Course Code: **GEPM-375**

Course Title**:**

Project Planning and Construction Management

What are going to discuss today?

- Project, Project planning, Construction Management
- Syllabus and References
- Definition of Project.
- Key Characteristics of Projects.
- Definition of Project in Organizations.
- **Distinction between other pieces of works:**

Project

What is Project:

PMI defines as a "**temporary endeavor** undertaken to **create a unique** product, service, or result".

- **Producing deliverables** is the key reason to start the project in the first place.
- A project deliverable can be **tangible or intangible**.
- Projects create a **unique product, result, or service** and then close. Although many construction projects result in comparable buildings, bridges, and dams, each of these structures is a unique product.
- If the output is repeated, then it is an **operation**, as an operation provides repeated output. An example of an operation is automobile production.

PRINCE2 defines the project as follows:

- A **temporary organization** that is created for the purpose of delivering one or more **business products**, according to **an agreed-upon business case.**

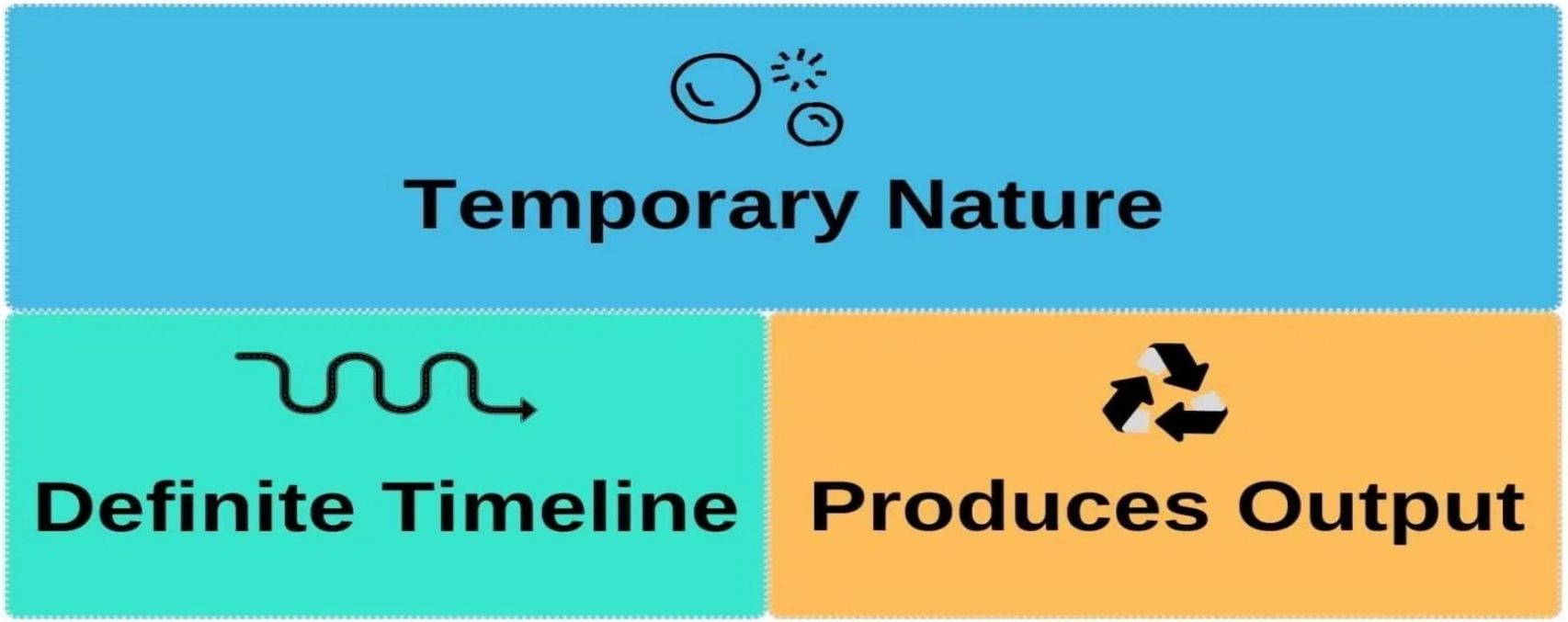
i. Word **"organization**" refers to the project team (i.e., all the people involved in the project).

ii. word **"temporary"** refers to the project having a definite start and end date.

ii. **Business case** includes reasons for completing the project, expected benefits, and the costs and time involved.

A project has the following **CHARACTERISTICS**

- **Temporary Nature:** All projects are temporary, which means that once they achieve their objectives, **they will end.**
- **Definite Duration:** A project has a well-defined timeline, with a **definite start and end date**.
- **Produces Output:** All projects produce an output, which can be a **unique product, enhancement, service, or result.**



Project Examples

- Constructing a building
- Modifying an organization's software system
- Researching the development of a new manufacturing process.

Most important characteristic of a project is its **temporary nature**; the project ends when it achieves its objective.

Project can also end when:

- Funding is exhausted.
- Project is no longer necessary.
- Resources are no longer available.
- Project is terminated for legal causes or convenience.
- **Government policy**

Types of Projects

Based on project management methodology, you can divide projects into three categories:

Waterfall:

- Most traditional, popular form of project management.
- Scope of work is fixed, and changes are uncommon.
- Most projects (e.g., infrastructure or construction) are examples of traditional Waterfall projects.

Agile:

- Newer method of managing software development projects.
- Useful when the scope of work is not well defined, and changes are common.

Hybrid:

- Combination of the projects mentioned above.
- Hybrid project management is helpful for large projects that include construction and software development elements.

Project Planning

- Project planning is an essential part of project management
- Project planning refers to the phase in project management in which you **determine the actual steps** to complete a project.
- This includes
  i. laying out **timelines**,
  ii. establishing the **budget,**
  iii. setting **milestones**,
  iv. assessing **risks,**
  v. **solidifying tasks** and assigning them to team members.
- Project planning is the second stage of the project management cycle, Full cycle includes **initiation**, **planning, execution**, and **closing**.

Components of a project plan

Components of project planning are: tasks, milestones, people, documentation, and time.

Tasks:

- Tasks are **activities** that need to be accomplished within a set period of time.
- Assigned to different members of the team according to their role and skill set.

Milestones:

- Milestones are important points within the schedule that indicate progress.
- Tend to **signify the completion** of a deliverable or phase of the project.

People:

- Includes the **people working** on your team and their roles.
- Each team member needs to understand their role and the tasks they're responsible for completing, ultimately creating a sense of personal responsibility for team members.

Documentation:

- Draft a project **plan that links to relevant documentation**. like a RACI chart, Charter, budget, risk management plan etc.

Time:

- Project plans should include the **estimated duration** of the project.
- Schedule will be the anchor of your project plan.
- Includes dates for starting and completing tasks, and dates (deadlines) for reaching specific milestones.



LEGEND
MASS RAPID TRANSIT LINES
MRT Line 1
MRT Line 1-Phase 2
MRT_L2
MRT Line 4
MRT Line 5 North
MRT Line 5 North Ph-2
MRT Line 5 South
MRT Line 5 South Ph-2
MRT Line 6
MRT Line 6 Ph-2
Gazipur
Baipail
Tongi
Uttara
Airport
Purbachal
Mirpur 10
Hemayetpur
Bhulta
Rampura
Kamalapur
Borpa
Chittagong road
Jhilmil
Narayanganj
DISTRICTS TO BE CONNECTED WITH DHAKA
NARAYANGANJ
GAZIPUR
NARSINGDI
MUNSHIGANJ
MANIKGANJ
METRO RAIL EXPANSION PLAN
Once the plan is executed, metro will have
250KM NETWORK
Daily passenger carrying capacity to rise to
75 LAKH
FIRST PHASE:
Narayanganj and Gazipur
129.90KM
new metro rail lines by 2030
MRT Line-4 from Kamalapur to Narayanganj to be included

Construction

- Covers the **processes** involved in **delivering product** (buildings, infrastructure, industrial facilities) and **associated activities** through to the end of their life.
- It typically starts with planning, financing, and design that continues until the asset is built and ready for use.



Construction Management

- **A professional service that provides a project's owner(s) with effective management of the project's schedule, cost, quality, safety, scope, and function.**
- Compatible with all project delivery methods.
- No matter the setting, a Construction Manager's (CMs) responsibility is to the owner and to a successful project.

At its core, a capital project is made up of **three parties** (excluding the CM):

- **Owner,** who commissions the project and either funds the project directly or finances it through a variety of methods.
- **Architect/engineer,** who designs the project.
- **General contractor**, who oversees day-to-day operations and manages subcontractors.

Construction Manager:

- Represents the **owner's interest and provides** oversight over the entire project directly for the owner.

- His/her mandate is to **work with all parties** to deliver the project **on time**, **at or under budget,** and to the owner's **expected standard of quality**, **scope**, and **function**.

- CMs are **uniquely qualified** through combined education and experience to work with the owner, architect, general contractor, and other stakeholders.

- A professional CMs can **save money**, **avoid or mitigate problems**, and **produce higher quality results** for the owners.

- Professional CMs use industry-standard practices to manage projects successfully and address all **six areas of construction management services: schedule**, **cost**, **safety, quality, function,** and **scope**.

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Course Content

Project Planning:

- Project Planning and Evaluation
- Planning and Scheduling
- Resource Scheduling
- PERT, CPM
- Resource Scheduling
- Project management Software
- Linear Programming and Application
- Feasibility Report

Construction Management

- Principles of Management
- Project organization, methods and practices
- Technology, management of materials and equipment.
- Site management, contracts and specifications.
- Inspection and quality control, safety and economy.
- Conflict management
- Human factors in management, human resource management.
- Demand forecasting, inventory control, stores management, procurement.
- Legal issues in construction, environmental regulation.

Finance:

- Time value of money, cash flow, payback period, internal rate of return, fisher's rate of intersection, cost-benefit ratio, cost-benefit analysis, case studies.

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Project planning and construction management

References

- Project Planning and Control by Albert Lester
- The Process of Management by William H. Newman
- Introduction of Operational Research by Hiller & Liberman.
- Project Management Techniques by A. O. Awani.
- Construction, Planning, Equipment and Methods by Puorifoy.
- Material Management & Inventory Control by A. K. Dutta
- Project Management by **S Chowdhury**

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Project planning and construction management

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How do you define a project?

Definition:

A project is defined as a **specific, finite activities** that **produces** an observable and measurable **result/results** under certain **preset requirement**.

Characteristic of Project

Key Characteristics of a Project (TUP)

Any project can be characteristics by:

Temporary

- Every project has a finite start and finite end.
- **Start is the time** when the project its initiated and its concept is developed.

Characteristics of Project (cont..)

Unique Deliverable(s)

- Any project aims to produce some deliverable(s)
- Which can be **a product**, **service** or **some other results**.

Progressive Elaboration

- Progressive elaboration is a project management technique that seeks to add detail to a project plan incrementally.
- With the progress of the project, **continuous investigation and improvement become available.**

Characteristics of project (cont..)

Some other characteristics of a Conventional Projects are:

- **Purposeful** as it has a rational and measurable purpose.
- **Logical** as it has a certain life cycle.
- **Structured** as it has interdependencies between its **tasks** and **activities.**
- Conflicts as it tries to solve a problem that creates some kind of conflicts.
- Limited mainly by available resources.
- Risk as all the projects have always some risk involvement

Example of Project- A Building Construction



How do you define a project in organizations?

In organizations, '**A project is defined as a piece of WORK** that is **planned for implementation** within the current business/professional environment.

Example: Establishment of a new ETP.

Work

- **Amount of effort applied** to **produce a deliverable** or to **accomplish a task** (a terminal element)/ **a group of related tasks** defined in the same level.

Distinction between other pieces of works:

Portfolio

- A collection of **projects** and **programs** that are managed as a group to achieve strategic objectives

Program

- A **collection of projects** that are managed as a group to achieve efficiencies of scale.

Work package

- Group of tasks to complete a project.

Work unit/Task

- An **identifiable and measurable activity** that is done by a small unit of work.

Activity - is defined as the **amount of works performed** that **convert inputs into appropriate outputs**.

Construction of a Residential Block



Construction of internal roads



What we tried to discuss today?

- Project, Project planning, Construction Management
- Syllabus and References
- Definition of Project.
- Key Characteristics of Projects.
- What does a project include?
- Definition of Project in Organizations.
- What is a Program in project Management?
- Task/activity, work-package and work-unit with example.

Thank You

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Project Planning and Construction Management

What we learned (important) in the last class?

- What is a Project ?
- Characteristics of a Project.
- Project in organizations.
- All FOUR forms the Work Breakdown Structure (WBS)

What we will try to discuss today:

- **Work Breakdown Structure (WBS)**
- Product Breakdown Structure (PBS)

Work Breakdown Structure (WBS)

Project Management

- Application of **knowledge, skills, tools, and techniques** to project **activities** to meet project **requirements**.
- Practice of **planning, organizing, and executing** the tasks needed **to turn a brilliant idea** into a **product, service, or result.**

Key aspects of project management include:

- Defining project **scope**
- Identifying **deliverables**
- Managing **risks**
- Effective **communication** across teams

Project Scope

- A **detailed outline** of all the **activities, resources,** and **deliverables** required to **complete a project**.

- Also includes the project's **boundaries**, **timelines**, and **stakeholders**.

What is Work-breakdown Structure (WBS)?

- A **key project deliverable** that **organizes the team's work** into **manageable sections.**

- A **hierarchical** (arranged in order of rank) **decomposition** of the **total scope of work** to be carried out by the **project team** to accomplish the **project objectives**.

- **Project scope** is the total amount of work that needs to be done to complete a **project/achieve project objective(s)**.

Project objective (s):

Project objectives are what you **plan to achieve** by the end of your project

Elements of WBS

- WBS is often used to **determine an Task/activity, based on the hierarchy of projects,** with **reference to desirables and objectives**.

Program- break down of series of projects.
Project

Task- an identifiable and measurable **activity** that create a small unit of work for a related project.

Work package - divisions of project tasks

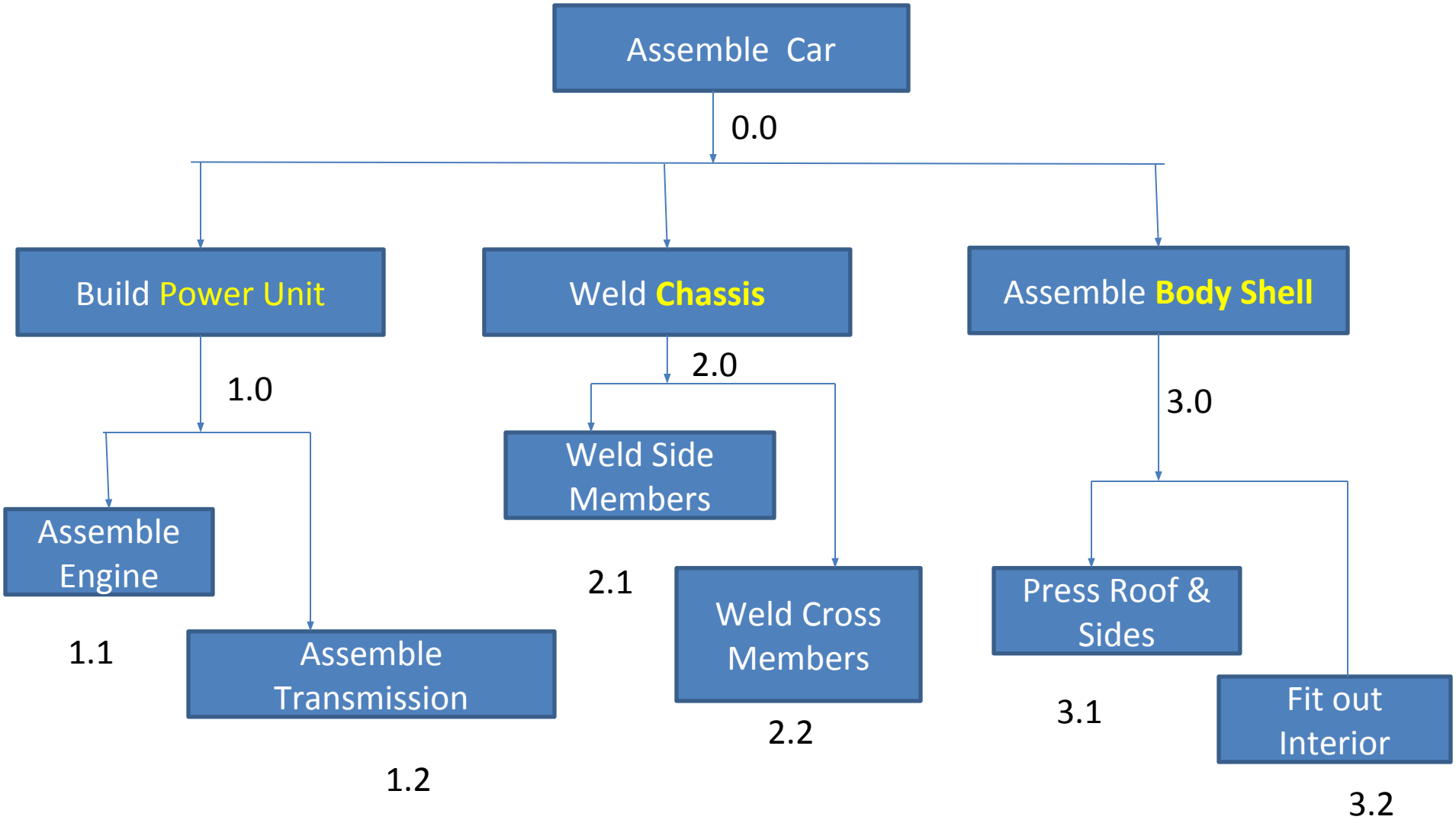
Work unit - divisions of work package

All FOUR are the elements of Work Breakdown Structure (WBS)

Task: Easily identifiable and measurable work performed by by a small unit.

Activity is defined as the **amount of works performed** that convert inputs into appropriate outputs.

Project – **Assemble of Car: WBS**



Assemble Car





Weld Chassis



Assemble Engine

Assemble Body Shell



Work Breakdown Structure-WBS

- WBS is **not a program** although it looks like.

- **Interrelationship shown by link** do not necessarily imply a time dependence or indeed a sequential operation

A Project-Assemble of Car

Car Assembly-Three Units:

a. Build Power Unit (1)
b. Weld Chassis Unit (2)
c. Assemble Body Shell Unit (3)

Build Power unit(1)- Assemble Engine (1.1) and Assemble Transmission(1.2)

Weld Chassis Unit (2)-Weld Side Members(2.1) and Weld Cross Members(2.2)

Assembls Body Shell Unit (3)-Press Roof and Sides (3.1) and Fit out Interior.

Requirements of WBS (M IGSTI)

- **Main task** decided upon.
- Main tasks **broken into subtasks** to be coded with the project cost.
- Assist in **identifying the whole strings of relationship** down to individual tasks.
- **Logical starting point** for subsequent planning network.
- A **graphical representations** of **task relationship** can be created.
- Very **useful tools** for disseminating information as well as a reporting medium to all stakeholders.
- **Ideal instrument** for reporting progress upward to senior management and thus status of each task is regularly updated.

Advantages

- **Cost allocation** can be given to each task in the WBS.
- **A risk factor** can also be added to each task.
  - Assist in **building up** the **total project cost**.
  - Able to **create a risk register** for subsequent and more rigorous risk assessment.

Objective of WBS:

To be **able to control the project** by allocating resources (human, material and financial) and giving time constraints to each task.

Explanation

- It is always **easier to control a series small entities** which make up a whole, the trying to control the whole enterprises as one operation.

- History has proven to be successful for **Armies.**

- Army-divisions-brigades-regiments-companys-platoons-sections-individuals.

True to a Project, small or big, sophisticated or straightforward

Product Breakdown Structure-PBS

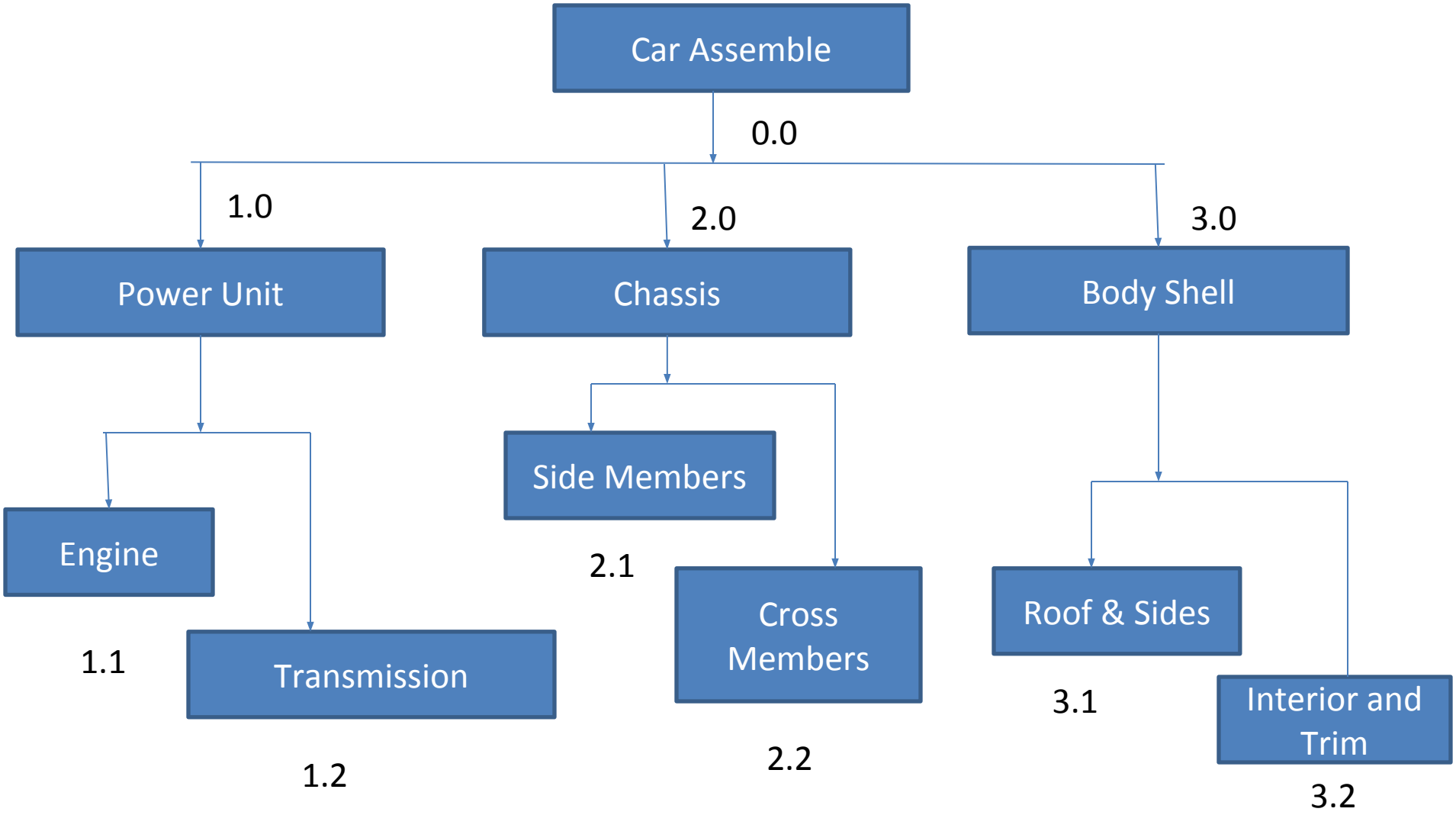
What is Product Breakdown Structure?

- A **Product Breakdown Structure** (PBS) is a **hierarchical structure of Product** that the **project will make** or **outcomes that it will deliver**.

- It can be thought of as the project **"shopping list."**

- It **decomposes** a "Main Project **Product**" into **its constituent parts** in the form of a hierarchical **structure**.

Project – Assemble of Car (Product Breakdown Structure)



Comparison between PBS and WBS:

- Both term are **used for hierarchy of stages** of a project.
- PBS is **hierarchical diagram of product** and WBS is for **hierarchical diagram for work.**
- Both are based on the principles of **sub dividing the project into manageable components.**
- Though they look a like, **they are not programs**, and interrelationships shown by link lines do not necessary imply a time dependent or **indeed a sequential operation.**
- **Degree to which they need to be broken**, will have to be decided upon by the Project Manager.

What we have discussed today:

- **Work Breakdown Structure (WBS)**
- Product Breakdown Structure (PBS)

Thank You

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Project Planning and Construction Management

What we discussed in last class:

- **Work Breakdown Structure (WBS)**
- Product Breakdown Structure (PBS)

What we are going to discuss today?

- **Cost Breakdown Structure (CBS)**
- Organization Breakdown Structure (OBS)
- **Responsibility matrix**

What is Cost breakdown structure (CBS)?

- **Cost Breakdown Structure** (CBS) represents **a breakdown of the costs** of the various components of the Work **Breakdown Structure** (WBS) or Product Break down Structure (PBS) **including all works or services done by the subcontractors.**

- It is **used to continuously compare the actual costs** with the **budget**, and **integrate to the cost control system**.

Bottom up Cost Estimate

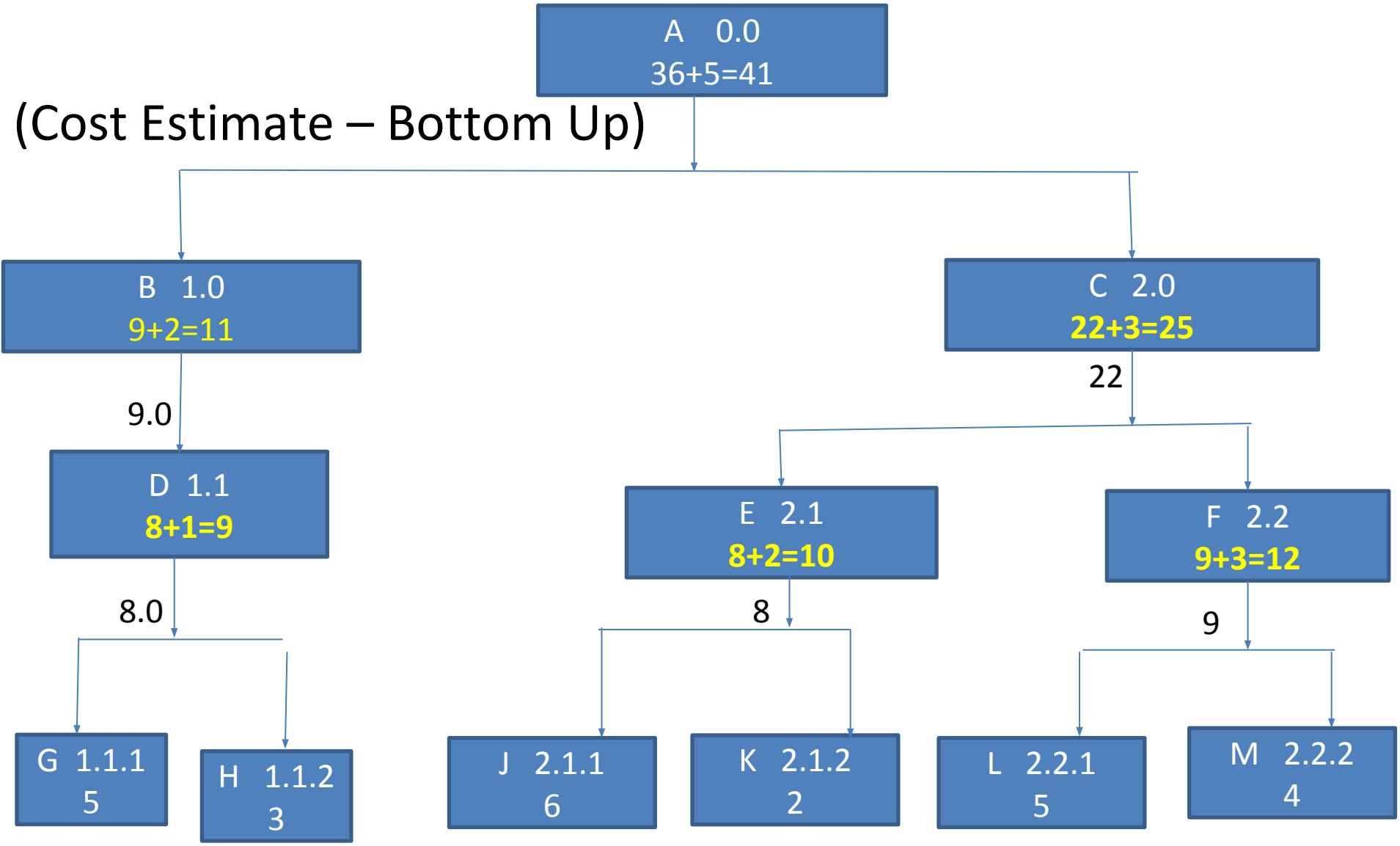
- Bottom-up cost estimate can be produced **starting at the lowest branch** of family tree (WBS or PBS).

- **Each work unit** is costed and arranged in such a way that the **total cost** of the packages on any branch **must add up** to the cost of the package of the parent package of the branch above.

- If the **parent package has a cost value of his own**, this must clearly be added before next stage of the package.

- **Following Figure** shows the bottom-up estimating process and also how the packages are can be **coded to produce a project cost coding system.**

(Cost Estimate – Bottom Up)



CBS: Top-down – Cost Estimate

- **Top-down estimating** is a **technique used by upper-level management** to **estimate** the **total cost** of a project by using **information from a previous, similar project**.

- In other words, one going to **estimate** the **cost** of the current project **based on the last time projects**.

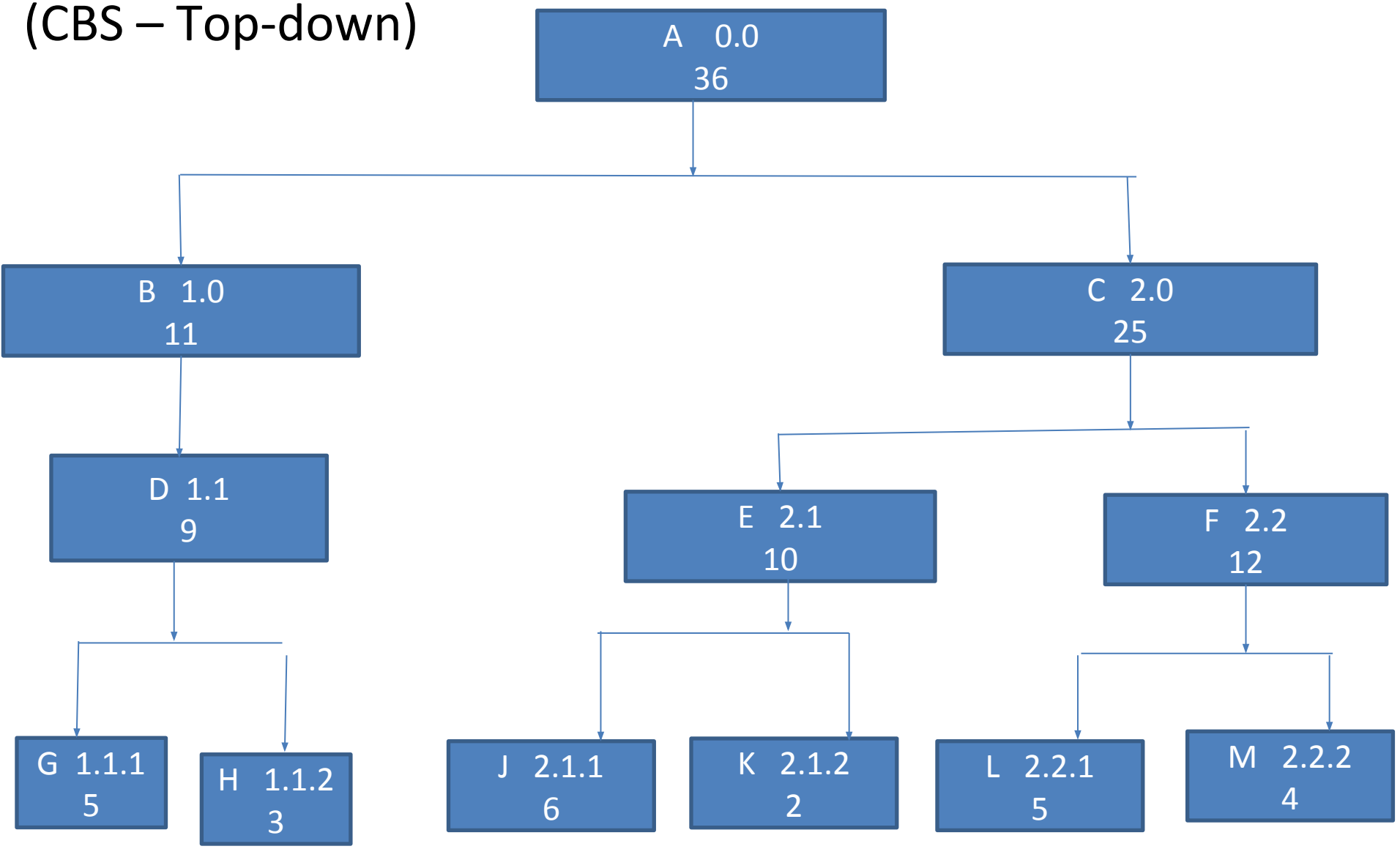
- Cost of the total project (sub project) has been **determined.**

- Total cost is **allocated to the top packages** of the WBS (PBS) diagram.

- **Work packages below are forced to accept** the appropriate cost.

- Total cost of each branch **cannot exceed of the package**.

(CBS – Top-down)


A 0.0
36
B 1.0
11
C 2.0
25
D 1.1
9
E 2.1
10
F 2.2
12
G 1.1.1
5
H 1.1.2
3
J 2.1.1
6
K 2.1.2
2
L 2.2.1
5
M 2.2.2
4

Use of CBS to Cost Estimate of a project.

- Estimator of a project **normally use bottom up** method on a WBS or PBS diagram to calculate the cost.

- When **total cost given** to the Project Manager,

  -he/she may **break the total cost down** into the different departments of the organization.

  -Ensures that sum of **total cost does not exceed** the estimated cost.

Top-Down vs. Bottom-Up

- Top-down usually encompasses a **vast area of macro variables** while bottom-up is **more narrowly focused**.

- Top-down **investing strategies** typically focus on **exploiting opportunities** that follow market cycles while bottom-up approaches are **more fundamental** in nature.

- While top-down and bottom-up can be very distinctly different. But **both are often used** in all types of financial approaches like **checks and balances.**



Organization Breakdown Structure (OBS):

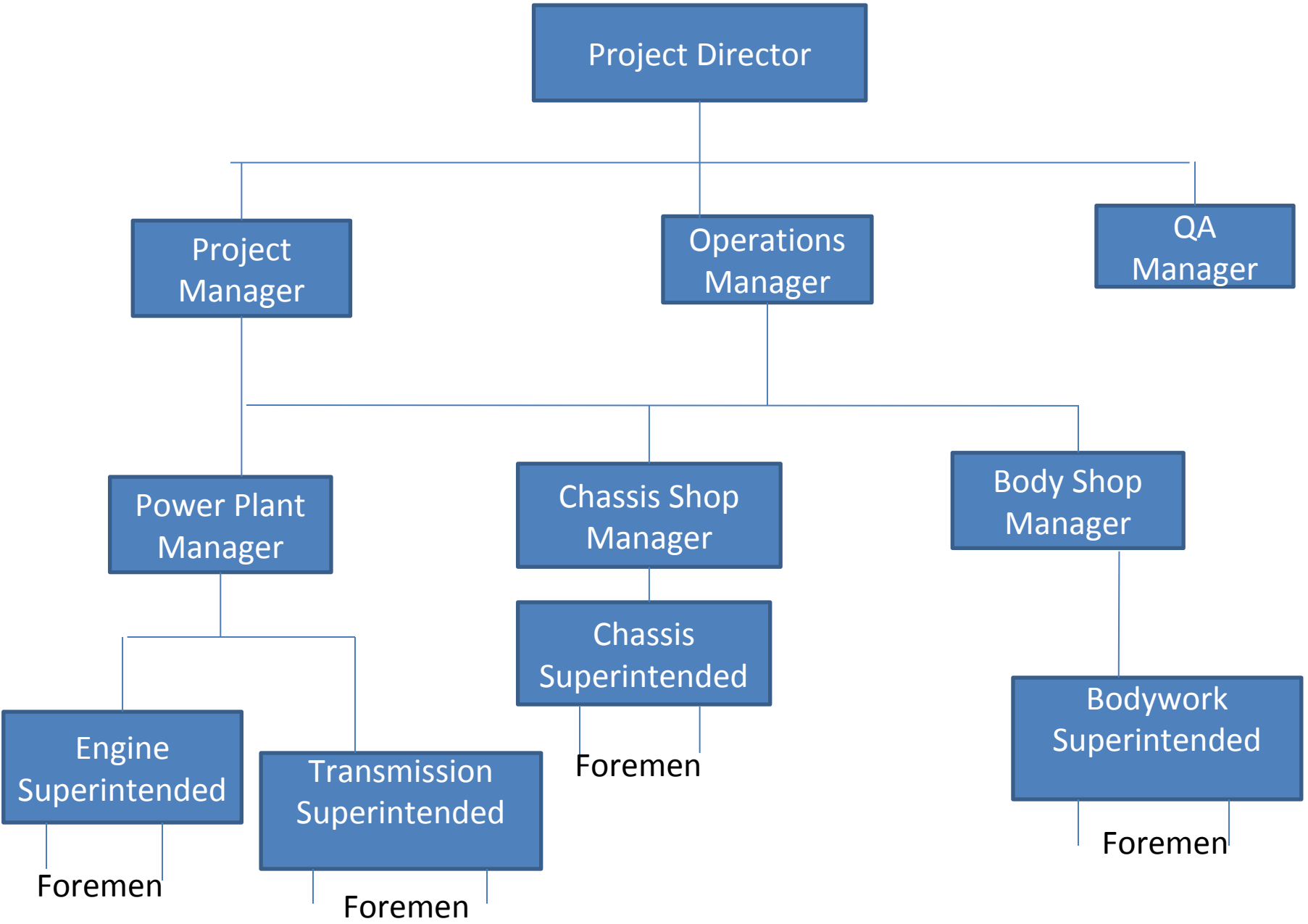
OBS is a hierarchical model describing the **establishing organizational framework** for:

- **project planning**,
- **resource management**,
- **time and expense tracking**,
- **cost allocation**,
- **revenue/profit reporting**, and
- **work management**.

