5159	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7854
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8804	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9773	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9865	0.9868	0.9871	0.9874	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9924	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9980	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
z	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90
P	0.9986	0.9990	0.9993	0.9995	0.9997	0.9998	0.9998	0.9999	0.9999	1.0000

Example2: Calculating the Probability of Finishing the Project in 48 Weeks

Calculate the probability of finishing the project in 48 weeks, where the schedule date = 44.66 weeks

Path Number	Activities on Path	Path Variance (weeks)
1	A,B,D,E,G,H,J,k	4.82
2	A,B,D,E,G,I,J,K	4.96
3	A,C,F,G,H,J,K	2.24
4	A,C,F,G,I,J,K	2.38

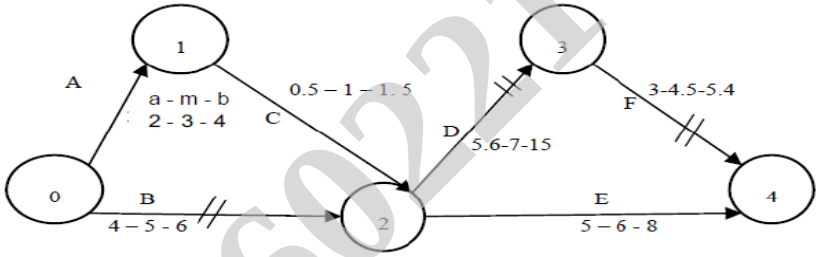
- Use the z values in the previous table to determine probabilities

$$z = \left(\frac{48 \text{ weeks} - 44.66 \text{ weeks}}{\sqrt{4.82}} \right) = 1.52$$

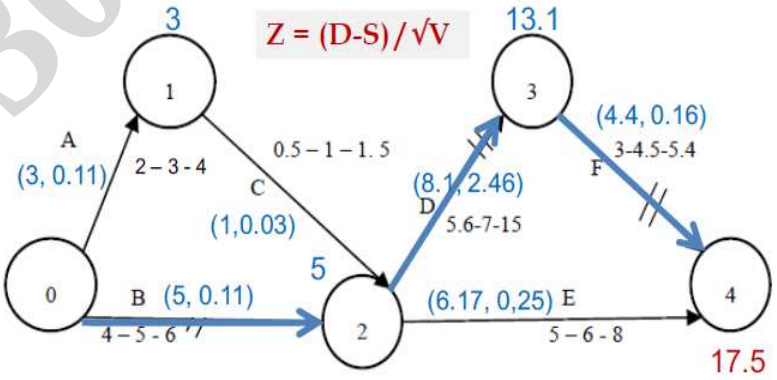
Path Number	Activities on Path	Path Variance (weeks)	z-value	Probability of Completion
1	A,B,D,E,G,H,J,k	4.82	1.52	0.9357
2	A,B,D,E,G,I,J,K	4.96	1.49	0.9319
3	A,C,F,G,H,J,K	2.24	2.23	0.9871
4	A,C,F,G,I,J,K	2.38	2.17	0.9850

Exercise: Calculating the Probability of Finishing the Project in 19 Weeks

Assume that a simple project has the network shown in the following figure. The activity times are in weeks and three estimates have been given for each activity in the order *a, m, b.* The scheduled date for completion is *week 19*.



Based on the CP (B,D,F). If the critical activities were to occur at their Optimistic times, event 4 would be reached in 12.6 Weeks but if the critical activities occurred at their Pessimistic times, event 4 would be reached in 26.4 Weeks.



V= 0.11 + 2.46 + 0.16 = 2.73

Z= (19 - 17.5) / 1.65 = 0.91 ➔ 0.8186 = 82%

The Probability of achieving the Scheduled date of Week **19** is **82%**

3.7 Project Crashing

- **Project Crashing** in **Project Management** is a **method** used to **Speed up a Project's Timeline** by **adding additional resources without changing the Scope of the Project**.
- **Project Crashing** – is the **Process** of **accelerating a project**.
- **Project Crashing** – also known as **Project Time Compression** and **Crashing the Project Schedule**.
- **Reduced Project Completion Time** is "**Crashing**".

Principal Methods for Crashing

- **Improving** Existing **Resources' Productivity**.
- **Changing** Work **Methods**.
- **Compromise Quality** and/or **Reduce Project Scope**.
- **Work Overtime**.
- **Increasing** the **Quantity of Resources**.

Reducing Project Completion Time

Project completion times may need to be Shortened because:

- **Different deadlines.**
- **Penalty clauses.**
- **Need to put resources on a new project.**
- **Promised completion dates.**

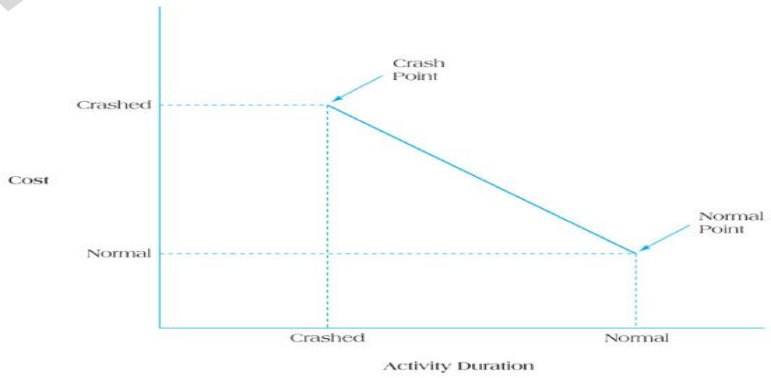
❑ **Crashing a project needs to balance:**

- ➢ **Shorten a project duration.**
- ➢ **Cost to shorten the project duration.**

❑ **Crashing a project requires you to know:**

- ➢ **Crash time of each activity.**
- ➢ **Crash cost of each activity.**

Time–Cost Trade-Offs for Crashing Activities



Example 1

Completion of Projects at Minimum Cost

A project consisting of **8 activities** are described in the following table. The **Cost for Completion** of these **8 activities** is £**5800 excluding the Site Overhead**. **The Overhead Cost** of general site activities is £**160/day**. **We are asked to:**

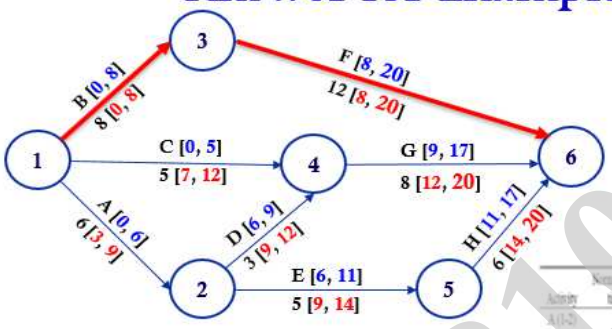
1. **Calculate** the **Normal Completion of the Project**, its **Cost**, and the **Critical Path**.
2. **Calculate** and **Plot on a graph** paper the cost/time function for the project and state:

- The **Minimum Cost** and the **associated Time**.
- The **Shortest Time** and the **associated Cost**.

Completion of Projects at Minimum Cost

Activity	Normal completion time (days)	Shortest completion time (days)	Cost of reduction per day (£)
A (1-2)	6	4	80
B (1-3)	8	4	90
C (1-4)	5	3	30
D (2-4)	3	3	-
E (2-5)	5	3	40
F (3-6)	12	8	200
G (4-6)	8	6	50
H (5-6)	6	6	-

Answer for Example 1



Paths	Time
BF	20
CG	13
ADG	17
AEH	17

Activity	Normal completion time (days)	Shortest completion time (days)	Cost of reduction per day (£)
A (1-2)	6	4	80
B (1-3)	8	4	90
C (1-4)	5	3	30
D (2-4)	3	3	-
E (2-5)	5	3	40
F (3-6)	12	8	200
G (4-6)	8	6	50
H (5-6)	6	6	-

- **The Cost of Project Normal Time =**

5800 + (160*20) = 9000 $

- **The Cost of Project Normal Time =**

5800 + (160*20) = 9000 $

Step 1. Reduce Critical Path by 3 days

(Reduce activity B by 3 days) =

9000 – (160*3) + (90*3) = 8790 $

Step 2. Reduce Critical Path by 1 day

(Reduce activities B & A by 1 day) =

8790 – (160*1) + (90+80) = 8800 $

Step 3. Reduce Critical Path by 1 day

(Reduce activities F & A by 1 day) =

8800 – (160*1) + (200+80) = 8920 $

Step 4. Reduce Critical Path by 2 days

(Reduce activities F & G & E by 2 day) =

8920 – (160*2) + 2 (200+50+40) = 9180 $

Paths	Time				
BF	20	17	16	15	13
CG	13				
ADG	17		16	15	13
AEH	17		16	15	13

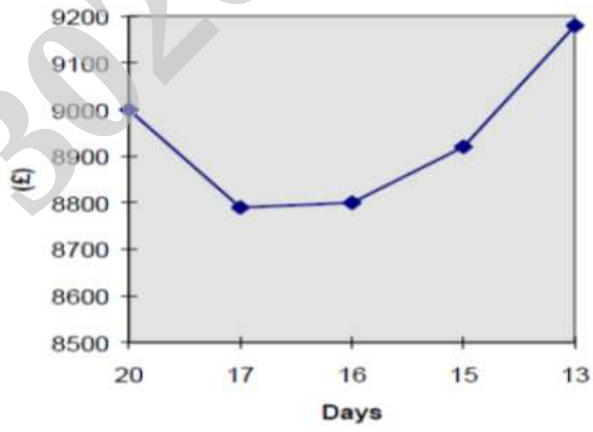
Completion time (days)	Cost (£)
20	9000
17	8790
16	8800
15	8920
13	9180

The Completion Times and Costs of the Project

Completion time (days)	Cost (£)
20	9000
17	8790
16	8800
15	8920
13	9180

- The Minimum Cost for Completing the Project is £8790 in 17-day, and that the Minimum Possible Completion Time is 13-day Costing £9180.

Completion time VS Cost



Completion time (days)	Cost (£)
20	9000
17	8790
16	8800
15	8920
13	9180

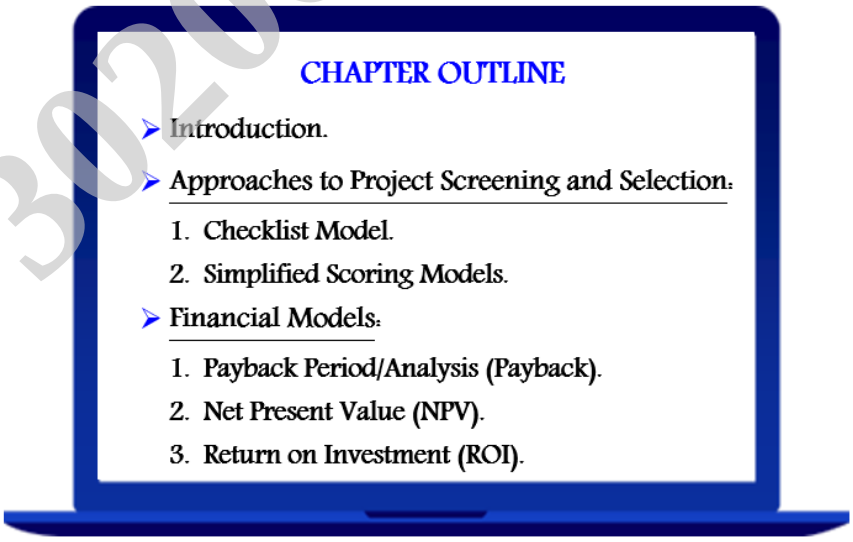
Exercise

Use the information in the table (all times are in days) **to determine the Lowest Extra Cost for 18-day Project.**

Activity	Normal Time	Minimum Time	Crash Cost ($/day)	Predecessor
A	10	6	$50	--
B	6	3	$30	--
C	2	2	--	B
D	4	2	$40	C
E	6	4	$80	A
F	8	5	$100	D, E

CHAPTER 4

PROJECT SELECTION



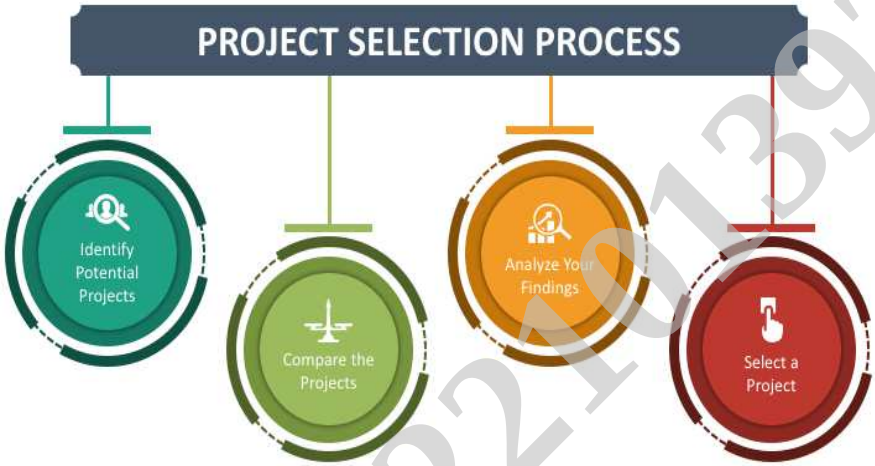
CHAPTER 4

PROJECT SELECTION

4.1 Introduction

Project Selection is a **process** to assess each project idea and select the project with the highest priority. **Projects** are still just suggestions at this stage, so the selection is often made based on only brief descriptions of the project.

Executives in charge of **assessing** and **choosing** new projects may use a **variety of decision models**. They vary from qualitative and basic to quantitative and complex, as we will demonstrate. All companies, on the other hand, aim to build a screening model that will allow them to make the best decisions possible within the restraints of **time** and **resources**. Presume you decided to build a framework that would allow you to successfully monitor project choices. How would you know if the framework was capable of choosing possible "**winners**" from a large number of project options? After plenty of thought, you decided to concentrate on your screening model and build one which will enable you to pick only projects with high potential profits. All other considerations are overshadowed by the primary consideration of financial results.



- **Project Selection** is the **Process** of **Evaluating** and **Choosing Projects** that both align with an organization's **Objectives** and **Maximize its Performance**.
- So, the **most Organizations aim** to build a **Screening Models** (or **collection of models**) that will allow them to make the best decisions choices among alternatives within the usual **Constraints** of **time** and **money** (cost).
- **Screening Models** help managers to **Pick** "**Winners**" from the large set of **Projects**.
- **Screening Models** are **Non-numeric** (**Checklist Model**) or **Numeric** (**Simplified Scoring Models**).

- **Leaders** should understand the following **Six** significant aspects when assessing **Screening Models**:

1. Realism:

A suitable methodology must represent organisational priorities and missions, as well as guidelines and procedures. In view of resource limitations such as human and financial resources, requirements must also be rational. Finally, the model must consider both commercial and technological risks, as well as efficiency, expense, and timeliness.

2. Capability:

A model should be adaptable enough to adjust as the environments in which tasks are carried out shift. For instance, the model should enable the business to evaluate multiple project types (lengthy against Short lived projects, projects involving a variety of sophisticated nature or requirements, projects with different financial and marketing goals).

3. Flexibility:

If test implementations need adjustments, the model should be simple to modify. It must, for instance, account for modifications in currency exchange, taxation policies, and building regulations, among other items.

4. Ease of use:

Individuals in all aspects of the organisation, both those in unique project roles and those in relatively similar areas, should be able to use the model. Furthermore, organisational participants should be able to understand the screening model used, the project selection decisions made, and the explanations for those decisions.

5. Cost effectiveness:

The screening process should be economical. A selection criterion that is costly to be used in terms of both duration and resources is apt to be the worst possible outcome: organisational participants will stop using it due to the expense of doing so. The expense of gathering selection data and producing desired output should be minimal enough to promote rather than limit the usage of the models.

6. Comparability:

The model must be versatile sufficiently to be used on a range of tasks. If a model is too strictly oriented, it can be unsuccessful in evaluating possible projects or promote prejudices against some ones over others. A good model should allow for broad comparison of project options.

4.2 Approaches to Project Screening

A **project screening model** that produces valuable information for project decisions in an accurate and relevant manner at a reasonable cost can be a valuable tool in assisting an organisation in making the right decisions across various options. Let us look for one of the more traditional project selection methods with these factors in mind.

4.2.1 Checklist Model

- **Checklist** is a **list of criteria** applied to possible projects.
  - ✓ **Requires agreement** on **Criteria**.
  - ✓ **Assumes** all criteria are **Equally Important**.
- **Checklists** are **valuable** for **recording Opinions** and **Encouraging discussion**.

Example: Presume S-A-P Enterprise, a pioneer in the numerical computation technology sector, is involved in creating a new online store and shipment distribution technology system. It's attempting to determine which of four possible projects to undertake. The company believes that the most critical selection criteria for its choice are *cost, profit potential, time- to-market,* and *development risks*, based on previous business encounters.

A basic checklist model with only four project options and four decision criteria is shown in Table as follows below. We build analytic descriptive terms that show how much the project options correlate to our main eligibility criteria in addition to creating decision criteria. We classify each parameter (high, medium, or low) to see which project has the most checks and therefore can be considered the best option.

Checklist Model Example.