Example of OBS

- If **names/designations** are given to WBS or PBS, it **becomes OBS**.
- Typical OBS for manufacturing Project-**Assemble of a Prototype Motor Car** shown.
- **Not identical** in lay out of WBS or PBS.
- **One of manager or task owner** can be **responsible for more than one task.**

Organization Breakdown Structure (OBS)



Project Director:

- A **project director** **directs** and **integrates** the activities of multiple, primary project operations.
- Have overall responsibility for the **successful conclusion** of construction projects.

Project Manager:

- A **project manager** is a **professional** who **organizes, plans, and executes projects** while working **within restraints** like budgets and schedules.

Operation Manager:

- **Operations managers** play a critical role in **overseeing** the day-to-day operations of an organization and **ensuring** their profitability.

QA Manager:

- **Quality assurance managers** work with other staff **to establish procedures and quality standards** and **to monitor** these against agreed targets.

Operational Manager:

- Responsible for **ensuring the quality** of their company's products and **services meet** or exceed customer expectations.

- They do this by **running various** processes, like **hiring** new employees, **training** them in specific skill sets and procedures, and **monitoring existing workers**, so **nothing falls through the cracks.**

Superintendent:

- A **skilled person** who is in charge of a particular department, group of workers.
- **Work on the ground** and is responsible for the execution of the work of his unit.

Foremen

- **A person in charge of leading a number of employees** in a particular field or profession, such as construction or engineering.

Where are the difference between OBS and WBS?

- **Operations manager** is in charge of the actual operating departments for pay and rations.
- **Each departmental manager** (or his designated project leader) has a reporting line to project manager.
- **Quality Assurances (QA) manager** reports directly to the director to ensure independence from the operating and the project department.

What are the responsibility of QA Manager?

- QA manager **will assist** all operating departments with **producing quality plans.**
- QA manager **will advice** on QA **requirements and procedures**
- QA Manager will **point out any short comings** if he observes.
- **Reports directly** to the Director to ensure independence from the operating and projects departments.

Responsibility Assignment Matrix (RAM)/RACI Matrix

RAM Matrix:

- **Describes the role and responsibilities** of various people and/or organizations in completing specific tasks for a project**.**

- By **combining the WBS/PBS with the OBS** it is possible to create Matrix.

- Using Car Assemble example, matrix is drawn by writing the **WBS work area vertically** and the **OBS personnel horizontally**.

- By placing a **suitable designatory letter** into the **intersecting boxes**, the **level of responsibility** for any work area can be recorded on the matrix.

A= Receiving monthly reports

B= Receiving weekly reports

C= Daily supervision

Responsibility Assignment Matrix (RAM for Car Assemble)

OBS → / WBS/PBS ↓	Director	Project Manager	Ops Manager	QA Manager	Power Plant Manager	Chassis Shop Manager	Body Shop Manager	Engine Supdt	Transmission Supdt	Chassis Supdt
Car Assembly	A	B	A	B						
Power unit	A	B	A	B	C					
Chassis	A	B	A	B		C				
Body Shell	A	B	A	B			C			
Engine		B	A	B	C			C		
Transmission		B	A	B	C				C	
Side Members		B	A	B		C				C
Cross Members		B	A	B		C				C
Roof and Floor		B	A	B			C			
Interior and Trim		B	A				C			

- **Vertical list giving PBS stages** could be replaced by the WBS stages.

- Horizontal lists showing the **different managers**, could have, the **names of departments** or **even consultants**, **contractors**, **sub-contractors**, and **suppliers** of materials or services.

RACI Matrix (For an Aesthetic Work)

RACI matrix example

R	Responsible
A	Accountable
C	Consulted
I	Informed

Project Activity / Deliverable	Project Manager	Consultant	Architect	Contractor	Client
Define functional and aesthetic needs	I	I	C	I	R
Assess risk	A	R	I	C	I
Define performance requirements	A	R	I	I	I
Create design	A	C	R	I	C
Execute construction	A	C	C	R	I
Approve construction work	I	I	C	C	R

So far what we have discussed today?

- **Cost Breakdown Structure (CBS)**
- Organization Breakdown Structure (OBS)
- **Responsibility matrix**

Thank You

GEPM 375

Project Planning and Construction Management

What you have learned in the last class

- Cost breakdown structure (CBS)
- Organization breakdown structure (OBS)
- Responsibility matrix.

What we are going to discuss today?

- **Project and Important Aspects of a Project.**
- Basic things for completion of project.
- **Project in country perspective**.
- **Project Management**
- **Tips for effective & successful project management**
- **Efficient Project management**

What is a project?

- A project is composed of **jobs, activities, functions or tasks** that are related to other/others in some manner and all of those **should be accomplished** in order to complete the project.

What are the important aspects of projects?

Every project must have:

- One **specific purpose**.
- **Start** at specific **moment /time**.
- **Finishes** when its **objective has been fulfilled at specific time.**

Basic Things required to complete a Project:

- **Material resources -** physical items needed to complete a project.

- **Manpower/human resources -** people who are required to complete a project, including their skills, experience, and availability.

Availability, quality and **use** of **human resources** is **a single determinant factor** in accomplishing project **activity.**

- For both**,** **technical know-how** is very important**.**

Project in Country Perspective - General:

- Projects can play a **significant role** in a country's **economic**, **social**, and **infrastructural** development.

- In developing countries, projects are considered the **basic building blocks** of development.

- Many countries those are **rich in material resources** but **poor in terms of level of production/plan** and vis-a-vis or **none**.

Example: **KSA, Japan and Bangladesh**







Following are the ways that projects can impact on country's Development:

- **Economic growth**

Projects can generate employment opportunities and **foster income generation,** which can contribute to **economic growth**.

- **Development**

Projects are considered the **"cutting edge" of development**. Without successful project **identification**, **preparation**, and **implementation, development plans may not be realized.**

Infrastructure

- **Projects can contribute to a country's infrastructure**. Infrastructure projects in development or execution **brings overall development** of the country.

Project in Country Perspective - Bangladesh:

For Bangladesh

- **Scarcity** of **material resources**.
- **Man power resources** are **not skilled**.
- **Sociology** has not kept pace with **technology**

Sociology is the study of **social life**, **social change**, and the **social causes** and **consequences of human behavior**.

Technology is application of **scientific knowledge** for **practical purposes.**

- Bangladesh is **not in a position to utilize the technological advancement fully and efficiently** unless we are able **to advance in social sphere.**

Here comes the rules of Management in project in Bangladesh.

• While **technology deals with the material things**, **management deals** with **both material** things as well **as human beings**.

• **Management increases the productivity through technical innovation** taking into account **human factors** in these advances.

Each project has three requirements:

- Project should be **completed** with **minimum elapse of time**.
- Project should **use** **available manpower and other resources** as **sparingly as possible without delay**.
- Project should be **completed** with a minimum **capital investment** without delay.

What is Project management?

- **Application** of **knowledge, skills, tools** and **techniques** to **project activities** to meet **project requirement**.

- Differences between **project management** and **just 'management'** is that project management has the **final deliverable** and a **finite time span**, unlike management which is an **ongoing process**.

Key aspects of project management include:

- **Defining** project **scope**
- Identifying **deliverables**
- Managing **risks**
- Effective **communication** across teams

Project Management Approaches

Project managers often rely on one of following three **primary approaches**.

Predictive Project Management (Waterfall)

- Best for when project and product requirements are **well-defined and stable at the beginning.**

- **Emphasizes detailed planning and execution based on initial requirements.**

Adaptive Project Management (Agile)

- Ideal for projects where requirements are subject to **high level of uncertainty and volatility** and are **likely to change throughout** a project.

- Uses an **iterative and incremental approach**, allowing more flexibility and adaptation.

Hybrid Project Management (Hybrid)

- **Combines aspects of both** predictive and adaptive approaches.
- Ideal for projects with **varying degrees of certainty and flexibility**.

Core Components of project management

- **Define reasons** of undertaking project.
- **Capturing requirements** ie. quality, resources, time etc.
- **Justify investment**
- **Secure corporate's agreement funding**
- **Leading and monitoring of project** by project team.

Tips for effective & successful project management

Foster clear and effective communication.

•PMI, in professional Report 2023 **reveals a range of "power skills"** for project management, as agreed by project managers.

•Top of the list? **Communication. 68%** of survey respondents say that communication is critical to achieving organizational objectives.

Set clear goals.

•A great **project manager starts by setting goals.**

•Clear goals keep your **team focused and aligned**.

Create a schedule

•A **thoughtfully crafted schedule** helps a project to run more smoothly.

•Guides your team to complete project tasks **on time**, while managing stakeholder expectations, too.

Use the right tools to monitor progress

- Easier for project team to operate efficiently with the right project **management software**.
- Nothing **slips through the cracks** because everyone can see what needs to be done.

Assemble a multi-skilled team

- A project is only as good as the people who work on it.
- You need the **right mix of personalities and skills** to aid productivity and minimize friction.

Motivate your project Team Members

- Skilled project managers know there are times when **Gantt charts, and WBS etc.** aren't enough to get your team over the finish line.
- These things definitely help, but the best teams have **something else in their favor - motivation.**

Identify and plan for risks

- Risk management is a crucial aspect of project management.
- **Unidentified risks can derail a project**.
- Unexpected problems that **impact budgets, deadlines, and deliverables**.

Identify and interact with key stakeholders

- Stakeholders are the people **who have a vested interest** in your project and those who are **affected by project outcomes**.
- Some will be **directly involved** in the project, some will **influence decisions**, and some just need to be **kept in the loop**.

Be a leading example

- As a project manager, you need to lead by example.

Tips for Effective and Successful Project Management -Summary

- **Communication -**effective.
- **Goals – set Cleary**
- **Schedule - create**
- **Monitor Progress – nothing slips**
- **Team – multi-skilled**
- **Motivate –team members**
- **Risks – identify and plan**
- **Stakeholders – identify and interact**
- **Leading – with example**

Best project leaders are: (ETT PA)

Ethical: Treat all team members fairly and **communicate** transparently and honestly at all times.

A Team player: ** Take **responsibility for their own mistakes and **share** credit with the whole team.

True to their word: **Deliver on the promises** and meet deadlines.

Proactive: ** Seek to **resolve challenges and **conflicts** as they arise.

Ask questions

- Some leaders like to behave as if **they have all the answers**.

- But the best **project leaders ask the important questions**.

Why Efficient Project Management is important?

- **32%** of projects **fail**, due to **poor management**.
- **68%** of projects **fail to meet dead lines**, **budgets** and **quality targets due to poor project management**.
- **97%** of **business believe that effective project management** is **essential** for success.
- 80% of **high performance projects** are led by a **project manager with qualifications.**
- On average, a **large IT project** runs **45% over budgets**.

WHY EFFICIENT PROJECT MANAGEMENT IS IMPORTANT:



What we have discussed today?

- **Project and Important Aspects of a Project.**
- Basic things for completion of project.
- **Project in country perspective**.
- **Project Management**
- **Tips for effective & successful project management**
- **Efficient Project management**

Thank You

GEPM 375

Project Planning and Construction Management

What we are going to discuss today?

- **Project Phases**
- Project Planning Phase- Importance and definition.
- **Project Planning Philosophy**

Project –phases:

Project management is a highly specialized jobs to **achieve the objective,** it involves following **5 phases**:

- Project **Initiation.**
- Project **Planning**. & **Scheduling**
- Project **Execution**.
- Project **Monitoring and Controlling**.
- Project **Closing**.

Project Phases

Project initiation

- Project's value and feasibility are assessed and decided if the project should be pursued.

Project planning & Scheduling

- Blueprint is created to achieve the project's goals on time and within budget.

Project execution

- Project plan is put into action.

Project monitoring and control

- Project's progress is monitored to ensure that project team stays on schedule and within budget.

Project closure

- All activities related to the project's completion are concluded i.e.. submitting a final deliverable.

Project planning

Project planning is the **most important phase** of project management, because:

- It provides **direction**.
- It provides an **unifying frame work**
- It helps to **reveal future opportunities** and **threat.**

What is Project planning? bpi

- **A bridge** between ***experience*** of the **past projects** and **proposed actions** that produce favorable results in the future.

- **Precautions** by which one can **reduce undesirable effects or unexpected happenings** and thereby **eliminating confusions, waste and loss of efficiency.**

- **Involves the prior determination** of **specified factors, effects** and ***their relationship*** necessary to reach the goal.

Project Planning Philosophy (DEE) – CE construction project

- Planning should be **done logically, thoroughly and honestly** to **have a chance of success**.

- **Previous experiences** (if have) of projects **provide logic.**

- **Differences in experiences** are used to make **exceptional features** in the **basic planning logic on**:

  -Unusual clients' requirements.
  -Out of way location.
  -Potential external and internal delaying factors etc.

- **Potential problems shall have to be tackled** to reduce their **negative effects** in preparation of **master plan** of the projects and later on **scheduling the project**.

- **Each aspects of the plan** should have the provision of an **individual scrutiny** with **input** from previous experiences and experts.





Project Planning Philosophy -Summary

Question: Why planning is an important phase of a Project. Describe the planning philosophy of a project.

Planning Philosophy

- Planning to be **done logically, thoroughly and honestly.**
- **Previous experiences** (if have) of projects provide **logic.**
- **Differences in experiences** are used to make **exceptional features.**
- **Potential problems** shall have to be **tackled.**
- **Each aspects of the plan** should have the provision of an **individual scrutiny**.

Differences in experiences are used to make **exceptional features** in the basic **planning logic on**:

- **-Unusual clients' requirements**.
- **-Out of way location**.
- **-Potential external and internal delaying factors etc**.

Unusual Clients' Requirements:
Example:

Business requirement:

- 'Build an **eco-friendly house** with high-efficiency solar panels that will **reduce** carbon emissions and environmental impact.'

Stakeholder/clients' requirement

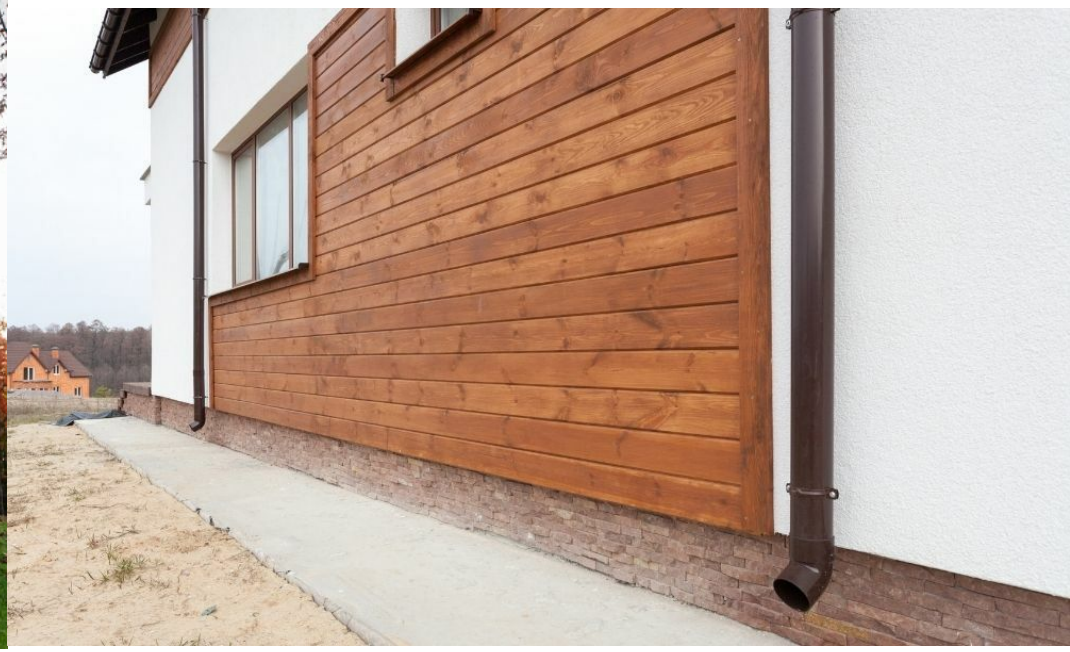
- as the owner of the house, you decide that you want **repurposed composite wood for the exterior** of your house.

Question: Describe the differences in experiences that are used to make in the basic planning logic in Project Planning Philosophy.

- However, after your **builder has placed the order**, **you discover** that your **Home Owners Association** only allows for **stucco and brick exteriors**.

- This **change** **will have a** **knock-on effect** in terms of **pricing**, **materials** and **design** and will ultimately **slow down the project**.





Repurposed woodwork for modern house

Exterior Brick work and Stucco

(Stucco: Fine plaster used for **coating wall surfaces** or **molding into architectural decorations**):





Out of way location:

- **Major drawback** is that **although the hotel is nice,** it is **in a run down area** with a lot of **graffiti** but **nowhere to go for a walk** or **have a cup of coffee**.

Graffiti: Graffiti is **writing or drawings made on a wall or** other surface, usually without permission and within public view.

Graffiti ranges from simple **written words** to elaborate **wall paintings**, and has existed since **ancient times**.







Question: Describe the Potential external and internal delaying factors etc that are used to make in the basic planning logic in Project Planning Philosophy.

Potential external and internal delaying factors etc.

Internal Delaying Factors: (FEP)

- **Financial solvency** of the company,

- **Equipment and other resources:** Company to have required equipment and other resources **on hand in time** to support the project.

- **Personnel issues** such as the **sickness or termination** of a key team member.

External Delaying Factors: (WPT)

- As. **weather, strikes, governmental or owner interference.**

- **Untimely payment** for work, may force the contractor to reduce his forces thus slowing the progress of the work.

- **Theft or damage** from accidents may cause a delay.

What we have discussed today?

- **Project Phases**
- Project Planning Phase- Importance and definition.
- **Project Planning Philosophy**

Thank You

GEPM-375

Project Planning and Construction Management

What we discussed last class?

- Project Phases
- Project Planning Phase- Importance and definition.
- Project Planning Philosophy

What we are going to discussed today?

- Types of Project Planning

Types of Project Planning







Types Project planning

Strategic planning – High level planning:

- **Long term/overall/grown-up version** of Project planning.
- **Thinking even further ahead** into the future,
- **Scrutinizing** with an even sharper eye, and
- **Accounting** for even **further unforeseen** organizational challenges and opportunities.

Question: Briefly describe the types of project planning.

Operational Planning – Execution level planning

- Project operations plan **prevents** **any unplanned action** that may not succeed in accomplishing **project** goals.

- Operations plan includes a **predetermined and documented** **course of action on the project**, which allows to review the **project** goals and determine the effectiveness of the **plan**.

Strategic planners

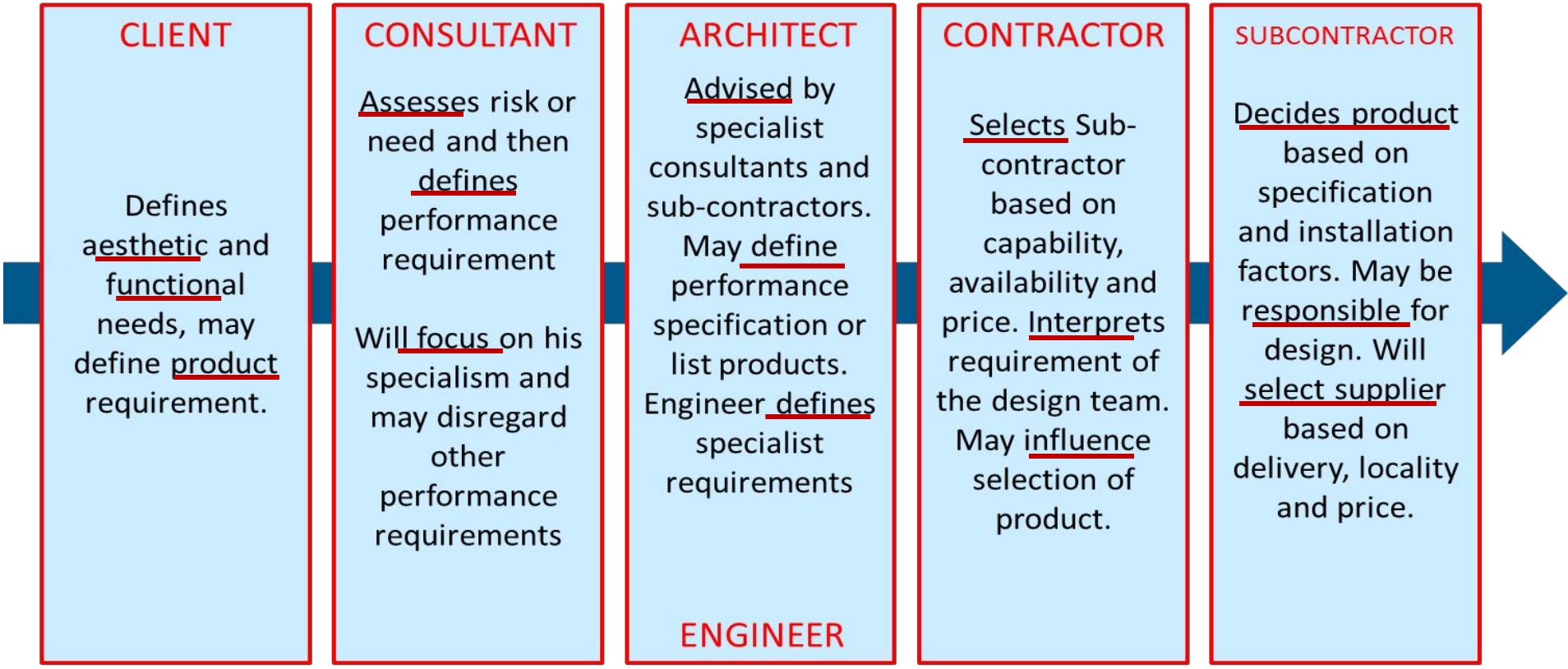
- Involves **high level persons** to select project objectives.
- They are **owner's corporate planners**.

Strategic Planners decide on the followings:

- **What project** to be built?
- What will be the **completion date** which has to meet the project goals/objectives.
- Set strategic **guidelines**.
- **Select Project Construction Team** which formulates the **project execution plan (PEP)**, within the guidelines set in strategic and operations plan.

Question: What do you understand the strategic project planning? What are points to be decided upon by the strategic planners?

Project Construction Team



Project execution plan (PEP) is the **governing document** that establishes the **means** to **execute, monitor, and control** projects.

Operational Planning

Operational Planning: Prepared by the **Project Construction Team**.

They get the **answers of certain questions** during the preparation of operational plan:

- Will operation plan **meet the strategic planning's target date?**
- Are **sufficient construction resources and services available** within the company to achieve the project objective?
- What will be **impact on the new project** on the existing work load.
- Where **we will get the resources** to handle any overload.
- What **company's policies may prevent the plan** from meeting the target date.
- Are any **long delivery of equipment or materials involved**.

Question: Define operations planning of a project. What are points to be considered during the preparation of operations plan of a project?

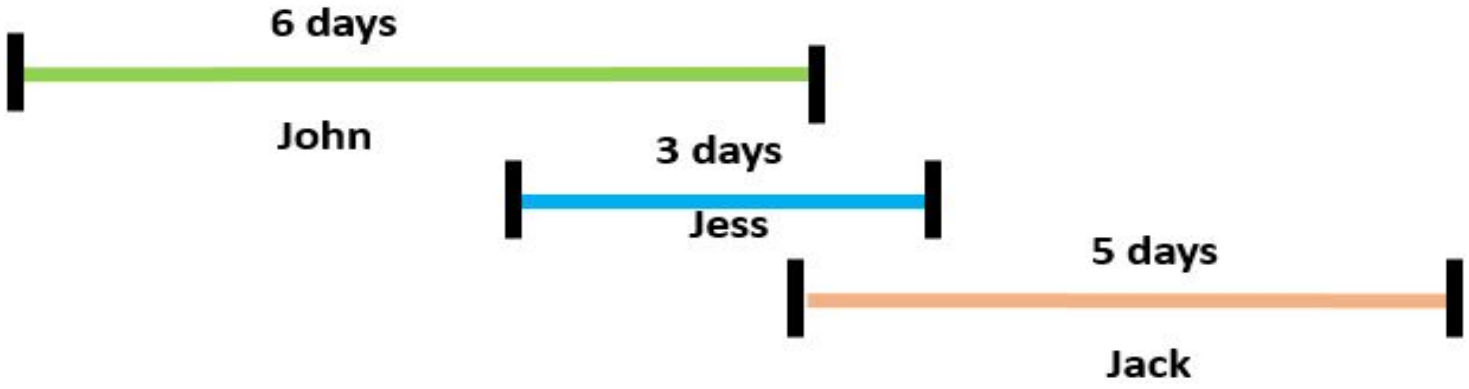
- Are the **project's concept and design firmly established, and ready to start the constructions.**

- Will it be more economical to use **a fast track** scheduling approach?

Fast Track Scheduling

- **Fast-tracking** is a **technique where activities** that would have been performed **sequentially** using the original schedule are **performed in parallel.**

- **Fast tracking** a **project** means the **activities are worked on simultaneously** instead of waiting for each piece to be completed separately.



Operations Planning -Summary

Points to be considered during preparation of operations plan of project:

- Meet the strategic planning‘s target **date.**
- **Availability** of sufficient construction **resources and services** within the company.
- **Impact** on the new project on the existing work load.
- **Additional resources** to handle any overload.
- **Limitations of company’s policies** which may prevent the plan from meeting the target date.
- **Involvement of long delivery** of equipment or materials.
- **Firm establishment of project’s concept and design** to start the constructions.
- A **fast track scheduling** approach for economic reasons.

Evaluation Project Operations Plan

- To be **reviewed, and evaluation** shall be done **as work progresses.**
- Minor **variations** are common, but major variations shall be considered with extreme cautions.

Question: Why evaluation of project operation plan is needed?

What we discussed last class?

- Types of project planning
- Strategic planning
- Operation planning

Thank you

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Project Planning and Construction Management

What we will discuss today?

What are done during project planning phase?

- **Plan is made**
  - -What is plan?
  - -Event and Activity

- **Strategies are set**
  - -How strategies are set?

- **Different aspects of project planning phase.**
  - -Six Aspects
  - -Examples

- **Policies, procedures and rules.**
  - -What these are with examples?

What is to be done in the Project Planning Phase?

- In the project planning phase
  -**Plan is made** &
  -**Strategies are set**

Taking into the considerations of Company's /Organization's
  -Policies,
  -Procedures &
  -Rules.

Project Plan

Plan is made in the project Planning Phase.

What is a plan?

- It is a **statement of intent** ie what is to be done.
- It is interpreted in terms of '**what has to be done to the resources to achieve the intent'.**
- **Plans are detailed methods,** formulated before hand, **for doing and making somethings.**

Project Planning

- Plans simply **list the targets** and **define the means of achieving them.**

Targets of plan are called **Events**, the **means** of achieving the targets are called **Activities**.

Event

- **Event is a step** that leads to the **action** or **status change** in the **project management**.
- It is the **start or the end** of the activity.
- Events **consumes neither time nor resources**.

Project planning

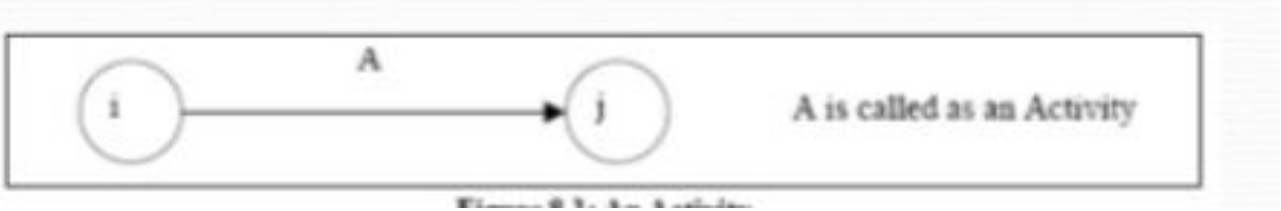
Activity

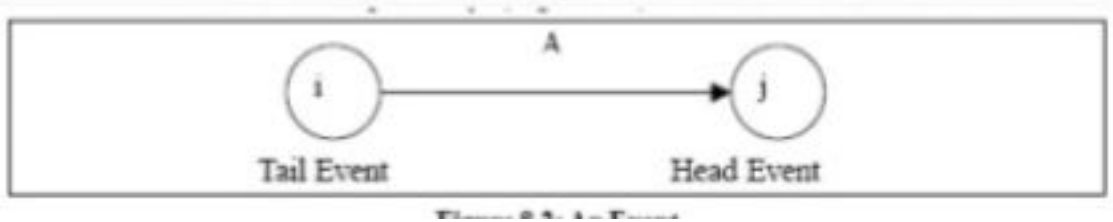
- Activity is the **actual performance of the tasks** and **requires times and resources** for its completions.

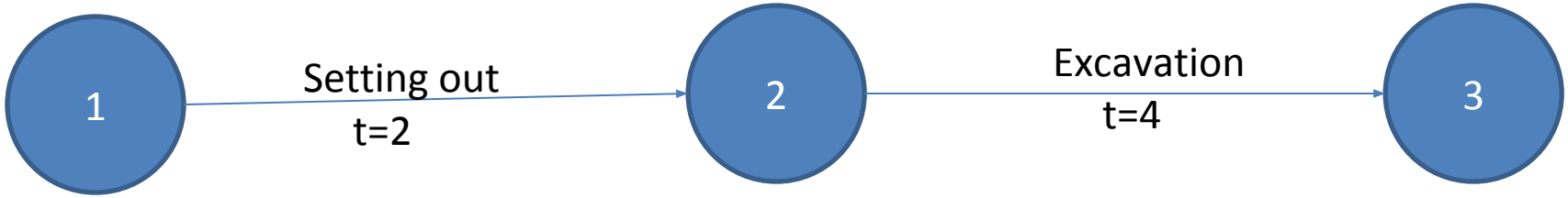
- It is the **works required** to complete a specific tasks.

- Activities are those **operations of the plan** which take time and on which resources are allocated for desired **output**.

Examples:







Tail
Event

Strategies are set at Project planning phase:

Strategies are set: **Strategies are important in planning phase**.

- Should be **aligned with corporate's goals** to drive business benefits.
- Should **specify the central concept** or **purpose** of the enterprise.
- Also **means by which it intends to carry out** the central purpose of the enterprise.

Different aspects of project planning phase: (TGOSTA)

Six Aspects of Project Planning Phase-

- **Strategic Theme**: C**ompartmentalize** strategic plan and operation plan, **specially on** quality**,** safety, people, customer, clients, service, finance, growth etc; and then **a theme is set.**

- **Goal**: **A broad statement** that translate the organization's vision statement into more meaningful and time bound.

- **Objectives**: **Quantifiable and measurable targets** of the company. (how much and when)

- **Strategies**: **Means by which it intends to carry out** the purpose.

- **Tactics or Events**: **Practical steps to achieve objective**.

- **Activities**: When **allotted to time and resources** for specific output.

Project Planning

Examples: Standard Entrepreneur or Company in Bangladesh:

- **Strategic Theme**:
- **Goal** (s):
- **Objective(s)**:
- **Strategy** (s):
- **Tactics** (**Events**):
- **Activities**:

Project Planning

Examples: **Standard Entrepreneur or Company in Bangladesh**.

- **Strategic Theme**: **Satisfaction**
- **Goal (s)**: To be considered a **trusted partners** by our clients.
- **Objective(s): Increase clients' satisfaction** from 70% to 80% by March 25.
- **Strategy** (s): Implementation of **annual client conference (1.1)**

Examples: Standard Entrepreneur or Company **(cont..)**

- **Tactics (Events):** 1.1.1 **Identify date and time**.
  1.1.2 **Develop agenda**
  1.1.3 Identify and invite **speakers**
  1.1.4 **Develop social events**
  1.1.5 Develop **menu**
  1.1.6 **Develop invitation**

- **Activities**: **Time** bound **& resources** allotment and **out put.**

Policies, Procedures and Rules

Policies, procedures and rules differ from each other in degrees of specificity:

- **Policies** usually set **broad guidelines** for the enterprises/companies.

Example of policy: 'If a customer is **dissatisfied** with any of its sale items, his/her money will be refunded'.

- **Procedures**: It **specify how to deal** in some situation.

Example of procedure:

- 'Before refunding the money of the customer, the sale's man should **carefully inspect** the items to be returned'.
- 'Then **obtain approval** from the manager for refund'.

Policies, Procedures and Rules

- **Rules:** A rule is even **more specific guidance** for the action.

Example of rule: 'Under no circumstances, will the money be refunded to the customer if she/he bring the defective items **after 3 days' of purchase**'.

Thus **Plan should be finalized, and strategies to be set** only after taking into considerations of the company's policies, procedures and rules.

Thank you

GEPM-375

Project Planning and Construction Management

What we are going to learn today:

- **Different steps in Project Planning.**
- Table of Contents
- **Important Appointments.**

Steps in Project Planning

Following are the **8 steps generally recognized** in the planning process of a Project: (DED-EDT- CD)

- **Define** the objective(s)/goal(s) of the project in definite words.
- **Establish** targets, objectives, and strategies intermediate, to **attain the final goal**.
- **Develop** forecast and means of achieving objectivres/goals.

Steps in project planning (cont..)

- **Evaluate** organizational **resources** – financial, managerial and operational – to carryout activities, and to determine what is feasible or what is not.
- **Determine** alternatives, individual courses of actions that will be able to accomplish the goal.
- **Test** for consistency with company's policy.
- **Choose** an alternative which is not only **consistent** with its goals and concept but also one that **can be accomplished** with evaluated resources.
- **Decide** on a plan.

Question: Briefly describe the different steps generally recognized in the planning process of a project.

Table of Contents-Project Planning

•INTRODUCTION

•GOALS AND OBJECTIVES

•SCOPE

•ASSUMPTIONS

•CONSTRAINTS

•PROJECT MANAGEMENT APPROACH

•ATTACHMENTS/APPENDICES

•APPROVALS

Important Appointments/ Committee in Project Management

Project Director

- **True leader** is at the strategic level.
- Responsibility is to **complete the each project** on **schedule**, within the **budget** and **scope** of the project.
- Responsible for **day-to-day management** on **behalf of the project owner** to ensure that the desired project goals are achieved.

Program Manager

- **Responsible for all related projects** under one common program.
- **All project managers are accountable** to the program manager.
- Manages the **program budget, monitoring costs** against the **benefits presented and realized** as the program progresses.

Project Sponsor

- Also called an **investor.**

- Has **ultimate authority** over the project.

- **Provides funding**, **resolves issues**, and **changes in project scope**, **approves key deliverables**, and **makes high-level decisions**.

- **Ensure the success** of the project.

- Primarily concerned with **ensuring that the project achieves** the agreed business benefits.

Project Manager

- **Bringing all project teams together** and ensuring that they can perform specialized tasks within the required time.

- **Apply the methodology approved** by the company to work on the project.

- **Project control**, which involves **monitoring the entire project**, such as **quality, schedule, budget, communication with stakeholders, and changing project plans** if they do not meet their goals.

Functional manager:

- **Directly affiliated with an organizational unit**, **with specific skills** that must meet the stated goals of the project, and has **managerial authority** over it.

- **Convey the information to the team** so that the team understands correctly what is expected of them.

- **Evaluate the overall performance**, as well as proposals for the allocation of resources.

Project Steering Committee (PSC)

•Steering Committee is a **group of high-level stakeholders** responsible for **the guidance** of overall strategic leadership and is the **highest decision-making body**.

•**Senior most member of the steering committee is the chairman** of the PSC.

Notification

The Government of the People's Republic of Bangladesh is pleased to constitute the following Steering Committee for the project "Urban Resilience Project: (URP)":

1	Secretary, Planning Division & Member, Programming Division	Chairperson
2	Secretary, Finance Division, Ministry of Finance	Member
3	Secretary, Economic Relations Division, Ministry of Finance	Member
4	Secretary, Local Government Division, MOLGRDC	Member
5	Secretary, Ministry of Disaster Management and Relief	Member
6	Secretary, Ministry of Home Affairs	Member
7	Secretary, Ministry of Housing and Public Works	Member
8	Secretary, Implementation Monitoring and Evaluation Division	Member
9	Chief, Programming Division, Planning Commission	Member
10	Chief, SEI Division, Planning Commission	Member
11	Chief, GED, Planning Commission	Member

12	Chief, Physical Infrastructure Division, Planning Commission	Member
13	Director General, PCMU, Programming Division, Planning Commission	Member
14	Director General, Department of Disaster Management (DDM)	Member
15	Chairman, Rajdhani Unnayan Kartripakka (RAJUK)	Member
16	Chief Executive Officer, Dhaka North City Corporation (DNCC)	Member
17	Chief Executive Officer, Dhaka South City Corporation (DSCC)	Member
18	Chief Executive Officer, Sylhet City Corporation (SCC)	Member
19	Director General, Fire Service and Civil Defence Department	Member
20	Joint Chief-2, Programming Division, Planning Commission	Member
21	Director (Training, Coordination and Procurement), PCMU, Programming Division, Planning Commission	Member Secretary

ToRs of PSC of Urban Resilience Project

2. Terms of Reference (ToR) of the PSC is as follows:

a) The PSC will oversee the implementation of the URP Project.

b) The PSC will review the project activities and consultants' reports regarding monitoring and evaluation.

c) The PSC will provide overall policy and strategic guidelines for the Project.

d) The PSC will review annual work plan of the project.

e) The PSC will look into the matters and issues that need to be resolved for smooth project implementation.

f) The PSC meeting will be held at least once in every 3 months.

g) The PSC may co-opt any other member, if needed.

Project Implementation Committee (PIC)

•Committee formed **by the senior members of the organization** where projects are implemented.

•**Head of the organization** normally chaired the committee.

•Members of other **concerned organizations** also present.

Project Implementation Committee (PIC)

1.	Vice-Chancellor	National University (NU)	Chairman
2.	Pro-Vice-Chancellor	National University (NU)	Member
3.	Director General	Directorate of Secondary and Higher Education (DSHE)	Member
4.	Dean (Post Graduate Studies, Training & Research Centre)	National University (NU)	Member
5.	Deputy Chief (Planning-1)	Ministry of Education (MoE)	Member
6.	Deputy Chief (Education Wing)	Planning Commission (PC), Ministry of Planning	Member
7.	Deputy Secretary (Development)	Ministry of Education (MoE)	Member
8.	Representative from ERD (Not below the rank of Deputy Secretary)	Ministry of Finance (MoF)	Member
9.	Director (P & D)	University Grants Commission of Bangladesh (UGC)	Member
10.	Representative from IMED (Not below the rank of Director)	Implementation Monitoring & Evaluation Division (IMED)	Member

11.	Registrar	National University (NU)	Member
12.	Director (P & D)	National University (NU)	Member
13.	Director	National Academy for Educational Management (NAEM)	Member
14.	Director	NTRCA	Member
15.	Senior Assistant Chief	Ministry of Education (MoE)	Member
16.	Deputy Director (P & D)	National University (NU)	Member
17.	Project Director	Project Management Unit (PMU)	Member-secretary

Terms of Reference :

- Provide guidance and direction to the PMU for proper implementation of the project
- Review the implementation progress of the project
- Monitoring and evaluation of financial and physical progress of the project as per work plan
- The PIC will sit at least quarterly.

What we have learned today:

- Different steps in Project Planning.
- Important Appointments/Committee.

Thank You

GEPM 375

Project Planning and Construction Management

Project Quality

What we learned in last class?

- Different steps in Project Planning.
- Important Appointments.

What we are going to discuss?

- **What is project quality?**
- Ensuring project quality.
- Importance of quality management.
- **What is a quality product?**
- Managing a quality product.
- **Functions and Actions needed for quality product,**
- **ISO & BSTI**

Project Quality:

Consists of **ensuring** that

- the **end product** **not only meets** the **customer specifications**,
- but is one that the **sponsor and key business experts** actually **want to use.**

Emphasizes **on**

- **preventing errors through out** ,
- **rather than inspecting** the product at the end of the project and **then eliminating errors**.

Ensuring the Project Quality:

Project Quality is a **management responsibility** and needs to be performed throughout the project.

Done by Creating the **Quality Plan** which involves:

- **setting** out the standards**,**
- **acceptance** criteria, and metrics
- that will be **used throughout the project** to ensure quality.

Quality plan, then, **becomes the foundation** for all the quality **reviews and inspections** performed **during the project** and is used **throughout project execution**.

Question: Your understanding of ensuring Quality Project

Quality Management in Project- ensuring quality through the project.

"Quality is remembered long after the price is forgotten"

Importance of Quality Management:

•A project may be **completed on time** and **within the given budget**, but if it **does not meet the specified quality** (or performance criteria), it will:

-at best attract criticism and

-at worst be considered failure.

•**Striking a balance** between meeting the three most essential criteria of **time**, **cost** and **quality** (Figure) is one of the critical tasks of PM.

Question: Describe the importance of quality management in a project**.**

- Even where, quality is synonymous to safety, **a failure in quality can be expensive, dangerous and can destroy an organization's reputation** far quicker than it took to build up.

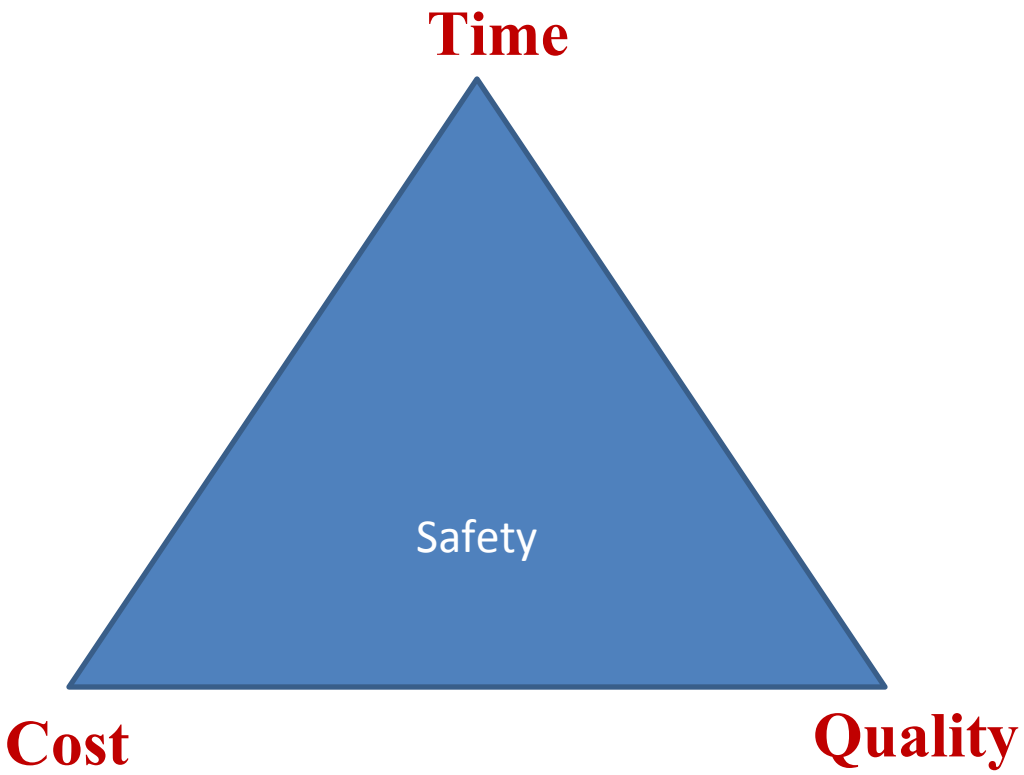


Figure: Project triangle

Describe the **quality product** of a project.

Quality Product:

- If **a product meet the "specified performance criteria** for specified **minimum time"**, it can be said to be a quality product.

A quality product has to be

- **defined**,
- **planned**,
- **designed,**
- **specified,**
- **manufactured** and
- **commissioned** to an **agreed set of standards**.

- **Works involve every department** of the organization from the top management to the dispatch.

Question: Describe the efficient and effective management of the quality of product in a project?

Managing Quality of Product

- **Every level** of an organization should be **involved and be committed to achieve the required performance standards** by setting out the operating procedures and standards.

- Quality is **an attitude of mind** that should **permeate right through** an organization from the **board of directors down to the operatives** on the shop floor.

- Every one should be responsible for **ensuring that his or her works meet the quality standards** set down by the management.

- **Checks and audits are to be carried out on regular basis** to ensure that the specified standards are met by QA Teams.

Question: What are the functions and actions need to be implemented to ensure the consistency of performance to obtain a quality product of a project?

Consistency of Performance:

Functions and Actions need to be implemented for **consistency of performance** to obtain a quality product**:**

- **Quality standards** have been **defined.**
- **Quality requirements** have been **disseminated**.
- **Correct equipment** has been **set up.**
- **Staffs and operatives** have been **trained**.
- **Materials** have been **tested and checked for conformity**.

- **Adequate control points** have been **set up**.
- **Designated components** have been **checked at predetermined stages and intervals.**
- **Feedback and rectification process** has been **set up**.
- **Regular quality audits and reviews** are carried out.

All these steps are to be **included in quality manual** with the quality policy, plan and program.

Important Quality Control Definition:

Quality Assurance (QA):

- **All the planned and the systematic actions necessary to provide confidence** that an item, service or facility will **meet the defined requirements.**

- A set of **documents which give evidence** of how and when the different quality procedures and systems are actually being implemented.

- **Guidelines for quality assurance standards are published by various national and international institutions.**

Question: Describe the quality assurance of a product to the customers by the project manager.

Important Terms – Related to Quality

Quality Control:

- QA actions provide **means of control** and **measure the characteristics** of an item, process or facility to establish requirements.

- **Control covers the actions** to be taken by different staffs and operators employed and the **availability of the necessary tools** to enable the works to be done.
- **Performance (measure) criteria are often set** by the **feed back** from market research & customer requirements and **confirmed** by top management.

Question: What is quality control in a Project?

Quality Plan

- **Defines** as **control document which set**, **applicable standards**, **inspection methods** and **inspection authority**.

- Also defines **contract specific documents** which can vary in content and size from company to company.

Defines followings in details in Quality Plan:

- **Processes** to be employed.
- **Hold points** of each production process.

Points to be included in a Quality plan: TCS- MPIA

- **Tests to be carried out** for different **materials and components**, which include:
  -Dimensional checks and weight checks.
  -Material test (physical and chemical)
  -Non-destructive tests (radiography, ultrasonic etc.)
  -Pressure test
  -Leakage test
  -Electrical tests
  -Qualification and capability tests

Quality Plan (cont.)

- **Control documents** including reports and concession requests.
- **Standards to be applied** for different components.
- **Methods of inspection**.
- **% of items or processes** (such as welds) to be checked.
- **Inspection authorities**, whether internal, external or statutory.
- **Acceptance criteria** for the tests and checks.

Question: What is a quality plan of Projects? What are points to be included in a quality plan of a project?

Organizations Control the Quality

- **ISO 9001**: Quality System- Model for **Quality Assurance** in design and development, production, installations and servicing.

- **ISO 9002**: Quality System- Model for Quality Assurance in **production** and **installations**.





ISO: International Organizations for Standardization.



- **Established:** As Federations of International Standard Association **(ISA) during WW II in 1942**.
- **After WWII**, members of ISA and UNSPSC (United Nations Standard Products and Services Council(UNSPSC) & delegates from 25 countries, **form ISO.**
- **Effective** in **February 1947**.
- HQ Geneva
- More than 250 technical committees decide on standardization.

BSTI: Bangladesh Standards and Testing Institute, Ministry of Industry.

- **Purpose: Controlling** the Standard of Services and Quality of Goods.
- **Established**: **1971**
- **Member** of ISO in **1974.**
- **Merges** of: Bangladesh Standard Institute
  Central Testing Laboratories
  Department of Agricultural Grading and Marketing.
- **Location**: Tejgaon Industrial Area.

Project Quality

Quality control in Bangladesh is handled by **global firms**:

- **Intertek**
- **Bureau Veritas**
- **QIMA**
- **Tetra Inspection**
- **AQF**

Local Specialists:

- BPO BD
- Group QA
- Crusher lab QA and SOAT Lab
- QC Hub Inspection and Services
- Believer Compliance
- IISPL

Project Quality

What we have discussed today?

- What is project quality?
- Ensuring project quality.
- Importance of quality management.
- What is a quality product.
- Managing a quality product.
- Functions and Actions needed for quality product,
- ISO & BSTI

Thank You

GEPM 375

Project Planning and Construction Management

Project Quality

Project Quality

What we discussed in the last class?

- What is project quality?
- Ensuring project quality.
- Importance of quality management.
- What is a quality product.
- Managing a quality product.
- Functions and Actions needed for quality product,
- ISO & BSTI

What we are going to discuss today?

- **Important terms** – related to quality.
  -Quality audit
  -Quality reviews
- **Cause and Effect Analysis**

Example – cause and effect analysis

- **Trend analysis**.

Quality Audit

•A **periodic check** that the **quality procedures set out** in the quality plan have been **carried out**.

•Where an organization is **officially registered as being in compliance with a specific quality standard** such as ISO 9000, an **annual audit by an independent authority** may be carried out **to ensure that the standards are still being met.**

Quality Reviews:

•A **periodic review** of the **quality standards**, **procedures and processes** to ensure their applicability to current requirements.

•As part of review processes, existing, proposed or new **suppliers and contractors have to confirm their compliance** with quality assurance procedures.

Cause and Effect Analysis (what it is?)

- **Select certain (usually critical) items** and
- **Identify all possible modes of failures** which could occur during its life cycle.
- **Probability, cause, impact of such failures** are then **assessed** and necessary **controls and rectification processes put in place**.
- If the **possible modes of failure are more,** then if necessary, **change the design**.





Example: Techniques can be applied to find the main causes affecting the probability of a **'Domestic Vacuum Cleaner'.**

Step-1:

- **List down all of the main causes** which are generally experienced when using such a machine.

- May **require the brain storming** session to generate the causes.

- **Causes are**:

  -Electrical

  -Physical (weight and size)

  -Mechanical (brush wear)

  -Suction (dust collection)

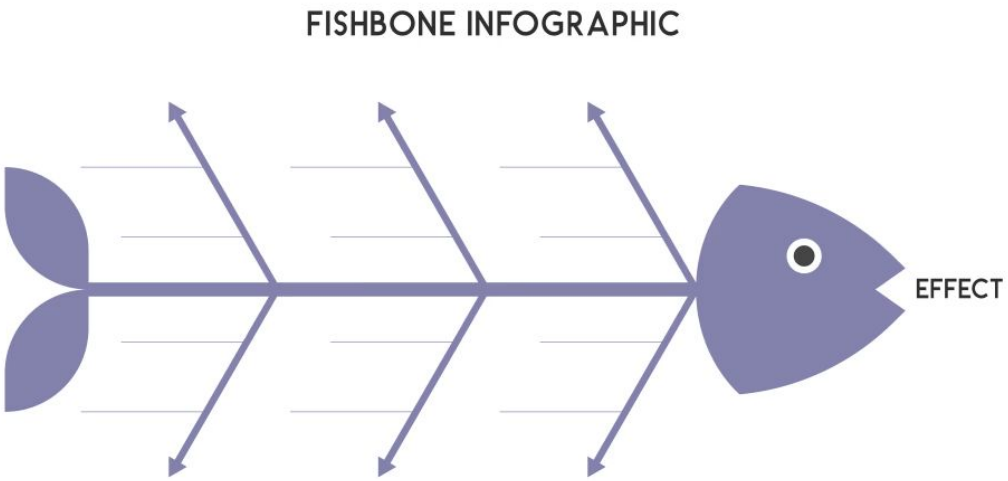


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Step-2

- Draw the **cause and effect diagram**, known *as* ***Ishikawa*** **or** ***fishbone*** diagram.

- From this diagram, it is possible to **see clearly how these causes affect the operation of the vacuum cleaner.**

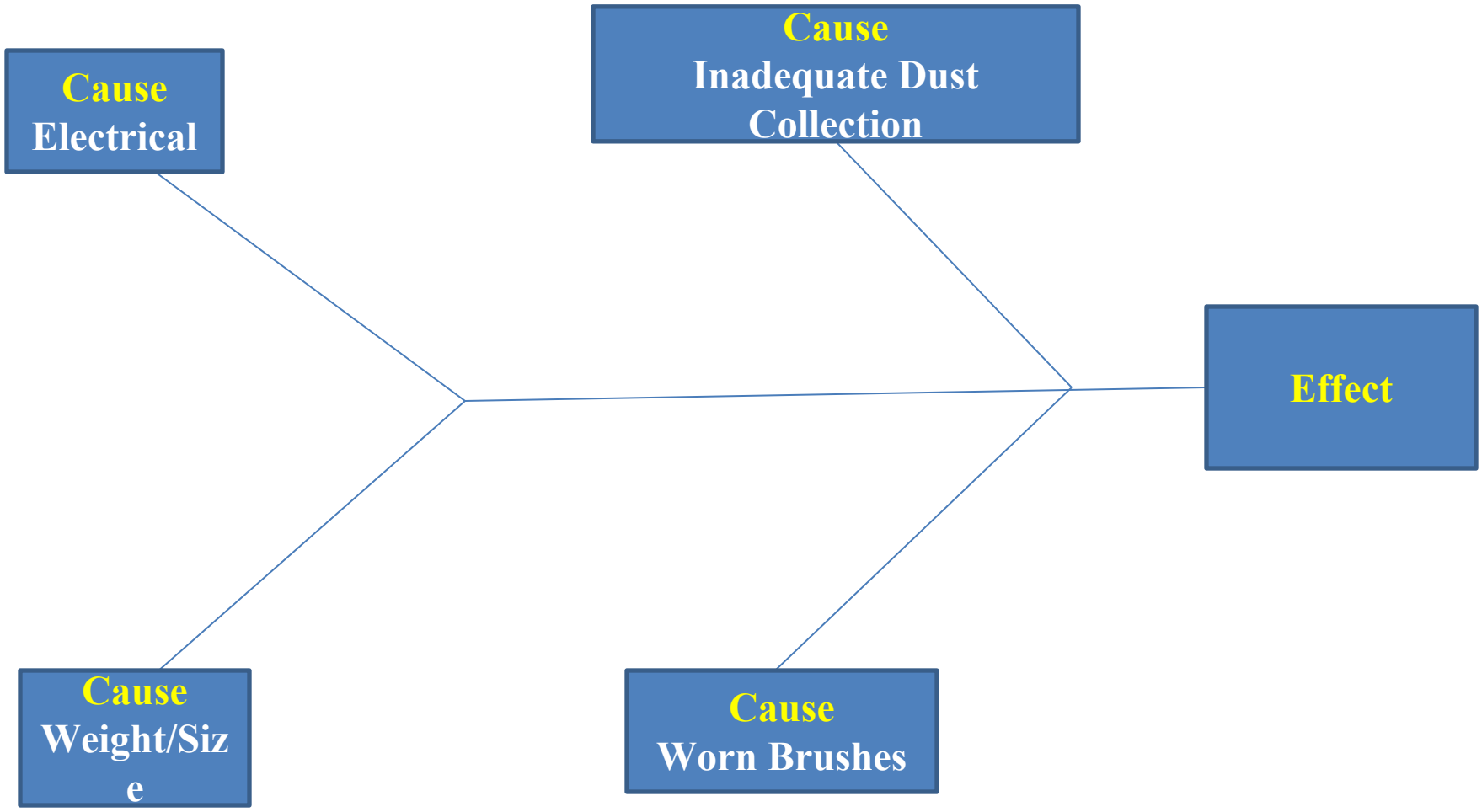


Kaoru Ishikawa (July 13, 1915 – April 16, 1989) was a **Japanese Organizational theorist.**

- Professor at the **Faculty of Engineering** at The University of Tokyo, noted for his **quality management innovations**.

- He is considered a key figure in the **development of quality initiatives** in Japan.

- He is best known outside Japan for the **Ishikawa or cause and effect diagram (also known as fishbone diagram)** often used in the analysis of industrial process.


Cause
Electrical
Cause
Inadequate Dust
Collection
Effect
Cause
Weight/Siz
e
Cause
Worn Brushes

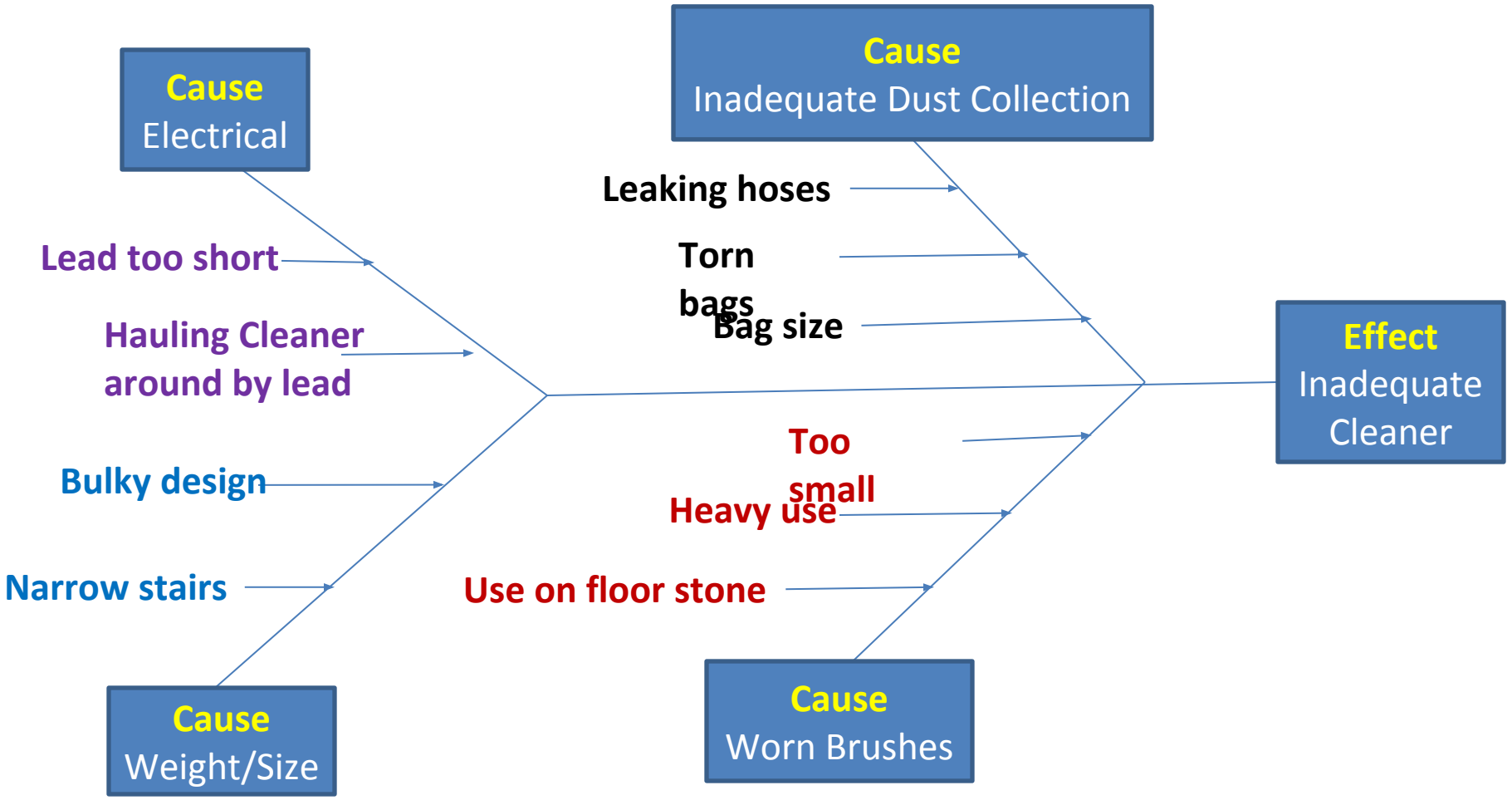
Step -3

- All the **sub-causes of main cause to be written** against the tributary lines (or fish-bones) of each cause.

- **Example**: the sub-cause of electric failure are:

  (i) the **lead being too short**, thus pulling the plug out of the socket, or

  (ii) hauling the cleaner by the lead and causing a break in the cable.


Cause
Electrical
Lead too short
Hauling Cleaner around by lead
Bulky design
Narrow stairs
Cause
Weight/Size
Cause
Inadequate Dust Collection
Leaking hoses
Torn bags
Bag size
Too small
Heavy use
Use on floor stone
Cause
Worn Brushes
Effect
Inadequate Cleaner

Step - 4

- **Assess** the **number of times, over a measured period,** each cause has resulted in a failure.

- **Concentration can be done on those causes** which are responsible for the most complaints.

- Assessment can be done by ***Pareto Analysis***.

Pareto Analysis:

- **Vilfredo Pareto**, Italian economist and sociologist, in 19th century.

- Discovered that in Italy, **90% of income was earned by 10% of the population.**

- Further study shows, that this **distribution, was also true for many other situations** from political power to industrial problem.

Pareto's Law:

- 'In any series of elements to be controlled, **a small fraction in terms of the number of elements always account for a large fraction in terms of effect'.**

Case of Vacuum Cleaner:

- A failure table is prepared as % figure that can be calculated by **tabulating the causes and number of times they resulted** in a failure over a given period (say 1 year), and then **converting these into a %** of the total number of failures.

- In general, only a **relative a small number of causes are responsible for the most serious effects**.

- Survey of faults in Failure table shows that out of 50 failures, the **four main causes examined**, **inadequate dust collection is responsible for 76% (nearly 80%) of the failures** or **cor**

- This is why, **Pareto's Law is sometimes called 80/20 rule**.

Cause	No. of failures	% of failures
Electrical	6	12
Physical	2	4
Mechanical	4	8
Suction	38	76
Total	50	100

Failure table

- In the **Pareto Chart**, if the **impact Y,** in terms of % of problems encountered are plotted against the number of **causes X, identified.**

- Shows 76% dust collection causes most of the failures of vacuum cleaner.

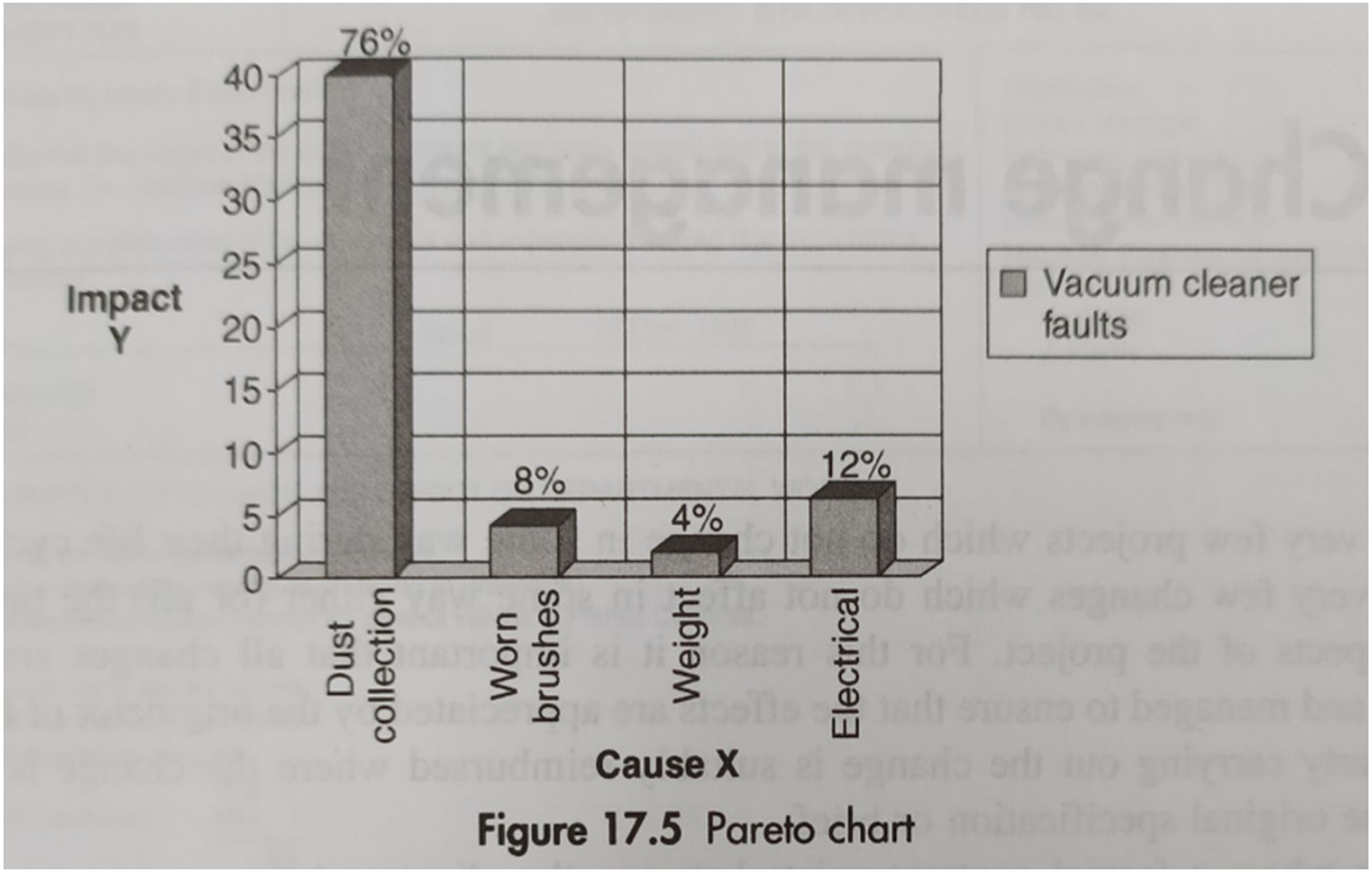


Figure 17.5 Pareto chart

Trend analysis:

- **Part of Project Control process** is to issue regular reports which **log:**
  - **nonconformance,**
  - **accepted or non accepted variances,**
  - **delays,**
  - **cost overruns or**
  - **other problems.**

- If these reports are **viewed on regular basis**, **trends may be found out**.

If trends are considered to be adverse, can be addressed by taking appropriate corrective action.

If trends are **considered to be opportunity,** can be taken to check:

- whether there has been a **deficiency in the procedures** or documents, and
- whether other **components are affected**.

- **Cause and source of a failure has to be identified** which may require a review of all the suppliers and subcontractors involved.

Thank You

GEPM-375

Project Planning and Construction Management

Project Risks

What we are going to learn today?

- **What is project risk?**
- How the risks to be analyzed**?**
- **Risk management plan.**
- Stages of risk management**.**
- Processes/methods of risk identification**.**
- Risk owners**.**

Project Risk

- A **risk is an event** that **may or may not happen**, if it happens, could have a **significant effect** on the **outcome** of a project.

Example:

- There may be a **50% chance** of a **significant change** in **sponsorship** in the next few months.
- CASE Project.

Analysis of Risks in Projects

•**Determination of both** the **probability** that a specific event may occur and if it does, assessing its **impact**.

•**Quantification** of both the probability and impact will lead to determining which are the **highest risks that need attention.**

•**Risk management** includes **not just assessing the risk**, but **developing risk management plans** to understand and communicate how the team will respond to the **high-risk events**.

Risk Management Plan:

- **Document produced at the start of project**, **sets out requirements of risk assessment** and **risk management procedures**.

- **Document also produced at the time of estimating** or **contract tender stage** so that **provisions can be made in the cost build-up** of the tender document.

Main Contents of a risk management plan

- **General/Introduction**: Explaining the **needs** for the risk management process.

- **Project Description**: Only required, if not part of PMP.

- **Type of risks**: Political, technical, financial, environmental, security, safety etc.

- **Tools and techniques**: Risk identification methods ie computer analysis etc.

- **Risk reports**: Updating of risk register, exception reports, change reports etc.

- **Attachments**: Important project requirements, dangers, exceptional problems etc.

Stages of Risk Management Procedures:

- Stage-1: Risk Awareness
- Stage-2: Risk Identification.
- Stage-3: Risk Assessment
- Stage-4: Risk Evaluation
- Stage-5: Risk Management

Stage-1: Risk Awareness

- Project team **begins to appreciate** that **there are risks** to be considered.

- Risks may be **pointed out** by **an out sider, or the team** may be able to draw on their **collective experience**.

- Once this **attitude of mind has been achieved**, ie **projects are at risk**, then go for next stage.

Stage-2: Risk Identification

Risk

A long list of activities which **may be affected** by **one or a number of adverse situations** or unexpected occurrences.

Process of Risk identification:

- Essentially a **team effort**, at which the **scope of the project is examined and each aspect is investigated** for a possible risks.

- Team may have **brain storming** for investigation and use a **prompt list or check list** compiled from risk issues from similar previous projects.

- **Obtain expert opinion** or **carry out interviews** with outside parties.

Risk Identification Methods/Processes:

- Brain storming
- Prompt lists
- Check lists
- WBS
- Delphi methods.
- Asking experts

Risks to be Considered:

- **Technical Risks:** New technology or materials - **Test failure**;

- **Environmental Risks**: Unforeseen weather condition - **Traffic restrictions**;

- **Operational Risks**: New systems and procedures - **Training needs**;

- **Cultural Risks**: Established customs and believes.

- **Financial Risks**: Freeze on capital, Bankruptcy of stakeholders. Currency fluctuation.

Risks to be considered (cont..)

- **Legal Risks:** Local laws - **Lack of clarity** of contract;
- **Commercial Risks**: Change in market conditions or customers;
- **Resource Risks**: Shortage of staffs, operatives or materials;
- **Economic Risks**: Slow-down in economy, change in commodity prices;
- **Political Risks**: Change in government or government policy;
- **Security Risks**: Safety, Theft, Vandalism.

Risk identification process/methods:

Brain Storming:

Advantages:

- Wide range of possible risks suggested for consideration.
- Involves a number of stakeholders.

Disadvantages:

- Time consuming,
- Requires firm control by facilitator.

Prompt List (from list of previous project):

Advantages:

- Gives benefit of past problems.
- Saves time by focusing on real possibilities.
- Easy to discuss

Disadvantages:

- **Restricts suggestions** to past experience.
- Past problems may **not be applicable**.

Checklist:

Advantages:– Similar to prompt list; company standards.

Disadvantages: Similar to prompt list.

Work breakdown structure:

Advantages:

- Focused on specific project risks.
- Quick and economical.

Disadvantages: May limit scope of possible risks.

Delphi Technique:

- **Delphi Technique** refers to the **systematic forecasting method** used to **gather opinions of the panel of experts** on the problem being encountered, through the **questionnaires**, often sent through mail.

- A **set of opinions pertaining to a specific problem**, obtained in writing usually through questionnaires from several experts in the specific field.

Advantages:

- Offers wide experience experts
- Can be wide ranging.

Disadvantages:

- Time consuming if experts are far away.
- Expensive if experts have to be paid.
- Advice may not be specific enough.

Asking Experts:

- Advantages: As Delphi
- Disadvantages: As Delphi

Who is risk owner:

- Person who is **the best to manage** each risk.
- He is **in charge of monitoring and managing risk** during the life of the project.

Thank You

GEPM-375

Project Planning and Construction Management

Evaluation of Project Risks

What we learned in the last class.

- **What is project risk?**
- How the risks to be analyzed**?**
- **Risk management plan.**
- Stages of risk management**.**
  - **-Stage 1: Risk awareness**
  - **-Stage 2: Risk identification**
- Processes/methods of risk identification**.**
- Risk owners**.**

Stage-3: Risk Assessment

What is to be done to select most probable risks from the long lists of risks?

•To reduce the number of risks being seriously considered from the very long list, **some form of screening** will be necessary.

•Only **those risks which pass certain criteria** need to be **examined more closely for risk assessment.**

•Risk assessment is the **qualitative stage** at which the **two main attributes** of risk, ***Probability* and *Impact*** *are examined.*

- **Probability of risk** has to be assessed using:
  - **Experience** and /or
  - **Statistical data** ie. Historical weather charts, or
  - **Close-out reports** from previous projects.

•Each risk can then be given **a probability rating** of **HIGH, MEDIUM, or LOW.**

- **Impact of risk has to be assessed taking into account all the**:

  -available data,

  -past project histories and

  -expert opinion.

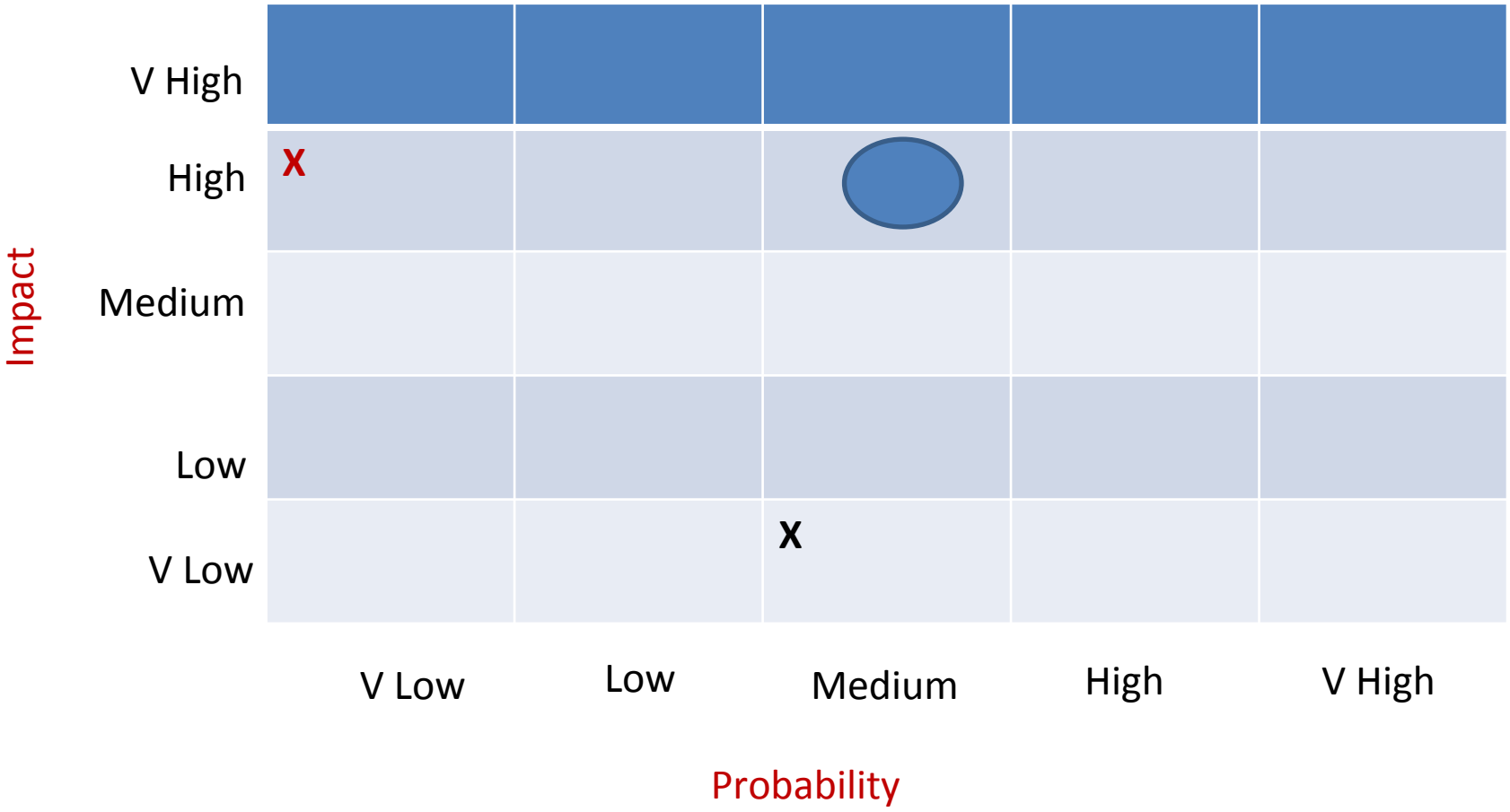
- Impact or effect on the project can be **rated** a **Very High, High, Medium or Low.**

- A **simple matrix can now be drawn up** which identifies whether a risk should be taken any further.

- **Probability v impact table** (Figure) could be **used for each risk worthy** and to **assess all major risks** to a project or program.

Table: Probability vs. Impact

Unforeseen weather- Severe Flood



- Each risk can now be given a **risk number** to **draw up a simple chart** which **lists all the risks** so far considered.

- **Risk summary Chart** will include:

  -risk **number**,
  -a short **description,**
  -probability **rating**,
  -impact **rating** and
  -risk owner.

	Risk summary Chart			
Risk No.	Description	Probability Rating	Impact Rating	Risk Owner
1.	Severe Flood	Medium	High	Mr. X
2.				