		Performance on Criteria		
Project	**Criteria**	**High**	**Medium**	**Low**
Project Alpha	Cost	X		
	Profit potential			X
	Time to market		X	
	Development risks			X
Project Beta	Cost		X	
	Profit potential		X	
	Time to market	X		
	Development risks		X	
Project Gamma	Cost	X		
	Profit potential	X		
	Time to market			X
	Development risks	X		
Project Delta	Cost			X
	Profit potential			X
	Time to market	X		
	Development risks		X	

Solution: Project Gamma, based on this research, is the best option for optimising our main parameters of cost, profit opportunities, time - to - market, and development risks. A checklist method to project assessment is a relatively easy tool for documenting perspectives and promoting dialogue.

As a result, checklists are best used in a discussion team environment as a way for starting a discussion, arousing dialogue, and sharing of ideas, and promoting the group's goals. The arbitrary nature of the high, medium, and low ratings is, nevertheless, one of the shortcomings in a model like that shown in Table. These definitions are vague and can be misunderstood. As a result, a new complex screening model will be implemented, in which we assign each parameter a simple *weight* to differentiate between more relevant and less relevant parameters.

4.2.2 Simplified Scoring Models

Each parameter is classified as per its perceived significance in the streamlined scoring model. As a result, our project selection will represent our ability to optimize the influence of specific parameters on our assessment.

- Each **Project** receives a score that is the Weighted sum of its grade on a list of Criteria. **Scoring models require**:
  - ✓ **Agreement** on **Criteria.**
  - ✓ **Requires agreement** on **Weights** for **Criteria**.
  - ✓ A **Score** assigned for each **Criteria**.

$$Score = \sum (Weight \times Score)$$

- Assign importance weights to each criterion.
- Assign score values to each criterion in terms of its rating (**High**= 3, **Medium**= 2, **Low**= 1).
- Multiply importance weights by scores to arrive at a weighted score for each criterion.
- Add the weighted scores to arrive at an overall project score.

Criterion	Importance Weight
Time to market	3
Profit potential	2
Development risks	2
Cost	1

Example: using the criterion weighting values we formed previously, sap corporate is trying to decide the best project to finance. while introducing a scoring aspect to our simple check list exacerbates our decision, it also provides us with a more detailed screening model—one that indeed better approximate our preference to prioritize certain parameters over others, as shown in table as follows.

Simplified Scoring Models Example:

Project	Criteria	(A) Importance Weight	(B) Score	(A) × (B) Weighted Score
Project Alpha				
	Cost	1	3	3
	Profit potential	2	1	2
	Development risk	2	1	2
	Time to market	3	2	6
	Total Score			13
Project Beta				
	Cost	1	2	2
	Profit potential	2	2	4
	Development risk	2	2	4
	Time to market	3	3	9
	Total Score			19
Project Gamma				
	Cost	1	3	3
	Profit potential	2	3	6
	Development risk	2	3	6
	Time to market	3	1	3
	Total Score			18
Project Delta				
	Cost	1	1	1
	Profit potential	2	1	2
	Development risk	2	2	4
	Time to market	3	3	9
	Total Score			16

Solution: The statistics in the column labelled Importance Weight in Table as follows indicate the quantitative value we've allocated to each set of criteria: *Time-to -market* often has a value of *3, profit potential* a value of *2,development risk* a value of *2,* and *cost* a value of *1.* Then, for every one of our four components, we allocate actual value.

The Xs in Table is replaced with their given score values by the figures in the Score column:

High = 3 & Medium = 2 & Low = 1

In Project Alpha, for instance, the *High* rating assigned to *Cost* turns *3* in Table, as *High* is here valued at *3*. Similarly, the *Medium* rating assigned to *Time-to-market* in Table, turns *2*. **However**, note what takes place when we tally the figures in the column labelled *Weighted Score*. When we multiply the numerical value of *Cost* (*1*) by its rating of *High* (*3*), we get a *Weighted Score* of *3*. Nevertheless, when we multiply the numerical value of *Time-to-market* (*3*) by its rating of *Medium* (*2*), we get a *Weighted Score* of *6*. Once we add the figures in the *Weighted Score* column for every project in Table and check the totals, Project Beta (with a total of *19*) is the best option, when contrasted to the others: Project Alpha (with a total of *13*), Project Gamma (with a total of *18*), and Project Delta (with a total of *16*).

Therefore, the basic scoring model requires the following:

1. Allocate each criterion with an importance weight ranking.
2. In terms of ranking, attribute score values to each criterion. (High = 3, Medium = 2, Low = 1).
3. To get a weighted score for each criterion, multiply importance weights by the scores.
4. To get an entire project score, add the weighted scores together.

4.3 Financial Models

- One other important set of models makes project selection decisions based on economic assessment.
- **Based on** the **Time Value of Money** (TVM) Principal:
  1. **Payback Period/Analysis (Payback).**
  2. **Net Present Value (NPV).**
  3. **Return on Investment (ROI).**
- **All of these Models** use **Discounted Cash Flows.**

4.3.1 Payback Period/Analysis (Payback)

- The **Payback Period** is the **amount of time it will take to recoup**, in the form of **Net Cash Inflows**, the **total** dollars **Invested** in a **Project**.
- **Payback** occurs when the **Net Cumulative Discounted Benefits** equals the **Costs**.
- Many **Organizations** want IT projects to have a **fairly Short Payback Period**.
- **Determines how long** it takes for a **Project** to reach a **Break-Even Point = (Break-Even Analysis).**

$$Payback\ Period = \frac{Investment}{Annual\ Cash\ Savings}$$

- **Cash flows should be Discounted.**
- **Lower numbers are Better (*Faster Payback*).**

Example: Using a payback period strategy, our organization needs to decide which of two strategic options is the more appealing investment option. We estimated the two projects' capital expenditures as well as the projected profits they would produce for us. Which project can we put our money into?

- **Payback Period Example 1.**

Initial Outlay and Projected Revenues for Two Project Options

	Project A		Project B	
	Revenues	Outlays	Revenues	Outlays
Year 0		$500,000		$500,000
Year 1	$ 50,000		$ 75,000	
Year 2	150,000		100,000	
Year 3	350,000		150,000	
Year 4	600,000		150,000	
Year 5	500,000		900,000	

Solution: The repayment for the two projects in our case can be estimated as shown in Table below. Dependent on a shorter predicted payback period, these findings indicate that Project A is a better option than Project B. (2.857 years versus 4.28 years).

Payback Period Example 1:

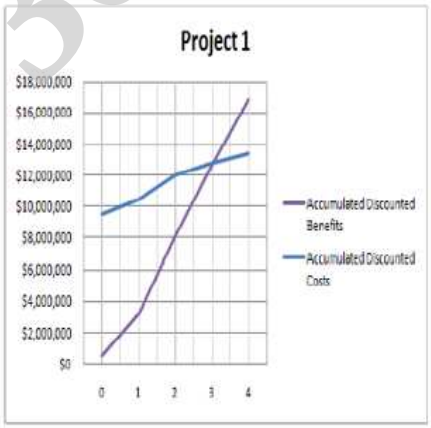
Project A	Year	Cash Flow	Cum. Cash Flow
	0	($500,000)	($ 500,000)
➢ Payback = 2.857 years.	1	50,000	(450,000)
	2	150,000	(300,000)
1. Payback = 3 – (50000 / 350000) = 2.857	3	350,000	50,000
	4	600,000	650,000
2. Payback = 2 + (300000 / 350000) = 2.857	5	500,000	1,150,000

Project B	Year	Cash Flow	Cum. Cash Flow
	0	($500,000)	($ 500,000)
	1	75,000	(425,000)
	2	100,000	(325,000)
	3	150,000	(175,000)
	4	150,000	(25,000)
➢ Payback = 5 - (875,000 / 900,000) = 4.028 years.	5	900,000	875,000

Payback Period Example 2:

Project 1							
Year	13% Discount Factor	Benefits	Discounted Benefits	Accumulated Discounted Benefits	Costs	Discounted Costs	Accumulated Discounted Costs
0	1.00	$500,000	$500,000	$500,000	$9,500,000	$9,500,000	$9,500,000
1	0.88	$3,100,000	$2,743,363	$3,243,363	$1,050,000	$929,204	$10,429,204
2	0.78	$6,200,000	$4,855,509	$8,098,872	$2,050,000	$1,605,451	$12,034,654
→ 3	0.69	$6,700,000	$4,643,436	$12,742,308	$1,050,000	$727,703	$12,762,357
4	0.61	$6,700,000	$4,109,235	$16,851,544	$1,050,000	$643,985	$13,406,342

Project 2							
Year	Discount Factor	Benefits	Discounted Benefits	Accumulated Discounted Benefits	Costs	Discounted Costs	Accumulated Discounted Costs
0	1.00	$0	$0	$0	$3,000,000	$3,000,000	$3,000,000
1	0.88	$1,000,000	$884,956	$884,956	$7,000,000	$6,194,690	$9,194,690
2	0.78	$4,500,000	$3,524,160	$4,409,116	$0	$0	$9,194,690
3	0.69	$7,500,000	$5,197,876	$9,606,992	$4,000,000	$2,772,201	$11,966,891
4	0.61	$10,000,000	$6,133,187	$15,740,179	$500,000	$306,659	$12,273,550



4.3.2 Net Present Value (NPV)

- **Projects** the **change in the firm's stock value** if a **project** is **undertaken**.

$$NPV = I_o + \sum \frac{F_t}{(1 + r + p_t)^t}$$

where

F_t = *net cash flow for period t*

R = *required rate of return*

I = *initial cash investment*

P_t = *inflation rate during period t*

Higher $NPV_{(project)}$ *Values are Better!*

Example 1: Presume you're debating whether or not to finance a $100,000 venture. Your business wants a ten percent rate of return, and you anticipate inflation to stay stable at four percent. The project will have a four-year expected lifespan, and you've forecasted the following potential cash flows: ($20,000 in the first year, $50,000 in the second year, $50,000 in the third year, and $25,000 in the fourth year)

Solution: We can start working on the NPV by filling in the Discount Factor column in Table below, considering r = 10% and p = 4%. Year 0 denotes the current year, while Year 1 denotes the first year of service.

How did we come up with the Year 3 Discount Factor? We estimated the following data using the equation we established above:

$$Discount\ factor = (1/ (1 + .10 + .04)3) = 0.6749$$

We can now refill the Inflows, Outflows, and Net Flow columns with data. Eventually, we multiply the Net Flow sum by the Discount Factor to finish the graph. The details for the NPV column of our table and the amount of the discounted cash flows (their net present value) *NPV* of the project are provided by the outcome. If the sum is positive, it means the project is profitable and should be continued.

Year	Inflows	Outflows	Net Flow	Discount Factor	NPV
0		$100,000	$(100,000)	1.0000	$(100,000)
1	$20,000		20,000	0.8772	17,544
2	50,000		50,000	0.7695	38,475
3	50,000		50,000	0.6749	33,745
4	25,000		25,000	0.5921	14,803
Total					$4,567

Net Present Value Example 2:

Should you **invest** $60,000 in a project that will **return** $15,000 per year for **five** years? You have a **minimum return** of **8%** and **expect inflation** to hold steady at **3%** over the next five years.

D= 1 / (1 + 0.08 + 0.03)^1 = 0.9009
D= 1 / (1 + 0.08 + 0.03)^2 = 0.8116
.....
D= 1 / (1 + 0.08 + 0.03)^5 = 0.5935

Year	Net flow	Discount	NPV
0	-$60,000	1.0000	$160,000.00
1	$15,000	0.9009	$13,513.51
2	$15,000	0.8116	$12,174.34
3	$15,000	0.7312	$10,967.87
4	$15,000	0.6587	$9,880.96
5	$15,000	0.5935	$8,901.77
NPV= 160,000 – [(60,000)+(55438.46)]			= -$4,561.54

The NPV column total is negative, so don't invest !

Net Present Value Example 3:

	A	B	C	D	E	F	G
1	Discount Rate						
2	Project 1	Restoration of a Data Center					
3		Year 0	Year 1	Year 2	Year 3	Year 4	Total
4	Savings from 3rd-Party Payments	$0	$100,000	$200,000	$200,000	$200,000	$700,000
5	Savings from Technology Transfer	$0	$500,000	$1,000,000	$1,500,000	$1,500,000	$4,500,000
6	Benefits from new systems	$500,000	$2,500,000	$5,000,000	$5,000,000	$5,000,000	$18,000,000
7	Total Benefits and Savings	$500,000	$3,100,000	$6,200,000	$6,700,000	$6,700,000	$23,200,000
8							
9	Costs (renovations of building)	$5,000,000	$50,000	$50,000	$50,000	$50,000	$5,200,000
10	Costs (IT)	$4,000,000		$1,000,000			$5,000,000
11	Costs (Connectivity & Maintenance)	$500,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$4,500,000
12	Total Costs	$9,500,000	$1,050,000	$2,050,000	$1,050,000	$1,050,000	$14,700,000
13							
14	Cash Flow	($9,000,000)	$2,050,000	$4,150,000	$5,650,000	$5,650,000	$8,500,000

NPV = total Benefit – total Cost
NPV = 23,200,000 – 14,700,000 = 8,500,000
NPV = Total Cash Flow = 8,500,000

4.3.3 Return on Investment (ROI):

- **Return on investment** (ROI) is **Calculated** by *subtracting* the project **Costs** from the **Benefits** and then *dividing* by the **Costs**.

$$ROI = \left[\frac{\Sigma(benefits) - \Sigma(costs)}{\Sigma(costs)}\right] \times 100\%$$

- **The Higher the ROI, the Better.**
- Many **Organizations** have a required **rate of return** or **minimum acceptable rate of return** on **investment** for **Projects**.
- **Return on Investment Example 1:**

	A	B	C	D	E	F	G
1	Discount Rate						
2	Project 1	Restoration of a Data Center					
3		Year 0	Year 1	Year 2	Year 3	Year 4	Total
4	Savings from 3rd-Party Payments	$0	$100,000	$200,000	$200,000	$200,000	$700,000
5	Savings from Technology Transfer	$0	$500,000	$1,000,000	$1,500,000	$1,500,000	$4,500,000
6	Benefits from new systems	$500,000	$2,500,000	$5,000,000	$5,000,000	$5,000,000	$18,000,000
7	Total Benefits and Savings	$500,000	$3,100,000	$6,200,000	$6,700,000	$6,700,000	$23,200,000
8							
9	Costs (renovations of building)	$5,000,000	$50,000	$50,000	$50,000	$50,000	$5,200,000
10	Costs (IT)	$4,000,000		$1,000,000			$5,000,000
11	Costs (Connectivity & Maintenance)	$500,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$4,500,000
12	Total Costs	$9,500,000	$1,050,000	$2,050,000	$1,050,000	$1,050,000	$14,700,000
13							
14	Cash Flow	($9,000,000)	$2,050,000	$4,150,000	$5,650,000	$5,650,000	$8,500,000

ROI = Total Cash Flow / Total Cost of the Project

ROI = 8,500,000 / 14,700,000 = 58 %

Exercise 1

Assume that the **Monetary Benefits** of an information system of $**50000** per year, **One-time Costs** of $**42500**, **Recurring Costs** of $**28500** per year, a **Discount Rate** of **12%**, and a **Five years' time horizon**, **Calculate**:

1. **Net Present Value** (**NPV**).
2. **Return on Investment** (**ROI**).
3. **Break-Even Analysis** = **Payback** :

$$\text{Break-Even Ratio} = \frac{\text{Yearly NPV Cash Flow} - \text{Overall NPV Cash Flow}}{\text{Yearly NPV Cash Flow}}$$

Answer for Exercise 1

	Year of Projects						TOTALS
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	
Net Economic Benefits	0	50000	50000	50000	50000	50000	
Discount Rate (0.12)	1	0.8929	0.7972	0.7118	0.6355	0.5674	
NPV of Benefits	0	44643	39860	35589	31776	28371	180239
One-time Cost	(42500)						
Recurring Costs	0	(28500)	(28500)	(28500)	(28500)	(28500)	
Discount Rate (0.12)	1	0.8929	0.7972	0.7118	0.6355	0.5674	
NPV of Costs	(42500)	(25446)	(22720)	(20286)	(18112)	(16172)	(145236)
1. Overall of NPV							35003
2. Overall of ROI							0.24 %
3. Break-Even Analysis							
Yealy NPV Cash Flow	(42500)	19196	17140	15303	13664	12200	
Overall NPV Cash Flow	(42500)	(23304)	(6164)	9139	22803	35003	
Actual Break-Even Occurred at 2.4 Years. → Payback = 3 – (9139 / 15303) = 2.4 Years.							