Figure: Risk Summary Chart

Probability of risk has to be assessed using:

- **Experience and**
- Statistical **data ie.** Historical weather **Charts,**
- Close-out **reports** from previous projects

Impact **h**as to be assessed taking into account all the:

- available **data,**
- past project **histories** and
- expert **opinion.**

Step-4: Risk Evaluation

- After the preparation of Risk summary Chart, a **quantitative analysis can now follow**, **which is known as Risk evaluation.**

- Now, **comparative values**, often to **scale 1-10, are given to the probability and impact of each risk**.

- By drawing up a **matrix of the risks**, an **order of importance or priority** can be established**.**

Question: Describe the process of risk evaluation of a project.

Risk Evaluation

Exposure rating:

- By **multiplying** the **impact rating** by the **probability rating**, the **exposure rating** is obtained.

- A **convenient indicator**, which may be used **to reduce the list** to only the top dozen, that require serious attention.

- But an **eye should always be kept on other minor ones**, some of which may **suddenly become serious** if unforeseen circumstances arise.

- Exposure table (Figure) shows clearly that the **higher the value, the greater the risk** and **more attention** it must receive to manage it.

Exposure Table:

Description of Risk: **Severe Flood**

Exposure Table- 1. Sever Flood								
	Probability							
	Rating		Very Low	Low	Medium	High	Very High	
Impact		**Value**	**1**	**2**	**3**	**4**	**5**	
	Very High	**5**						
	High	**4**			**3x4=12 (1)**			
	Medium	**3**						
	Low	**2**						
	Very Low	1						

Exposure Rating

5 X 5 Matrix

Number the Rating:

- To quantify both the **impact and probability** is to number the ratings from 1 for very low to 5 for very high.

- By multiplying the appropriate numbers in the boxes, a **numerical exposure rating** is obtained.

- **Numerical exposure rating gives a measure of seriousness and importance** for further investigation.

- If the impact is rated 3 (ie. Medium) and the probability 4 (ie. High), the exposure rating is **3x4=12.**

- Establish lists of prioritized risks.

5 X 5 Matrix

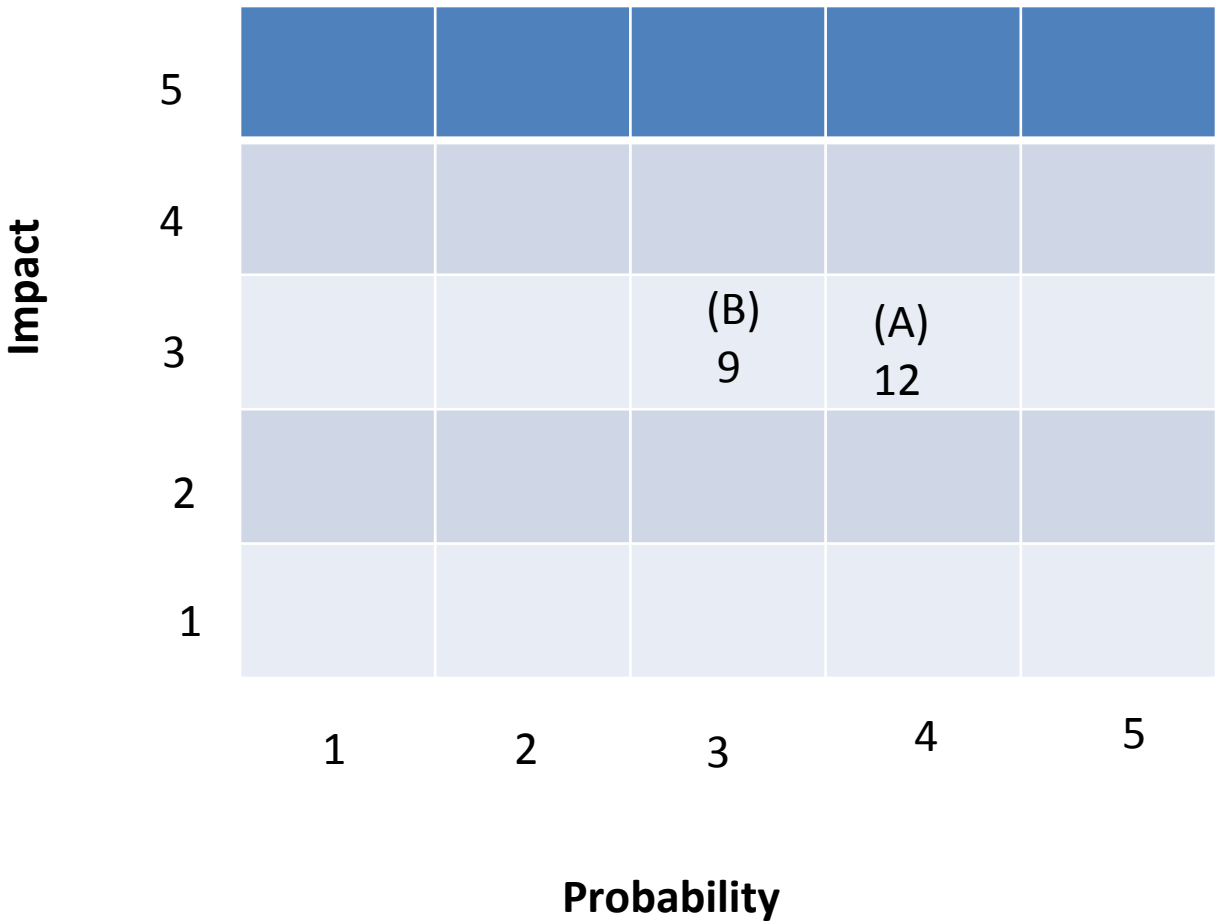


Figure: 5x5 matrix

Example:

Risk A:

Impact=3

Probability=4

Risk rating=3x4=12

Risk B:

Impact=3

Probability=3

Risk rating=3x3=9

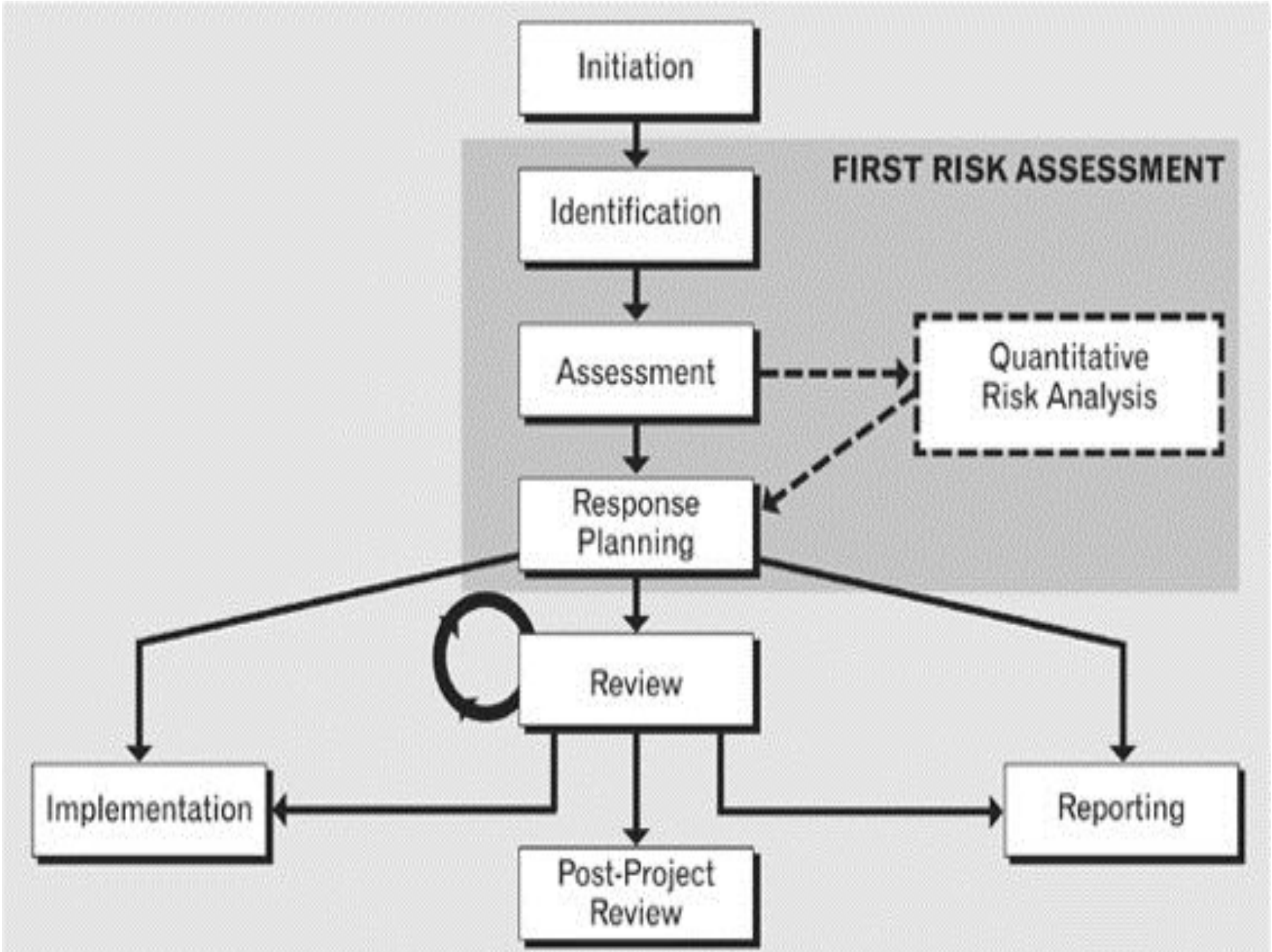
5 X 5 Matrix

Stage 5: Risk Management

- Having **listed and evaluated the risks and established a table of priorities**, the next stage is to **decide how to manage the risks.**

- **Manage the risks**, means **what to do about them and who should be responsible for managing them.**

- A **risk owner** to be appointed to every risk, who has to monitor and control the risk.


Initiation
FIRST RISK ASSESSMENT
Identification
Assessment
Quantitative
Risk Analysis
Response
Planning
Review
Implementation
Reporting
Post-Project
Review

Risk Owner

•Employed by project management team.
•An individual or team
•Well trained
•Responsible for managing and mitigating effects of risks by monitoring, assessing, developing response plan and setting up strategies to execute during risks.

Rules of Risk Owner:

- Owns risks
- Determine risk rating,
- Reassess or change rating.
- Implement risk response plan
- Monitor and reports.

Options Available

Options available to the Project Manager (PM)/Risk Owner when he faced with a set of risks:

- **Avoidance** – keeping away from.
- **Reduction** - act of making something smaller or less.
- **Sharing** - process of dividing and distributing.
- **Transfer** - move from one to another.

Options available to the project manager when he faced with a set of risks (cont):

- **Deference** – to put off (an action or event) to a later time; postponement.
- **Mitigation** - to lessen in severity
- **Contingency** - something that might happen in the future
- **Insurance** - protection from financial loss.
- **Acceptance** - action of consenting to receive or undertake something offered.

Options for a set of Risk faced by PM/Risk Owner are explained with

Example:

"Owner of **semi-detached** house **decides to replace part of his roof with solar panels** to save on his hot water heating bill".





Risk 1 : **Installer may fall off the roof**.

Option: Transfer –Employ a builder who is covered by insurance.

Risks can all be managed by applying one or several of options available to Project Manager:

Risk 1 : **Installer may fall off the roof**.
Option: Transfer –Employ a builder who is covered by insurance.

Risk 2: Roof may leak after completion.
Option: Transfer – Insist on a two-year guarantee for the work.

Risk 3: Panel may break after installation.
Option: Insurance – Add the panel replacement to the house insurance policy.

Risk 4: Birds may befoul the panels..
Option: Mitigation – Provide access for cleaning.

Risk 5: Electronics control may not work.
Option: Reduction – Ensure a control unit is used which has been proven for a number of years

Risk management (cont..)

Risk 6: Heat recovered may not be sufficient to heat the water on a cold day.

Option: Contingency – Provide an electric immersion heater for cold spells.

Risk 7: It may not cover the cost if the house is sold within 2-3 years.

Option: Deference – Wait for three year before selling the house.

Risk 8: Cost of the work will probably never pay for itself.

Option: Avoidance – Don't go for the work.

Risk 9: Cost may escalate due to the unforeseen structural problems.

Option: Sharing – persuade the neighbor in the adjoining house to install a similar system at the same time.

Risk Monitoring

- To control of the risks, a **risk register should be maintained** which **lists all the risks** and **their method of management.**
- **Risk owners** if appointed, will be identified on the register.
- Risks must be **constantly monitored** at preset periods.
- Register must be **reassessed and if necessary amended**, to show the latest position.
- As the projects proceed, the **risks reduce in number**; contingency **sums** may be allocated to other area of the project.
- If **new risks emerge**, they must be taken care off.

Thanks

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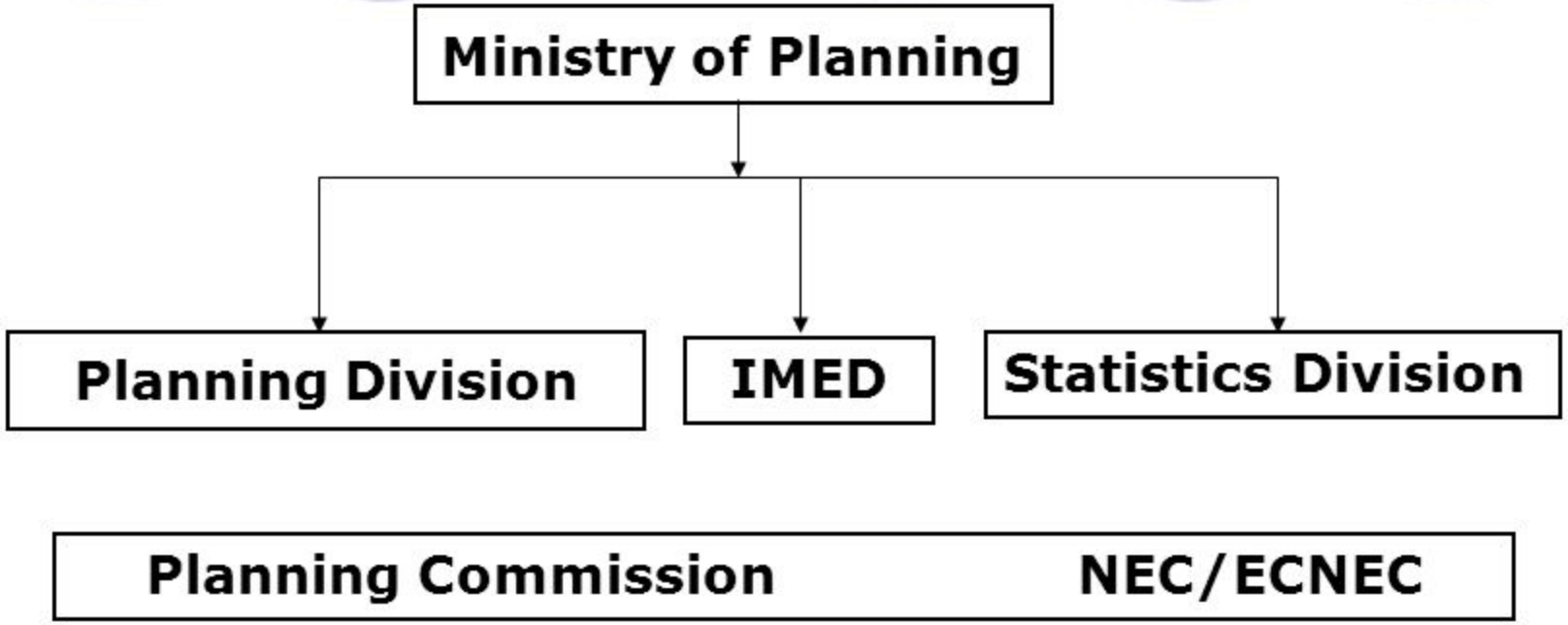
Project Planning and Construction Management

Planning Process of Development Project in Bangladesh

Today we are going to learn:

- Organization of Ministry of Planning.
- Structure, Rules and Functions of Planning Commission.
- ADP
- Works of Planning Commission through NEC and ECNEC
- ADP Formulation and ADP of FY 25
- Planning Process and Approval of Dev Project
- Duties od IMED & CPTU

Ministry of Planning :



Planning Division works as the secretariat of the Planning Commission



Ministry of Planning

Responsible for **socio-economic development planning** and **statistical management** of Bangladesh.

GDP – Gross Domestic Product:

- **Total monetary or market values** of all **finished goods and services produced within country's boundary** in a specific period of time.
- **Comprehensive score card** of country's **economic status**.
- GDP is around **$450-$460 billion** (nominal) for 2024/2025. with projections for **2025 around $475 billion**.
- **Per capita GDP** is roughly **$2,700-$2,820** (BBS FY 2025)
- Per capita GDP varies significantly by country in 2025, with wealthy nations like Ireland $108,919 and **Switzerland $104,896** USA $89,105, **Singapore $92,932** and Qatar &71,653.

Ministry of Planning

Planning Division:

- Bangladesh Institute of Development Studies (BIDS)
- Planning Commission (PC)
- National Academy of Planning and Development (NAPD)

Statistic Division:

- Bangladesh Bureau of Statistics (BBS)

IMED – Implementation, Monitoring and Evaluation Division

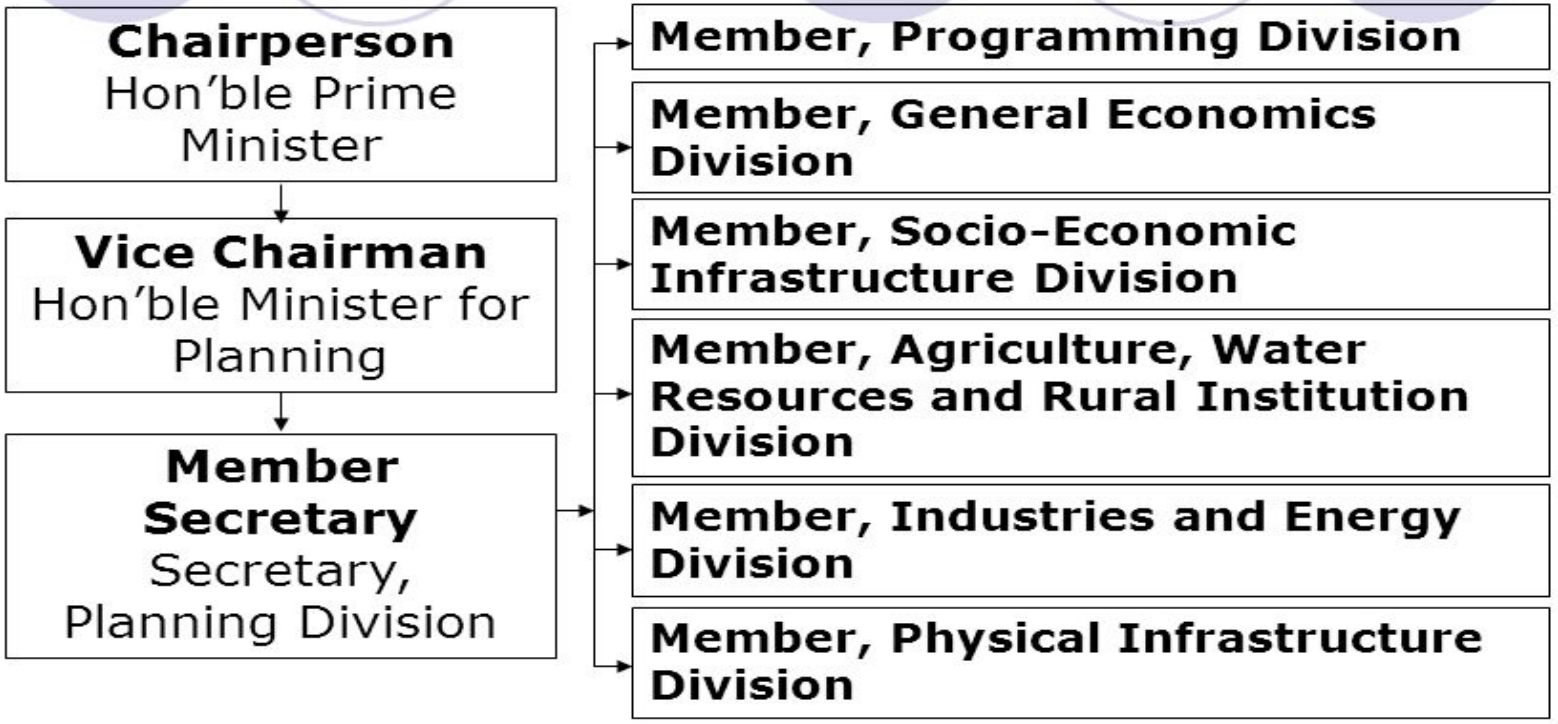
- CPTU – Central Procurement and Technical Unit

Planning Commission (PC):

- **Institute of Public Finance (IPF)** of GoB.
- In **tandem under Ministry of Planning** and **alongside Ministry of Finance.**
- **Planning Division**, Ministry of Planning works as **secretariat** of PC.

Planning Process in Bangladesh

Structure of Planning Commission



Planning Process in Bangladesh

Role of Planning Commission

- **Planning Commission is entrusted with the task of planning socio-economic development of the country**
- **It has a three-fold role in development**
  - **Advisory role:** Advising the government in matters of development goals and objectives, priorities, strategies and policy measures
  - **Executive role:** Preparation of plan, processing of development projects for approval, preparation of Annual Development Programme (ADP)
  - **Coordination role:** Co-ordination of whole range of planning activities

Question: Describe the task and roles of Planning Commission in the planning of socio-economic development of Bangladesh.

What is ADP?

- Annual Development Program (ADP) - is the **operational document of the GoB's 5 year plan** and includes all types of
  - **-GoB funded** and
  - **-Foreign Aided Projects** which are ongoing and newly included.

- **ADP consists of the**
  - **-main investment program**,
  - **-technical assistance program** and
  - **-self-financed program**, which are sub-divided into the different government sectors.

- ADP is **published** in June and is available to the public.

Works of Planning Commission

Planning Commission mainly works through:

- National Economic Council (NEC)
- Executive committee of National Economic Council (ECNEC)

National Economic Council (NEC)

- NEC the highest body for consideration of development activities reflecting of long term national policies and objectives

- **Composition**
  - Chairperson: Hon'ble Prime Minister
  - Member: All Members of the Council of Ministers
- **Persons required to assist NEC**
  - Cabinet Secretary, Principal Secretary
  - Governor, Bangladesh Bank
  - All Members of Planning Commission
  - Secretaries of Ministries/Divisions

Question: What is NEC?

What is cabinet or council of Ministers?

- **Cabinet of Bangladesh** (বাংলাদেশের মন্ত্রিসভা–*Bānglādēśēr Mantri'sabhā*) or **Council of Ministers** বাংলাদেশের মন্ত্রিপরিষদ – *Bānglādēśēr Mantri'pariṣad*) is the **chief executive body of the People's Republic of Bangladesh.**

- Cabinet is the **collective decision-making body** of the entire government under the **Office of the Prime Minister**, composed of:

  Prime Minister and

  -25 Cabinet Ministers,

  -7 Advisers,

  -18 State Ministers, and

  -3 Deputy Ministers.

Functions of NEC

- Provides overall guidance for perspective plan, Five Year Plans, PRS, ADP & Economic Policies
- Finalizes & approves plans, programmes & policies
- Reviews implementation progress of development programmes/projects
- Takes any decision as and when necessary for socio-economic development
- Appoint committees as required to assist NEC

Planning Process in Bangladesh

ECNEC

- **Composition**
  - Hon'ble Prime Minister – Chairperson
  - Minister of Finance– Member
  - Minister of Planning – Member
  - Minister of Agriculture – Member
  - Minister of Labour and Employment – Member
  - Minister of Water Resource – Member
  - Minister of Commerce – Member
  - Minister of Communications – Member
  - Minister of Shipping – Member
  - Ministers / State Ministers of relevant Ministries – Member

- **Officers of assisting ECNEC**
  - Cabinet secretary
  - Principal secretary/secretary, office of the Prime Minister
  - Secretaries, Planning, Finance, ERD & IMED
  - All members of the planning Commission & relevant secretaries.

ADP Formulation

A simplified series of steps in the formulation Process of Annual Development Programme

The Inter-ministerial "Resource Committee" at the Finance Division estimates the resources availability for the ADP

↓

Programming Division of Planning Commission prepares the sector/project wise ADP allocation in consultation with the Sector Divisions, GED of the Planning Commission, sponsoring Ministries and agencies.

↓

Programming Division place the draft ADP at the Planning Commission Meeting for finalization

↓

Planning Division Submits the final ADP to NEC for formal Approval

15

Question: Write down the different steps in the formulation process of ADP.

ADP FY 2025-2026

- Highest economic policy-making body of the Bangladeshi government has approved a **2.3 trillion taka** Annual Development Program (ADP) for the next fiscal year 2025-26 (July 2025-June 2026).

- Out of the ADP outlay of **2.3 trillion taka for the next fiscal year**, **1.44 trillion taka** will come from **local sources** while the rest of **860 billion taka** as **foreign project assistance.**

- Amount is **6.58 percent higher** than that of the revised ADP of the current fiscal year 2024-25 (June 2024-July 2025).

- ADP was **approved** at a **National Economic Council (NEC) meeting** presided over by the Bangladeshi interim government's Chief Advisor and NEC Chairperson Muhammad Yunus on **19.05.2025**

ADP FY 2025-26

- ADP attaches the **highest importance to** the **transport, communication** and **power and energy** sectors alongside putting priority on ensuring optimum utilization of public funds through checking misuse.

- A total of **1,143 projects are included** in the next fiscal year ADP for execution. (1 U.S. dollar=122 taka).

- **Climate Change: 228 projects** under the Bangladesh Climate Change Trust Fund (BCCTF).

- **Public- Private Partnership (PPPs): 79 projects** under PPP to attract private investment.

- **Project Mix:** Includes **investment projects**, feasibility studies, **technical assistance**, and completion projects.

Key Focus Areas of ADP in FY 2025-26

- **Infrastructure: High priority on transport, communication, power, and energy sectors.**

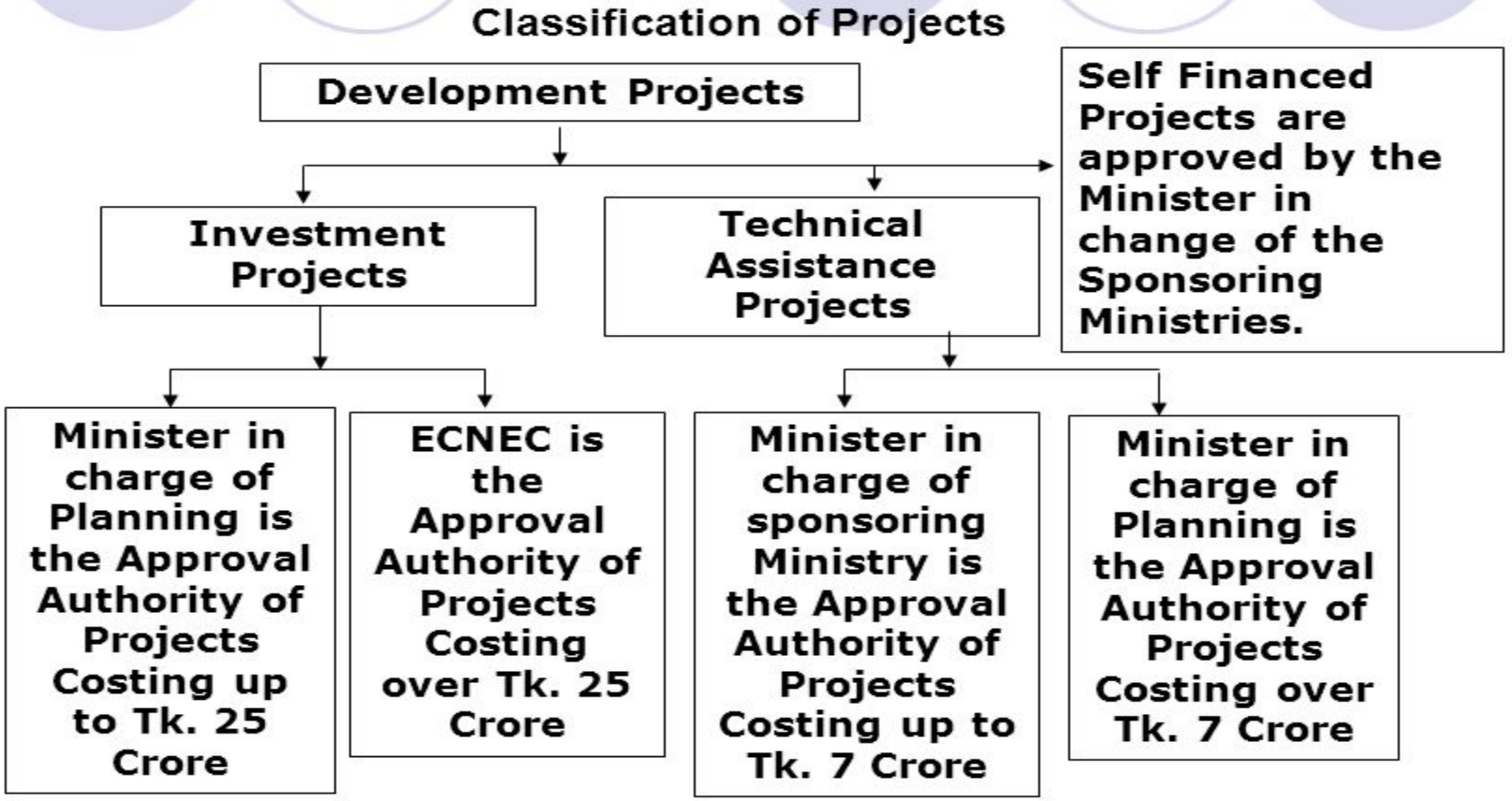
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Approval Authority of Development Projects

Project Planning



Different Duties of IMED

Cost rationalisation

Participating PEC meeting,
Participating ADP review meeting in ministries
Comments on time extensions of projects,

Imparting training for different officials

CPTU :-

All matters relating to Procurement

Proper implementation of PPR & PPA

Today we have so far discussed:

- Organization of Ministry of Planning.
- Structure, Rules and Functions of Planning Commission.
- ADP
- Works of Planning Commission through NEC and ECNEC
- ADP Formulation and ADP of FY 25
- Planning Process and Approval of Dev Project
- Duties od IMED & CPTU

Thank You

EWC-301

Project Planning and Construction Management

Project Life Cycle

We discussed in the last class:

- Organization of Ministry of Planning.
- Structure, Role and Functions of Planning Commission.
- **What is ADP?**
- NEC and ECNEC.
- **Formulation ADP.**
- **Approval of Development Projects**
- **IMED & CPTU**

What we are going to discuss today?

- What is **Project Life Cycle**?
- **Importance and stages** of Project Life Cycle.
- **Uses** of Project Life Cycle
- **Concurrent Engineering** in Project Life Cycle.
- Basic **Pattern of Project** Life Cycle

What is a project?



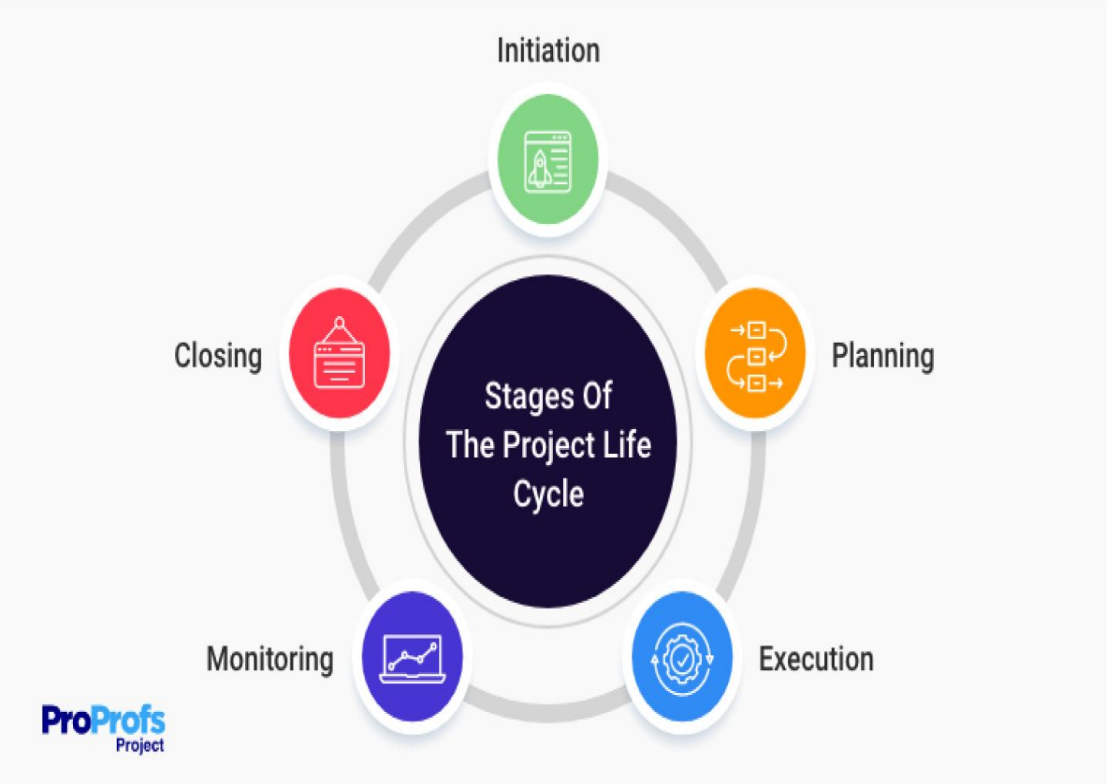
- A project is defined **as a specific, finite activity** that produces **an observable and measurable result** under certain **preset requirements.**

What is Project Life Cycle?

•A project life cycle is the **sequence of phases** that a project goes through from its **initiation** to its **closure**.

•**Project lifecycle can be defined and modified** as per the needs and aspects of the organization.

Even though every project has:
•a definite **start and end**,
•the particular **objectives**,
•**deliverables**, and
•**activities** vary widely.



Importance:

- Lifecycle provides the **basic foundation of the actions** that has **to be performed** in the project, irrespective of the specific work involved in different phases.

- **Phases** have a **definite start, end,** and **control points** that **are constrained** by time.

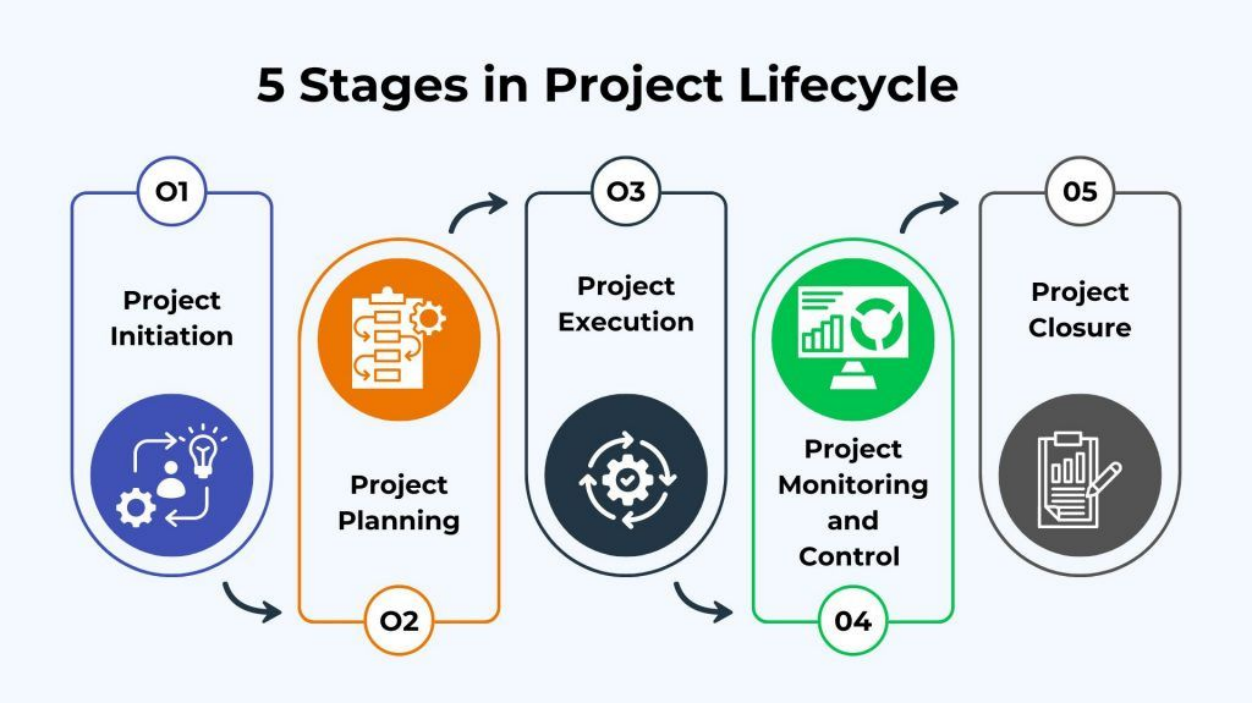
How many phases of Project Life Cycle will be in a Project?

Number and sequence of Phases **of the project life cycle are determined by the management** and **various other factors**:

- **needs** of the organizations involved in the project
- **nature** of the project, and
- its **area** of application.

Broad Phases of Project Life Cycle

- **Initiation Phase:** Starting of the project, **get authorization**
- **Planning Phase:** Organizing and Preparing, **prepare detailed road map**.
- **Execution Phase:** Carrying out **planned work**.
- **Monitoring and Control Phase:** Continuous monitoring and controlling**, tracking progress**.
- **Closure Phase:** Closing the project **formally.**



Uses of Project Life Cycles

- Are the **control systems and decision stages** of the project at which the position of the project is **revised.**

- Form the convenient **milestones** of the project from the **progress of payment** and **reporting** to top management**.**

- Top management can **take the decision** whether to **abort** the program or to provide further **funding**.

Concurrent Engineering in Project Life Cycle:

- In case of certain design and construction contracts, the interface of the phases of the **project life cycles overlap**, where **construction starts before the design is finished.**

- Concurrent engineering are often employed **to reduce duration** of **the overall project progress.**

Basic pattern of Project Life Cycle

Pattern of project life cycle–medium to large project: (CFEA-ICOT)

- **Concept**: basic ideas, business case, statement of requirement, scope etc.
- **Feasibility**: test for technical, commercial, financial viability etc.
- **Evaluation**: application of fund, static risks etc
- **Authorization**: approval, permits etc.
- **Implementation**: develop design, procurement, installation, commissioning etc.
- **Completion**: performance test, handover, post project appraisal etc.
- **Operation**: production, maintenance, revenue, earning period etc.
- **Termination**: close down, decommissioning, disposal etc

Types Project Life Cycle

Normal project life cycle:

• In a project, where the **project ends with the issuance of an acceptance certificate**, after **performance tests** have been successfully completed (ie completion of project).