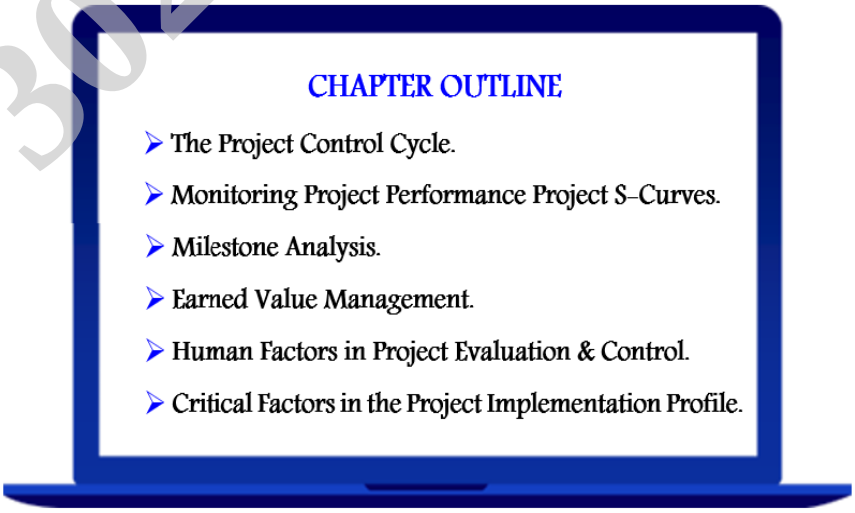
Exercise 2

Assume that the **Monetary Benefits** of an information system of $**85000** per year, **One-time Costs** of $**75000**, **Recurring Costs** of $**40,000** per year, a **Discount Rate** of **12%**, and a **Five years' time horizon**, **Calculate**:

1. **Net Present Value** (**NPV**).
2. **Return on Investment** (**ROI**).
3. **Break-Even Analysis**.

CHAPTER 5

PROJECT EVALUATION AND CONTROLLING



CHAPTER 5 PROJECT EVALUATION AND CONTROLLING

5.1 Introduction

Many large projects frequently experience overshot timelines, cost overruns, and increasing workloads. This could be due to insufficient information during estimations, judgment bias, scope creep and many other factors. The reason this happens is not due to lack of effort or intention. This happens because of lack of project control and management. It is important to note that project control plays a significant role in ensuring that the project stays on schedule, and within budget while ensuring quality of the delivered product.

A **project manager** is responsible for managing as well as controlling a project. That means as a project manager it is important to ensure that the project is being scheduled correctly, and the budget and quality of the project is maintained. A project manager must have relevant knowledge and expertise in managing different domains of a project. This can either be acquired through formal education or on the job.

Formal education can be attained by acquiring certifications or by enrolling in project management programs. A Project Management certificate course can help you better comprehend and prepare for the exam by giving you in-depth knowledge of project management methodologies and procedures as well as hands-on experience.

- **Project controlling** is the **process** of **gathering** data on the progress of the project schedule and the cost **incurred** and **ensuring** that it is on track.
- The **project controlling process** includes **evaluating** the project progress, **forecasting** the future based on current measurements and then **implementing** measures to improve performance.
- Since the project environment is **dynamic** and **unpredictable**, controlling projects is fairly challenging as things don't always go the way planned.

5.2 The Project Control Cycle

A general model of organizational control includes four components that can operate in a continuous cycle and can be represented as a wheel. These elements are:

1. Setting a goal:

Project goal setting goes beyond overall scope development to include setting the project baseline plan. The project baseline is predicated on an accurate Work Breakdown Structure (WBS) process. Remember that WBS establishes all the deliverables and work packages associated with the project, assigns the personnel responsible for them, and creates a visual chart of the project from the highest level down through the deliverable and task levels. The project baseline is created as each task is laid out on a network diagram and resources and time durations are assigned to it.

2. Measuring progress:

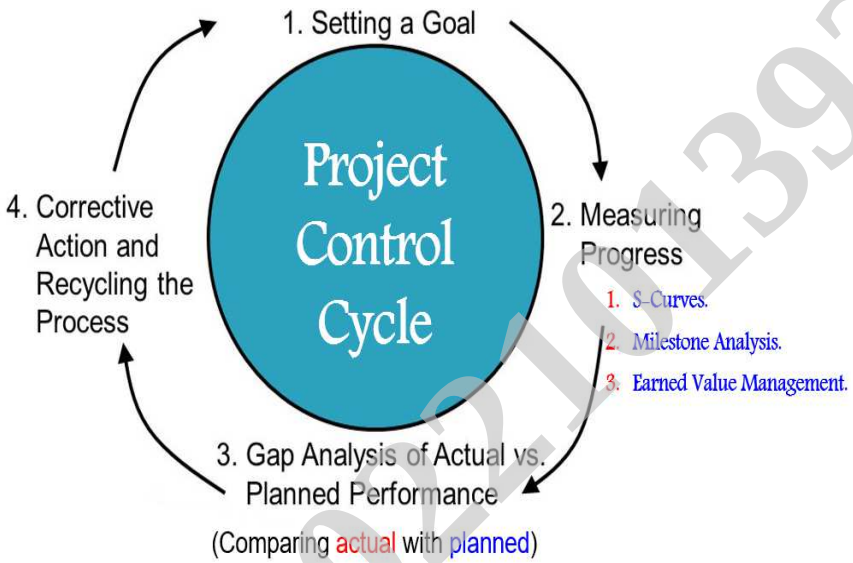
Effective control systems require accurate project measurement mechanisms. Project managers must have a system in place that will allow them to measure the ongoing status of various project activities in real time. We need a measurement system that can provide information as quickly as possible. *What to measure* also needs to be clearly defined. Any number of devices will allow us to measure one aspect of the project or another; however, the larger question is whether or not we are getting the type of information we can really use.

3. Comparing actual with planned performance:

When we have some sense of the original baseline (plan) and a method for accurately measuring progress, the next step is to compare the two pieces of information. A gap analysis can be used as a basis for testing the project's status. *Gap analysis* refers to any measurement process that first determines the goals and then the degree to which the actual performance lives up to those goals. The smaller the gaps between planned and actual performance, the better the outcome. In cases where we see obvious differences between what was planned and what was realized, we have a clear-cut warning signal.

4. Taking action:

Once we detect significant deviations from the project plan, it becomes necessary to engage in some form of corrective action to minimize or remove the deviation. The process of taking corrective action is generally straightforward. Corrective action can either be relatively minor or involve significant remedial steps. At its most extreme, corrective action may even involve scuttling a nonperforming project. After corrective action, the monitoring and control cycle begins again.



This figure above demonstrates, the **control cycle** is continuous. As we create a plan, we begin measurement efforts to chart progress and compare stages against the baseline plan. Any indications of significant deviations from the plan should immediately trigger an appropriate response, leading to a reconfiguration of the plan, reassessment of progress, and so on. Project monitoring is a continuous, full-time cycle of target setting, measuring, correcting, improving, and re-measuring.

Another perspective for more ***effective project control*** is to follow these steps:

- Break the overall program into phases and subsystems (WBS).
- Clearly define objectives, results, and deliverables.
- Define measurable milestones and quantitative checkpoints.
- Obtain commitment from all team members and management.
- Ensure that different teams can work together, and that outputs are compatible.
- Project tracking - ensure proper project control.
- Ensure measurability of progress parameters.
- Hold regular reviews of project goals, plans, progress, etc.
- Ensure interesting work to maintain interest (take personal preferences into account).
- Communication, communication, communication!!
- Leadership - making people feel strong and in control.
- Minimize threats - manage conflict and power struggles, avoid surprises (up or down) and unrealistic demands, foster mutual trust.

- Design an appropriate personnel appraisal and reward system.
- Assure continuous senior management involvement, endorsement, and support.
- Personal drive - project manager must be enthusiastic about the project.
- Note all problems experienced in the project database, for future reference.
- Successful project management requires a proper project plan, commitment from.

5.3 Monitoring Project Performance

As we discovered in chapter 3, once we have established a **project baseline** budget, one of the most important methods for indicating the ongoing status of the project is to evaluate it against the original budget projections. For project monitoring and control, both individual task budgets and the cumulative project budget are relevant. The cumulative budget can be broken down by time over the project's projected duration.

5.3.1 Project S-Curves

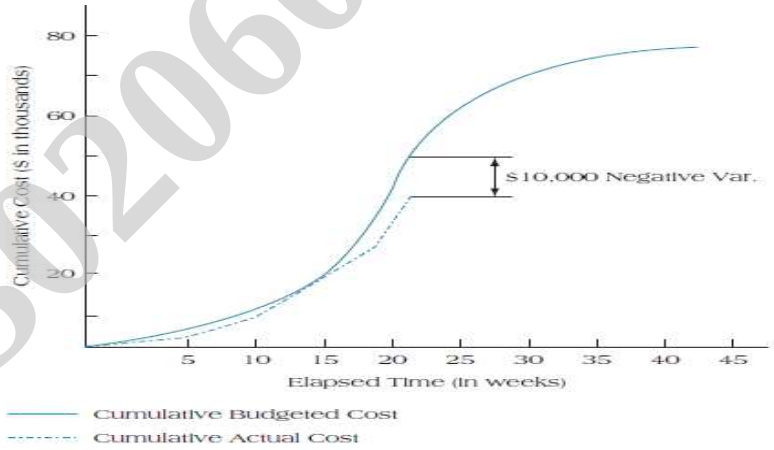
As a basis for evaluating **project control** techniques, let us consider project XX with four work packages (Design, Engineering, Installation, and Testing), a budget to completion of $80,000, and an anticipated duration of 45 weeks. Table as follows gives a breakdown of the project's cumulative budget in terms of both work packages and time.

Budgeted Costs for Project XX (in thousands $)

	Duration (in weeks)									
	5	10	15	20	25	30	35	40	45	Total
Design	6	2								
Engineer		4	8	8	8					
Install				4	20	6				
Test						2	6	4	2	
Total	6	6	8	12	28	8	6	4	2	
Cumul.	6	12	20	32	60	68	74	78	80	80

To determine project performance and status, a straightforward time/cost analysis is often our first choice. Here the project's status is evaluated as a function of the accumulated costs and labor hours or quantities plotted against time for both budgeted and actual amounts.

We can see that time (shown on the *x,* or horizontal, axis) is compared with money expended (shown on the *y,* or vertical, axis). The classic **project S-curve** represents the typical form of such a relationship. Budget expenditures are initially low and ramp up rapidly during the major project execution stage, before starting to level off again as the project gets nearer to its completion. Cumulative budget projections for Project XX shown in Table above, have been plotted against the project's schedule. The S-curve figure represents the project budget baseline against which actual budget expenditures are evaluated.



Monitoring the status of a project using S-curves becomes a simple tracking problem. At the conclusion of each given time period (week, month, or quarter), we simply total the cumulative project budget expenditures to date and compare them with the anticipated spending patterns.

Any significant deviations between actual and planned budget spending reveal a potential problem area. Simplicity is the key benefit of S-curve analysis. Because the projected project baseline is established in advance, the only additional data shown are the actual project budget expenditures. The S-curve also provides real-time tracking information in that budget expenditures can be constantly updated, and the new values plotted on the graph. Project information can be visualized immediately and updated continuously, so S-curves offer an easy-to-read evaluation of the project's status in a timely manner. (The information is not necessarily easily interpreted, however, as we shall see later). Our Project XX example (whose budget is shown in Table above) can also be used to illustrate how S-curve analysis is employed.

Suppose that by week 21 in the project, the original budget projected expenditures of $50,000. However, our actual project expenditures totalled only $40,000. In effect, there is a $10,000 budget shortfall, or negative variance between the cumulative budgeted cost of the project and its cumulative actual cost. Figure shows the tracking of budgeted expenditures with actual project costs, including identifying the negative variance shown at week 21. In this illustration, we see the value of S-curve analysis as a good visual method for linking project costs (both budgeted and actual) over the project's schedule.

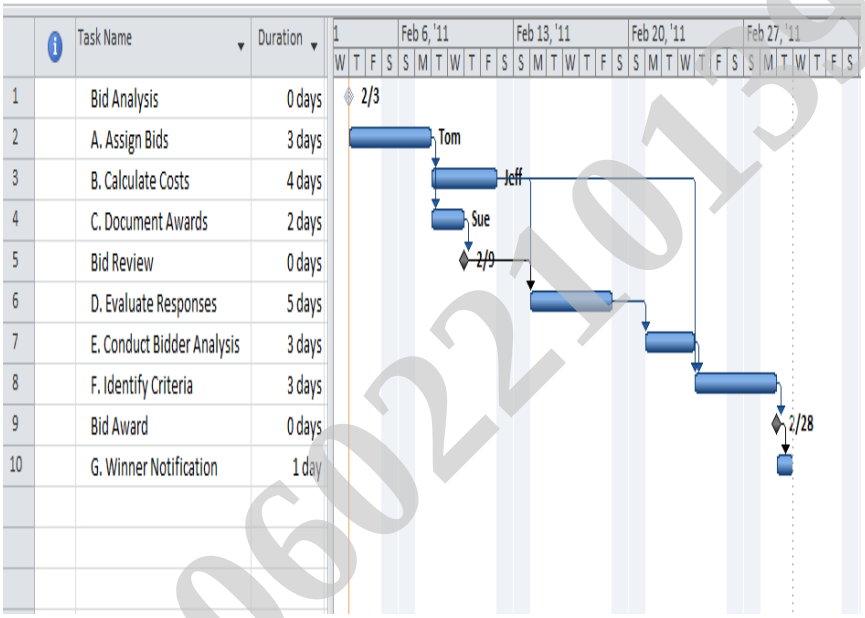
5.3.2 Gantt Chart for Monitoring

Gant chart encompasses two methods for monitoring project progress, a "Milestone Analysis" and "Tracking Gantt Chart".

1. Milestone Analysis

- **Milestones** are **Events** or **Stages** of the project that represent a significant accomplishment.
- **Milestones**:
  - …**Show Completion of important Steps**.
  - …**Signal** the **team** and **suppliers**.
  - …can **Motivate** the **team**.
  - …**Offer Reevaluation Points**.
  - …**Help Coordinate Schedules**.
  - …**Identify Key Review Gates**.
  - …**Delineate Work Packages**.

Gantt Chart with Milestones



This Figure gives an example of a simple Gantt chart with milestones included. The milestones in this case are simply arbitrary points established on the chart; we could just as easily have placed them after completed work packages or by using some other criteria.

Problems with Milestones:

Milestones, in one form or another, are probably the simplest and most widely used of all project control devices. Their benefits lie in their clarity; it is usually easy for all project team members to relate to the idea of milestones as a project performance metric. The problem with them is that they are a reactive control system. You must first engage in project activities and then evaluate them relative to your goal. If you significantly underperform your work to that point, you are faced with having to correct what has already transpired.

Imagine, for example, that a project team misses a milestone by a large margin. Not having received any progress reports until the point that the bad news becomes public, the project manager is probably not in a position to craft an immediate remedy for the shortfall. At this point, the problems are compounded. Due to the delay in receiving the bad news, remedial steps are themselves delayed, pushing the project even farther behind.

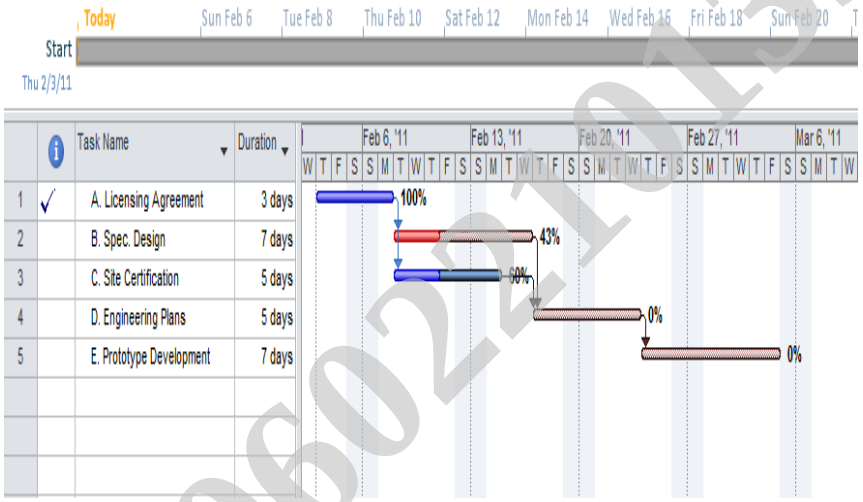
2. The Tracking Gantt Chart

One form of the Gantt chart, referred to as a tracking Gantt chart, is useful for evaluating project performance at specific points in time. The tracking Gantt chart allows the project team to constantly update the project's status by linking task completion to the schedule baseline. Rather than monitor costs and budget expenditures, a tracking Gantt chart identifies the stage of completion each task has attained by a specific date within the project.

For example, Figure below represents Project Blue, involving five activities. As the project progresses, its current status is indicated by the vertical status bar shown for Thursday, February 10. To date, activity A (Licensing Agreement) has been 100% completed, while its two subsequent tasks, Specification Design and Site Certification, are shown as having progressed proportionally by the identified tracking date. That is, activity B (Specification Design) is rated as 43% completed, and activity C (Site Certification) as 60% completed. Activities D and E have not yet begun in this example.

Assessing Project Blue's Status

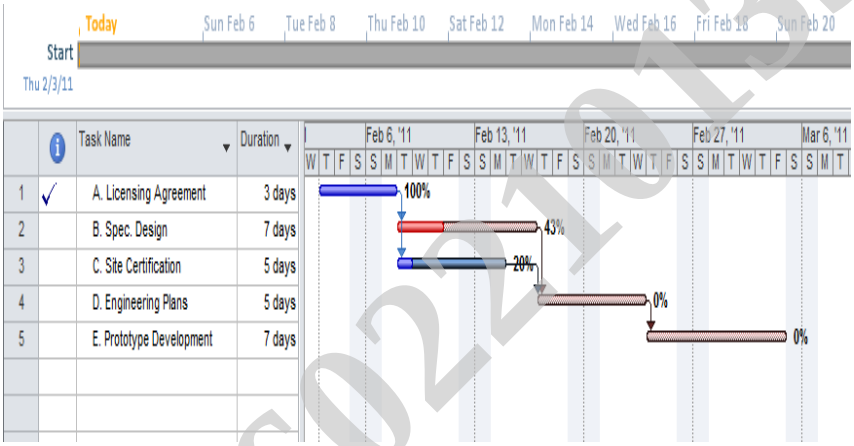
Using Tracking Gantt Chart



It is also possible to measure both positive and negative deviations from the schedule baseline with the tracking Gantt chart. Let us suppose, using our Project Blue example, that activity B remains approximately 43% completed as of the baseline date indicated. On the other hand, activity C has not progressed as rapidly and is only 20% completed as of the February 10 date. The chart can be configured to identify the variations, either positive or negative, in activity completion against the project baseline. These features are demonstrated in Figure above, showing the current date for the project and the delay in progress on activity C.

Tracking Gantt with Project

Activity Deviation



Project status is updated by linking
completion to the schedule baseli

Benefits and Drawbacks of Tracking Gantt Charts:

A key benefit of tracking Gantt charts is that they are quite easy to understand. The visual nature of the feedback report is easy to assimilate and interpret. This type of control chart can be updated very quickly, providing a sense of real-time project control. On the other hand, tracking Gantt charts have some inherent drawbacks that limit their overall utility:

First, although they may show which tasks are ahead of schedule, on schedule, and behind schedule, these charts do not identify the underlying source of problems in the cases of task slippage. Reasons for schedule slippage cannot be inferred from the data presented.

Second, tracking control charts do not allow for future projections of the project's status. It is difficult to accurately estimate the time to completion for a project, particularly in the case of significant positive or negative variation from the baseline schedule. Is a series of early finishes for some activities good news? Does that signal that the project is likely to finish earlier than estimated? Because of these drawbacks, tracking charts should be used along with other techniques that offer more prescriptive power.

5.4 Earned Value Management (EVM)

Thus far, our examples have covered monitoring for parts of projects. The monitoring of performance for the entire project is also crucial. Individual task performance must be monitored carefully because the timing and coordination between individual tasks is important. But overall project performance is the core of the matter and must not be overlooked.

One way of measuring overall performance is by using an aggregate performance measure called **earned value**.

There is a considerable body of literature devoted to earned value. One must, however, exercise some care when reading any article pertain to earned value, as various ratio index numbers have almost as many names (and hence, acronyms) as there are writers. We will adopt and stick to the PMBOK version of things, but will also note the names and acronyms used by Microsoft Project. The origins of EVM date to the 1960s when U.S. government contracting agencies began to question the ability of contractors to accurately track their costs across the life of various projects.

As a result, after 1967, the Department of Defence imposed 35 Cost/Schedule Control Systems Criteria that suggested, in effect, that any future projects procured by the U.S. government in which the risk of cost growth was to be retained by the government must satisfy these 35 criteria. In the more than 4 years since its origin, EVM has been practiced in multiple settings, by agencies from governments as diverse as Australia, Canada, and Sweden, as well as by a host of project-based firms in numerous industries.

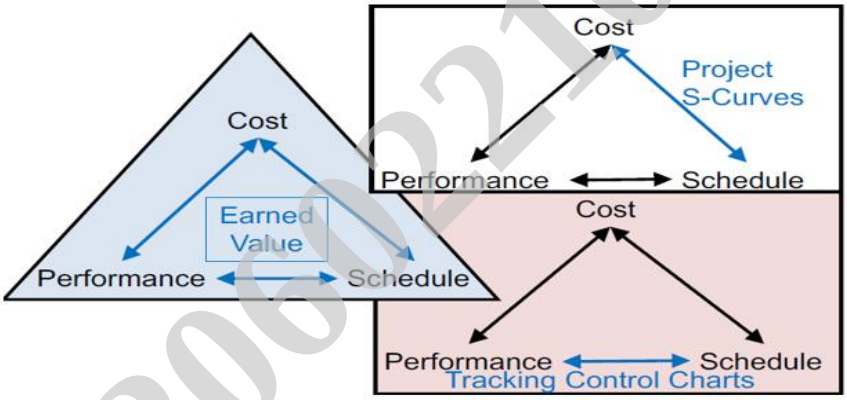
Unlike previous project tracking approaches, EVM recognizes that it is necessary to jointly consider the impact of time, cost, and ***project performance*** on any analysis of current project status. Figure as follows illustrate the advance in the project control process that Earned Value Management represents by comparing it to the other project tracking mechanisms.

Project S-curve analysis directly links budget expenditures with the project schedule. Again, the obvious disadvantage to this approach is that it ignores the project performance linkage.

Project control charts such as tracking Gantt charts link project performance with schedule but may give budget expenditures short shrift as shown in figure below. The essence of a tracking approach to project status is to emphasize project performance over time.

Although the argument could be made that budget is implicitly assumed to be spent in some preconceived fashion, this metric does not directly apply a link between the use of time and performance factors with project cost. **Earned value (EV),** on the other hand, directly links all three primary project success metrics (cost, schedule, and performance).

This methodology is extremely valuable because it allows for regular updating of a *time-phased* budget to determine schedule and cost variances, as identified by the regular measurement of project performance as depicted in figure as follows:



A serious difficulty with comparing actual expenditures against budgeted or *baseline* expenditures for any given time period is that the comparison fails to take into account the amount of work accomplished relative to the cost incurred. The earned value of work performed(*value completed*) for those tasks in progress is found by multiplying the estimated percent physical completion of work for each task by the planned cost for those tasks. The result is the amount that should have been spent on the task thus far. This can then be compared with the actual amount spent.

Making an overall estimate of the percent completion of a project without careful study of each of its tasks and work units is not sensible—though some people make such estimates, nonetheless. Instead, it is apparent that at any date during the life of a project the following general condition exists: Some work units have been finished, and they are 100 percent complete; some work units have not yet been started, and they are 0 percent complete; other units have been started but are not yet finished, and for this latter group we may estimate a percent completion.

Terminology for Earned Value

Following are some of the key concepts that allow us to calculate earned value and use its figures to make future project performance projections.

1. **PV Planned value**: A cost estimate of the budgeted resources scheduled across the project's life cycle (cumulative baseline).
2. **EV Earned value**: This is the real budgeted cost, or "value," of the work that has actually been performed to date.
3. **AC Actual cost of work performed**: The cumulative total costs incurred in accomplishing the various project work packages.
4. **SPI Schedule Performance Index**: The earned value to date divided by the planned value of work scheduled to be performed (EV/PV). This value allows us to calculate the projected schedule of the project to completion.
5. **CPI Cost Performance Index**: The earned value divided by the actual, cumulative cost of the work performed to date (EV/AC). This value allows us to calculate the projected budget to completion.
6. **BAC Budgeted cost at completion**: This represents the total budget for a project.

➢ Creating Project Baselines:

The first step in developing an accurate control process is to create the project baselines against which progress can be measured. Baseline information is critical regardless of the control process we employ, but baselines are elemental when performing EVM. The first piece of information necessary for performing earned value is the planned value, that is, the project baseline.

The PV should comprise all relevant project costs, the most important of which are personnel costs, equipment and materials, and project overhead, sometimes referred to as *level of effort.*

Overhead costs (level of effort) can include a variety of fixed costs that must be included in the project budget, including administrative or technical support, computer work, and other staff expertise (such as legal advice or marketing). The actual steps in establishing the project baseline are fairly straightforward and require two pieces of data: the Work Breakdown Structure and a time-phased project budget.

1. The Work Breakdown Structure identified the individual work packages and tasks necessary to accomplish the project. As such, the WBS allowed us to first identify the individual tasks that would need to be performed. It also gave us some understanding of the hierarchy of tasks needed to set up work packages and identify personnel needs (human resources) in order to match the task requirements to the correct individuals capable of performing them.

2. The time-phased budget takes the WBS one step further: It allows us to identify the correct sequencing of tasks, but more importantly, it enables the project team to determine the points in the project when budget money is likely to be spent in pursuit of those tasks. Say, for example, that our project team determines that one project activity, Data Entry, will require a budget of $20,000 to be completed, and further, that the task is estimated to require two months to completion, with the majority of the work being done in the first month. A time-phased budget for this activity might resemble the following:

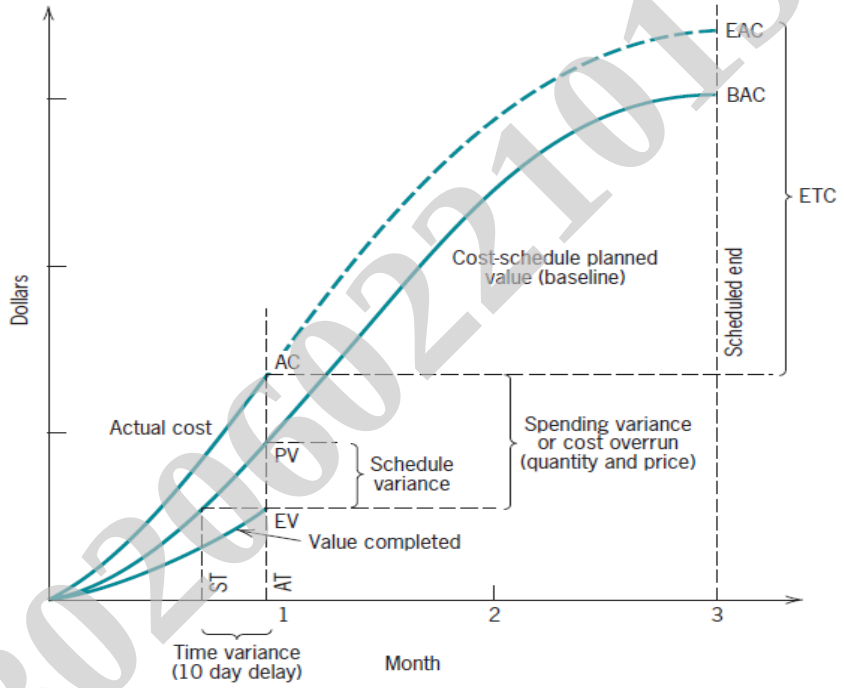
Activity	Jan	Feb	...	Dec	Total
Data Entry	$14,000	$6,000		-0-	$20,000

Once we have collected the WBS and applied a time-phased budget breakdown, we can create the project baseline. The result is an important component of earned value because it represents the standard against which we are going to compare all project performance, cost, and schedule data as

we attempt to assess the viability of an ongoing project. This baseline, then, represents our best understanding of how the project *should* progress. How the project is actually doing, however, is another matter.

A graph illustrating the concept of earned value such as that shown in Figure as follows can be constructed using the above rules and provides a basis for evaluating cost and performance to date. If the total value of the work accomplished is in balance with the planned (baseline) cost (i.e., minimal scheduling variance), as well as its actual cost (minimal cost variance), then top management has no particular need for a detailed analysis of individual tasks. Thus, the concept of earned value combines cost reporting and aggregate performance reporting into one comprehensive chart. The baseline cost to completion is indicated on the chart and referred to as the budget at completion (BAC).

The actual cost to date can also be projected to completion, as will be shown further on, and is referred to as the estimated cost at completion (EAC).



We identify several variances on the earned value chart following two primary guidelines:

- A negative variance is "bad," and
- The cost and schedule variances are calculated as the earned value minus some other measure.

Specifically, the *cost* (or sometimes the *spending*) *variance* (CV) is the difference between the amount of money we budgeted for the work that has been performed to date, that is, the *earned value*, EV, and the actual cost of that work (AC). The *schedule variance* (SV) is the difference between the EV and the cost of the work we scheduled to be performed to date, or the planned value (PV). The *time variance* is the difference in the time scheduled for the work that has been performed (ST) and the actual time used to perform it (AT). In compact form:

EV - AC = cost variance (CV, overrun is negative)

EV- PV = schedule variance (SV, behind is negative)

ST- AT = time variance (TV, delay is negative)

Typically, variances are defined in such a way that they will be negative when the project is behind schedule and/or over cost. As we have noted, however, this practice is not universal either in the literature or in practice.

The variances are also often formulated as ratios rather than differences so that the cost variance becomes the Cost Performance Index (CPI) = EV/AC, the schedule variance becomes the Schedule Performance Index (SPI) = EV/PV, and the time variance becomes the Time Performance Index **(TPI) = ST/AT**.

Use of ratios is particularly helpful when an organization wishes to compare the performance of several projects (or project managers), or the same project over different time periods. As we just noted, however, the accuracy and usefulness of all these performance measures depend on the degree in which estimates of percent completion reflect reality.

Cost and schedule variances (or CPI and SPI) are very commonly used. A short example illustrates their application. Assume that operations on a work package were expected to cost $1,500 to complete the package. They were originally scheduled to have been finished today. At this point, however, we have actually expended $1,350, and we estimate that we have completed two-thirds of the work.

What are the cost and schedule variances?

- **Cost variance = EV - AC**

  = $1,500 (2/3) - 1,350

  = -$350

- **Schedule variance = EV - PV**

  = $1,500 (2/3) - 1,500

  = -$500

- **CPI = EV/AC**

  = $ (1,500 (2/3)) /1,350

  = .74

- **SPI = EV/PV**

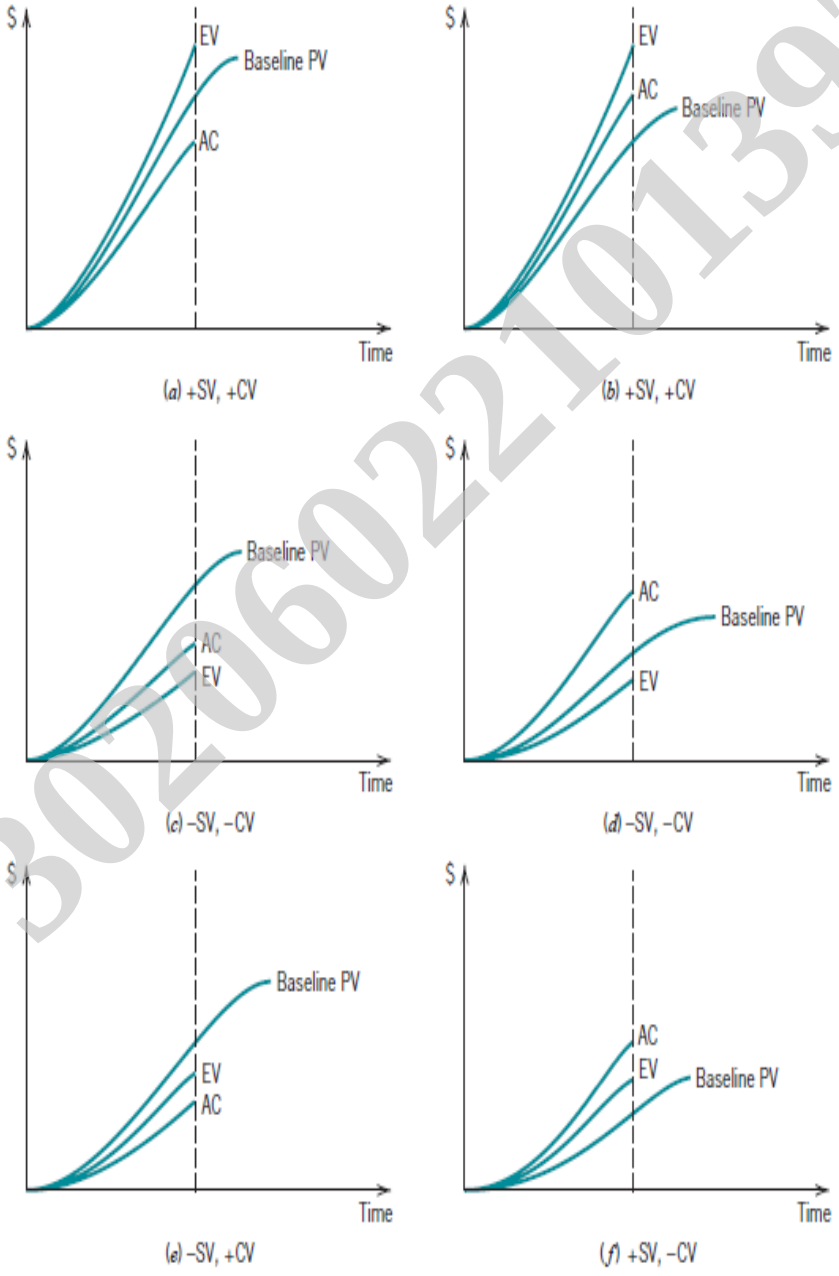
  = $ (1,500 (2/3)) /1,500

  = .67

In other words, we are spending at a higher level than our budget plan indicates, and given what we have spent, we are not as far along as we should be (i.e., we have not completed as much work as we should have). It is, of course, quite possible for one of the indicators to be favorable while the other is unfavorable. We might be ahead of schedule and behind in cost, or vice versa.

There are six possibilities in total, all illustrated in Figure as follows. The scenario shown in this Figure, where both SV and CV are negative, is captured in arrangement *d* of Figure.

The example immediately above, which also results in negative values of SV and CV, is arrangement *c* of Figure below. Barr (1996) combines the two indexes, CPI and SPI, to make a type of "critical ratio" called the Cost–Schedule Index.