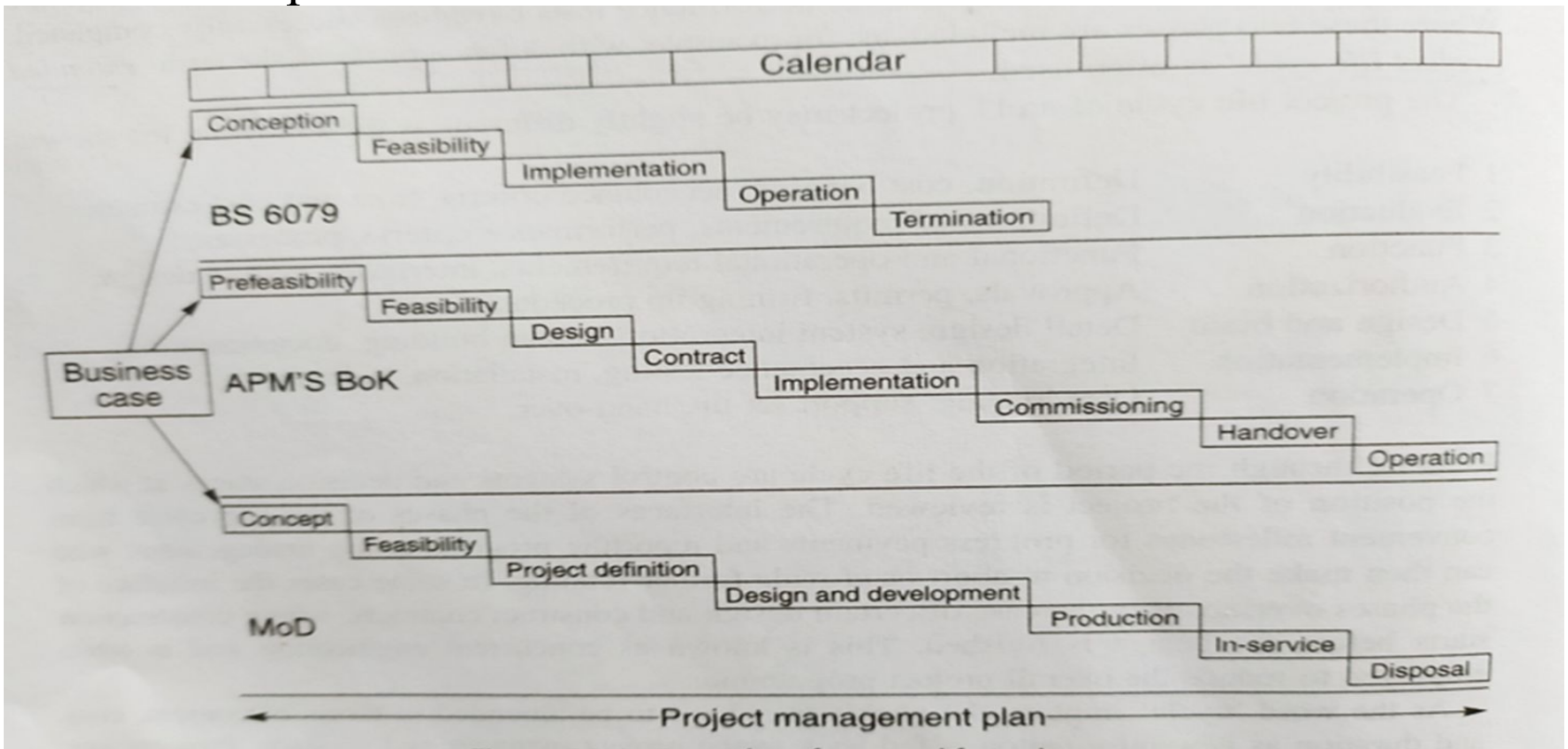
Extended project life cycle:

•In defense related projects under MoD, **two additional phases** like **operation** (ie **uses, maintenance in service**) and **termination** (ie **decommissioning, disposal**) included in the project life cycle.

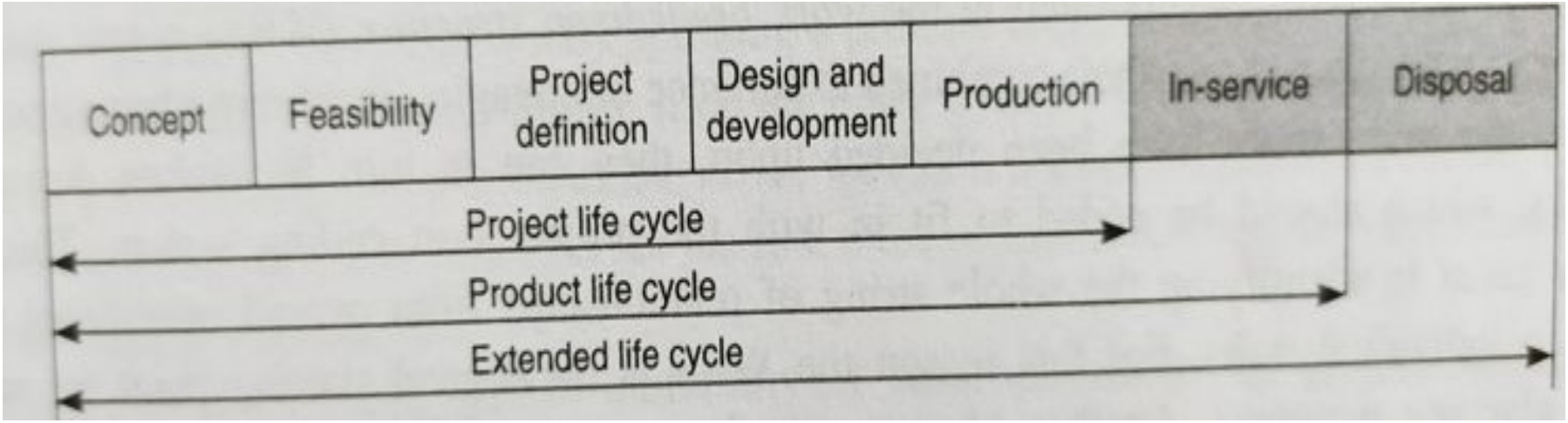
•This called ‘extended project life cycle.

Example: In typical **weapon system** project under MoD, where phases of :

- **Concept**, **Feasibility**, **project Definition** are the responsibility of **MoD**;
- **Design and Development** and **Production** are carried out by the **Manufacturer**; and
- **In Service Maintenance and Decommissioning** and **Disposal** are the phases when weapons are in the hand **of Armed Forces**.



Life Cycle of MoD Project

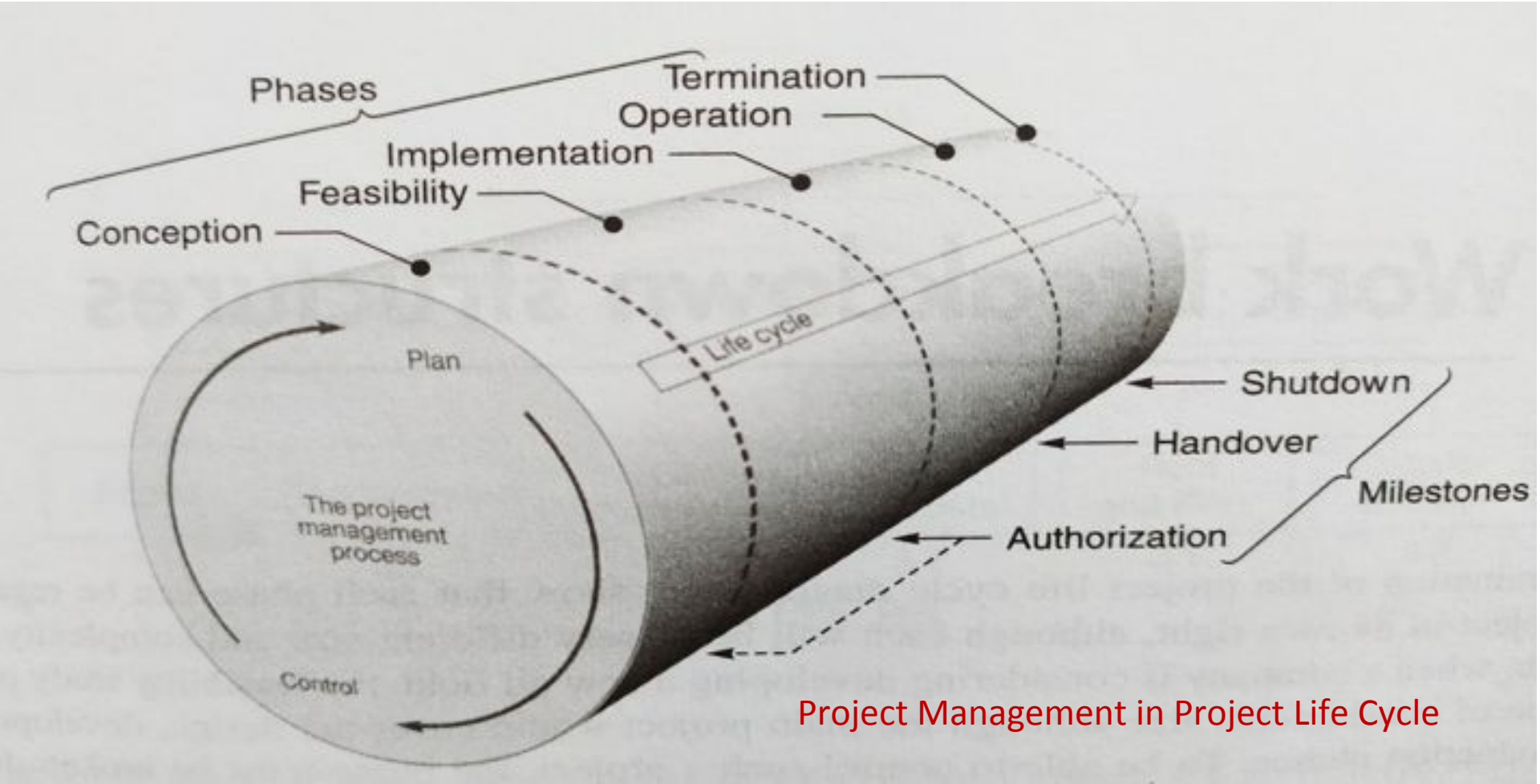


Life Cycle of MoD project can be split into:

- **Project life Cycle-** Phases under the control of project team ie. **Concept to Production.**
- **Product life Cycle-** Phases of interest to the sponsor, which includes **in-service**.
- **Extended Life Cycle-** which includes **disposal**.

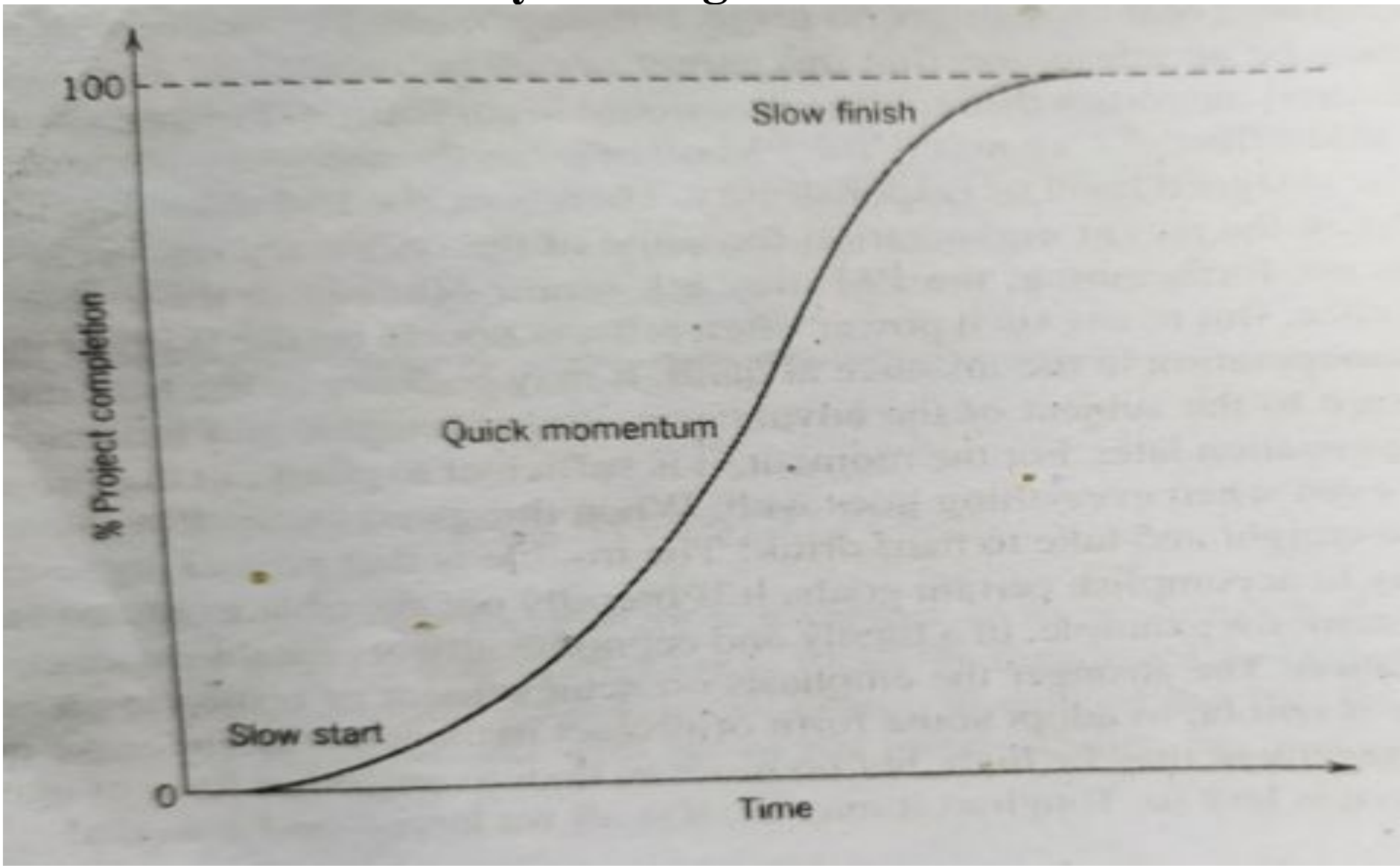
Project Management in Project Life Cycle in Project Management process:

- Life cycle which shows the **decision points** or **milestones**; sometimes called '**trigger points**' or **go or no go gates** relate to the phase of a project life cycle.



Project Management in Project Life Cycle

Life Cycle Progress Curve



Stretched – S: Project Progress Life Cycle

Life Cycle Progress Curve

- Most projects go through **similar stages on the path** from origin to completion shown the diagram.

Slow Start: Project is **born**, **start-up phase**:

- a **manager is selected**,
- **project team and initial resources are assembled** and
- the **work program** is **organized.**

Quick Momentum: Works get under way:

- **momentum quickly build**;
- progress is made and
- continues until the end in sight.

Slow Finish:

- **Completing the final tasks**,
- **seems to take longer time**, partly due to a **lot of works that must come together**, and partly due to **team members 'drag their feet'** for various reasons & try to **avoid final steps**.

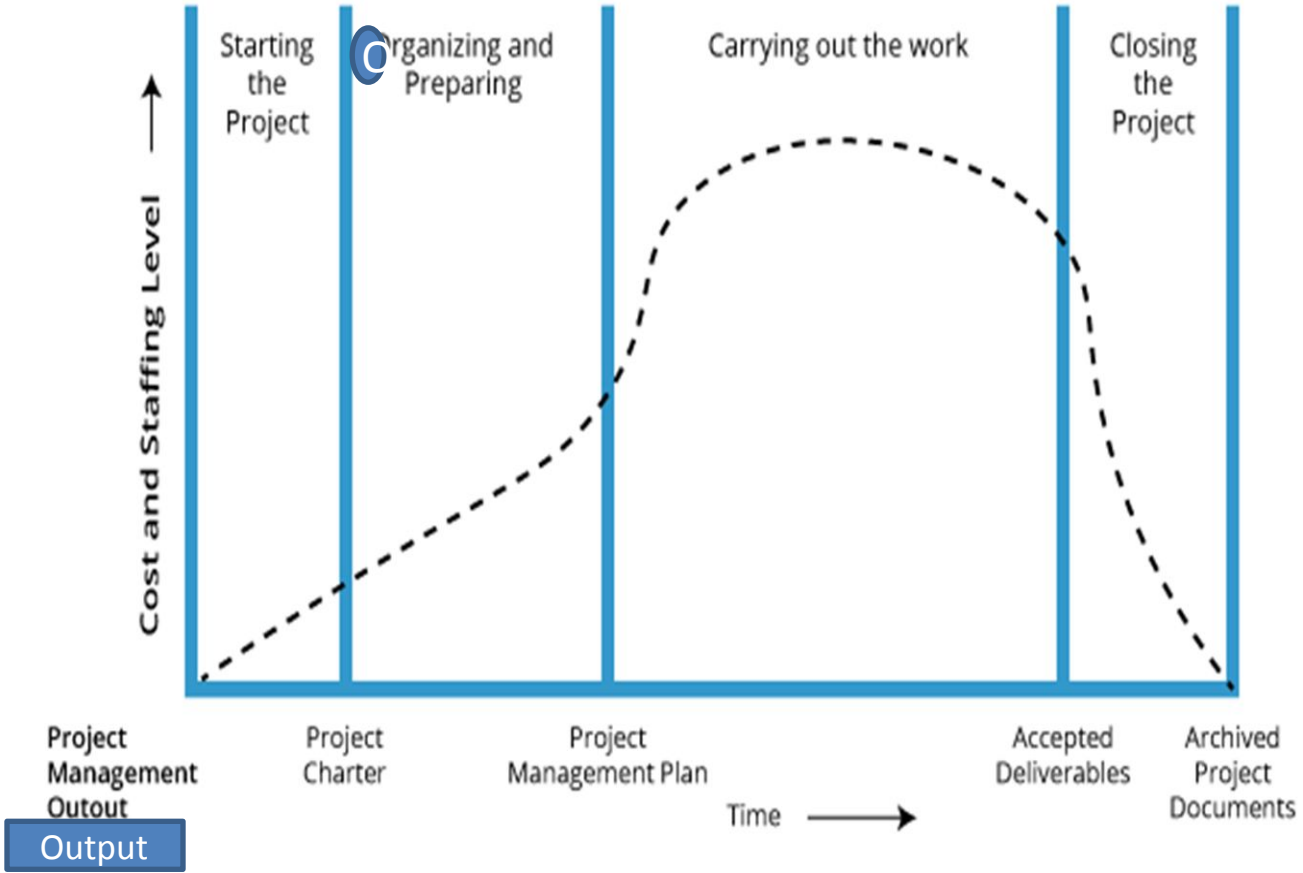
Generic Project Life Cycle with output (time) cost & staffing level

Commonly exhibits the following characteristics:

- At the start, **cost and staffing levels are low** and reach a peak when the work is in progress.

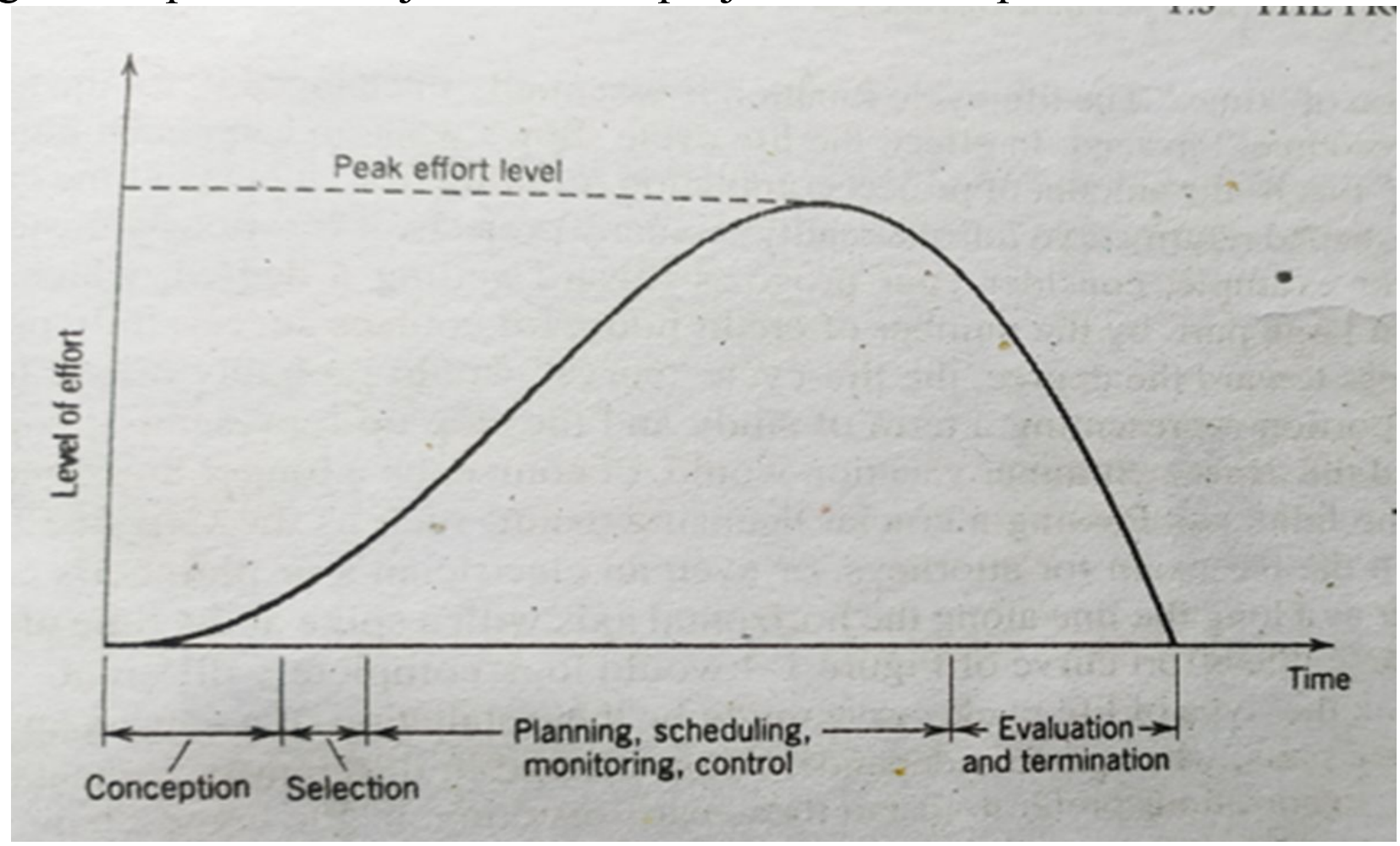
- It again **starts to drop rapidly** as the project begins to halt.

- **Considerable expenses** are required to secure essential resources early in its life cycle.



Time Distribution of Project Effort:

- **Diagram shows the project's Level of efforts**, usually in terms of persons hour or resources expended per unit of time.
- **Time is broken up** into several phases of project life.
- **Minimal effort** is required at the beginning, when the project concept is being developed and subjected to the project selection process.

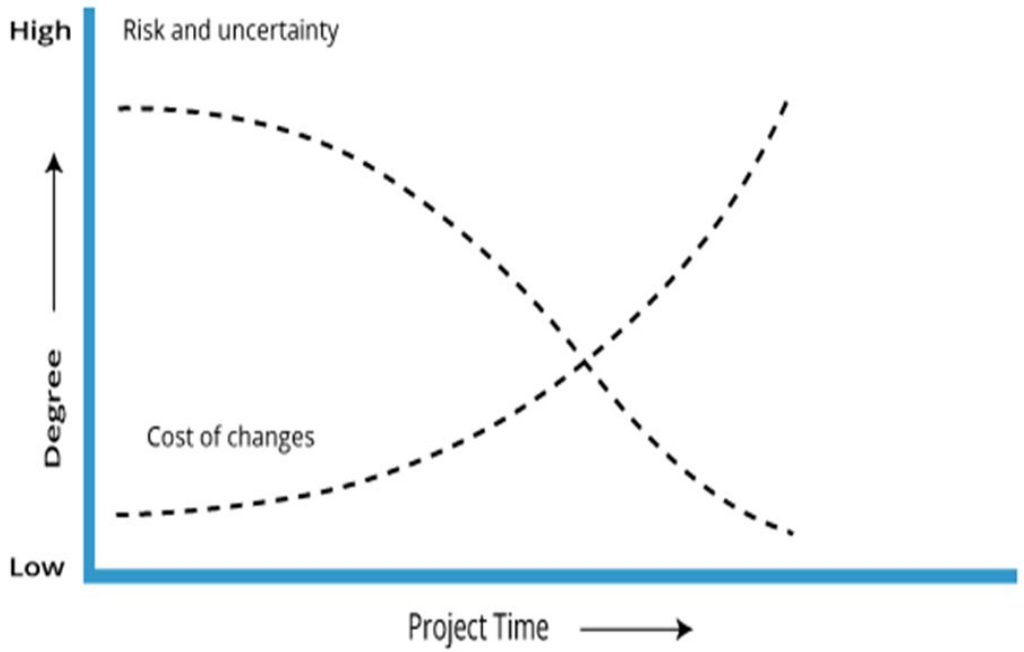


Project's Cost, Risk and uncertainty with time

- **Risk and uncertainty** are **at their peak** at the beginning of the project.
- These **factors drop over the lifecycle** of the project as decisions are reached, and deliverables are accepted.

- Ability to **affect the final product** of the project without impacting the cost drastically.

- It is clear that the cost of **making new changes and rectifying errors** **increases** as the project approaches completion.



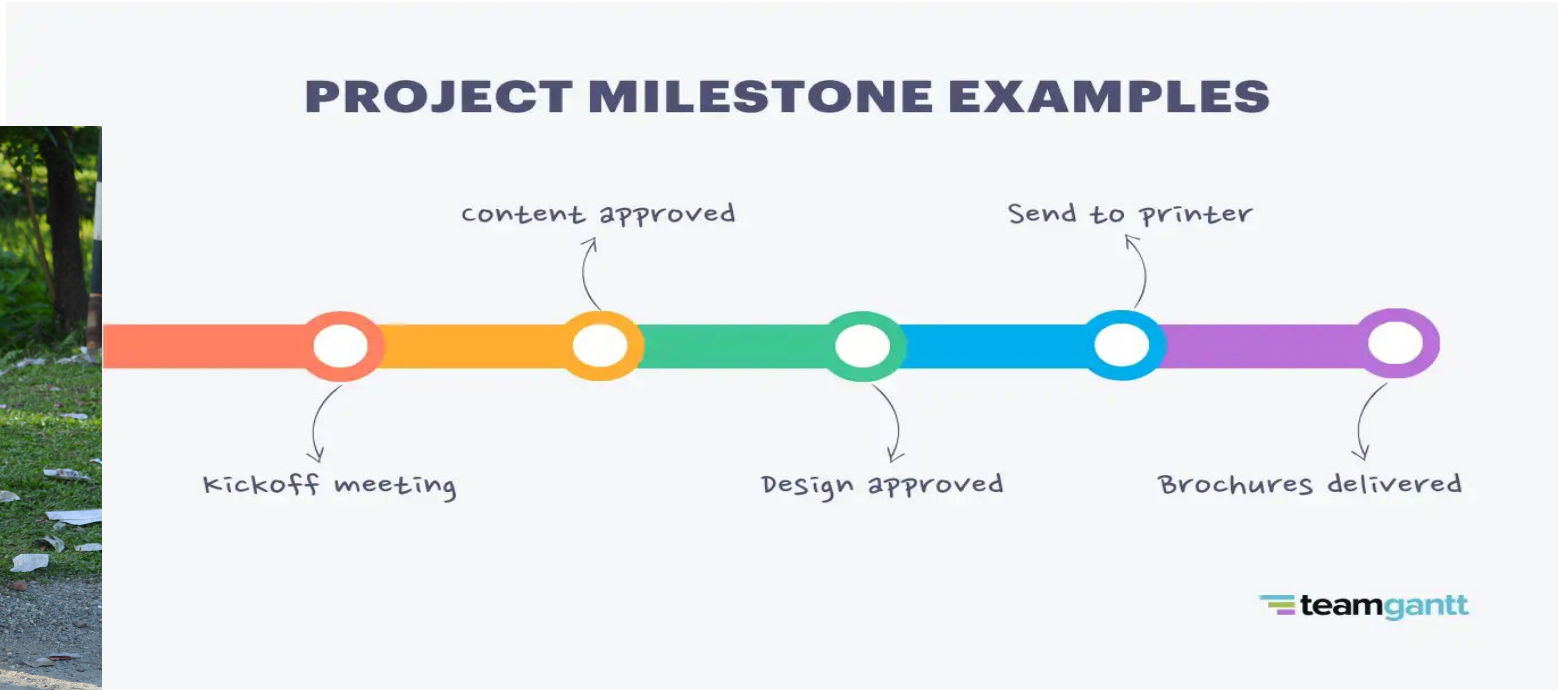
Project's Milestones

- Project milestones are **key checkpoints** or **significant events** **within a project timeline** that help **track progress** toward project completion.

- Help teams to **track progress**, **stay aligned**, and **manage complex work** by focusing on critical goals rather than daily tasks.

- **Act as signposts**, showing the start/end, approvals etc. often appearing as **zero-duration items** on schedules.





Thank You

GEPM-375
Project Planning and Construction Management

Conflicts in Project Management

Conflict Management and Negotiation

Four Stages Model of a project.

- Project **Formation**.
- Project **Planning**, **budgeting**, **scheduling** and concentration of **resources**.
- Project **Execution**.
- Project **Termination**.

Four Stage Model of a Project:

Stage -1:
Project Formation.

- Senior Management **tentatively**, sometimes **unofficially**, **approves** the preliminary planning for a project.

- **Management recognition is preceded** by some strictly **unofficial 'bootleg' work** to test the **feasibility** of an idea.

- **Initial planning** is undertaken, **basic objectives** are often adopted, and project may be **scoped out**.

Tentatively- subject to further confirmation; not definitely

Boot-leg- something produced, sold, or transported illegally, (boot-leg film)

Stage -2:

- **Detailed**:

-planning – creating detailed road map

-budgeting- Estimating, allocating, and controlling financial resources.

-scheduling – Organizing and mapping out sequence of tasks, time lines and resources.

-aggregation of resources- summing up all the required resources**.**

Stage-3: Execution

- **Lion's share of the actual work** on the project is accomplished.
- Detailed plan is put into action.

Stage-4:

Termination

- **Final stage of life cycle,**
  -work is completed and
  -products/deliverables are handed over to clients or users.
- Also includes, **disposition of project's assets and personnel**.

- May include **preparation of the initial stage** of another project to follow.

PM (Project Manager)

- **Individual** who has the **responsibility**, **authority** and **accountability** assigned to him or her to **achieve** **safely the project objective** within **agreed time, cost** and **quality** **criteria**.



Functional Manager

- Person who has **management authority** within a business/project **unit/department with direct supervision** over one or more resources and/or
- Person who has **direct responsibility** for the functions that affected by or that affect the **project** deliverable(s)



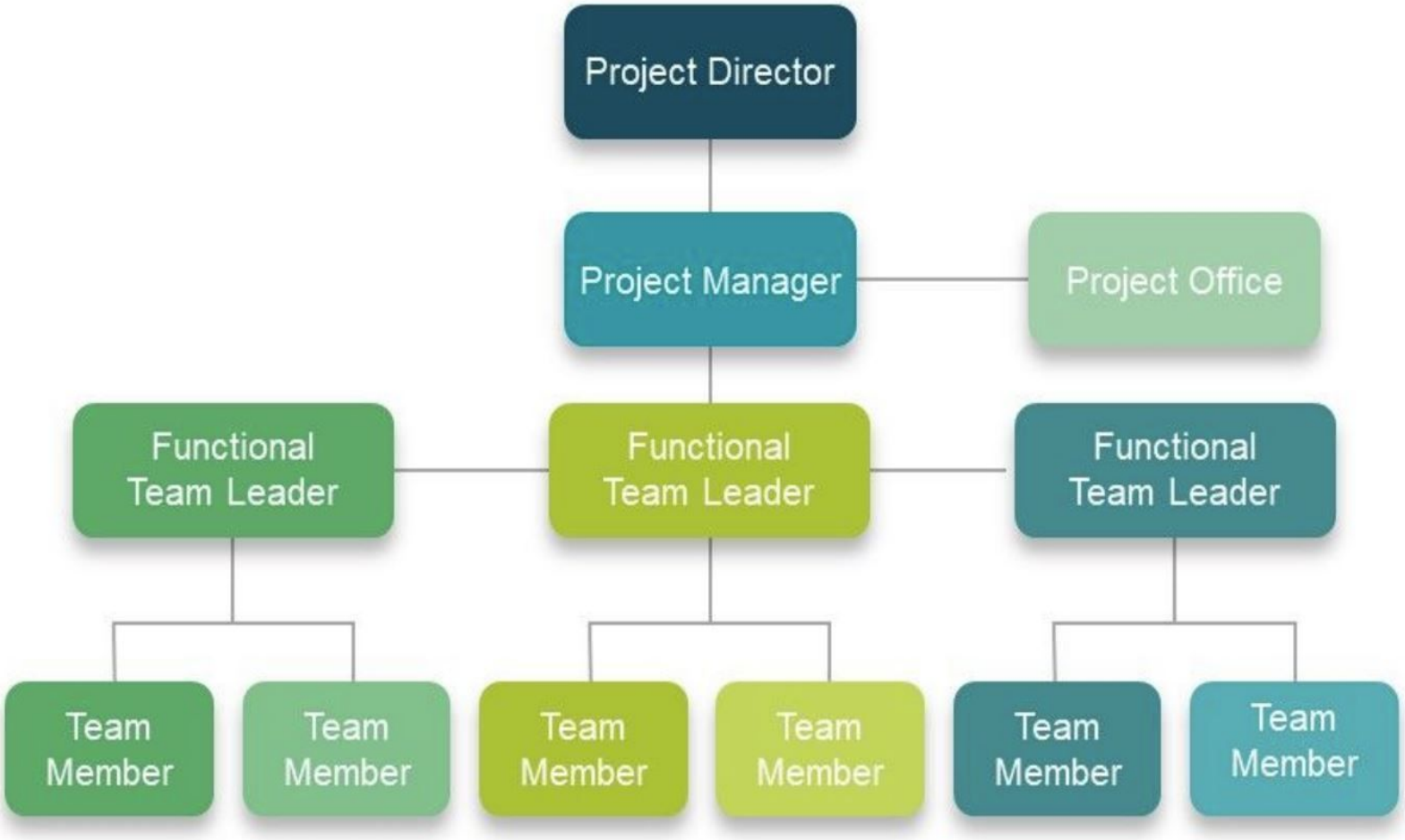
Project Team:

- **PM and the group of individuals** who work together on a project to **achieve its objectives.**
- **Consists** of people from **different teams** with **precise subject matter knowledge** or **with the required skill** set to carry out the work of the project.
- **Structure and characteristics** of a project team **usually vary,** but the **project manager's role as the leader of the team** remains constant.
- **Amount and nature of authority** the project manager has over the members can differ.

Project Team Member:

- **Mainly the people who work on various phases of the project.**

- Could be **in-house staff or external consultants** and may be working on a **full-time or part-time basis**.



Conflicts in Projects

To be discussed today?

- Definition of conflict
- Sources of conflicts
- Satisfaction and resolve of conflict.
- Methods/Ways of resolving conflicts.

Definition of Conflict

•A **serious disagreement** or **argument**, typically a protracted one.

•Process which begins when **one party perceives that other has frustrated, or is about to frustrate**. (Thomas, 1976).



Sources of Conflict in a Project:

From where Conflict arise?

- Conflict **can arise over issues of:**
  - **-belief or -**
  - **-feeling or**
  - **-behavior or**
  - **-goal.**





When does goal conflict occur?

- When an individual or group **pursues goals** that **are different** from those other individuals or goals.

Satisfaction of Conflict:

- When all parties to the conflict are **satisfied to the point**, that is, when the **level of frustration has been lowered** to the point where **no action, at present or in future, is contemplated,** the conflict is **said to be resolved**.

- Acceptance of the status quo or a final agreement, effectively **ending the conflict through inaction or cessation of hostilities**

Methods/Ways of Resolving Conflicts:

Many ways of resolving conflict:

- **Withdrawal**
- **Smoothing**
- **Compromising**
- **Forcing**,
- **Confrontation/problem solving**.

Five ways of Conflict Resolution

Withdrawing:

- **Easier to refrain** than to retreat from an argument.
- **Silence is golden**.
- See **no evil**, hear no evil, speak no evil.

Smoothing:

- **Play down the differences** and **emphasizes** common interest.
- **Issues** that might cause divisions or hurt feelings are not discussed.

Compromising:

- **Splitting the differences and bargaining points**, search for an **intermediate positions**.
- Better half a loaf than none at all.
- **No one loses or no one wins.**

Forcing:

- **A win-lose situation**.
- Participants are antagonists, competitors, not collaborators.
- Fixed positions, polarization.
- Creates a victor and vanquished.

Confrontation-Problem solving:

- Open exchange of information about the conflict or problem as each sees it.
- Working through of their differences to reach a solution that is optimal to both.
- **Both can win.**

Effective and Ineffective Methods of Solving Conflict:

Facing the issues directly (confrontation), such as

- **negotiation** is the most **effective method,**
- **arbitration,**
- **rules of laws, and**
- while **forcing or brute force**, is the **most ineffective**.

Brute force, of course, is time-honored method, as is the **absolute rule of monarch**,

Rule of law is the method of choice for modern societies, if **negotiation or arbitration has not already succeeded** in spite of occasional lapses.

Negotiation: Discussion aimed at reaching an agreement.

Arbitration: Solve with an agreed negotiators

Methods of solving Conflict

Arbitration to Resolve conflict in Project Management:

- Use of an **arbitrator** to settle a dispute.
- **It** is a procedure in which a **dispute is submitted**, by **agreement of the parties, to one or more arbitrators** who make **a binding decision** on the dispute.
- In choosing **arbitration**, the parties opt for a **private dispute resolution procedure** instead of going to court.

Arbitrator: An **independent person** or **body officially appointed to settle a dispute**

Rule of Law: Conflict resolution is the ultimate purpose of law.

Methods of solving Conflict

Usually Conflicts arise in a project can be solved by the following **methods**:

- **Negotiation**
- **Arbitration** and
- **Use of law**.

Uses of Laws

- **Rules and Regulations of Organizations:**

Organizations **establish elaborate and complex rules and regulations** to **settle disputes**:

-between the **organizations itself**, and
-between the **organizations and the individuals**, and
-between the **organizations and the groups** with whom it interacts.

- **Contracts:**

Contracts between:

-a firm and its suppliers,

-a firm and its trade unions, and

-a firm and its customers

are written document to **govern the settlement of potential conflicts.**

Why even Contract Fails to solve conflict:

- **Various parties-at-interests (stakeholders) do not always agree**:

-about the meaning of a law or

about a provision in a contract.

- **No agreement**, however detailed, **can cover all the circumstances** that might arise in the extensive relationships:

-between the **buyer and the seller** of complicated industrial equipment,

-between **users and the supplier** of engineering consulting services,

-between the **producer and the user** of computer programs,

Lists of potential conflicts is endless.

Thank you

GEPM-375

Project Planning and Construction Management

Conflict Management and Negotiation

Conflict Management and Negotiation

What we discussed in last class?

- What is conflict?
- From where conflicts arise?
- Satisfaction and resolve of conflict.
- Ways of resolving conflict.

What we are going to discussed today?

- Methods of solving Conflict
- Rules, regulations and contracts
- **Project Stages considered for Conflict Solving**
- **Categories of Conflict**

Effective and Ineffective Methods of Solving Conflict:

Confrontation/Facing the problems directly:

- such as **negotiation** is the most **effective** method
- while **forcing or brute force**, is the most **ineffective**.

Brute Force and Rules of Law:

- **Brute force**: Absolute rule of monarch.

- **Rule of law:** Method of choice for modern societies, if **negotiation or arbitration** has not already succeeded in spite of occasional lapses.

Solving Conflict in Project Management

Conflicts arise in a project **can be generally solved by the following methods:**

- **Negotiation**
- **Arbitration** and
- **Use of law**.

  -Rules and regulations of the organization and **contract**

  -Country's law (going to the **Court)**

Why Organizations/ rules and contracts not always enough to solve the conflicts?

- **Various parties-at-interests (stakeholders) do not always agree**:

  -about the **meaning of a rules** or

  about a **provision in a contract**.

- **No agreement/contract**, however detailed, **can cover all the circumstances** that might arise in the extensive relationships:

  -between the **buyer and the seller** of complicated industrial equipment,

  -between **users and the supplier** of engineering consulting services,

  -between the **producer and the user** of computer programs.

- **List of potential conflicts is endless.**

Where the conflicts arises in Projects?:

Conflicts center on such matters as:

- **Schedules**
- Priorities
- **Staffs and labor requirements**
- Technical factors
- **Administration procedures**
- Cost estimates, and
- Of course, **personality conflict**.

Categories of Conflict

Fundamentally conflicts are in three categories:

- **Goals and Expectations Conflict:** Groups working on a project may have different goals and expectations.

- **Authority Conflict:** There is a significant uncertainty about who has the authority to make decisions.

- **Interpersonal Conflict:** There are interpersonal conflict between people who are parties-at-interest in the project.

Goals and Expectations Conflict

•Works on projects is usually carried out by many **different units of the organization**.

•Units that **often differ** **in their objectives and technical judgements.**

•Units have **different expectations** about

-the **project** itself,
-its **costs and rewards**,
-its **relative importance** and
-its **timings.**

- **Conflicts** about:
  -schedules,
  -Intra-project and inter-project priorities,
  -cost estimates, and
  -staff time.

Why there are always Conflict arises between PM and FM

- Because **PM and functional manager** have **different goals.**

- **PM's concern** is the **project itself**, complete project within time, budget and quality.
- But the **primary interest of functional manager** is the **daily operation** of the functional department.

- Significant uncertainty about **who has the authority** **to make decisions.**

- Both **technical and administrative procedures** are important aspects of project management.

- Uncertainty about who has the **authority to make decisions on:**

  -resource allocation,

  -administrative procedures,

  -communication,

  -technical choices, and

  -all other matters

Those affecting the project, **produces conflict** between PM and the other parties.

It is simple to state that the:

- **functional manager controls who works on the project** of his department and **makes technical decisions,** while

- **PM controls** the **schedule** and **flow of work**.

- In practice, in the commonly hectic environment of the project, amid the **day's countless little crises**, faced by PM and functional manager alike, the **distinction is rarely clear who to make what decision.**

Interpersonal Conflicts

- Conflicts **between people who** are parties-at-interest in the project.
- Reflect the fact that **human being are an integral p**art of all projects.
- In an **environment** that **depends on the cooperation of many persons,** it seems inevitable that **some personalities will clash.**
- Interpersonal conflicts between:
  -the **PM** and **the client** or
  -between **Senior Management** and **the Project Manager**,.

it is the **PM who personifies the project** and thus is generally a **party to conflict**.

Project Conflicts by Category and Parties-at-Interest

Conflicts can be categorized **as conflicts over different goals**, **over uncertainty about the locus of authority**, and **between personalities.**

Parties-at-Interest	Categories of Conflict		
	Goals	Authority	Interpersonal
Project Team	Schedules Priorities	Technical	Personality
Client	Schedules Priorities	Technical	-
PM and Senior Management	Schedules Priorities Labor Cost	Technical Administrative	Personality

Thank you

GEPM 375

Project Planning and Construction Management

Conflict in Different Project Stages

What we learned in the last class?

- Matters on which conflicts center during a project life cycle.
- **Fundamental categories of conflicts**.
- Constant source of conflict in a project.
- **Methods for settling conflicts about priorities**
- Locus-of-authority conflicts

What we are going to learn today?

•Conflicts into Chronological Perspective of Project Stages

- Conflicts in Project **Evaluation Stage.**
- Conflicts in Project **Build-up Stage**
- Conflicts in Project **Main Stage**
- Conflicts in Project **Phase-out Stage**

Conflicts in Project Evaluation stage

- Technical objectives
- Resources allocation
- Priorities of projects
- Solving of conflicts

Describe the Conflicts in Project Evaluation stage:

- Most of the **conflict centers** around the **inherent confusion of setting up a project.**

- Almost **nothing about the project or its governance has been decided.**

- Even the **project's technical objectives**, **not clearly defined or established.**

- **Moving from** the **state of semi-chaos,** to the relatively **ordered world** of the build up stage is **difficult.**

Question: Why do you think about conflicts in the project evaluation phase?

Fundamental Issues: (Must be handled for transition from semi chaos to Build-up stage)

- **1st: Technical objectives of the project must be specified** to a degree that **will allow the detailed planning** of the build up stage to be accomplished.
- **2nd: Commitment of the resources to the project must be forthcoming** from senior management and from functional managers.
- **3rd: Priority of the project**, relative to the priorities of the parent project organization's other projects, **must be set and committed.**
- **4th**: These three conditions are not sufficient but most necessary if the **conflicts of the formation stages are resolved at reasonable level** so that not to be exaggerated in build up stage.

Question: Describe the fundamental issues that must be handled for transition from the **state of semi-chaos,** to the relatively **ordered world** during the build up stage of the project life cycle.

Conflict Management in Build-up stage of project

- PM who **practices conflict avoidance** in this stage is inviting disaster in the next stages.

Three fundamental issues ie.

- **delimiting** the technical objectives,
- getting management **commitment of resources** and
- setting up the **project's relative priorities**;

must be resolved irrespective of what organizational form is selected for the project.

- **Clarification of PM and FM Rules in the Project**

-More independent and stand alone the project, the **more authoritative role to be played by PM.**

-Weaker the project and more functional ties, **more authority is embedded to the functional managers.**

-Lack of clarity about the relative **power/influence/authority** of the PM and the functional managers is **major component of all conflicts**, involving **technical decisions**, **resource allocation**, and **scheduling**.

Critical Matters that underlies Four fundamental issues in solving conflicts:

- ***Which*** **of the functional areas** will be needed to accomplish the project tasks?
- ***What*** **will be the required level of involvement** of each of the functional areas?
- ***How*** **will conflicts over resources/facility usage** between this and other projects to be settled?
- ***Who*** **has the authority to decide** the technical, scheduling, personnel and cost questions that will arise?
- ***How*** **will changes in the parent organization's priorities** to be communicated to everyone involved?

Conflicts in Project Build-up stage

- Project **Priorities**
- **Schedules**
- **Administrative** procedures
- **Technical issues**, mainly between PM and functional managers.

How Conflicts arise in Project Build up stage:

- **Transition stage**.

- **Projects moves from a general concepts to highly detailed set** of plans and **conflict at its highest** in this transition period.

- Conflicts occur over **project priorities**, **schedules**, and **administrative procedures**.

- As project's plans become detailed, **conflicts over technical issues** between the PM and functional area **tend to predominate**.

- If **PM is a generalist**, Functional departments **can claim more technical expertise.**

- If **PM is a specialist**, discussion between functional manager and PM about **the best technical approach often result in conflict.**

Conflicts in Project Main program

- **Schedules**
- **Technical issues**

Conflicts in Project Main Program – mainly two types

- **Schedules are still a major source of conflicts** but usually differ than earlier stage.

- And then **technical conflicts**

Project plans have been **developed and approved** by everyone involved, and **actual work is underway**.

Schedule Conflicts:

•Assume that **some activity runs into difficulty** and **is late in being completed.**

•**Every task** that is dependent on this late activity **will also be delayed.**

•Some of these subsequent activities will, if sufficiently late, and if the **late work is not made up**, **delay the entire project.**

Prevent Delay of Entire Project

•To **prevent the consequences**. PM must try to **get back the schedule to track.**

•But **catching up is considerably more difficult** than falling behind.

•**Catching up requires extra resources** that the functional groups who are doing the 'catching up' will demand more resources but which the PM may not have.

- **More complex the projects**, the **more difficult it is to trace and estimate the impact of all the delays,** and the more resources that must be consumed to get things back on schedule.

- PM's job of **managing time/cost/scope trade-offs**, but **adding** to the project's cost or **scaling down** the project's technical capabilities to save time.

- PM **will not take if there is any viable alternative**.

- PM's **trade-offs is often constrained** by **contract, company' policy** and **ethical considerations** which makes trade-offs decision quite difficult.

Question: What is schedule conflict in the main program stage of a project? Describe the role of project manager in handling the effects of such conflict to keep the project in schedule.

Main Program Stage

Technical Conflicts:

- Are **serious and frequent** during main program stage.

- **Sources of technical conflicts are somewhat different** than in earlier stage.

Example Computer and Printer

- Computer and printer must be **correctly linked** together in order to perform properly.

- Linkages are **known as interfaces**, the **number of which increases** as the project gets larger ie. System gets more complex.

•As the **number of interfaces get increases**, so does the **probability that the problems will arise** at the interfaces.

•**Need to manage** these interfaces and to correct incompatibilities is the key to the technical conflicts in the main program phase.

Conflicts in Project Phase-out

- **Schedules**
- **Technical issues (rare)**
- **Interpersonal stress**

Schedule is the major source of conflict during project phase-out.

- If **schedule slippage has occurred in the main program** stage, the consequences will surely be felt in this final stage.

- Project with **firm deadlines** develop an environment best described **as hectic**.

•**Project manager** and **project team** and **functional group**, **often combine together** to do what is necessary to complete the project on time.

•**Cost overruns**, if not outrageously high, are tolerated.

Phase out

Technical Conflicts in phase-out stage in a project:

- Technical problems are **comparatively rare** during phase-out because most have been solved or by passed earlier.
- **Working interfaces** have been developed and put in place.
- If the project involves **in implementing a technology** in an out side client's system, technical conflicts will probably arise, but they are usually intense.

Question: What do you understand the technical conflicts prevail in the phase-out stage in a project?

Personnel Conflicts in phase-out stage of a project:

•Personality conflicts are the **second ranked source of conflicts** during phase-out.

•Ascribe these conflicts **to interpersonal stress** caused by:

-the **pressure t**o complete the project, and

-to **individual' natural anxiety** about leaving the project either to be assigned to another or to be returned to the functional unit.

•Sometimes, **bitter conflicts** arise on the **distribution of project's capital equipment and supplies** when he project is completed.

•Conflicts also **arises between projects phasing out and those just starting,** particularly if the latter need resources or personnel with scarce talents being used by the former.

Phase Out

Example- Conflict in multi functional design teams:

- One team member speaking of another said, "**He will do what ever he thinks is right, to get his (own) job done**, **whether or not it's good for (the company) or anyone else".**

- In context, it is clear that this **conflict** was **between a problem-oriented individual and one who is discipline oriented.**

Thank you

GEPM 375

Project Planning and Construction Management

Conflict Negotiation

What we discussed in the last Class?

Conflicts into Chronological Perspective of Project Life Cycle

- Conflicts in Project **Evaluation Stage.**
- Conflicts in Project **Build-up Stage**
- Conflicts in Project **Main Stage**
- Conflicts in Project **Phase-out Stage**

Question: Describe the conflicts arise in to chronological perspective of project life cycle**.**

What we are going to discuss today?

- What is conflict negotiation?
- Pareto-Optimal Solution and Concept to the two Party Conflict.
- Ethical Situation during negotiation.
- Partnering, Chartering and Scope Change to conflict negotiation.

What is Conflicts Negotiation?

- **Ability to reduce and resolve conflict** in ways that **support achievement of the project's goal**, is a prime requisite for success as a Project Manager.

- **Primary tool** is Negotiation.

Explanation:

- Conflict is an **inherent characteristics** of projects, and

- **Project manager** is **constantly beset** by conflict.

- **Methods of handling conflict**, established in the project **formation stage**, will **set the pattern** for the entire project.

- **Style of negotiation** adopted by PM is critical and **must has been written** on conflict resolution.

What is negotiation?

- **Favored technique** for resolving conflict.

- ‘**Process through which two or more parties seek an acceptance rate of exchange for items.**

Explanation

- ‘Negotiation **focuses on gaining the favor of people** from whom we want things’.

- Even if **no single definition neatly fits** all the activities that level ”negotiation”.,

- It is **recognized that such terms as**
  - ‘mediate’,
  - ‘make peace’ etc

Pareto-Optimal Solution to the two Party Conflict:

- General objectivity of negotiation should be **to find a solution such that no party can be made better off without making another party worse off** by the same amount or more.

- That is **Pareto-optimal solution**.

Explanation

- Discusses the **nature of bargaining processes** **required to reach optimality.**

- Conflicting parties **may not know and understand the complex trade-offs.**

Concept of Pareto-optimal solution:

- Proper outcome of this type negotiation should be to "**optimize the outcome in terms of organizational goals".**

- **No win-No lose solution** rather win-win solution.

Explanation

- Approaching **intra-project conflicts** with a **desire to win a victory over other parties is inappropriate.**

- PM must remember that he **will be negotiating with project stake holders many times in future**.

- If PM conducts a **win-lose negotiation** and the other party loses, from then on, PM will face a **determined adversary** who seeks to differ him, which will not be helpful.

What is ethics?

•"Ethics is concerned with **how we should live our lives.**

•It **focusses on questions** about what is **right or wrong**, **fair or unfair, caring or uncaring, good or bad, responsible or irresponsible, and the like**". –Jaksa and Pritchard.

What is professional Ethics in negotiation?

•"The principle behind professional ethics is that **one's actions are designed to create the greatest good** for both the client and community rather than **to enhance the position and power of the practitioner**". Cutlip



Ethical Situation on issues that Project Management facing.

Example:

•Consider the situation, where a **firm requests an outside contractor** to **develop a software package** to achieve some function.

•When the **firm asks for a specific objective to be accomplished**, **firm frequently does not know** it that is a **major task** or **a trivial task** **because it lacks technical competence** in that area.

•**Contractor has the opportunity to miss-present the task to its customer, either inflating the cost** for a **trivial task or minimizing the impact** of a **significant task** in order to **acquire the contract and then boosting the cost later**.

•Ethics of the situation require that **each party in the negotiation be honest with the other**, even in situation where it is clear that there will not be further work between two.

•These are by far the **most common and most troublesome issues**, project management facing.

Partnering, Chartering, and Scope Change

Three situations commonly arising during projects that **call for the highest level of negotiating skills**:

- **use of subcontractors**,
- **use of input**, to design and develop the project's mission, and
- **management changes of ordered** in the project's deliverables and/or **priorities** after the project is under way.

All account for **more litigation** than all other aspects of the projects combined.

Question: Describe the situations commonly arising during project that call for the highest level of negotiating skills of project manager.

What is **project partnering** as tools of Negotiation of Project Management?

Project Partnering is:

- A method of transferring **contractual relationship** into a **cohesive, cooperative project team** with a single set of goals **and**

- **Established procedures for resolving disputes** in a timely and effective manner.

Concept of partnering is developed in Project.

- Frequency of **outsourcing parts of projects** is an steady growth.

- **External suppliers are delivering parts of projects**, including the tangible products and services as well as intangible knowledge and skills.

Many **reasons that firms entering partnering** arrangements with each others in Projects: (DARSP)

- **Diversification of technical risks**.
- **Avoidance** of **capital investment**,
- **Reducing political risks** on multinational projects.
- **Shortening the duration** of the projects and
- **Pooling of complementary knowledge** among others.

Question: Describe the various reasons that firms entering partnering arrangements with each other.

Why the concept of partnering develops in project management

Relationship between Organization and Subcontractors:

•Generally, relations are **best characterized as adversarial.**

•**Parent's organization's objective** is to **get deliverable** at the lowest possible **cost,** as **soon as** possible. **Subcontractor's objectives** is to **produce the deliverable** at the highest possible **profit** with the least **effort.**

•This **conflicting interests** create an atmosphere of **mutual suspicion and antagonism**.

- Two parties will have **significantly different ideas** about the exact nature of deliverable itself.

- But, **adversarial relationship** **makes cooperation difficult** in the best of cases.

- Concept of '**Partnering',** has been developed **to replace this adversal atmosphere** with one of **cooperation and mutual helpfulness.**

Multi-steps Process for Building partnered projects:

Step 1:
Parent firm must **make a commitment** to partnering, **select subcontractors** who will also make such a commitment, engage in **join team building exercise**, and develop a **'charter' for the project**.

Step 2:
Both parties must implement the partnering process with an **agreement on**:
- **Joint evaluation**' of the project progress,
- A **method for solving any problem or disagreements**,

Step 3:
Acceptance of a goal for continuous improvement, known as Total Quality Management (TQM) for joint project.

Step 4:
Continuous support for the process of partnering from senior management of both parties.

Step 5:
•***Parties* commit to a joint review of 'Project Execution'** when the project is completed.

Example of Partnered project:
•**Airbus Industry**, originally British, French, Spanish and German.

•Airbus Industry is not only a **consortium of private firms from four different nations,** but each of the **four governments subsidized their respective private firms.**

•This venture, apparently **undertaken in order to foster a European competitor to USA's Boeing Aircraft.**

Problems in Partnering and Lessening the problems:

Partnering is not without its problems. Those who have not had much experience with partnering, underrate its difficulties.

- Partnering **requires strong support from** senior management of all participants, and **requires continuous support** of project objectives and partnering agreements.

- Most difficult of all, it **requires open and honest communication** between the partners.

With all its problems, **partnering yields benefits great enough to be worth the efforts** required to make it work correctly.

Question: What problems in partnering in the project?

Project Chartering

What is project charter?

- **Agreements between groups**, partnering on large endeavors are **often to as charters**.

- A project **charter is simply a written agreement between the PM, senior management and the functional managers** who are committing resources and /or people to a specific project.

Charter may take many different form:

- **Details the expected deliverable**, often includes schedules, budgets, and resource commitments.

- It attests to the fact that **senior management of all the relevant organizations, functional managers and the PMs are 'on the same pace'**, "agreeing about what is to be done, when, and what at cost.

- Has an implication that **none of the parties will change the agreement unilaterally**, or, at least, without prior consultation with other parties.

- **Many projects do not have charters**, which is one reason for observing that many projects are not completed on specification, on time and on budget.

In chartering, Points to which partnering team sign for commitments as charter:

- **Meet the design intent (ie** long-term viability of the project**)**,

- **Complete contract** without need for litigation (ie process of taking legal action).

- **Finish product on schedule**:
  - -Timely resolution of issues
  - -Manage joint schedule

- **Keep cost growth** to less than 2% etc.

Scope Change

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

In other words, it is **what needs to be achieved** and the **work that must be done to deliver a project**.

Basic Causes of Scope Change in Projects:

First Cause: Some changes result because:

•Planners **erred in their initial assessment** about how to achieve a given end

or

•**Planners erred in their choice of proper goal** for the project.

Example:

•**Technological uncertainty** is the fundamental causal factor for either error.

- **Foundation for a building must be changed** because a preliminary geological study did not reveal a weakness in the structure of the ground on which building will stand.

- **An R & D must be altered** because metallurgical test results indicate another approach, should be adopted.

- Project team **becomes aware of a recent innovation** that allows a faster, cheaper solution to the conformation of new computer.

Second Cause: Other changes result because **Client/user or project team learn more about:**

- **Nature** of the project deliverable or
- **Setting** in which it is to be used.

Example:

- A **computer program must be extended or rewritten** because the user thinks of new uses for the software.

- Physicians request that **ICUs in a hospital be equipped with laminar air flow control** in order to accommodate patients highly subject to infection who might otherwise not be admissible in an ICU.

- Fledgling audio-addicts **upgrades specifications** for a system to **include very high frequencies** so that his dog can enjoy music too.

(Fledgling - a person or organization that is immature, inexperienced, or underdeveloped.)

Third Cause:

- **Source of change is the mandate.**
- This is a **change in the environment** in which the project is being conducted. As such, it can not be controlled by the PM.

Example:

- A **new law** is passed.
- A government regulatory unit articulates a **new policy**.
- A trade association sets **a new standard**.
- Parent organization of the user applies a **new criterion for its purchase.**
- The **rules of conduct for the projects are altered**.

Thank you

GEPM 375

Project Planning and Construction Management

Negotiation Methods

Today we are going to discuss

- **Requirements** of Conflict Negotiations Methods.

- Negotiation **Techniques** to maintain win-win solution**.**

- ***The key to finding a negotiator's interests and concerns is to ask "why", when he or she states a position***. **Explain.**

- **Phases of Negotiation**

Requirements of Conflict Resolution/reduction or Negotiations Methods:

- **First requirement**, methods must **allow the conflict to be settled** without irreparable harm to the project's objectives.

- **Second requirement**, methods used by the PM is that **they allow (foster) honesty** between negotiators.

- **Third requirement**, that all the **conflicting parties to seek solutions to the conflict** that:
  -not only satisfy their **own individual needs**,
  -but also satisfy he **needs of other parties** to the conflict,
  -as well as the **needs of the parent organization**.

In a **language of negotiation**, that is called **'win-win' solution.**

Negotiating to a win-win solution is the key to conflict resolution in project management.

Negotiation techniques to maintain win-win solution

Following techniques called '**principled negotiation**' ie win-win:

- ***Separate the People from the Problem*.**
- ***Focuses on interests, not positions*.**
- ***Before trying to reach agreement, invent options for mutual gain.***
- ***Insists on using objective criteria.***

Question: Describe the negotiation techniques to maintain win-win solution.

1.Separate the People from the Problem:

- Conflicting parties are often **highly emotional**.
- Conflicting parties **tend to attack one another** rather than the problem.
- To **minimize the likelihood that the conflict will become strictly interpersonal**, the **substantive problem should be carefully defined.**
- Then **every one can work on it rather than each other**.

2. Focuses on interests, not positions:

- **Positional bargaining** occurs when the **PM says to a functional manager**: **'I need this subassembly by November 15,'** The functional manager responds, '**My group can't possibly start on it this year. We might be able to deliver it by February 1.'.**

- These are the **opening lines of dialogue** that sound suspiciously like the haggling of the tourist and the rug of peddler.

- A simple, **'Let's us talk about the schedule for this subassembly'**, would be sufficient to open discussion.

- Otherwise each party **develops a high level of ego**, involvement in **his or her position**.

- And negotiation **never focusses on the real interests and concerns of the conflicting parties** – the central issue of the conflict.

- Such **exchange deteriorates into a series of positional compromise** that **do not satisfy either party** and leave both parties **feeling** that **they have lost something important.**

3. Before trying to reach agreement, invent options for mutual gain:

- Parties-in-conflict **usually enter negotiations knowing the outcome they would like**.

- As a result, **they are blind to other outcomes** and are particularly **not creative**.

- As soon as **substantive problems are spelled out**, some efforts should be devoted to find a **wide variety of possible solutions or elements** that advance the mutual interest of the conflicting parties.

- Success at **finding options that produce mutual gain** positively **reinforces win-win negotiations.**

Example: Reports on a **conflict between a couple** in which, **he wanted to go mountains, and she wanted to go to the shore**.

- A creative win-win solution is sent them both to **Lake Tahoe.**

Lake Tahoe- a large freshwater lake in the Sierra **Nevada** Mountains, straddling the border of California and Nevada.

It's known for its **beaches and ski resorts.**

Lake Tahoe includes **Sand Harbor Beach** and Spooner Lake, a gateway to the long-distance Tahoe Rim Trail.



4. Insists on using objective criteria:

- Rather than bargaining on positions, **attention should be given to finding standards** (ie market value, expert opinion, law, company policy) **that can be used to determine the quality of an outcome.**

- **By doing, this tends to make the negotiation is less a contest of wills or exercise in stubbornness.**

Example:

- If a functional manager wants to use an **expensive process to test a part**, it is **acceptable for the PM to ask** if such a process is required to ensure that the parts meet specified quality standards.

***The key to finding a negotiator's interests and concerns is to ask "why", when he or she states a position*. Explain.**

- Positions taken by negotiators are not truly understandable **without first understanding the interests and concerns** that prompt those positions.

Example:

- Statement that **a test is requested for May 15**, **can not be run until June 2,** may simply mean that the **necessary test supplies will not be delivered until the later date**.

- If the **PM can get the supplies from another source in time** for the May 15 deadline, the test can be run on schedule.

- But the ability to do this **depends on knowing why the test was to be delayed.**

- If the **negotiation remain a debate on positions**, the **PM will never find out** that the test could have run on time.

- So, the **key to finding a negotiator's interests and concerns is to ask 'why?' when he or she states a position.**

Stages or Phases of Negotiation

Once it has been **agreed upon by both parties** to enter into negotiation, both parties should **follow a series of phases or stages** to **achieve maximum benefit from negotiation**: **(PPIOBAF)**

Phase 1: Preparation

- **Collect Documents**: Negotiations will have a greater chance of succeeding if the **arguments are backed by good documentation;**

- **Set Concise Data**: Preparation phase **consists largely of collecting and collating these documents** and **distilling them** into a coincide set of data suitable for discussion.

- **Back up documentation:** Which will give a clear picture of what the issues are.

Phase 2: Planning Stage

- **Find out Intention**: It is pointless even considering a negotiation process if there is **no intention to compromise**.

- **Establish Degree of compromise and the limits of concessions:** Which can be accepted, have to be established in this phase.

- **Location of negotiation:** Must be given some consideration as it may be necessary to call in advisers or experts at some stage.

Phase 3: Introduction

- **Establish Good Relationship and Rapport**: Negotiations are carried out by people and establishment of a good relationship and rapport can be very beneficial.

- **Past Ventures**: Past co-operative ventures should be mentioned.

- **Discussion: Discussion of common acquaintances**, **alliances** and **interests** will help to break the ice and tend to put all parties at their ease.

- **Quick Overview: A quick overview of he common goal as well as the differences** may be enable the parties to focus on the **important issues**, which can then be categorized for the subsequent stages.

Phase 4: Opening Proposal

- **Initial offer:** One of the parties must **make an initial offer** which sets out their case and requirements.

- **Wording:** **Wordings of this opening would give some indication of the flexibility** as an inducement to reaching a mutually acceptable settlement.

- **Body Language:** Other party's body language such as hand gestures, postures, eye movement and facial expressions can give clues as to the acceptance or no acceptance of particular suggestions or offers.

- **Common identification:** It is **of important points** will help to lead the discussion into next phase.

Phase 5: Bargaining

- **Purpose is to reach: An agreement which lies somewhere between the initial extreme positions taken by the parties**.

- **Employ well-known tactics: Both parties may employ well-known tactics** such as veiled threats, artificial explosion of anger or outrage, threats of walking out or other devices, but this all part of the process.

- **Balancing:** Concessions on one aspect can be balanced by enhancement on another.

Example 1:

- A supplier **may reduce his price** to the level required by the buyer, provided his production (and hence his delivery) **period can be increased** by a few weeks or months.

- Buyer has to decide which aspects **takes priority; money or time.**

- **Concessions should always be traded** for a gain in another area, which may not be necessarily in the same units or terms.

Example 2:

- A **reduction in price can be balanced** by an **increase in number of units** ordered or a later delivery.

- Should always be **a number of issues on the table** for discussion, so that '**quid pro quo' deals** can be struck between them.

Quid pro quo: **A favor or advantage granted in return for something**.

Phase 6: Agreement

- **Negotiators are only successful if these end with an agreement.**

- If both parties **walk away without an agreement**, **negotiators have not done their jobs.**

- **Case probably end up in adjudication**, **arbitration** or **litigation.**

- Both parties should be **satisfied enough to wish to continue working or trading together** and both are probably aware that there is always the risk that **the legal costs of an action** can exceed the amount in dispute.

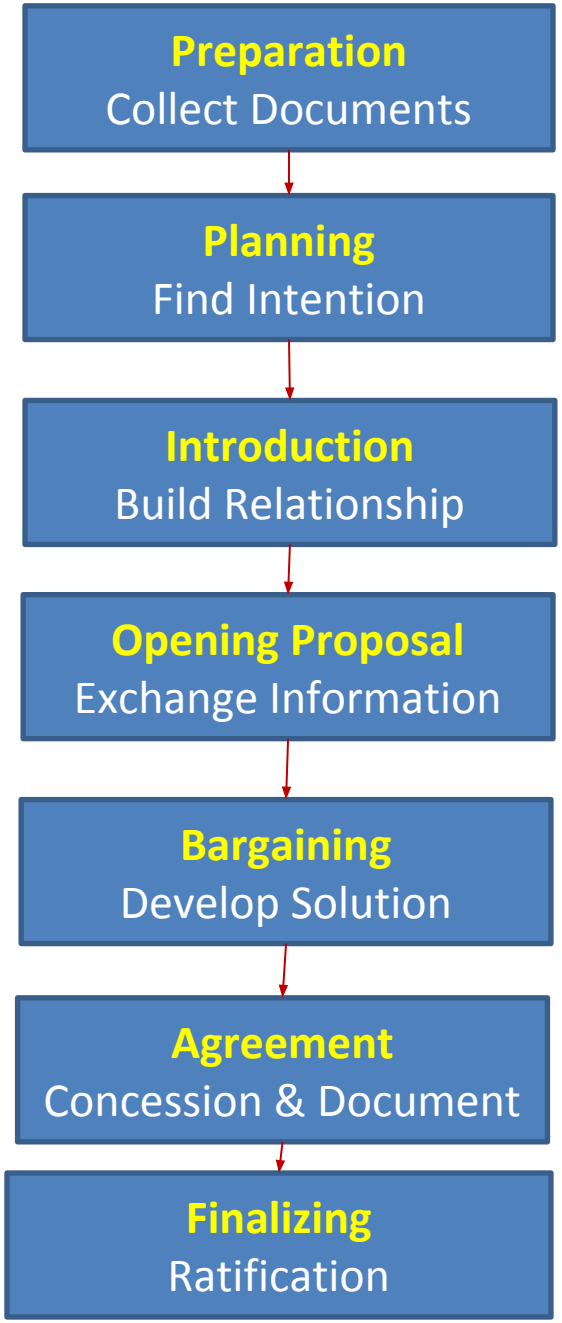
Phase 7: Finalization

- **Written Document**: When agreement has been reached, the **deal has to be finalized by a written statement,** setting out terms of agreement.

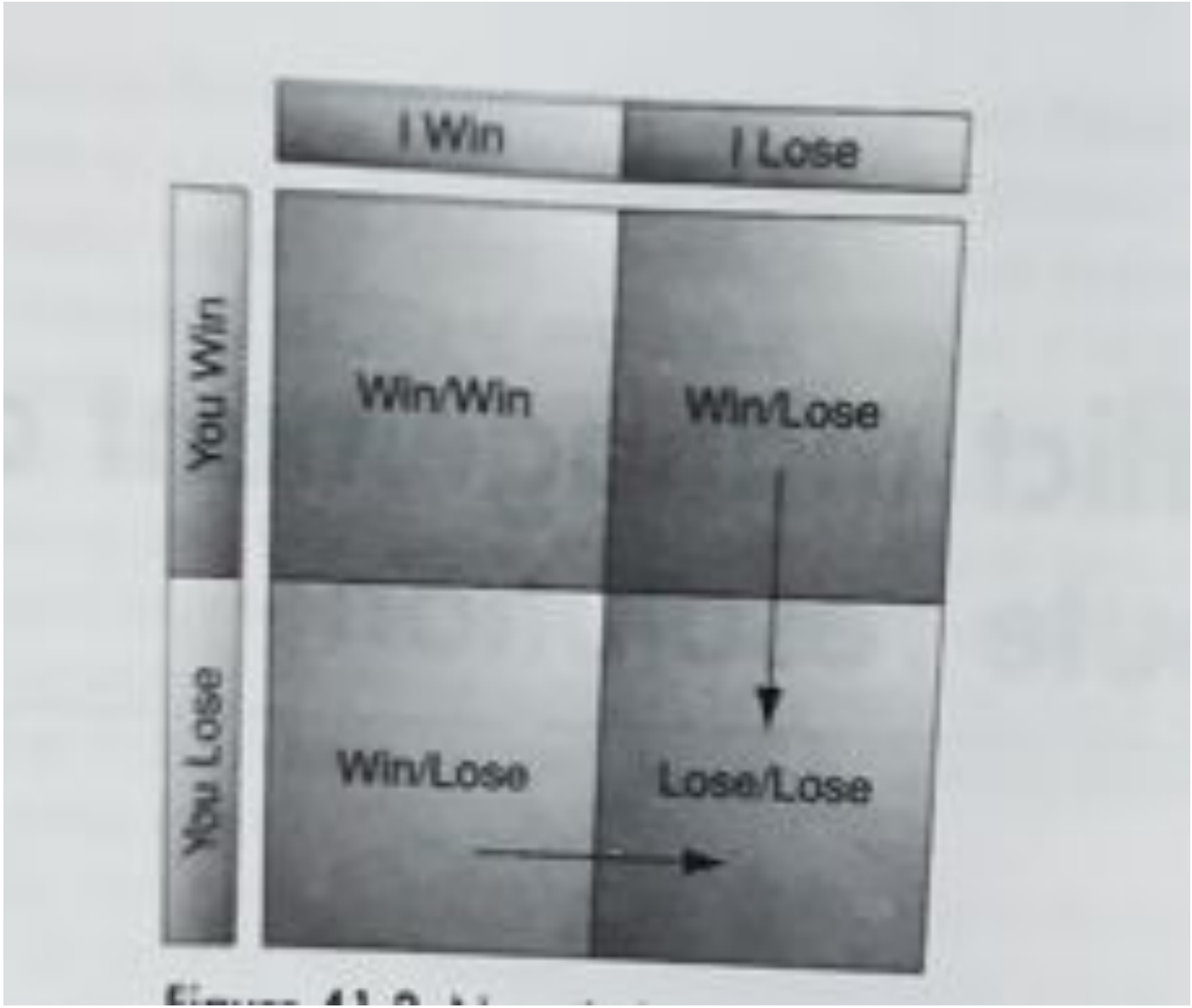
- **Signing: Must be signed by both parties** attending the negotiations.

- **Ratification**: In some cases, the agreement reached will be subjected to **ratification by senior management**, but if the settlement is reasonable, such confirmation is usually given without question.

Negotiation Stages or Phases



Negotiation Outcome



Today what we have discussed?

- **Requirements** of Conflict Resolution/reduction or Negotiations Methods.

- Negotiation **Techniques** to maintain win-win solution**.**

- ***The key to finding a negotiator's interests and concerns is to ask "why", when he or she states a position***. **Explain.**

- **Phases of Negotiation**

Thanks

GEPM 375

Project Planning and Construction Management

Linear Programming

Linear Programming Class-1

What we are going to learn today?

- **What is optimization?**
- Definition of Linear Programming
- **Example of a linear programming problem**.
- Formulating a real life problem in LP problem.
- **Common Terminologies**
- Steps and Process of LP

Optimization, is the way of life:

- We all have **finite** **resources and time** and we **want to make** **the most out of them.**

- From **using your time**, **productively** to solving **supply chain problems** for your company – **everything uses optimization**.

- It **starts with** **simple problems**, but can get very complex.

For example:

- **Sharing chocolates** among siblings is a simple optimization problem. We don't think in mathematical term while solving it.

Question: What is optimization in project management? Describe with example.

- On the other hand **devising inventory and warehousing strategy** can be very complex.

- **Millions of SKUs** with **different popularity** in **different regions** to be **delivered in defined time and resources**.

(A **stock keeping unit- SKU**, is **a store or catalog's product** and **service identification code**; it is often portrayed as a machine-readable bar code)

Inventory refers to the goods, materials, and products a business **holds for sale, production, or use**





Linear Programming (LP)

- LP is **one of the simplest ways to perform optimization.**
- Helps **to solve some very complex optimization problems** by **making a few simplifying assumptions**.
- As an engineer you are **bound to come across different applications and problems** to be solved by Linear Programming.

Question: Define linear programming in project management perspective.

What is Linear Programming?

- A **simple technique** where we **depict** **complex relationships through linear functions** **and** then **find** the **optimum points/solutions**.