There are Six possible arrangements of AC, EV, and baseline PV resulting in four combinations of positive and negative schedule variance (SV) and cost variance (CV).

=$ (1,500 (2/3))2 / (1,350) (1,500)

= $1,000,000/2,025,000

= 0.49

As Barr writes, CSI < 1 is indicative of a problem. One can continue the analysis to forecast the future of this work unit under the condition when no measures are taken to correct matters. The cost to complete the work unit can be estimated as the budgeted cost of the entire unit, less the earned value to date, adjusted by the CPI to reflect the actual level of performance. The budget at completion (BAC) in our example is $1,500. The earned value to date (EV) is $1,500 * 2/3 = $1,000. The estimated cost to complete (ETC) is defined as:

- **ETC = (BAC _EV) / CPI**

= $ (1,500 _1,000) /0.74

= $676

The estimated cost at completion (EAC)—and we use Barr's term (1996) rather than Microsoft's FAC or any of the many other names in the literature—is the amount expended to date (AC) plus the estimated cost to complete (ETC):

- **EAC = ETC + AC**

  = $676 + 1,350

  = $2,026

Rather than the original estimate of $1,500. We also could consider the ETC as a probabilistic number, and, given upper and lower bounds and an estimated distribution for ETC, we can easily apply simulation to find a distribution for EAC.

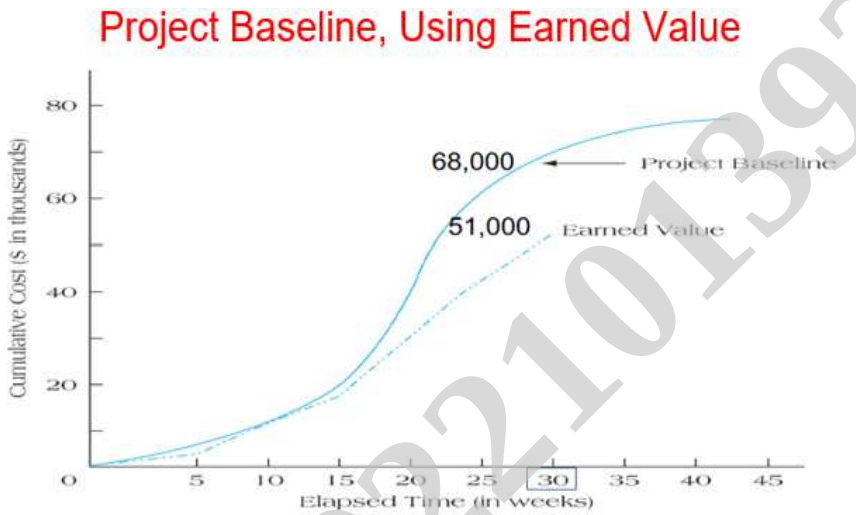
Note: The planned values (PV) for each task would normally be known from the WBS and budget for the project tasks. However, when distributing PV over the scheduled time for a task (e.g., 3 weeks) for comparison to EV for monitoring purposes during the actual project, consideration should be given to how each task's EV is going to be determined. **For example**, if the PV is assumed to be generated in proportion to the time spent on the task, then the use of a 0–100 percent rule for EV will result in the project always appearing behind schedule.

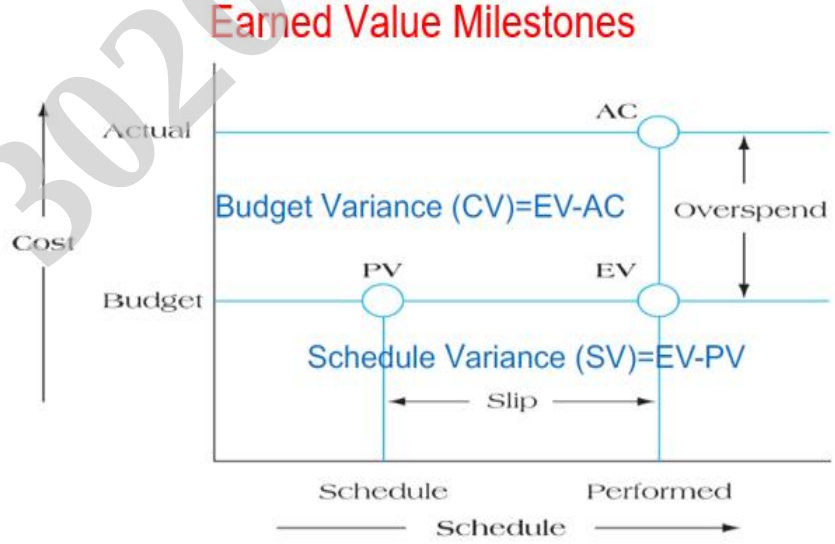
This is fine if the person monitoring the project understands that this difference of measurement methods is the cause of the "behind schedule" appearance. However, an alternative approach would be to distribute the PV for each task in the same manner that the EV is going to be measured for each task, and then the comparison of the EV to the PV will be more realistic.

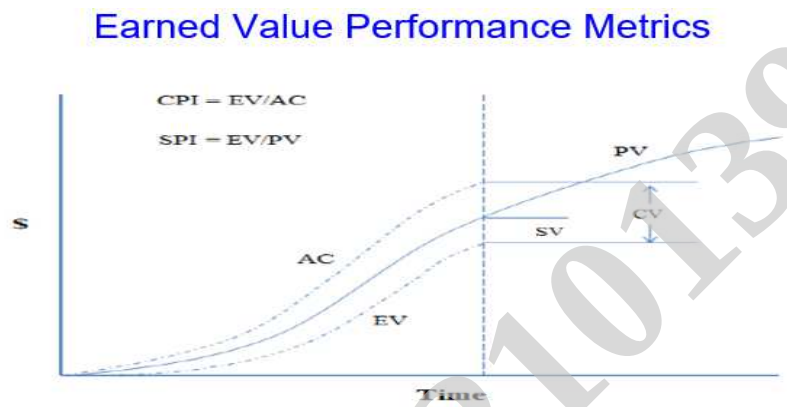
Now, we are ready to summarize the Steps in Earned Value Management. There are five steps in Earned Value Management (EVM):

❑ Steps in Earned Value Management:

1. **Clearly define each activity** including its **resource** needs and **budget**.
2. **Create usage schedules** for **activities** and **resources**.
3. **Develop a time-phased budget** (**PV**).
4. **Total the actual costs** of doing each **task** (**AC**).
5. **Calculate** both the **Budget Variance** (**CV**) and **Schedule Variance** (**SV**).







Exercise 1

Using the following data, calculate the **planned** and **actual** monthly **budgets** through the **end of July**. Assume the Project is **Planned** for a **4-month** duration and a $ **38 Budget**.

Activities	Jan	Feb	Mar	Apr	Plan	% Comp.	Value
Staffing	8	7			15	100	
Blueprint			4	6	10	80	
Prototype			2	8	10	60	
Design				3	3	33	
Monthly Plan	8	7	6	17	38	Σ	
Cumulative							
Monthly Actual							
Cumulative Actual							

Answer for Exercise 1

Earned Value for Exercise 1

Activities	Jan	Feb	Mar	Apr	Plan	% Comp.	Value
Staffing	8	7			15	100	15
Blueprint			4	6	10	80	8
Prototype			2	8	10	60	6
Design				3	3	33	1
Monthly Plan	8	7	6	17	PV 38	Σ	EV 30
Cumulative	8	15	21	38			
Monthly Actual	8	11	8	13			
Cumulative Actual	8	19	27	AC 40			

SPI (EV/PV)= 30/38= 0.79

CPI (EV/AC)= 30/40= 0.75

Earned Value for Exercise 1

Schedule Variances

Planned Value (PV) = 15+10+10+3 = **38**

Earned Value (EV) = 15+8+6+1 = **30**

Schedule Performance Index **SPI** = EV / PV = 30/38 = **0.79**

Estimated Time to Completion = (1 / 0.79) x **4** months = **5 months**.

Cost Variances

Cumulative Actual Cost of Work Performed (AC) = 8+11+8+13 = **40**

Earned Value (EV) = 15+8+6+1 = **30**

Cost Performance Index **CPI** = EV / AC = 30/40 = **0.75**

Estimated Cumulative Cost to Completion = (1 / 0.75) x $ **38** budget = $ **50.7**

Exercise 2

The following table presents the first components of a calculated earned value analysis on Project Mercury. This project has a **planned Seven-months** duration and a $**118,000 budget**. The project **began in January**, and we are interested in calculating its earned value as of the **End of June**.

Activities	Jan	Feb	Mar	Apr	May	June	July	Plan	% Comp.	Value
Staffing	8	7						15	100	
Blueprinting			4	6				10	80	
Prototype			2	8				10	60	
Development								0		
Full Design				3	8	10		21	33	
Construction					2	30		32	25	
Transfer							10	10	0	
Punch List						15	5	20	0	
Monthly Plan	8	7	6	17	10	55	15	118	Σ	
Cumulative										
Monthly Actual	8	11	8	11	10	30	0			
Cumulative Actual										

Answer for Exercise 2

Earned Value for Exercise 2

Activities	Jan	Feb	Mar	Apr	May	June	July	Plan	% Comp.	Value
Staffing	8	7						15	100	15
Blueprinting			4	6				10	80	8
Prototype			2	8				10	60	6
Development								0		0
Full Design				3	8	10		21	33	7
Construction					2	30		32	25	8
Transfer							10	10	0	0
Punch List						15	5	20	0	0
Monthly Plan	8	7	6	17	10	55	15	118	Σ	44
Cumulative	8	15	21	38	48	103	118			
Monthly Actual	8	11	8	11	10	30	0			
Cumulative Actual	8	19	27	38	48	78	78			

Earned Value for Exercise 2

Schedule Variances	
Planned Value (PV)	103
Earned Value (EV)	44
Schedule Performance Index	EV/PV = 44/103 = .43
Estimated Time to Completion	(1/.43 × 7) = 16.3 months

Cost Variances	
Cumulative Actual Cost of Work Performed (AC)	78
Earned Value (EV)	44
Cost Performance Index	EV/AC = 44/78 = .56
Estimated Cumulative Cost to Completion	(1/.56 × $118,000) = $210,714

5.5 Human Factors in Project Control

- Optimistic Progress Reports.
- Level of Detail.
- Process Evaluation.
- Non-technical Performance Measurement.

5.6 Critical Success Factors in The Project Implementation Profile

1. Project Mission.
2. Top Management Support.
3. Project Plans & Schedules.
4. Client Consultation.
5. Personnel.
6. Technical Tasks.
7. Client Acceptance.
8. Monitoring & Feedback.
9. Communication Channels.
10. Troubleshooting.

CHAPTER 6

MICROSOFT PROJECT BASICS

CHAPTER 6

MICROSOFT PROJECT BASICS

6.1 Introduction

A project is usually considered a one-time activity that is done to produce something new, such as a product, service, or Outcome. That is to state, a project should have a definite start and finish date. Projects are created in all types of industries. Sometimes to understand what is considered a project we need a set of examples.

➢ What Is Microsoft Project

Microsoft Project is a project management application. Project management application is a computer software that aids project team in the management of activities and plans, as well as the tracking of progress, resource allocation, and budgeting.

➢ Who uses MS Project?

This product is for project managers and anybody else involved in a project. It is one of the most widely used project management software since it allows managers to do most of their planning tasks.

➢ What can you do in MS Project?

The following features are commonly seen in project management software:

Planning

In terms of project management fundamentals, we should begin by planning our major tasks and activities. Deadlines, due dates, time frames, durations, and priorities must all be planned.

Tracking

Once the main tasks have been planned, it is time to track the tasks. Tracking is a task monitoring and control activity. The project management application software will allow you to use tracking tools to keep track of and control your work, as well as guarantee that the project stays on track.

Measuring

We can't be confident that our project is going as planned if we don't measure it. We may utilize formulae to build and apply key performance indicators (KPIs) and measurements using project management application software.

Reporting

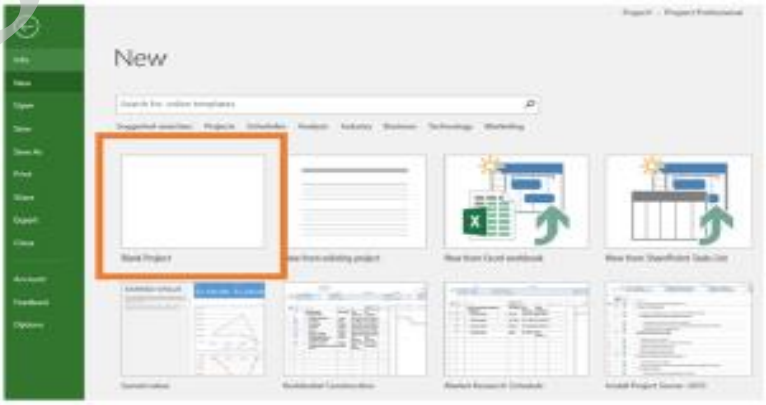
We must create reports at the end of our project that reflect the present condition of the project and the status of its tasks. We will be able to create project reports and assess percent completion for each job and objective using the project management application system.

6.2 Microsoft Project Interface

➢ Interface Tour

Get to know MS Project Environment

1. Start a new project with creating a blank project.
2. Go to File menu, click New > Blank Project



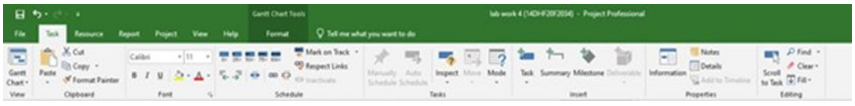
3. Click on each label for the explanation

1. Most commonly used command in the application and it can be customized
2. Your project file name and the version of the software
3. Button for minimize, maximize and close application window
4. Ribbon tabs, groups and icon. Each tab contains several groupings of buttons and drop-down lists which are related to one another.
5. The Timeline View displays the timelines of all your active projects in a visual format.
6. Task view shows list of activities contained in the project
7. Gantt chart can be either time-phased work or Gantt chart

➢ Ribbon tabs

Microsoft Project Ribbon Tabs consists of:

➢ Task tabs



provides buttons for adding, formatting, and working with tasks.

➢ Resource tabs

View

The View group is a drop-down menu where we can choose any custom view. The default view that is available to select is the Resource Sheet view.

Assignment

The Assignments group has an option to assign resources to the task in the project. It also has an option to create a resource pool to be able to share resources between different projects. It also has an option to refresh and update the resource pool.

Insert

The Insert group has a drop-down menu where we get to choose where to add resources from such as the address book or Active Directory. It also has options for adding resources that are work, material, or cost resources.

Properties

The Properties group is where we can easily access resource information. We can also access resource notes, and resource details.

Level

The Level group is where you can access many options to level resources in Microsoft Project.

➢ Report Tab

Compare

The Compare Projects group compares two versions of the same project. A comparison report is created to show any differences between the two project schedules.

View Reports

The View Reports tab is where we can view any new reports, dashboards, resources, cost, in progress, getting started, custom, and recent reports. This is where we can create new reports and view already existing reports.

Export

The Export group is where we can find visual reports that can be exported either to MS Excel or MS Visio.

➢ Project tab

Insert

The Insert group helps insert a related project as a subproject to the current project file. This will make the current project file a master project file with subprojects.

Add-ins

The Add-ins group is where we can find new add-ins using the Get Add-ins options.

Properties

The Properties group is where we can find project information, create or modify custom fields, add links between projects, create a WBS structure, or modify calendars and working times.

Schedule

The Schedule group is where we can quickly re-calculate our project by using the Calculate Project option.

Status

The Status group gives us the ability to quickly change the status date and also update the project file.

Proofing

The Proofing group is where we can check spelling in Microsoft Project.

➢ View Tab

Task Views

The Task Views group is where we can access different task views such as the Gantt Chart, Task Usage, Network Diagram, Calendar, Timeline view, and any other out of the box views

Resource Views

The Resource Views group is where we can access different resource views such as the Resource Sheet, and Resource Usage or any customized views

Data

The Data group is where we can access information in our schedules such as sort, show different outline levels, and access any tables.

Zoom

The Zoom group is where we can zoom our schedule any way we want. We can quickly use the dropdown to filter by day, month, or year.

Split View

The Split View group is where we can split the current view we are on into multiple panes

Window

The Window group is where we can have multiple new windows to work on different parts of the schedule.

Macros

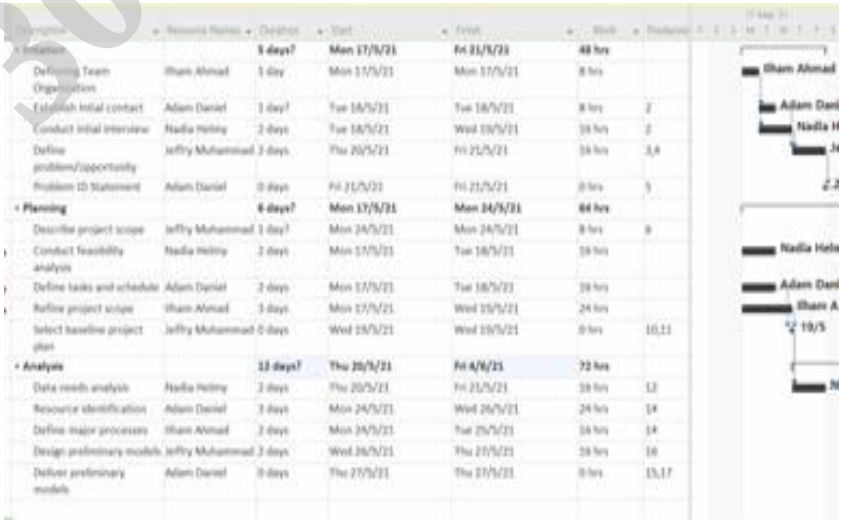
The Macros group is where we can access any macro information.

➢ Format Tab

6.3 Creating your First Schedule

➢ Project Schedule

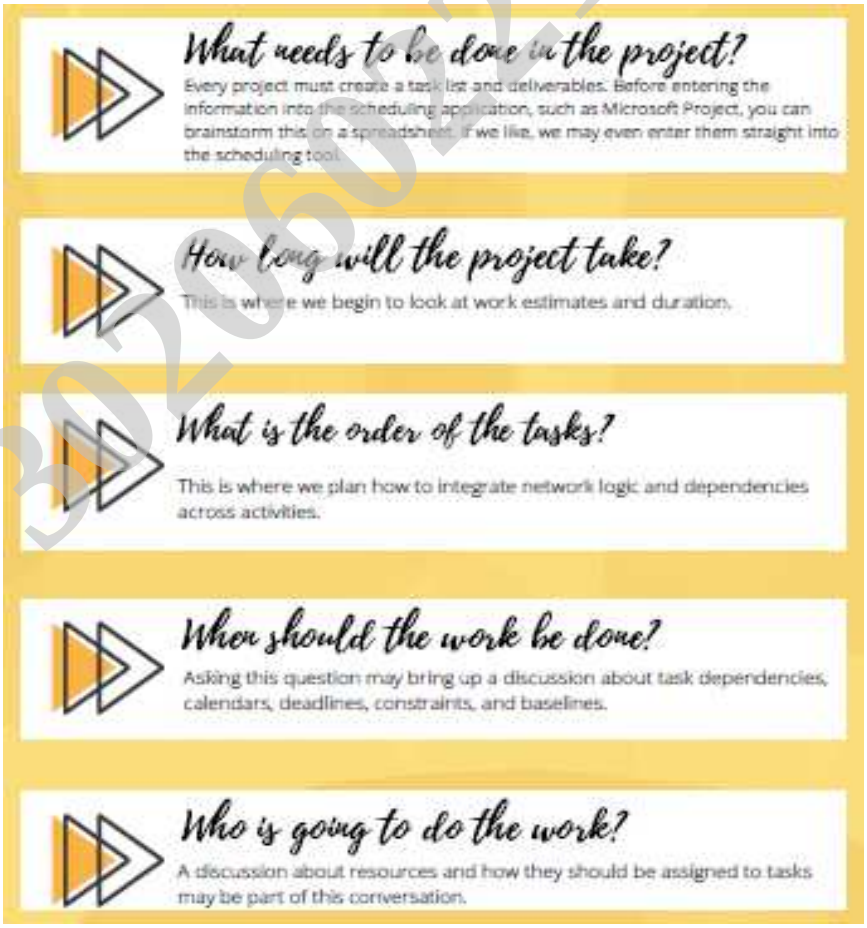
A project schedule outlines the tasks that must be completed, the resources that must be utilized, and the deadline for completion.



It's a timetable that outlines start and end dates and milestones that must be met for the project to be completed on time.

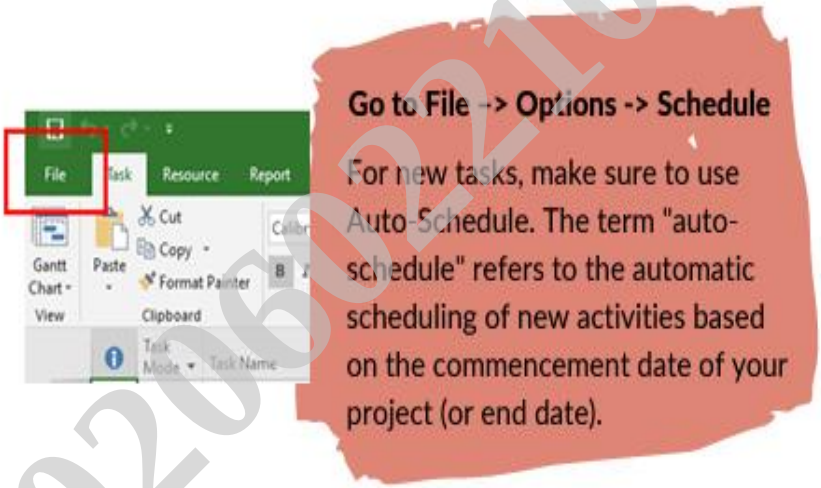
It is often used in conjunction with a work breakdown structure (WBS) to distribute work among team members.

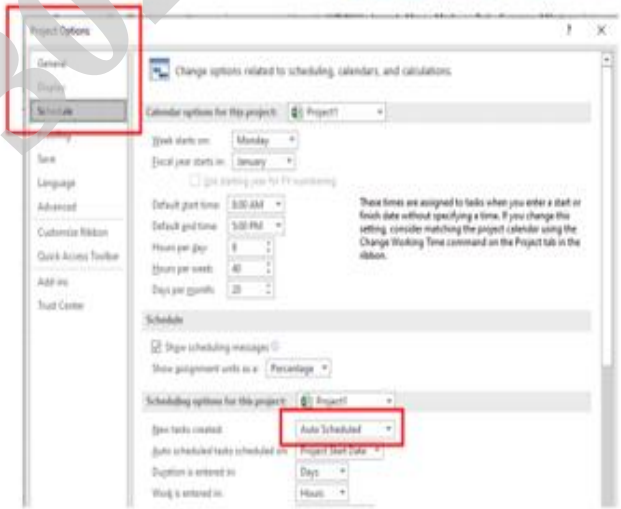
Before beginning a project, there are some questions to ask yourself and your project team on the project schedule as follows.



Let's get started on your first project in just a few steps.

- Let's do some basic configuration before you create your schedule creating our first schedule set auto scheduling as the default option.

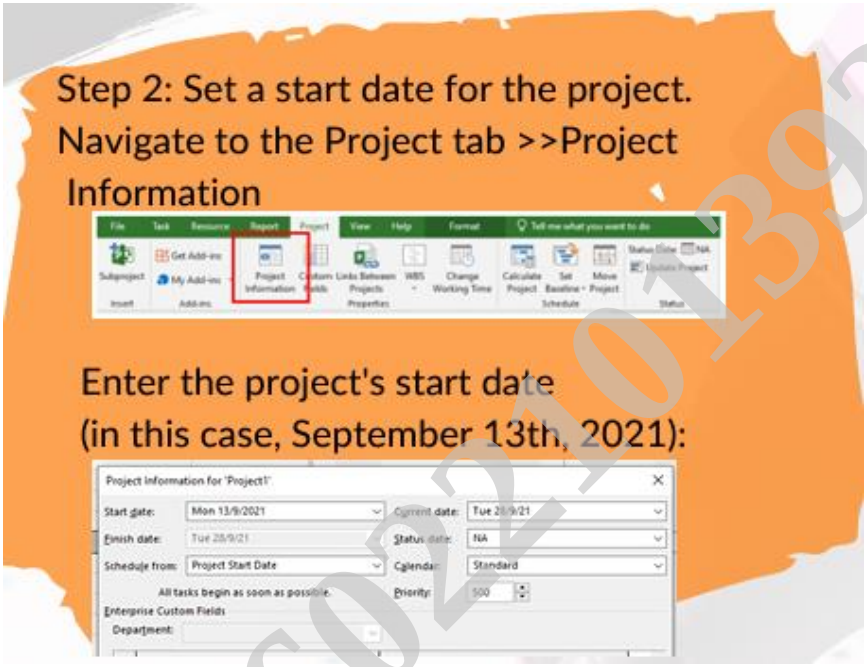




➢ Now, let's schedule a simple project! Creating our first schedule to make a project plan, follow the steps below.

Here's what you should see:

Choose a suitable name for your project.



Step 3: Create a task list

The following tasks must be completed as part of this project:

- Make a business plan.
- Obtain a business license.
- Open up a bank account.
- Funding
- Choose a location for your business
- Set up office
- Recruit a team
- Make a promotion.

- Let's complete Microsoft Project with those tasks. Fill up the Task Name column with the tasks.

	Task Mode	Task Name	Duration	Start	Finish	Predecessors
0		**Min Café Project**	**1 day?**	**Mon 13/9/21**	**Mon 13/9/21**	
1		Make a business plan	1 day?	Mon 13/9/21	Mon 13/9/21	
2		Get a business license	1 day?	Mon 13/9/21	Mon 13/9/21	
3		Create a bank account	1 day?	Mon 13/9/21	Mon 13/9/21	
4		Get funding	1 day?	Mon 13/9/21	Mon 13/9/21	
5		Select business location	1 day?	Mon 13/9/21	Mon 13/9/21	
6		Set up office	1 day?	Mon 13/9/21	Mon 13/9/21	
7		Hire crew	1 day?	Mon 13/9/21	Mon 13/9/21	
8		Run promotion	1 day?	Mon 13/9/21	Mon 13/9/21	

Step 4: Enter task durations

At this point, the Project has no estimate of how long each task will take. As a result, there is a question mark in the duration column, and the start and end dates are not yet valid.

- Now we'll update the Project about the duration of each work. Fill in the estimated time in the duration column.

For example, you can type "3d" to select 3 days or "2w" to designate 2 weeks.

	Task Mode	Task Name	Duration	Start	Finish
0		**Min Café Project**	**21 days?**	**Mon 13/9/21**	**Mon 11/10/21**
1		Make a business plan	5 days	Mon 13/9/21	Fri 17/9/21
2		Get a business license	1 day?	Mon 13/9/21	Mon 13/9/21
3		Create a bank account	1 day?	Mon 13/9/21	Mon 13/9/21
4		Get funding	21 days	Mon 13/9/21	Mon 11/10/21
5		Select business location	5 days	Mon 13/9/21	Fri 17/9/21
6		Set up office	2 days	Mon 13/9/21	Tue 14/9/21
7		Hire crew	10 days	Mon 13/9/21	Fri 24/9/21
8		Run promotion	4 days	Mon 13/9/21	Thu 16/9/21

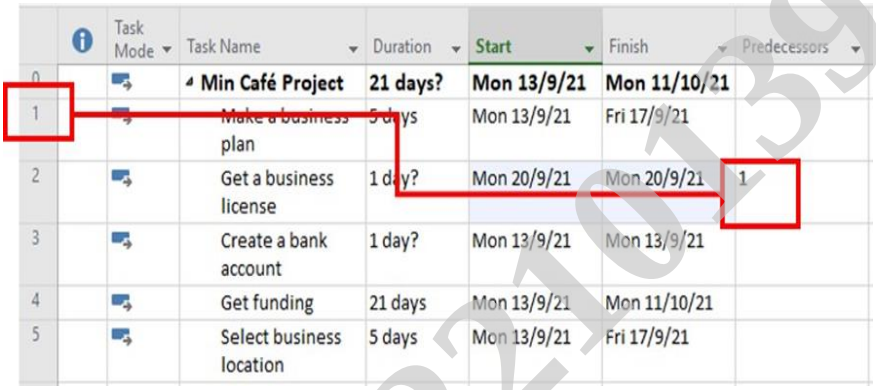
You'll see from the list that the tasks must be completed in a specified order. The tasks are linked in several ways. For example, we can't get funding without a business license.

It's now time to "link" all tasks and enter the estimated durations

Step 5: Link tasks in the right sequence

Each task should be completed in a particular order. To carry out the order, let's link the tasks sequentially. Step 5: Link tasks in the right sequence

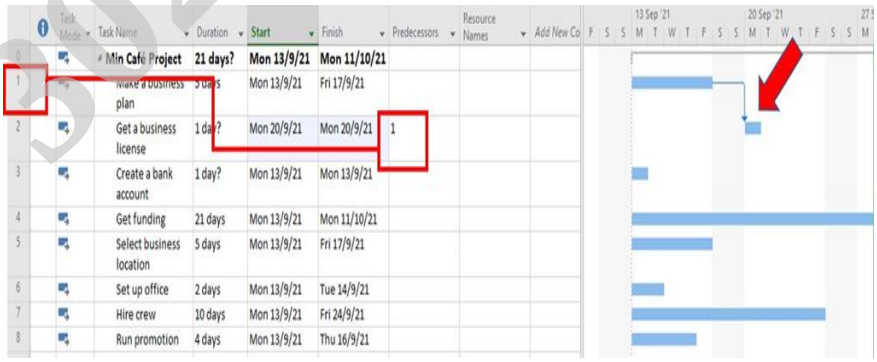
For example, we want a business license to follow after creating a business plan.



	Task Mode	Task Name	Duration	Start	Finish	Predecessors
0		**Min Café Project**	**21 days?**	**Mon 13/9/21**	**Mon 11/10/21**	
1		Make a business plan	5 days	Mon 13/9/21	Fri 17/9/21	
2		Get a business license	1 day?	Mon 20/9/21	Mon 20/9/21	1
3		Create a bank account	1 day?	Mon 13/9/21	Mon 13/9/21	
4		Get funding	21 days	Mon 13/9/21	Mon 11/10/21	
5		Select business location	5 days	Mon 13/9/21	Fri 17/9/21	

Enter Task 1 as a predecessor of task 2 in the Predecessor column.

Task "Get a business license" has been moved to the right of the task "Create business strategy" (refer to blue taskbars).).



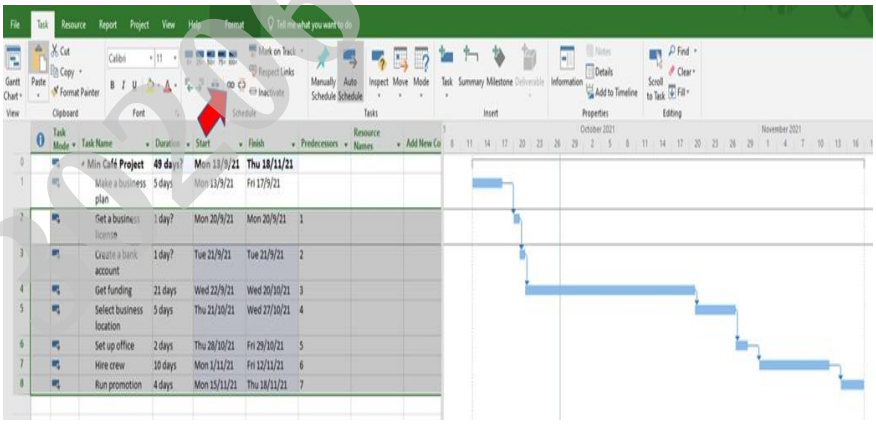
	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
0		**Min Café Project**	**21 days?**	**Mon 13/9/21**	**Mon 11/10/21**		
1		Make a business plan	5 days	Mon 13/9/21	Fri 17/9/21		
2		Get a business license	1 day?	Mon 20/9/21	Mon 20/9/21	1	
3		Create a bank account	1 day?	Mon 13/9/21	Mon 13/9/21		
4		Get funding	21 days	Mon 13/9/21	Mon 11/10/21		
5		Select business location	5 days	Mon 13/9/21	Fri 17/9/21		
6		Set up office	2 days	Mon 13/9/21	Tue 14/9/21		
7		Hire crew	10 days	Mon 13/9/21	Fri 24/9/21		
8		Run promotion	4 days	Mon 13/9/21	Thu 16/9/21		

The next step is to put the remaining tasks in the correct order. To do this, we can use the alternate method of linking dependent activities.

- Select the remaining tasks in rows 2-8

	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
0		**Min Café Project**	**21 days?**	**Mon 13/9/21**	**Mon 11/10/21**		
1		Make a business plan	5 days	Mon 13/9/21	Fri 17/9/21		
2		Get a business license	1 day?	Mon 20/9/21	Mon 20/9/21	1	
3		Create a bank account	1 day?	Mon 13/9/21	Mon 13/9/21		
4		Get funding	21 days	Mon 13/9/21	Mon 11/10/21		
5		Select business location	5 days	Mon 13/9/21	Fri 17/9/21		
6		Set up office	2 days	Mon 13/9/21	Tue 14/9/21		
7		Hire crew	10 days	Mon 13/9/21	Fri 24/9/21		
8		Run promotion	4 days	Mon 13/9/21	Thu 16/9/21		

- Click the link button on the Task tab.



Our tasks are now in the correct order, and the Gantt chart has been updated.

Step 6: Adding Resources

To complete the project's tasks, you'll need resources. They can be people, equipment, facilities, financing, or anything else (excluding labor) required to finish a project assignment. The key to successful project management is optimal resource scheduling.

Work Resource Names You can name your resource according to your convenience.

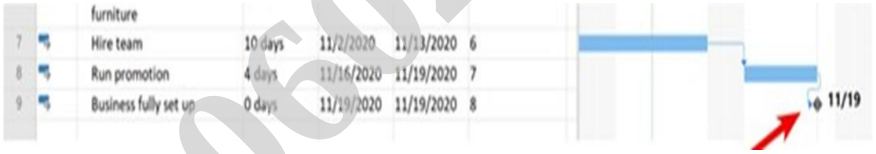
Resource	Example
Identified person.	Christ, Amy
A job or group	Engineer, Trainer, Typist
Equipment	Photostat machine, Printer

Step 7: Add a milestone to your schedule

You have certain milestones to work towards across every project. Milestones are specific points in time whenever a goal must be fulfilled. We haven't yet included any milestones, so let's do that right now.