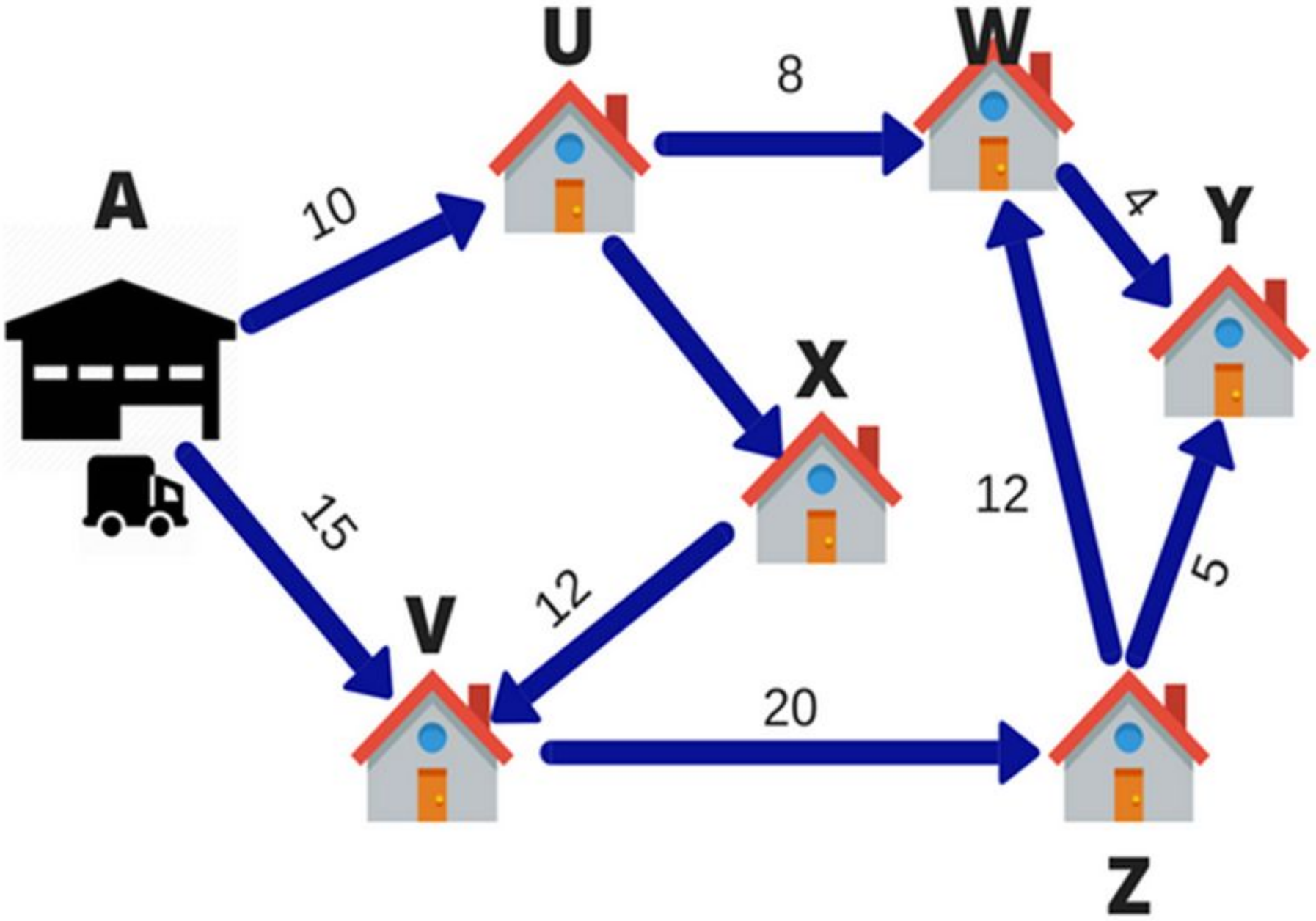
Important word is **depict**.

- **Real relationships might be much more complex** – but we **can simplify them to linear relationships.**

- A **linear function** has one independent variable and one dependent variable.)

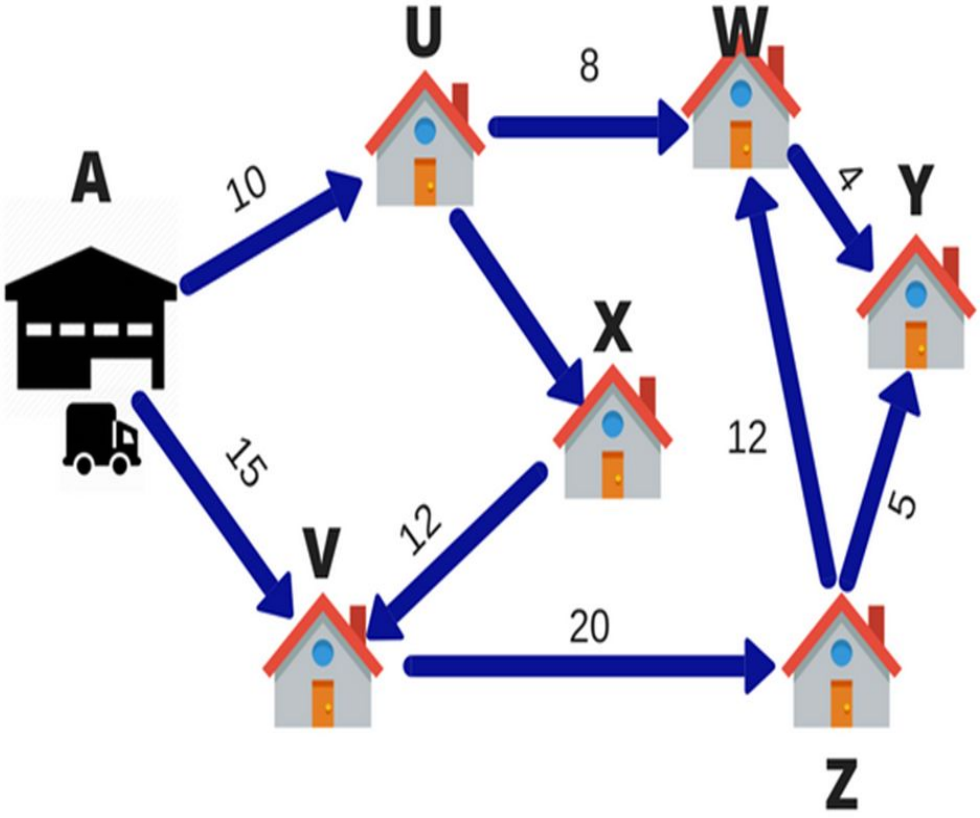
Applications of linear programming are everywhere around you.

- You use LP at **personal and professional fronts.**
- You are using LP when you are **driving from home to work and want to take the shortest route**.
- Or when you have a **product delivery,** you **make strategies to make your team work efficiently** for **on time** delivery.


A
U
W
Y
X
V
Z
10
8
4
15
12
12
5
20

Example of a linear programming problem

- Let's say a FedEx delivery man has **6 packages to deliver in a day.**
- Warehouse is located **at point A**.
- **6 delivery destinations** are given by U, V, W, X, Y and Z.
- **Numbers** on the lines **indicate the distance** between the destinations, cities.
- **Save on fuel and time** the delivery person wants to take the **shortest route**.



- Delivery person **will calculate different routes** for going to all the 6 destinations and then **come up with the shortest route**.

- **This technique of choosing the shortest route is called linear programming.**

Question: Explain linear programming problem with an example.

Here,
Objective of the delivery person is to **deliver the parcel on time** at all 6 destinations.

Process of choosing the best route is called **Operation Research**.

Operation research is **an approach to decision-making**, which involves a **set of methods to operate a system.**

In the above example, the **system is** as the **Delivery model**.

Concept of using LP Method

- **LP is used for obtaining the most optimal solution for a problem with given constraints**.

- In LP, **formulation of real life problem into a mathematical model**.

- And involves an **objective function**, **linear inequalities** with subject **to constraints**.

Question: In linear programming, formulation of real life problem in to a mathematical model. Describe with example.

Example of LP in real life problem:

- **Linear representation of the 6 points** is the representation of **real world**.

- It is **oversimplification** as the **real route would not be a straight line**.

- It would likely have **multiple turns**, **U turns**, **signals** and **traffic jams**.

- But **with a simple assumption**, we have **reduced** the complexity of the problem drastically and are **creating a solution** which should work in most scenarios.

Formulating a real problem into LP:

Let's manufacture some chocolates:

Example: Consider a chocolate manufacturing company which produces only **two types of chocolate** – A and B. Both the chocolates require **Milk and Choco** only. To manufacture each unit of A and B, following quantities are required:

- **Each unit of A** requires **1 unit of Milk and 3 units of Choco**
- **Each unit of B** requires 1 unit of Milk and **2** units of Choco

Question: How do you formulate a real world problem for linear programming? Explain with example.

Linear Programming

- Company **kitchen has** a total of **5 units of Milk and 12 units of Choco**.

- **On each sale**, the company makes a profit of

  Taka 6.00 per unit A sold.
  Taka 5.00 per unit B sold.

- Now, the company wishes to **maximize its profit**.

- **How many units of A and B should it produce respectively**?

Linear Programming

Solution:

- First thing, is to **represent the problem in a tabular form** for better understanding.

	Milk	Choco	Profit per unit
A	1	3	Taka 6.00
B	1	2	Taka 5.00
Total	**5**	**12**	

- **Let** the **total number of units** produced of **A be = X**
- Let the **total number of units** produced of **B be = Y**
- Now, **the total profit** is represented by **Z**

•Total profit the company makes is given by the total number of units of A and B produced multiplied by its per unit profit Tk 6 and Tk 5 respectively.

Total Profit: $Z = 6X+5Y$

which means we have to **maximize Z**.

•Company will try to **produce as many units of A and B to maximize the profit.**

•But the **resources Milk and Choco are available in limited amount.**

Milk:

•As per the above table, each unit of A and B requires **1 unit of Milk**. The **total amount of Milk available is 5 units**.

•To represent this **mathematically,**

$X+Y \leq 5$

Choco:

•Also, each unit of A and B requires 3 units & 2 units of Choco respectively. The **total amount of Choco available is 12 units**.

•To represent this **mathematically**,

$$3X+2Y \leq 12$$

•Also, the **values for units of A and B can only be integers**.

•So we have **two more constraints**, $X \geq 0$ & $Y \geq 0$

For the company to make **maximum profit**, the **above inequalities have to be satisfied**.

This is called formulating a real-world problem into a mathematical model.

Question: What is called the formulating a real time problem in to mathematical model? Explain with example.

Parameters used in Linear Programming

- **Decision Variables**
- **Objective functions**
- **Constraints**
- **Non-negative restrictions.**

Decision Variables:

- Decision variables are the variables **which will decide the output.**

- **Represent the ultimate solution**.

- To solve any problem, it is needed **first to identify the decision variables.**

- For the above example, the **total number of units for A and B denoted** by **X & Y respectively are the decision variables.**

Objective Function:

- Defined as the **objective of making decisions**.

- For the above example, the **company wishes to increase the total profit represented by Z.**

- So, **profit Z is the objective function.**

Constraints:

- Constraints are the **restrictions or limitations on the decision variables.**

- Usually **limit the value of the decision variables**.

- In the above example, the **limit on the availability of resources Milk and Choco are the constraints**.

- Milk for A is 1 and Choco for A is 3 is constraints.
- Milk for B is 1 and Choco for B is 2 is constraints.

Non-negativity restriction:

•For all linear programs, the **decision variables should always take non-negative values**.

•Which means the values for decision variables should be **greater than or equal to 0**.

•Previous example, $X \geq 0$ & $Y \geq 0$

Process/steps to define a Linear Programming problem

Let us look at the **steps of defining a Linear Programming** problem generically:

Step-1:
•Identify the decision variables
Step-2
•Write the objective function
Step-3
•Mention the constraints
Step-4
•Explicitly state the non-negativity restrictions.

For a problem to be a linear programming problem, the **decision variables, objective function and constraints all have to be linear functions.**

- If the all the above conditions are satisfied, it is called a **Linear Programming Problem**.

Question: What is linear programming problem? Describe the different steps of defining a linear programming problem generically.

Thank you

GEPM 375

Project Planning and Construction Management

Linear Programming-2

Process/ Steps in Formulating Real Life Problems into LP Problems:

- **Step-1:** Identify the decision variables –which decides output (X and Y)
- Step-2: Define the objective functions – optimized solution. ($Z=6X+5Y$)
- Step-3: Write down constraints – Limitations on decision variables.
($X + Y \leq 5$ and $3X+2Y \leq 12$)
- State Non-negativity variables ($X \geq 0$ and $Y \geq 0$)

Methods of Solving LP Problems

- **Graphical Method**
- **Open Solver method**
- **Simplex Method**
- **North-West Corner Method**
- **Least Cost Method**

Graphical Method:

- A linear program can be solved by multiple methods.

- **One of the methods is Graphical method for solving a linear program.**

- Graphical method is ***used to solve a two variable linear program.***

- If there is **only two decision variables**, you should use the graphical method to find the optimal solution.

Question: What is graphical method of solving LP program?

Process of Graphical method

• A graphical method involves **formulating a set of linear inequalities subject to the constraints.**

• Then the **inequalities are plotted on a X-Y plane.**

• Once we have plotted all the inequalities on a graph the **intersecting region gives us a feasible region**.

•**Feasible region** explains **what all values our model can take**.

•And model also **gives us the optimal solution**

Question: Write down the process of solving LP problems by graphical method.








Let's understand Graphical methods with the help of an example:

Example: A farmer has recently acquired an **110 hectares piece of land.** He has decided to **grow Wheat and Barley** on that land. Due to the quality of the sun and the region's excellent climate, the entire production of Wheat and Barley can be sold. He wants to know **how to plant each variety in the 110 hectares,** given the **costs, net profits** and **labor requirements** according to the data shown below:

Variety	Cost (Price/Hec)	Net Profit (Price/Hec)	Man-days/Hec
Wheat	100	50	10
Barley	200	120	30

Farmer has a budget of **US$10,000** and an availability of **1,200 man-days** during the planning.

Find the optimal solution and the optimal value.

Solution: To solve this problem, first to formulate the linear program.

Formulation of Linear Problem

Step 1: Identify the decision variables

- Let, the total area for growing Wheat = X (in hectares)
- Let, the total area for growing Barley = Y (in hectares)

X and Y are the decision variables.

Step 2: Write the objective function:

- Since the production from the entire land can be sold in the market.
- Farmer would want to **maximize the profit** for his total produce.
- Here it is given net profit for both Wheat and Barley.
- Farmer earns a net profit of US$50 for each hectare of Wheat and US$120 for each Barley.

Objective function (given by Z) is, Max Z = 50X + 120Y

Step 3: Writing the constraints

- It is given that the farmer has a **total budget of US$10,000.**
- **Cost of producing** Wheat and Barley per hectare is also given to us.
- We have the **total cost spent** by the farmer. So our equation becomes,

1st constraint: $100X + 200Y \leq 10{,}000$

- Availability of total man-days is **1200 man-days.**
- Man-days for wheat and barley is 10 & 30 man-days respectively

2nd Constraints: $10X + 30Y \leq 1200$ **(man-days)**

3rd constraint is the **total area present for plantation**.

- Total available area is **110 hectares**.

- So the equation becomes,

3rd constraint: $X + Y \leq 110$

Step 4: The non-negativity restriction

- Values of X and Y will be greater than or equal to 0. This goes without saying.

$X \geq 0, Y \geq 0$

- Formulation of linear program is done.

- It's time to solve it.

Question: For the problem given, formulate the linear program.

Solving a LP through Graphical method

- Since we know that X, Y ≥ 0, **consider only the first quadrant.**

- To plot for the graph for the equations, first **simplify all the equations**.

- **100X + 200Y ≤ 10,000** can be simplified to **X + 2Y ≤ 100** by dividing by 100.

- **X + 2Y ≤ 100 (cost) --------- (1)**

10X + 30Y ≤ 1200 can be simplified to **X + 3Y ≤ 120** by dividing by 10.

- **X + 3Y ≤ 120 (man-days) ----------(2)**

Third equation is in its simplified form, **X + Y ≤ 110**

- **X + Y ≤ 110 (total land) ---------- (3)**

Plot the equation (1) and (2) on a graph in **first quadrant (like shown below)**

•Optimal feasible solution is achieved at the point of **intersection** where the budget & man-days **constraints are active**.

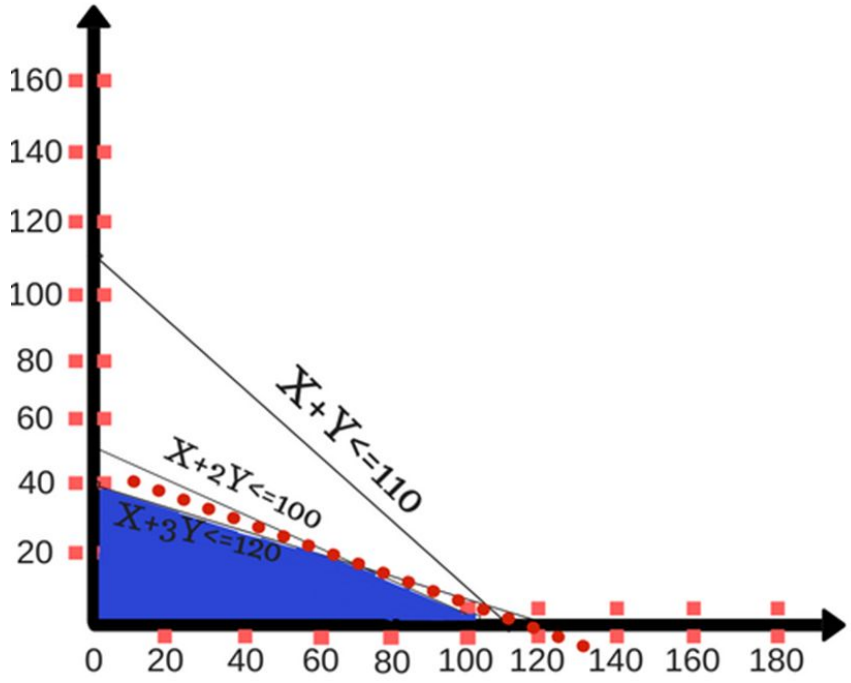
•This means the point at which the equations $X + 2Y \leq 100$ and $X + 3Y \leq 120$ **intersect gives** us the optimal solution.

•Values for X and Y which gives the optimal solution is at (60,20).

•Maximize profit the farmer should produce Wheat and Barley in **60 hectares and 20 hectares** of land respectively

Maximum profit the company will gain is,

Max Z = 50 * (60) + 120 * (20)
= US$5400



Other Methods of solving LP problems

- Open Solver method.
- Simplex Method
- Northwest Corner Method and
- Least Cost Method

Solve Linear Program using Open-Solver

- In reality, a linear program can **contain 30 to 1000 variables** and solving it either Graphically or Algebraically is next to impossible.

- Companies generally use Open-Solver to tackle these real-world problems.

- Open-Solver is an **open source linear and optimizer for Microsoft Excel.** It is an advanced version of built-in excel Solver

Simplex Method:

• Simplex Method is one of the **most powerful & popular methods** for linear programming.

•**Standard technique** in linear programming for solving an optimization problem, typically one involving **a function and several constraints** expressed as inequalities.

Northwest Corner Method:

•Adopted to compute the initial feasible solution of the **transportation problem**.

•Name is given to this method because the basic variables are selected from **the extreme left corner**.

Northwest Corner Method:

- Concept of North-West Corner can be well understood through **a transportation problem** given below:

Source \ To	D	E	F	Supply
A	5	8	4	50
B	6	6	3	40
C	3	9	6	60
Demand	20	95	35	150

Northwest Corner Method:

In the table:

- Three **sources A, B and C** with the production **capacity of 50 units, 40 units, 60 units** of product respectively is given.

- Every day the **demand of three retailers** D, E, F is to be furnished with at least 20 units, 95 units and 35 units of product respectively.

- **Transportation costs** are also given in the matrix.

Source \ To	D	E	F	Supply
A	5 (20)	8 (30)	4	50
B	6	6 (40)	3	40
C	3	9 (25)	6 (35)	60
Demand	20	95	35	150

Northwest Corner Method:

- Select the **north-west or extreme left corner** of the matrix, assign as many units as possible to cell AD, within the supply and demand constraints. Such as **20 units are assigned to the first cell,** that satisfies the demand of destination D while the supply is in surplus.

- **Now move horizontally** and **assign 30 units to the cell AE**. Since 30 units are available with the source A, the **supply gets fully saturated.**

- **Now move vertically** in the matrix and **assign 40 units** to Cell BE. The supply of **source B also gets fully saturated**.

Northwest Corner Method:

- **Again move vertically**, and **assign 25 units** to cell CE, the **demand of destination E is fulfilled**.

- **Move horizontally** in the matrix and **assign 35 units** to cell CF, both the demand and supply of origin and destination **gets saturated**.

Now the total cost can be computed.

- The Total cost can be computed by multiplying the units assigned to each cell with the concerned transportation cost. Therefore,
- **Total Cost** = 20*5+ 30*8+ 40*6+ 25*9+ 35*6 = Tk 1015.00

Least Cost Method:

•Least Cost Method is another method used to obtain the **initial feasible solution for the transportation problem**.

•Here, the allocation **begins with the cell which has the minimum cost.**

•Lower cost cells are chosen over the higher-cost cell with the **objective to have the least cost of transportation**.

Let's understand the concept of Least Cost method through a problem given below:

Source \ To	D	E	F	Supply
A	5	8	4	50
B	6	6	3	40
C	3	9	6	60
Demand	20	95	35	150

Least Cost Method:

Minimum transportation cost can be obtained by following the steps given below:

Source \ To	D	E	F	Supply
A	5	8 (50)	4	50
B	6	6 (5)	3 (35)	40
C	3 (20)	9 (40)	6	60
Demand	20	95	35	150

Least Cost Method:

•**In the given matrix**, the supply of each source A, B, C is given Viz. 50units, 40 units, and 60 units respectively.

•Weekly demand for three retailers D, E, F i.e. 20 units, 95 units and 35 units is given respectively.

•Shipping cost is given for all the routes.

- **Minimum cost in the matrix is Rs** 3, but there is a **tie in the cell BF, and CD**, now the question arises in which cell we shall allocate.

- Generally, the **cost where maximum quantity** can be assigned should be chosen to obtain the better initial solution.

- Therefore, **35 units shall be assigned** to the cell BF. With this, the **demand for retailer F gets fulfilled**, and only **5 units are left with the source B**.

•Again the **minimum cost in the matrix is Rs 3**.

•Therefore**, 20 units shall be assigned** to the cell CD.

•With this, the demand of retailer D gets fulfilled. Only 40 units are left with the source C.

- Next minimum cost **is Tk 4**, but however, the demand for F is completed, we will move to the next minimum cost which **is Tk. 5**.

- Again, the demand of D is completed.

- Next minimum cost is **Tk. 6**, and there is a **tie between** three cells. But however, no units can be assigned to the cells BD and CF as the demand for both the retailers D and F are saturated.

- So, we shall assign **5 units to Cell BE**. With this, the supply of source B gets saturated.

Least Cost Method:

- Next minimum cost is **Tk. 8, assign 50 units** to the cell AE.

- Supply of source A gets saturated.

- Next **minimum cost is Tk. 9**; we shall **assign 40 units** to the cell CE.

- With his both the demand and supply of all the sources and origins gets saturated.

Total cost can be calculated by multiplying the assigned quantity with the concerned cost of the cell.
Therefore,

- **Total Cost** = 50*8 + 5*6 + 35*3 +20*3 +40*9 = Tk. 955.00

Difference between Least Cost method and North west corner method:

- **Least Cost Method** is considered to produce more optimal results than the **North-west Corner because**:

-it **considers the cost** while making the allocation, basing on the availability and supply requirement.

-whereas the North-West corner method **only considers the availability and supply requirement** and allocation **begin with the extreme left corner, irrespective of the shipping cost.**

Thank you

GEPM-375
Professional Practices and Construction Management

Cash Flow in Projects

- **What is it?**
- **Importance**
- **Sources of money in cash flow**
- **FCF and Positive cash Flows**
- **Critical Parts of Financial Statement**
- **Cash flow does not necessarily show all the company's expenses.**
- **Types of cash flow**
- **Other Financial Statement with cash Flow:**

Cash Flow:

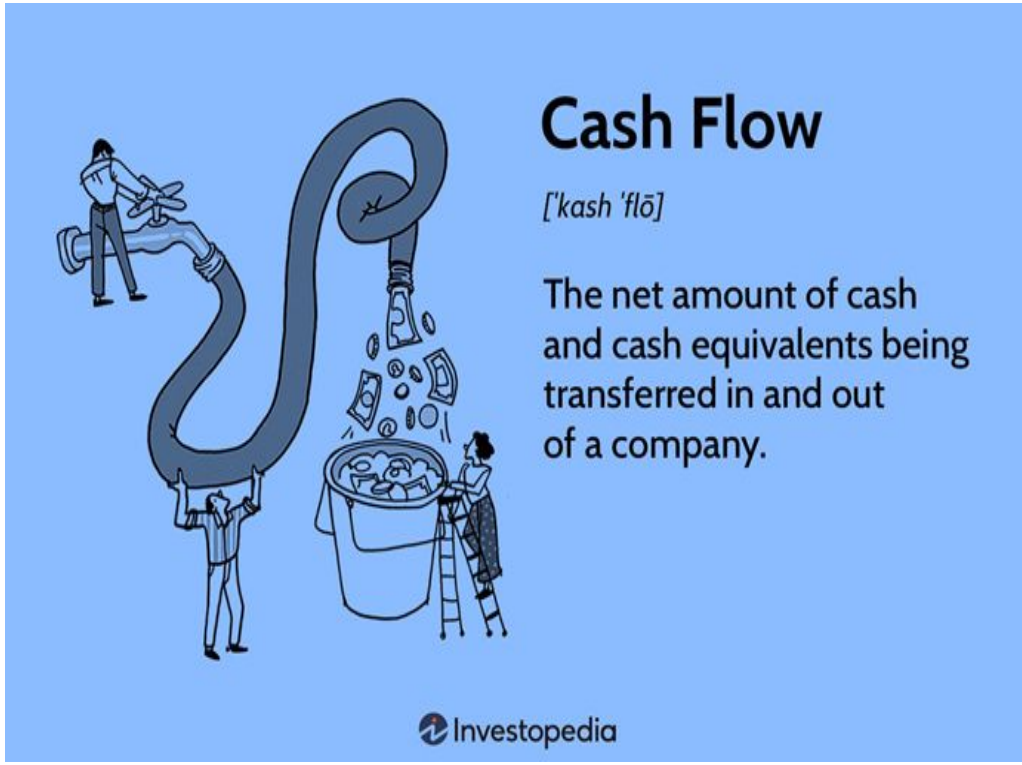
- Refers to the **net amount of cash** and **cash equivalents** being **transferred in and out** of a specific project **over a time**.

- Cash **received** represents **inflows**, while money **spent** represents **outflows.**

Positive Cash Flows: Inflows > Outflows; the project generates more cash than it spends.

Negative Cash Flows: Outflows > Inflows; the project costs more than it brings in during that period, common early on.

Net Cash Flow: Total Inflows - Total Outflows **over a period**.



Working Capital: Funds needed for day-to-day operations, often a key factor in project cash flow

Importance of Cash Flow:

- **Indicates Financial stability and liquidity.**
- **Helps in business growth and investment opportunity.**
- **Indicates Credit worthiness and borrowing capacity**
- Helps in **Decision-making and financial planning.**
- Helps to **Create valuation and investor confidence.**

Sources of Money in Cash Flow:

- Amount of **cash that comes in and goes out** of a company.

Businesses take in **money from sales, as revenues** and **spend money on expenses**.

Money may also receive income from
- interest,
- investments,
- royalties, and licensing agreements and
- sell products on credit, expecting to actually receive the cash owned at a late date.

Assessing the **amounts, timing**, and **uncertainty of cash flows**, along with where they originate and where they go, is one of the **most important objectives of financial reporting.**

It is essential for assessing a company's **liquidity, flexibility**, and **overall financial performance.**

Free Cash Flow:

- Ability to **create value for shareholders** is **fundamentally determined** by its ability to **generate positive cash flows** or, more specifically, to **maximize long-term Free Cash Flow (FCF).**

- FCF is the cash **generated by a company from its normal business operations** after **subtracting all the expenses.**



Positive Cash Flow

- Positive cash flow **indicates that a company's liquidity assets are increasing.**

- Enabling the company to:

  -Cover obligations,
  -Reinvest in its business,
  -Return money to shareholders,
  -Pay expenses, and
  -Provide a buffer against future financial challenges.

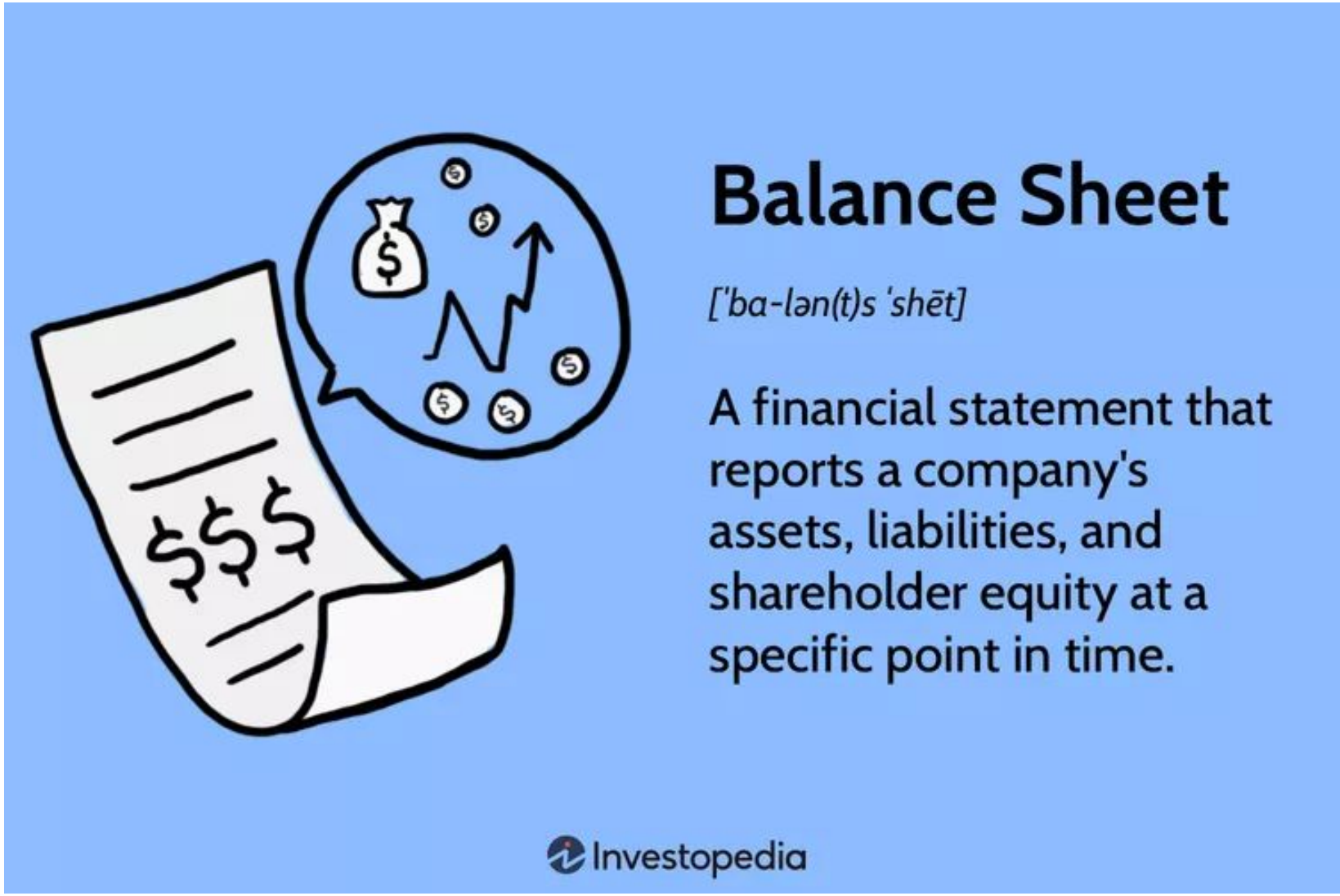
- Companies with **strong financial flexibility** can take **advantage of profitable investments**.

Critical parts of a company's financial statements:

- **A formal record of the financial activities** and **position** of a business/project.

Balance Sheet

- Balance sheet is a **financial statement** that **reports a company's assets, liabilities and shareholder equity** at a specific point in time.



Income Statement

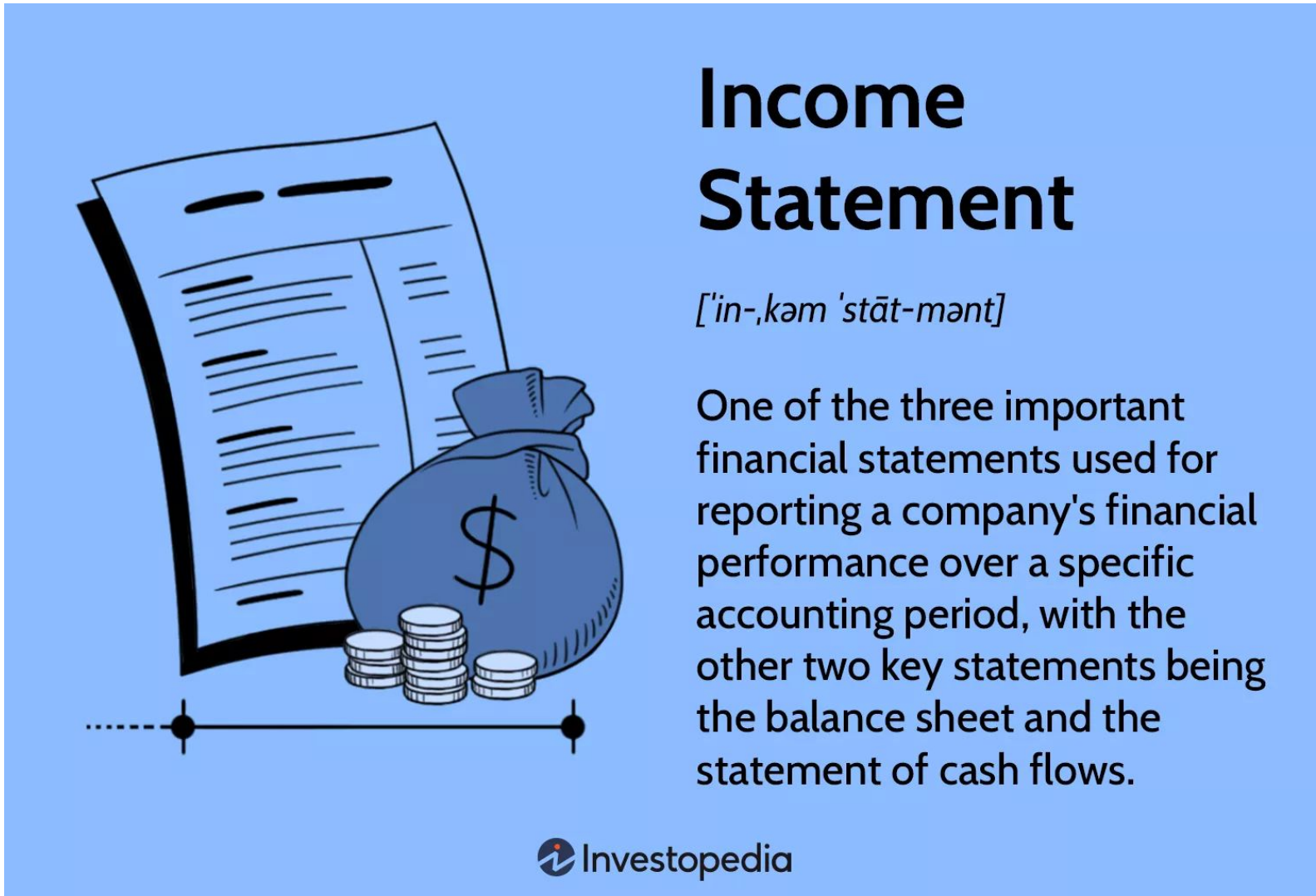
Cash Flow Statement

Income Statement

- An income statement is a **financial report** that shows a company's **revenue**, **expenses**, and **profits & loss** over a **specific accounting period**.

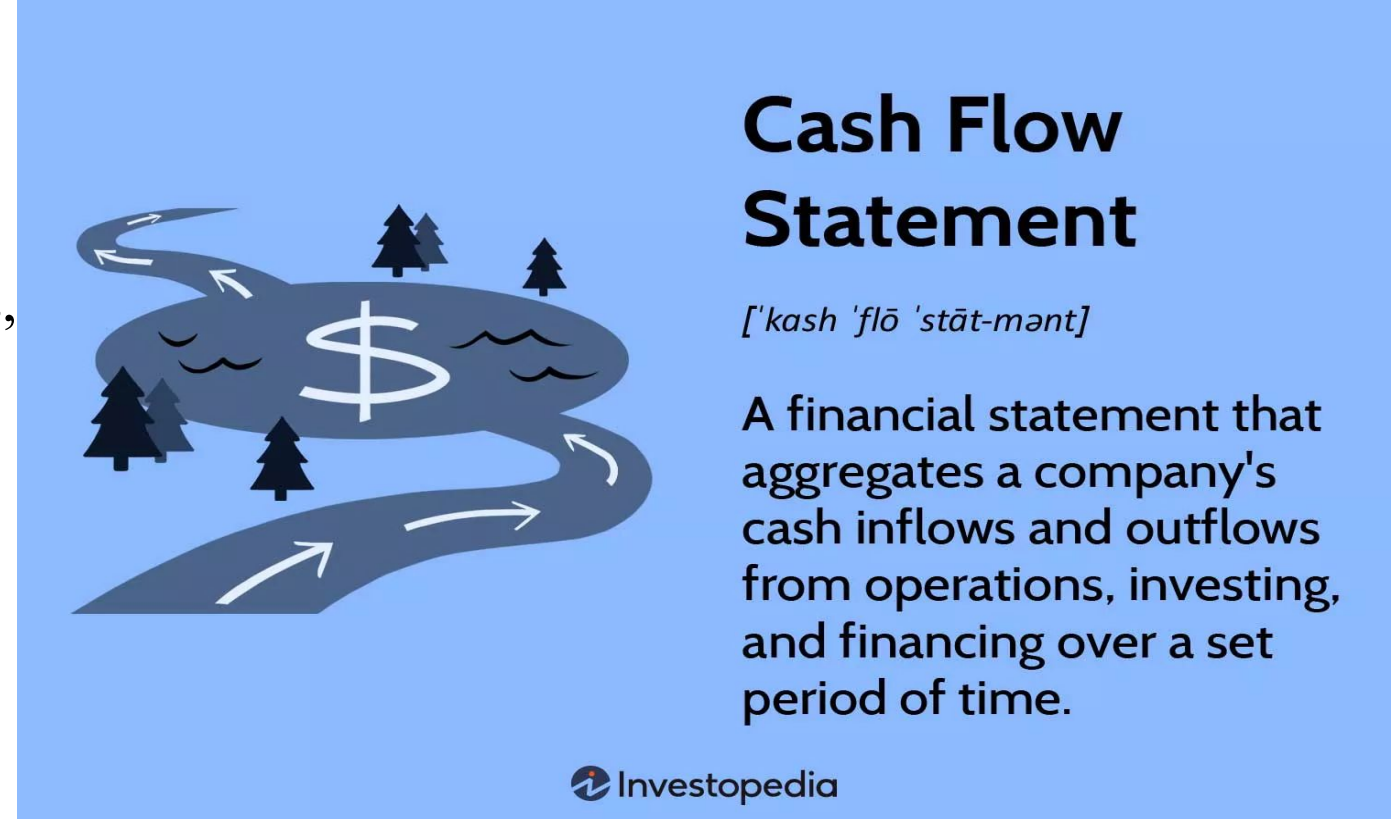
- It's also known as a **profit and loss (P&L) statement**.