Create a new milestone called 'Business fully set up' to mark the completion of our business setup.

By setting a task's duration to zero, you can establish a milestone (zero days). Grey diamonds represent milestones:



The milestone we entered also represents the project's estimated completion date.

6.4 Practice a Project Planning

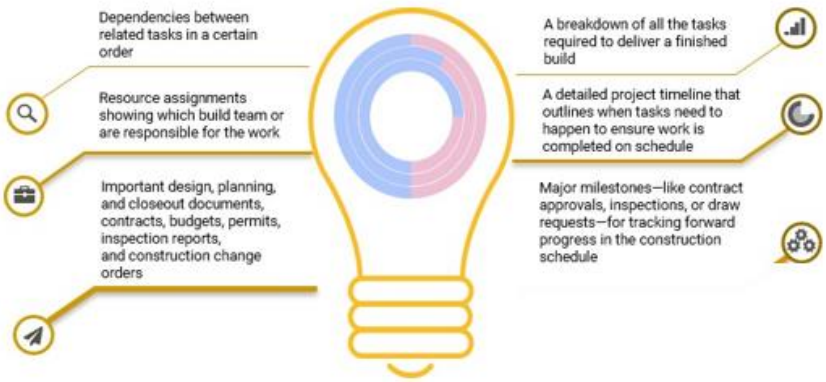
Practicing planning a project based on the scenario given

➢ **Things to consider before building a house**

After assessing the needs that have been considered, he met with the manager construction company to discuss the design plan of the house, the estimated construction cost, and the facilities that will be obtained before the agreement is made by both parties. A contract for new home construction will describe in detail and include a listing of all the parts to be included in the house.

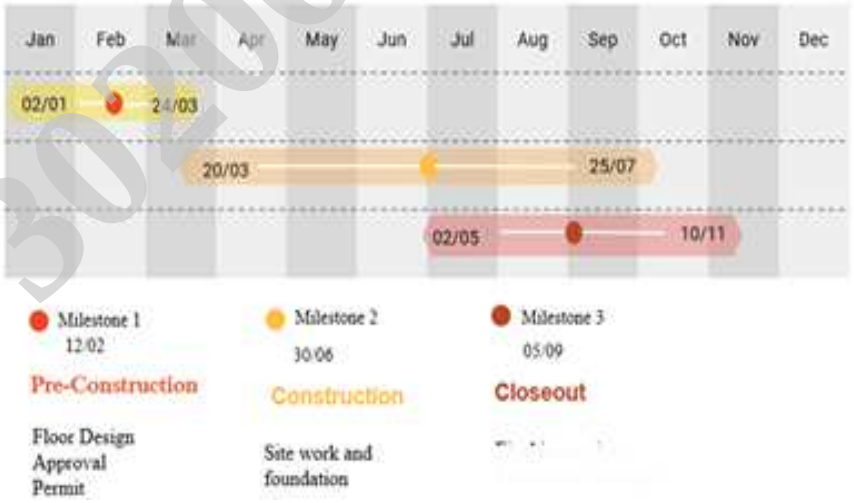
- **Construction Planning & Timeline**

Finishing a construction project on time and on budget is every builder's goal. So how do you set yourself up for success? Whether you're renovating a bathroom or building a new home from the ground up, every construction project starts with a plan. What is a construction plan? A construction plan is a document that outlines the tasks, resources, and requirements needed to complete a build on time and budget. What is a construction plan?



P-D-C-A Flow

Construction planning roughly



Steps Activity the Home Building Process

Activity No	Activity	Duration	Dependency
1.0	Pre-Construction		
1.1	Design and planning	1 month	
1.2	Sample approval	1 week	2
1.3	Bids and Contracts	2 weeks	3
1.4	Contract Execution	0	4
2.0	Prepare the site for construction and Pour Foundation:		
2.1	Obtaining Permits and Applying for Permits	7	5
2.2	A construction crew levels the ground.	8	7
2.3	Installs temporary foundation forms made of wood.	9	8
2.4	The Footings Have Been Installed	10	8,9
	Draw #1	0	10
3.0	Complete the Rough Framing		
3.1	The floor, wall, and roof systems have all been completed.	7	11
3.2	Exterior Walls are sheathed and protected with protective wrap.	5	13
	Draw #2	0	14
4.0	Rough Plumbing, Electrical, and HVAC		
4.1	Pipes Wires	12	15
4.2	Vents and Sewer Lines	10	17,15FS + 2 days
4.3	Lines of Water Supply	15	18

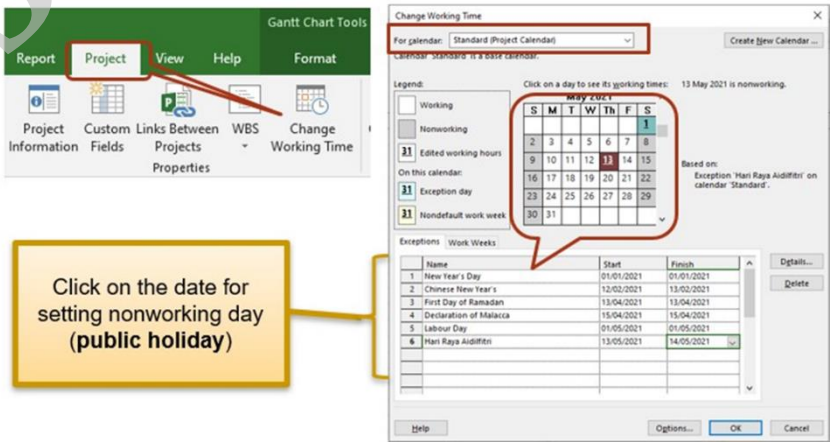
Activity No	Activity	Duration	Dependency
4.4	Shower Units and Bathtubs	3	19FF+3 days
4.5	Ductwork for a Heating and Air Conditioning System	7	20
4.6	Vent Pipes in the HVAC System	13	21
	Draw #3	0	22
5.0	Install Insulation		
5.1	Fiberglass	8	23
5.2	Cellulose	4	25
5.3	Mineral Wool Foam	5	26
5.4	Blocks of Concrete	7	27FS+5 days
5.5	Concrete Forms for Insulation	10	28
5.6	Foam Spray	7	29
5.7	Insulated Panels for Structural Use	15	30
5.8	Ridged Foam vs. Foam Board	12	31
	Draw #4	0	32
6.0	Complete the Drywall and Interior Fixtures, Start Exterior Finishes		
6.1	Drywall is Hung and Taped	20	33
6.2	The texturing has been completed.	7	35FF+4 days
6.3	Paint is applied to the first coat.	1 week	36
6.4	The exterior finishes (brick, stucco, and stone) are applied.	1 month	37SS+5 days

Activity No	Activity	Duration	Dependency
7.0	Finish Interior Trim, Install Exterior Walkways and Driveway		
7.1	Installed doors, windowsills, and decorative trim	10	38
7.2	Installed cabinets, vanities, and fireplace mantles	15	40
7.3	The Last Coat of Paint	7	41
	Draw #5	0	42
8.0	Install Hard Surface Flooring, Countertops; Complete Exterior Grading	3 weeks	43
9.0	Finish Mechanical Trims; Install Bathroom Fixtures	2 weeks	44
10.0	Install Mirrors, Shower Doors; Finish Flooring, Exterior Landscaping	1 month	45
11.0	Final Walk-Through	2 weeks	46
12.0	Move - in	0	47

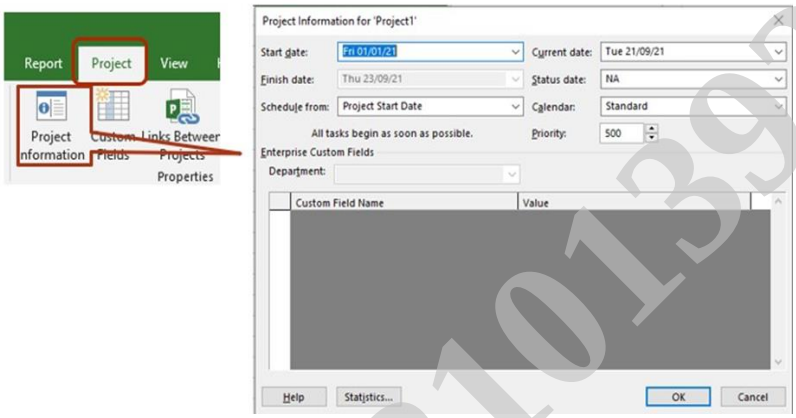
➢ Plan the Project:

1. Start **New Project** File

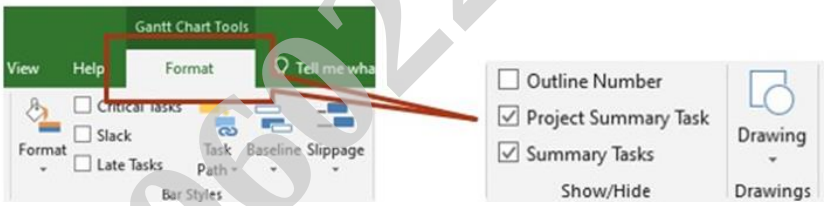
- Change Working time before start the planning task



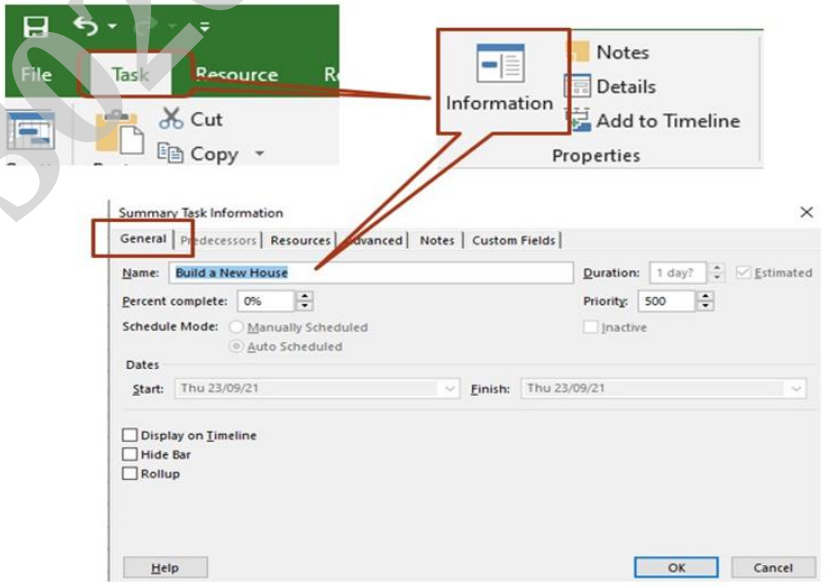
2. Project start Date: **01 Jan 2021**



3. Show the **Project Summary**



4. Project Title "**Build a New House**"



5. Save your New Project File as **"MyNewHouse_ProjectPlan.mpp"**

6. Enter Task with Details as listed in the table below:

7. Set WBS for:

a. Pre-Construction:

Design and Planning:
Sample approval
Bids and Contracts
Contract Execution

b. Prepare the site for construction and Pour Foundation:

Obtaining Permits and Applying for Permits
A construction crew levels the ground.
Installs temporary foundation forms made of wood.
The Footings Have Been Installed.

c. Complete the Rough Framing

The floor, wall, and roof systems have all been completed.
Exterior Walls are sheathed and protected with protective wrap.

d. Rough Plumbing, Electrical, and HVAC

- Pipes and Wires
- Sewer Lines and Vents
- Lines of Water Supply
- Shower Units and Bathtubs
- Ductwork for a Heating and Air Conditioning System
- Vent Pipes in the HVAC System

e. Install Insulation

- Fiberglass
- Cellulose
- Mineral Wool Foam
- Blocks of Concrete
- Concrete Forms for Insulation
- Spray Foam
- Insulated Panels for Structural Use
- Ridged Foam vs. Foam Board

f. Complete the Drywall and Interior Fixtures, Start Exterior Finishes

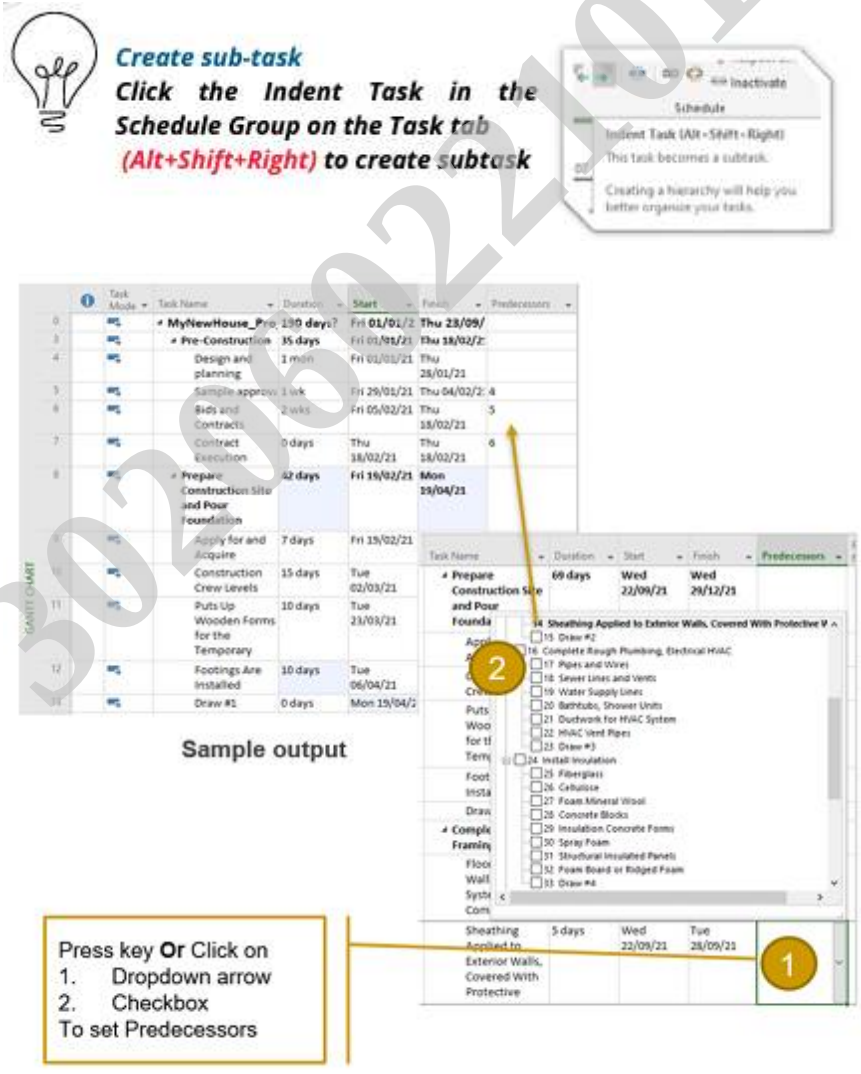
- Drywall is Hung and Taped
- The texturing has been completed.
- Paint is applied to the first coat.
- The exterior finishes (brick, stucco, and stone) are applied.

g. Finish Interior Trim, Install Exterior Walkways and Driveway

Installed doors, windowsills, and decorative trim.

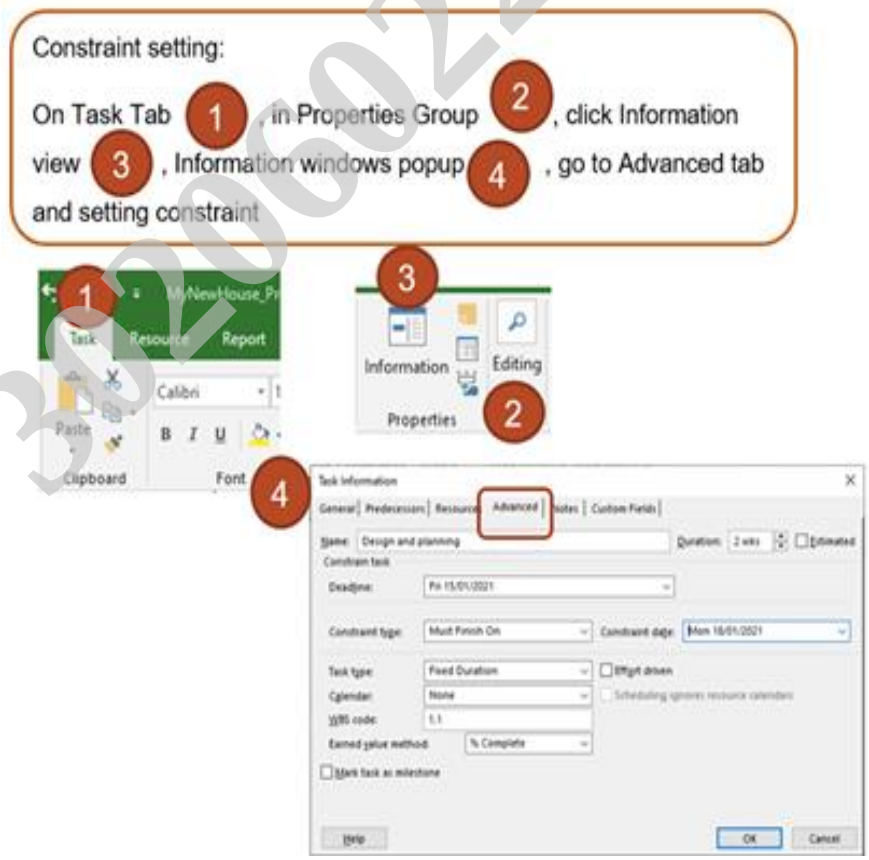
Installed cabinets, vanities, and fireplace mantles.

The Last Coat of Paint.

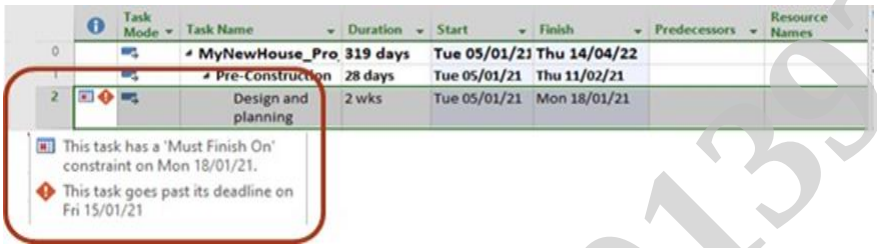


8. Set Constraint for:

Task Name	Constrai nt Type	Constraint Date
Design and planning	MFO	18/01/2021
The Footings Have Been Installed	SNET	26/03/2021
Ductwork for a Heating and Air Conditioning System	MFO	25/06/2021
Fiberglass	SNLT	16/07/2021
Move-in	ASAP	26/04/2022



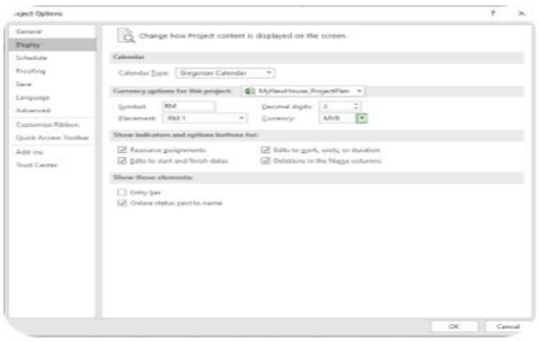
Sample Output



9. Set Constraint for:

Resource Name	Type	Max.	Std. Rate (RM)	Cost/use (RM)
Zakwan Ahmad	Work	100%	2500.00/week	0.00
Color Setting Services	Work	100%	100.00/hour	0.00
Electrical Setting Services	Work	100%	500.00/day	0.00
Plumbing Services	Work	100%	150.00/hour	0.00
Alvin Sean	Work	100%	2000.00/week	0.00
Johny Evans	Work	100%	65.00/hour	
Mr. Shahril	Work	100%	0.00/hour	
Interior Design	Work	100%	200.00/hour	
Exterior Design	Work	100%	200.00/hour	

Tips: How to change Currency Format
On File tab -> Option view -> Display - > Currency option -> OK



	Resource Name	Type	Mate Label	Initial	Gr	Ma Un	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base Calendar
1	Zakwan Ahmad	Work		Z		1	RM 2,500.00/wk	RM 0.00/hr	RM 0.00	Prorated	Standard
2	Color Setting Services	Work		C		1	RM 100.00/hr	RM 0.00/hr	RM 0.00	Prorated	Standard
3	Electrical Setting Services	Work		E		1	RM 500.00/day	RM 0.00/hr	RM 0.00	Prorated	Standard
4	Plumbing Services	Work		P		1	RM 150.00/hr	RM 0.00/hr	RM 0.00	Prorated	Standard
5	Alvin Sean	Work		A		1	RM 2,000.00/wk	RM 0.00/hr	RM 0.00	Prorated	Standard
6	Johny Evans	Work		J		1	RM 65.00/hr	RM 0.00/hr	RM 0.00	Prorated	Standard

Sample Output

10. Assign Resources to:

Resource Name	Assigned to task
Zakwan Ahmad	Draw #1, Final Walk-Through
Color Setting Services	The Last Coat of Paint, Draw #5
Electrical Setting Services	Fiberglass, Draw #4
Plumbing Services	Draw # 3, Pipes and Wires
Alvin Sean	Design and planning, Draw # 2, Final Walk-Through
Johny Evans	Draw # 3, Draw #4, Final Walk-Through
Interior Design	Draw #5
Exterior Design	The exterior finishes (brick, stucco, and stone) are applied.
Mr. Shahril	Move - in

Sample Assign Resources to:

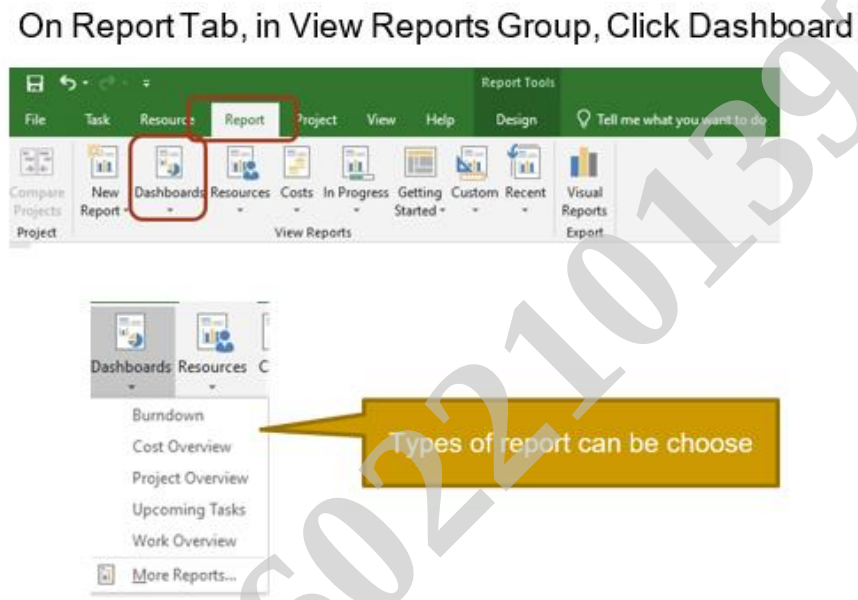
11. Enter fixed cost for: (Table Cost. Gantt Chart View)

Task Name	Fixed Cost
Footings Are Installed	RM7,000.00
Floor System, Walls, Roof Systems Are Completed	RM20,000.00
Doors, Windowsills, Decorative Trim Installed	RM15,000.00
Cabinets, Vanities, Fireplace Mantles Installed	RM25,000.00
Install Hard Surface Flooring, Countertops; Complete Exterior Grading	RM10,000.00

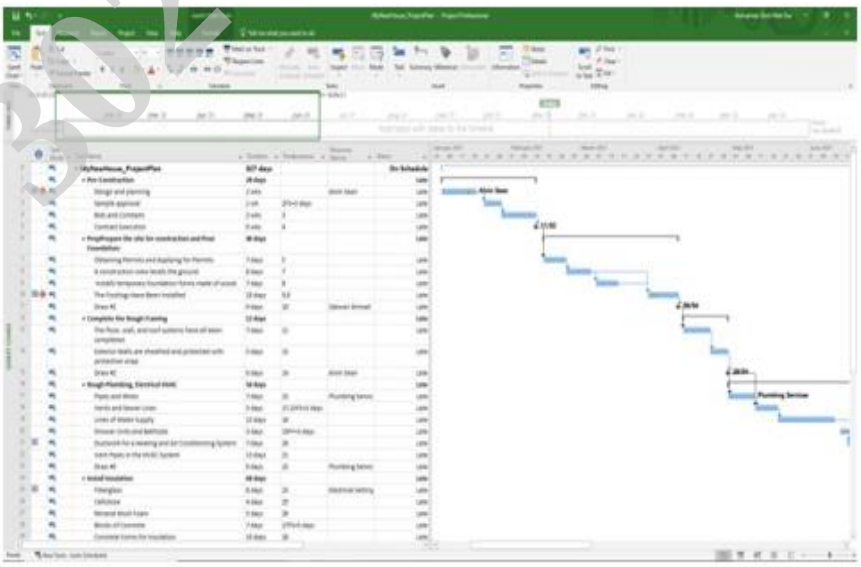
	Task Name	Fixed Cost	Fixed Cost Accrual	Total Cost	Baseline	Variance
0	MyNewHouse_ProjectPlan	RM 0.00	Prorated	RM 145,200.00	RM 0.00	145,20
1	Pre-Construction	RM 0.00	Prorated	RM 4,000.00	RM 0.00	M 4,00
2	Design and planning	RM 0.00	Prorated	RM 4,000.00	RM 0.00	M 4,00
3	Sample approval	RM 0.00	Prorated	RM 0.00	RM 0.00	RM
4	Bids and Contracts	RM 0.00	Prorated	RM 0.00	RM 0.00	RM
5	Contract Execution	RM 0.00	Prorated	RM 0.00	RM 0.00	RM
6	Prepare Construction Site and Pour Foundation	RM 0.00	Prorated	RM 7,000.00	RM 0.00	M 7,00
7	Apply for and Acquire Permits	RM 0.00	Prorated	RM 0.00	RM 0.00	RM
8	Construction Crew Levels Site	RM 0.00	Prorated	RM 0.00	RM 0.00	RM
9	Puts Up Wooden Forms for the Temporary Foundation	RM 0.00	Prorated	RM 0.00	RM 0.00	RM
10	Footings Are Installed	RM 7,000.00	Prorated	RM 7,000.00	RM 0.00	M 7,00
11	Draw #1	RM 0.00	Prorated	RM 0.00	RM 0.00	RM
12	Complete Rough Framing	RM 0.00	Prorated	RM 20,000.00	RM 0.00	M 20,00
13	Floor System, Walls, Roof Systems Are Completed	RM 20,000.00	Prorated	RM 20,000.00	RM 0.00	M 20,00

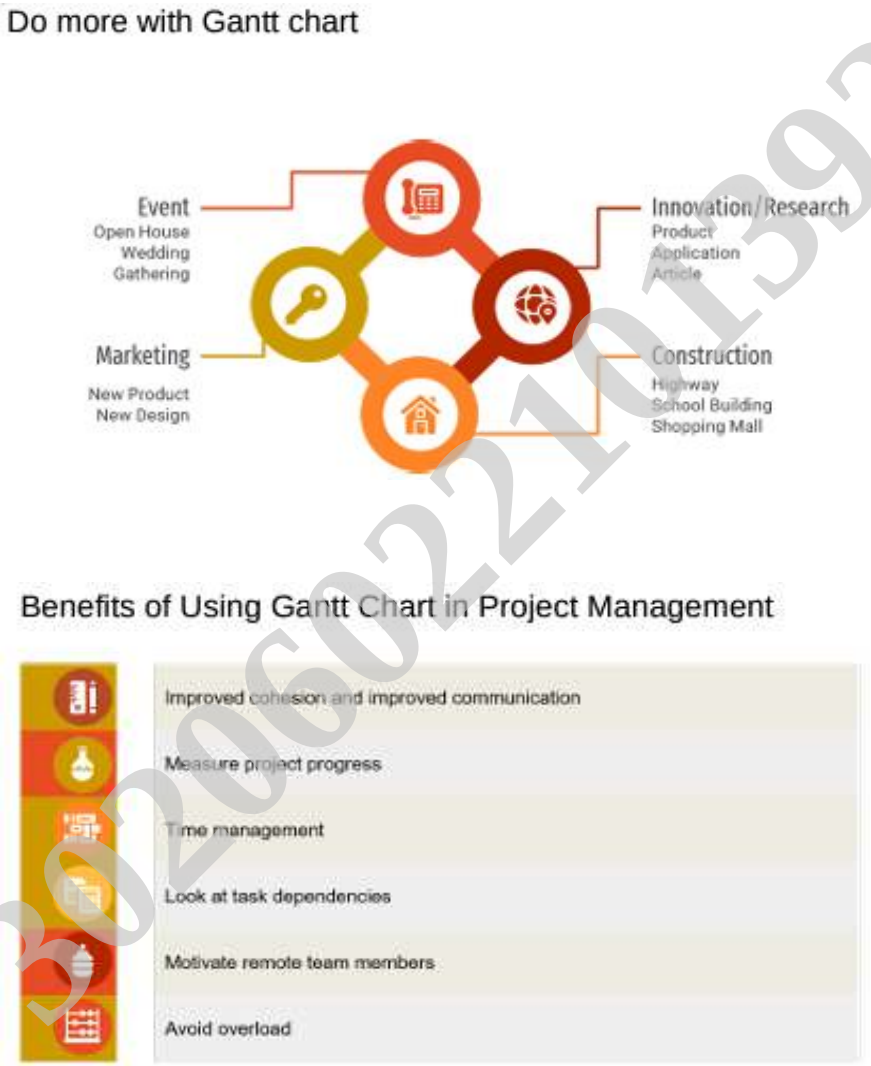
Sample Output

12. View a Dashboard



13. Save file and Close





REFERENCES

Bell, M. (2013). Effective and Efficient Project Management - "A simple approach to structuring, running and making projects successful. Simple Improvement [Internet]. [Citado 22 Oct 2017] Disponible en: http://www. simple improvement. co. uk/Effective% 20and% 20Efficient% 20P roject% 20Management. pdf.

Binder, J. (2016). Global project management: communication, collaboration and management across borders. Routledge.

Carstens, D. S., & Richardson, G. L. (2019). Project management tools and techniques: A practical guide. CRC Press.

Harrison, F., & Lock, D. (2017). Advanced project management: a structured approach. Routledge.

Harrison, F., & Lock, D. (2017). Advanced project management: a structured approach. Routledge.

Heagney, J. (2016). Fundamentals of project management. Amacom.

Horine, G. (2012). Project Management Absolute Beginner's Guide: Proj Manag Abso Beg Gui _p3. Que Publishing.

Jovanovic, P., & Beric, I. (2018). Analysis of the available project management methodologies. Management: Journal of Sustainable Business and Management Solutions in Emerging Economies, 23 (3), 1-13.

Kerzner, H. (2017). Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons.

Layton, M. C., Ostermiller, S. J., & Kynaston, D. J. (2020). Agile project management for dummies. John Wiley & Sons.

Luckey, T., & Phillips, J. (2006). Software project management for dummies. John Wiley & Sons.

Marchewka, J. T. (2016). Information technology project management: Providing measurable organizational value. John Wiley & Sons.

Meredith, J. R., Shafer, S. M., & Mantel Jr, S. J. (2017). Project management: a strategic managerial approach. John Wiley & Sons.

Meredith, J. R., Shafer, S. M., Mantel Jr, S. J., & Sutton, M. M. (2020). Project management in practice. John Wiley & Sons.

Murphy, A., & Ledwith, A. (2007). Project management tools and techniques in high-technology SMEs. Management research news, 30(2), 153-166.

Passenheim, O. (2014). Project management. Bookboon.

Phillips, J. (2004). IT project management: On track from start to finish. McGraw-Hill, Inc..

Pinto, J. K. (2007). Project management: achieving competitive advantage. Upper Saddle River, NJ, USA: Pearson/Prentice Hall.

Portny, J. L., & Portny, S. E. (2022). Project management for dummies. John Wiley & Sons.

Radujković, M., & Sjekavica, M. (2017). Project management success factors. Procedia engineering, 196, 607-615.

Schwalbe, K. (2009). Introduction to project management. Boston: Course Technology Cengage Learning.

Shamim, M. I. (2022). Exploring the success factors of project management. American Journal of Economics and Business Management, 5(7), 64-72.

Singh, H., & Williams, P. S. (2021). A Guide to the Project Management Body of Knowledge: PMBOK (®) Guide. In Project Management Institute.

Vaidyanathan, G. (2013). Project management: process, technology, and practice. Upper Saddle River: Pearson.

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Work Experience

Current Positions:

- Assistant Professor (Lecturer) – October 2020 – Present.
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Previous Positions:

- Assistant Lecturer – **February** 2016 – **September** 2020.
  Business Information Systems (BIS) Department, Faculty of Commerce and Business Administration, **Helwan University**, Cairo, **Egypt**.
- Teaching Assistant – **September** 2010 – January 2016.
  Business Information Systems (BIS) Department, Faculty of Commerce and Business Administration, **Helwan University**, Cairo, **Egypt**.

Education

- **Ph.D. in Information Systems (IS) – 2020.**
  Faculty of **Computers & Artificial Intelligence**, **Helwan University**, Cairo, **Egypt**.
- **MSc. in Information Systems (IS) – 2016.**
  Faculty of **Computers & Artificial Intelligence**, **Helwan University**, Cairo, **Egypt**.
- **Diploma in Business Information Technology (BIT) – 2012.**
  Faculty of **Computers & Artificial Intelligence**, **Helwan University**, Cairo, **Egypt**.
- **Bachelor in Business Information Systems** – (Grade: **Excellent**) – **May 2009.**
  Faculty of **Commerce & Business Administration**, **Helwan University**, Cairo, **Egypt**.

Main Courses Taught

- Introduction to Information Systems & Computers.
- Introduction to Information Technology.
- Introduction to Business Informatics.
- Introduction to Operating Systems.
- Database Management System (DBMS).
- Programming languages.
- Management Information Systems (MIS).
- E-Commerce.
- Project Management (PM).
- Decision Support Systems (DSS).