- Reports on financial performances.



Cash Flow Statement

- A financial statement that **aggregates a project's inflows and out flows** from operations, investing and financing over a set period of time.



- Cash flows **can be analyzed** using the **Cash Flow Statement**.

One of the **most important financial statements** issued by a company, along with the

- **balance shee**t and
- **income statement**

But the cash flow does not necessarily show all the company's expenses.

- Because **not all expenses the company accrues are paid right away**.
- Although the **company may incur liabilities**, any payments toward these liabilities are not recorded as a cash outflow **until the transaction occurs**.

- This liabilities are likely to be recorded as the **net increase/decrease in Cash and Cash Equivalents** (CCE).
- Reports the **overall change in the company's cash and its equivalents** (the assets that can be immediately converted into cash) over the last period.

Types of Cash Flow

Cash Flows from Operations (CFO)/Operating Cash Flow:

- **Money flows involved directly with the production and sale of goods** from ordinary operations.
- **Indicates** whether or not a company has **enough funds** coming in to pay its bills or operating Expenses.
- Must be **more operating cash inflows than cash outflows** for a company to be financially viable in the long term.
- **Calculated by taking cash received from sales and subtracting operating expenses** that were paid in cash for the period.

Cash Flows From Investing (CFI)/Investing Cash Flow:

•Reports **how much cash has been generated or spent** from various **investment-related activities** in a specific period.

Investment-Related Activities

- Investing activities include **purchases of speculative assets**, **investments in securities**, or **the sale of securities or assets.**

•**Negative cash flow from investing activities** might be due to significant amounts of cash being invested in the long-term health of the company, such as Research and Development(R&D), and is **not always a warning sign**.

Cash Flows From Financing (CFF)/Financing Cash Flow:

•A section of a company's cash flow statement that **shows the net flows of cash that are used to fund the company.**

•Financing activities include **transactions** involving debt, equity, and **dividends**.

• Cash flow from financing activities provide investors with **insight into a company's financial strength** and how well a company's capital structure is managed.

Cash Flow vs. Profit : Contrary to what you may think, **cash flow isn't the same as profit**.

- It isn't uncommon to have these two terms **confused** because they seem very similar.

Cash Flow

- Remember that **cash flow is the money that come in and goes out of a business**.

Profit

- Profit, is specifically used **to measure a company's financial success** or **how much money it makes overall**.
- Amount of money that is **left after a company pays off all its obligations**.
- **Profit is whatever is left** after subtracting a company's expenses from its revenues.

Other Financial Statement with cash Flow:

Using the cash flow statement in conjunction with other financial statements can help **analysts and investors** arrive at various metrics and ratios used **to make informed decisions** and **recommendations**.

•Even **profitable companies can fail** if their operating activities **do not generate enough cash** to stay liquid.

•**This can happen** if **profits are tied up in outstanding account receivable** (AR) and **overstocked inventory**, or **if a company spends too much on capital expenditures** (CapEx).

•Investors and creditors, want to know if the company has **enough CCE** to settle short-term liabilities.

•To see if a company can meet its current liabilities with the cash it generates from operations, **analysts look at the Debt Service Coverage Ratio** (DSCR).

*Debt Service Coverage Ratio = **Net Operating Income / Short-Term Debt Obligations (or Debt Service)***

Example of Cash Flow Statement

Below is a reproduction of **Walmart's cash flow statement** for the fiscal year (FY) ending on Jan. 31, 2019. All amounts are in millions of U.S. dollars.

Walmart Statement of Cash Flows (2019)	
Cash flows from operating activities:	
Consolidated net income	7,179
(Income) loss from discontinued operations, net of income taxes	—
Income from continuing operations	7,179
Adjustments to reconcile consolidated net income to net cash provided by operating activities:	
Unrealized (gains) and losses	3,516
(Gains) and losses for disposal of business operations	4,850
Depreciation and amortization	10,678
Deferred income taxes	(499)
Other operating activities	1,734
Changes in certain assets and liabilities:	
Receivables, net	(368)
Inventories	(1,311)

Cash Flow Example

Accounts payable	1,831
Accrued liabilities	183
Accrued income taxes	(40)
Net cash provided by operating activities	27,753
Cash flows from investing activities:	
Payments for property and equipment	(10,344)
Proceeds from the disposal of property and equipment	519
Proceeds from the disposal of certain operations	876
Payments for business acquisitions, net of cash acquired	(14,656)
Other investing activities	(431)
Net cash used in investing activities	(24,036)

Cash Flow Example

Cash flows from financing activities:	
Net change in short-term borrowings	(53)
Proceeds from issuance of long-term debt	15,872
Payments of long-term debt	(3,784)
Dividends paid	(6,102)
Purchase of company stock	(7,410)
Dividends paid to noncontrolling interest	(431)
Other financing activities	(629)
Net cash used in financing activities	(2,537)
Effect of exchange rates on cash and cash equivalents	(438)
Net increase (decrease) in cash and cash equivalents	**742**
Cash and cash equivalents at beginning of year	**7,014**
Cash and cash equivalents at end of year	**7,756**

What we have discussed today

Cash Flow in Projects

- **What is it?**
- **Importance**
- **Sources of money in cash flow**
- **FCF and Positive cash Flows**
- **Critical Parts of Financial Statement**
- **Cash flow does not necessarily show all the company's expenses.**
- **Types of cash flow**
- **Other Financial Statement with cash Flow:**

Thanks

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Net Present Value (NPV)

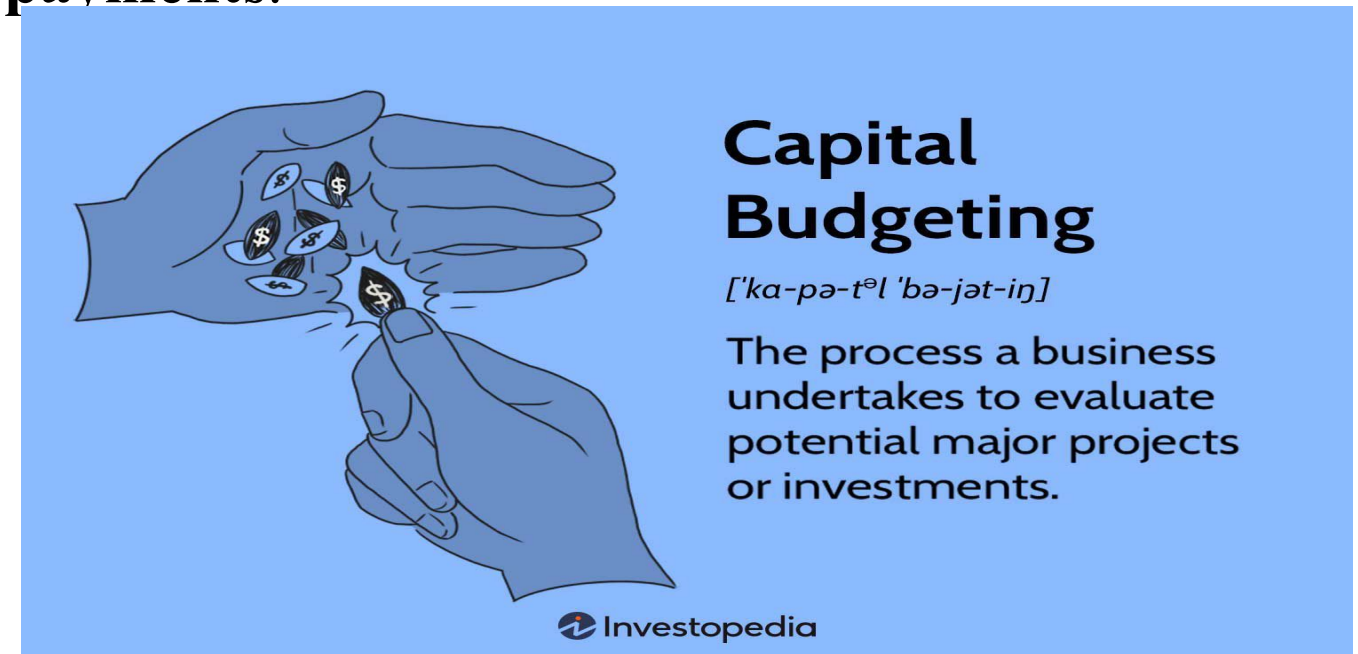
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- Used in **capital budgeting** and **investment planning** to **analyze** the **profitability of a projected investment or project.**

- NPV is the **result of calculations used** to **find the current value of a future stream of payments.**





What Net Present Value Can Tell You?/Implications of NPV:

- NPV **accounts for the time value of money (TVM)** and can be used to **compare the rates of return (ROR) of different projects,** or to **compare a projected rate of return with the hurdle rate** required to approve an investment.

- **TVM** is represented in the **NPV formula** by the **discount rate**, which might be **a hurdle rate for a project based** on a company's cost of capital.



- No matter how the discount rate is determined, **a negative NPV shows the expected rate of return will fall short of it, meaning the project will not create value.**

- In the context of **evaluating corporate securities**, the **NPV** calculation is often called discounted cash flow **(DCF)** analysis.

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For example discount rate,

- An investor could receive $100 today or a year from now.
- Most investors would not be willing to postpone receiving $100 today.
- However, what if an investor could choose to receive $100 today or $105 in one year?
- The 5% rate of return might be worthwhile if comparable investments of **equal risk, offered less** over the same period.
- If, on the other hand, an investor could earn 8% **with no risk over the next year**, the offer of $105 in a year **would not suffice**.
- In this case, **8% would be the discount rate**.

Positive vs. Negative NPV:

- A positive NPV indicates that the **projected earnings** generated by a project or investment, **discounted for their present value—exceed the anticipated costs**, also in **today's dollars**.
- It is assumed that an investment with a **positive NPV will be profitable**.
- An investment with a **negative NPV** will **result in a net loss**. This concept is the basis for the Net present value rate, which says only investments with a positive NPV should be considered.
- NPV can be calculated using tables, spreadsheets (for example, Excel), or financial calculators.

Limitations of Net Present Value:

- A notable limitation of NPV analysis is that it **makes assumptions about future events** that **may not prove correct**.
- **Discount rate** value used is **a judgment call**, while the **cost of an investment and its projected returns** are necessarily **estimates.**

Net Present Value vs. Payback Period:

- **NPV doesn't evaluate a project's Return on Investment** (ROI), a key consideration for anyone with finite capital.

- NPV **estimates how much value a project will produce**, it **doesn't tell** you whether it is an **efficient use** of your investment dollars.

Pay back period

- **Payback period**, is a **simpler alternative to NPV**.

- Payback method **calculates how long it will take to recoup an investment**.

- **One drawback** of this method is that it **fails to account for the time value of money. f**or this reason, payback periods calculated for **longer-term investments** have a greater potential for inaccuracy.

- An **investment's rate of return can change significantly over time**, comparisons using payback periods assume otherwise.

NPV vs. Internal Rate of Return (IRR)

- IRR is calculated by solving the **NPV formula** for the **discount rate required to make NPV equal zero.**

- Used to **compare projects of different time spans** on the basis of their projected return rates.

For example, IRR could be used to **compare the anticipated profitability** of a three-year project with that of a 10-year one.

- Although the IRR is **useful for comparing rates of return**, it may obscure the fact that the rate of return on the three-year project is only available for three years, and **may not be matched once capital is reinvested.**

- NPV and IRR are closely related concepts, in that the **IRR of an investment is the discount rate that would cause that investment to have an NPV of zero.**

What Is a Good NPV?

- In theory, an NPV is "**good" if it is greater than zero**.
- After all, the NPV calculation already **takes into account the factors** such as the investor's cost of capital, opportunity cost, and risk tolerance **through the discount rate**.
- And the **future cash flows of the project**, together with the time value of money (TVM), are also captured.
- Therefore, even an **NPV of $1 should theoretically qualify as "good,"** indicating the project is worthwhile.
- In practice, since estimates used in the calculation are **subject to error many planners** will set a **higher bar for NPV** to give themselves an additional margin of safety.

NPV Calculation:

Net Present Value (NPV) is a calculation that helps project managers **determine the profitability of a project.**

The formula for calculating NPV is:

$$\mathbf{NPV} = \frac{\boldsymbol{Cash\ Flow}}{(\mathbf{1}+\boldsymbol{i})^{\boldsymbol{t}}} \mathbf{-\ Initial\ investment}$$

In this formula, (i) is the discount rate, and (t) is the number of time periods

Example 1 of Calculating NPV

Imagine a company can **invest in equipment** that would **cost $1 million** and is expected to **generate $25,000 a month in revenue for five years**. Alternatively, the company could invest that money in securities with an **expected annual return of 8%.** Management views the equipment and securities as comparable investment risks.

Step 1: NPV of the Initial Investment

- Because the equipment is **paid for upfront**, this is the **first cash flow** included in the calculation.

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Step 2: NPV of Future Cash Flows

•**Identify the number of periods (t):** The equipment is expected to generate monthly cash flow **for five years**, which means that there will be **60 periods** included in the calculation after multiplying the number of years of cash flows by the **number of months in a year**.

Step-3 Identify the discount rate (i):

• Alternative investment is **expected to return 8% per year**.

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Using the following formula, we find that the periodic monthly compound rate is 0.64%.

$$\textbf{Periodic Rate} = (1.0 + 0.08)^{\frac{1}{12}} - 1 = 0.64\%$$

$$NPV = -\$1{,}000{,}000 + \Sigma_{t=1}^{60} \frac{25000x60}{(1.0+0.0064)^{60}}$$

$$NPV = -\$1{,}000{,}000 + \$1{,}242{,}322.82 = \$242{,}322.82$$

- In this case, the NPV is positive; the **equipment should be purchased**.
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A positive NPV value suggest positive investment.

Example 2: Machinery Investment

- **Initial Investment:** 100,000$ (year 0)
- **Expected Annual Cash Inflows:** $30,000$ (Years 1-4)
- **Discount Rate (10%) (0.10)**

1. **Calculate Present Value (PV) for each year:**

- **Year 1:** $30,000/(1+0.10)1=$27,272.73
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Because the NPV is negative, this project would not be considered a good investment at a 10% discount rate

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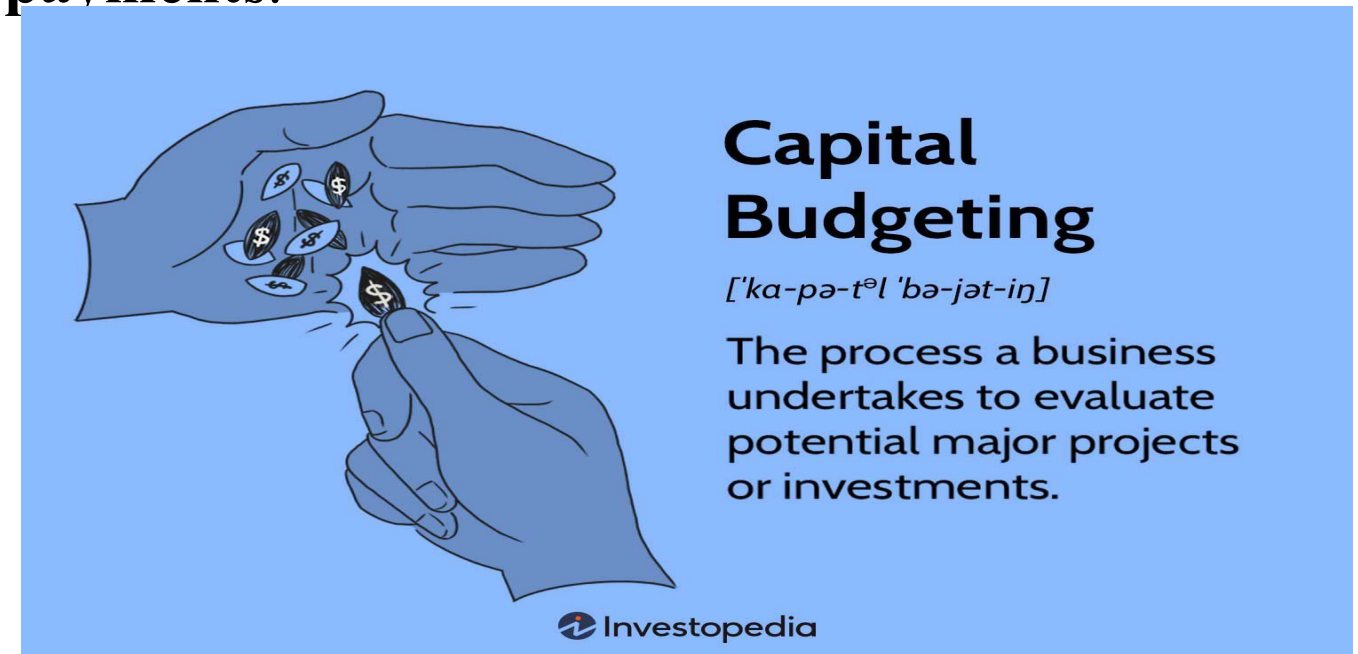
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Time Value Money

Time Value of Money:

- If you're like most people, you would **choose to receive** the $10,000 **now.**
- After all, three years is a long time to wait.
- For most of us, taking the money in the present is just plain instinctive.
- So at the most basic level, the '**time value of money**' **demonstrates** that **all things being equal,** it seems **better to have money now rather than later**.

But why is this?

- A **$100 bill** has the same value as **a $100 bill one year from now**, doesn't it?
- Actually, although the **bill is the same**, you can do much more with the money if you have it now because **over time** you can **earn more profits on your money**.

Previous Example:

Option-A:

- By **receiving $10,000 today**, you are poised to **increase the future value of your money** by **investing and gaining interest** **over** **a period of time**.

Option-B:

- You **don't have time on your side**, and the payment received in **three years** would be your future value.

Explain TVM with Time line

For choosing Option A:

- Future value will be **$10,000 plus any profit** acquired over the **three years**.

For choosing Option B:

- **Future value for Option B**, on the other hand, would only be $10,000.

So how can you **calculate exactly how much** ***more Option A is worth***, compared to Option B?

Let's take a look.:

Time value of money ***often*** ***ignores detrimental impacts to finance*** *such as* ***negative interest rates*** *or* ***capital losses****.*

In situations where losses are known and unavoidable, ***negative growth rates can be used****.*

Future Value Basics:

- If you **choose Option A** and **invest the total amount** at a simple **annual rate of 4.5%,** the future value of your investment at the end of the **first year is $10,450**.
-
- We arrive at this sum by multiplying the principal amount of $10,000 by the interest rate of 4.5% and then adding the interest gained to the principal amount.

- If the **$10,450 left in your investment account at the end of the first year is left untouched** and you invested it at 4.5% for another year, how much would you have?

- To calculate this, you would take the $10,450 and multiply it again by **10450 (0.045 +1).** At the **end of two y**ears, you would have **$10,920.25**.

Present Value Basics

- If you **received $10,000 today**, its present value would, of course, be $10,000 because the present value is what your investment gives you now **if you were to spend it today**.

- If you were to **receive $10,000 in one year**, the **present value** of the amount **would not be $10,000** because you **do not have it in your hand now**, in the present.

- **To find the present value of the $10,000 you will receive in the future**, you **need to pretend that the $10,000 is the total future value of an amount that you invested** today.

- In other words, to find the present value of the future $10,000, we **need to find out how much we would have to invest today** in order to receive that $10,000 in one year.

- To calculate the present value, or the amount that we would have to invest today, you must **subtract** the (hypothetical) accumulated interest from the $10,000.

- To achieve this, we can discount the **future payment amount ($10,000)** by the **interest rate** for the period.

Calculating Present Value

- Let's walk **backward from the $10,000** offered in Option B.

- Remember, the $10,000 to be received in **three years is really the same** as the future value of an investment.

- If we had **one year to go before getting the money**, we would **discount the payment back** one year.

- Using our present value, at the current two-year mark, the present value of the $10,000 to be received in **one year** would be **$10,000 x $(1 + .045)^{-1}$ = $9569.38.**

- Note that if today we were at the **one-year mark**, the above **$9,569.38 would be considered the *future value*** of our investment one year from now.

- Continuing on, at the end of the first year we would be expecting to receive the payment of $10,000 in two years. At an interest rate of 4.5%, the calculation for the present value of a $10,000 payment expected in two years would be **$10,000 x $(1 + .045)^{-2}$ = $9,157.30.**

- So the present value of a future payment of $10,000 is worth $8,762.97 today if interest rates are 4.5% per year. In other words, choosing Option B is like **taking $8,762.97** now and **then investing it for three years.**

- **Option A is better** not only because it offers you money right now but because it offers you $1,237.03 **($10,000 - $8,762.97) more in cash**!

- Furthermore, if you invest the $10,000 that you receive from Option A, your choice gives you a **future value that is $11,411.66** (=$11,411.66 - $10,000=) greater than the future value of Option B.

Present Value of a Future Payment

Let's up the ante on our offer.

- What if the future payment is more than the amount you'd receive right away?
- Say you could **receive either $15,000 today or $18,000 in four years**.
- The **decision is now more difficult**.
- If you **choose to receive $15,000 today** and **invest the entire amount**, you may actually end up with an amount of cash in four years that is less than $18,000.

How to decide?

- You could find the future value of $15,000, but since we are **always living in the present**, let's find the **present value of $18,000**.
- This time, we'll **assume interest rates are currently 4%.**

- In the equation above, all we **are** **doing is discounting the future value** of an investment.

- Using the numbers above, the **present value of an $18,000 payment** in four years would be calculated as $\$18{,}000 \times (1 + 0.04)^{-4} =$ **$15,386.48.**

- From the above calculation, we now know **our choice today is between** opting for **$15,000 or $15,386.48.**

- Of course, we should choose to postpone payment for four years!

What is Concept Time Value of Money?

- Time value of money is the **concept that money today is worth** more than money tomorrow.
- Because money today can be **used, invested, or grown**.
- Therefore, $1 earned today is **not the same** as $1 earned one year from now because the money **earned today** can generate profit, **unrealized gains, or unrealized losses**.

What Is the Difference Between Present Value and Future Value?

Present value is the time value of money for **a series of cash flow that calculates the value of the money today.**

- For example, if you want to find the value of **$1,000 to be received one year from now** or the value of **$2,500 to be received each month for the next two years**, you are trying to find the present value.

Alternatively, **future value** is time value of money **concept of finding the value of a series of cash flows at a point in time in the future**.

- You'd be calculating the future value if you want to know what **your $500 may be worth in 10 years.**
- You'd also be finding the future value if you want to find out what your **retirement balance will be if you contribute $250 every month for 10 years.**

Why Does Time Value of Money Matter?

- **Helps decision-makers select the best option**.
- **Equalizes options based on timing,** as absolute dollar amounts spanning different time spans **should not be valued equally**.
- **Businesses** often use **to compare projects with varying cash flows**.
- **Businesses** also use to determine whether a project with an **initial cash outflow and subsequent cash inflows will be profitable.**
- **Companies** may also be required to use time value of money principles for **external reporting requirements**.
- **Individual investors** use time value of money to better understand the **true value of their investments and obligations over time.**
- Time value of money is used to **calculate what an investor's retirement balance** will be in the future.

- **Calculations demonstrate that time literally is money**—the value of the money you have now is not the same as it will be in the future and vice versa.

- So, it is important to know how to calculate the time value of money so that you can **distinguish between the worth of money related options offered to you now and in the future**.

These options could be **investment opportunities**, **loan transactions**, **mortgage payment** options, or even charity related donations.

- Whenever, **money coming or going**, at some point in time, is involved, **time value of money should be considered.**

Time Value of Money

Thanks

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Internal Rate of Return (IRR)

IRR

What Is Internal Rate of Return (IRR)?

- **Internal rate of return (IRR) is a metric used in financial analysis to estimate the profitability of potential investments.**
- IRR is a **discount rate** that makes the net present value (**NPV) of all cash flows equal to zero** in a discounted cash flow analysis.
- IRR is not the actual dollar value of the project; it is the **annual return that makes the NPV equal to zero.**

Generally speaking, the **higher an internal rate of return**, the more desirable an investment is to undertake. IRR is uniform for investments of varying types and, as such, can be used to rank multiple prospective investments or projects on a relatively even basis. In general, when comparing investment options with other similar characteristics, the **investment with the highest IRR probably would be considered the best.**

IRR

Importance of IRR:

- Generally speaking, the **higher an internal rate of return**, the **more desirable an investment is to undertake.**
- **IRR is uniform for investments of varying types** and, as such, can be **used to rank** multiple prospective investments or projects on a relatively even basis.
- In general, when comparing investment options with other similar characteristics, the **investment with the highest IRR probably would be considered the best.**

IRR

Calculation of IRR

$$0=NPV=\sum_{t=1}^{T}\frac{CF_t}{(1+IRR)^t}-C_0$$

where:

CF_t=Net cash inflow during the period t

C_0=Total initial investment costs

IRR=The internal rate of return

t=The number of time periods

IRR

Understanding IRR:

- Ultimate goal of IRR is **to identify the rate of discount**, which makes the present value of the sum of annual nominal cash **inflows equal to the initial net cash outlay** for the investment.
- Several methods can be used when **seeking to identify an expected return**, but **IRR is often ideal method for analyzing the potential return of a new project** that a company is considering undertaking.
- Consider IRR as the **rate of growth that an investment is expected to generate annually**.
- Most similar to a **Compound Annual Growth Rate** (CAGR).
- In reality, **an investment will usually not have the same rate of return each year**.
- Usually, the **actual rate of return that a given investment ends up generally will differ** from its estimated IRR.

IRR

What Is IRR Used for?

- In capital planning, one popular scenario for IRR is **comparing the profitability of establishing new operations** with that **of expanding existing operations**. For example, an energy company may use IRR in deciding whether to open a new power plant or to renovate and expand an existing power plant.

- Individuals can also **use IRR when making financial decisions**—for instance, when evaluating different insurance policies using their premiums and death benefits. The general consensus is that **policies that have the same premiums and a high IRR are much more desirable.**

- Another common use of **IRR is in analyzing investment returns**. In most cases, the advertised return will assume that any **interest payments or cash dividends** are reinvested back into the investment. What if you **don't want to reinvest dividends** but **need them as income when paid**? And if dividends are not assumed to be reinvested, are they paid out, or are they left in cash?

IRR

Using IRR With WACC:

- Most IRR **analyses will be done in conjunction** with a view of a company's weighted average cost of capital (WACC) and NPV calculations. IRR is typically a relatively high value, which allows it to arrive at an NPV of zero.

- Most companies will require an **IRR calculation to be above the WACC**.

- WACC is a measure of a **firm's cost of capital** in which each category of capital is proportionately weighted. **All sources of capital**, including common stock, preferred stock, bonds, and any other long-term debt, **are included in a WACC calculation**.

- Any project with **an IRR greater than its cost of capital should be profitable**. In planning investment projects, firms will often establish a Required Rate of Return (RRR) to **determine the minimum acceptable return percentage** that the investment in question must earn to be worthwhile. RRR will be higher than the WACC.

IRR

IRR vs. Compound Annual Growth Rate (CAGR):

- CAGR **measures the annual return on an investment over a period of time**.
- **IRR is also an annual rate of return**; however, the **CAGR typically uses only a beginning and ending value t**o provide an estimated annual rate of return.
- **IRR differs in that it involves multiple periodic cash flows**—reflecting that cash inflows and outflows often constantly occur when it comes to investments.
- Another distinction is that **CAGR is simple enough that it can be calculated easily**.

IRR

IRR vs. Return on Investment (ROI)

- Companies and analysts may also look at the **Return on Investment (ROI)** when making capital budgeting decisions.

- **ROI tells an investor about the total growth**, start to finish, of the investment. It is not an annual rate of return.
- **IRR tells the investor what the annual growth rate is**. The two numbers normally would be the same over the course of one year but won't be the same for longer periods of time.

- ROI is the **percentage increase or decrease of an investment** from beginning to end. It is calculated by taking the difference between the current or expected future value and the original beginning value, divided by the original value, and multiplied by 100.

- ROI figures can be **calculated for nearly any activity into which an investment has been made and an outcome can be measured;** however, ROI is not necessarily the most helpful for lengthy time frames.

IRR

Limitations of IRR:

- IRR is generally **ideal for use in analyzing capital budgeting projects**. It can be misconstrued or misinterpreted if used outside of appropriate scenarios. **In the case of positive cash flows followed by negative ones and then by positive ones, the IRR may have multiple values.**

- IRR is a very popular metric for estimating a project's annual return; however, **it is not necessarily intended to be used alone.** IRR is typically **a relatively high value**, which allows it to arrive at an NPV of zero. The IRR itself is only a single estimated figure that provides an annual return value based on estimates.

- Most companies **do not rely on IRR and NPV analyses alone**. These calculations are usually also studied in conjunction **with a company's WACC and an RRR**, which provides for further consideration.

IRR

Investing Based on IRR:

- IRR rule is a **guideline for evaluating** whether to proceed with a project or investment.
- IRR rule states that if the IRR on a project or investment is **greater than the minimum RRR**—typically the cost of capital, then the project or investment can be pursued.
- If the IRR on a project or investment is lower than the cost of capital, then the best course of action may be to reject it.
- Overall, while there are some limitations to IRR, it is an industry standard for analyzing capital budgeting projects.

IRR

IRR Example:

Assume a company is **reviewing two projects**. Management must decide whether to move forward with one, both, or neither. Its cost of capital is 10%. The **cash flow patterns** for each are as follows:

Project A

Initial Outlay = $5,000

Year one = $1,700

Year two = $1,900

Year three = $1,600

Year four = $1,500

Year five = $700

IRR

Project B

Initial Outlay = $2,000

Year one = $400

Year two = $700

Year three = $500

Year four = $400

Year five = $300

IRR

The company **must calculate the IRR** for each project. Initial outlay (period = 0) will be negative. Solving for IRR is an iterative process using the following equation:

$$\$0 = 0 = NPV = \sum_{t=1}^{T} \frac{CF_t}{(1+IRR)^t} - C_0$$ where:

CF_t = net cash flow

IRR = internal rate of return

t = period (from 0 to last period)

-or-

$$\$0 = (initial\ outlay * -1) + (CF_1 \div (1 + IRR)^1) + (CF_2 \div (1 + IRR)^2) + \ldots + (CF_x \div (1 + IRR)^n)$$

Using the above examples, the company can calculate IRR for each project as:

IRR Project A

$0 = (−$5,000) + $1,700 ÷ (1 + IRR)1 + $1,900 ÷ (1 + IRR)2 + $1,600 ÷ (1 + IRR)3 + $1,500 ÷ (1 + IRR)4 + $700 ÷ (1 + IRR)5

IRR Project A = **16.61 %**

IRR Project B

$0 = (−$2,000) + $400 ÷ (1 + IRR)1 + $700 ÷ (1 + IRR)2 + $500 ÷ (1 + IRR)3 + $400 ÷ (1 + IRR)4 + $300 ÷ (1 + IRR)5

IRR Project B = **5.23 %**

Given that the company's cost of capital is 10%, management should **proceed with Project A** and reject Project B.

Example Calculation:

Consider a project with an initial investment of -$10,000 and expected cash flows of $4,000 per year for the next 3 years:

- **Year 1:** Cash flow = $4,000
- **Year 2:** Cash flow = $4,000
- **Year 3:** Cash flow = $4,000

Trial and Error Calculation:

Guess 1:

Discount rate = 10%

NPV = ($4,000 / (1+0.1)) + ($4,000 / (1+0.1)²) + ($4,000 / (1+0.1)^3) - $10,000 = $1,069.99 (Positive NPV)

Guess 2:

Discount rate = 15%NPV = ($4,000 / (1+0.15)^1) + ($4,000 / (1+0.15)^2) + ($4,000 / (1+0.15)^3) - $10,000 = -$420.23 (Negative NPV)

Interpolate:

Since the first guess resulted in a positive NPV and the second a negative NPV, the IRR lies between 10% and 15%.

By further iterations (trying rates closer to 10% and 15%), you can eventually find a discount rate that brings the NPV very close to zero, which will be your IRR.

Thanks

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Payback Period

Payback Period

What Is the Payback Period?

- Refers to the **amount of time it takes** to recover the cost of an investment.
- Simply put, it is the **length of time an investment reaches a breakeven point**.
- People and corporate **mainly invest their money to get paid back**, which is why the **payback period is so important**.
- In essence, the **shorter payback an investment** has, the more attractive it becomes.
- Determining the payback period is useful for anyone and can be done by **dividing the initial investment by the average cash flows.**

Payback Period

Understanding/Importance the Payback Period:

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

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

Payback Period = Cost of Investment ÷ Average Annual Cash Flows

Payback Period

- **Shorter the payback**, the more desirable the investment. Conversely, the **longer the payback**, the less desirable it becomes.

Example: If solar panels cost $5,000 to install and the **savings are $100 each month**, it would take 4.2 years to reach the payback period.

- In most cases, this is a **pretty good payback period** as experts say it can take as much as eight years for residential homeowners in the United States to break even on their investment.

- Capital budgeting is a key activity in corporate finance.

- One of the most important concepts every corporate financial analysist must learn is how to value different investments or operational projects to **determine the most profitable project** or **investment** to undertake.

- **One way** corporate financial analysts do this is **with the payback period**.

Payback Period

- Although calculating the payback period is useful in financial and capital budgeting, this metric **has applications in other industries.**
- It can be used by **homeowners and businesses** to calculate the return on energy-efficient technologies such as solar panels and insulation, including maintenance and upgrades.
- ***Average cash flows*** *represent the money going into and out of the investment.*
- *Inflows are any items that* ***go into the investment****, such as deposits, dividends, or earnings.*
- ***Cash outflows include any fees or charges*** *that are subtracted from the balance.*

Payback Period

Special Considerations of Payback Period:

There is one problem with the payback period calculation.

- Unlike other methods of capital budgeting, the **payback period ignores the TVM**.

TVM: Idea that money is worth more today than the same amount in the future because of the earning potential of the present money.

- Most capital budgeting formulas, such as NPV, IRR, and discounted cash flow, **consider the TVM**.

- So if you pay an investor tomorrow, it must **include an opportunity cost.**

- TVM is a concept that assigns a value to this opportunity cost.

Payback Period

- **Payback period disregards the time value of money** and is determined by counting the number of years it takes to recover the funds invested.
- For example, if it takes five years to recover the cost of an investment, the **payback period is five years.**
- This period **does not account for what happens after payback occurs**.
- Therefore, it ignores an investment's **overall profitability**.
- Many managers and investors thus **prefer to use NPV as a tool** for making investment decisions.
- NPV is the difference between the present value of cash coming in and the current value of cash going out over a period of time.
- Some analysts favor the **payback method for its simplicity**. Others like to use it as an additional point of reference in a capital budgeting decision framework.

Example of Payback Period:

Here's a hypothetical example to show how the payback period works.

- Assume Company A **invests $1 million** in a project that is expected to **save the company $250,000 each year**. If we divide $1 million by $250,000, we **arrive at the payback period of 4 years for this investment.**

Example: Consider another project that costs $200,000 with **no associated cash savings** that will make the company an incremental $100,000 each year for the next 20 years at $2 million.

- Clearly, the second project can make the company twice as much money, but **how long will it take to pay the investment back?**

- Answer is found by dividing $200,000 by $100,000, which is **two years**. The second project will take less time to pay back, and the company's earnings potential is greater.

- **Based solely on the payback period method, the second project is a better investment.**

Payback Period

Good Payback Period

- Best payback period is the **shortest one possible**.
- Getting repaid or recovering the initial cost of a project or investment should be achieved as quickly as it allows.
- However, **not all projects and investments have the same time horizon**, so the shortest possible payback period needs to be nested within the larger context of that time horizon.
- For example, the payback period on a **home improvement project can be decades** while the payback period on a **construction project may be five years or less**.

Payback Period

Is the Payback Period the Same Thing as the Break-Even Point?

- While the two **terms are related**, they are **not the same**.
- Breakeven point is the **price or value** that an investment or project **must rise to cover the initial costs or outlay.**
- Payback period refers to **how long it takes** to reach that breakeven point.

How Do You Calculate the Payback Period?

Payback Period = Initial Investment ÷ Annual Cash Flow

Payback Period

What Are Some of the Downsides of Using the Payback Period?

- As the equation above shows, the **payback period calculation is a simple one**.
- It **does not account for TVM**, **the effects of inflation**, or **the complexity of investments** that may have unequal cash flow over time.
- **Discounted Payback Periods** is often used to **better account for some of the shortcomings**, such as using the present value of future cash flows.
- For this reason, the **simple payback period may be favorable**, while the discounted payback period might indicate an unfavorable investment.

Payback Period

When a Company will Use the Payback Period for Capital Budgeting?

- Payback period is **favored when a company is under liquidity constraints** because it can not show how long it should take to recover the money laid out for the project.

- If short-term cash flows are a concern, a **short payback period may be more attractive** than a longer-term investment that has a higher NPV.

Problem-1:
A project required an upfront investment of $500,000 with no residual value. The pay back period had a maximum of 3 years. The company expects the following cash inflow from the investment over the next 5 years:

Year-1:	$100,000
Year-1:	150,000
Year-3:	150,000
Year-4:	50,000
Year-5:	125,000

What is the payback period for the investment? Should the company accept or reject the project bases on the required payback period?

Solution:

Initial Investment=$500,000

Up to Year-4 Cash Flow= (100,000+150,000+150,000+50,000) $**450,000**

Cash Flow needed for year-5= (500,000-450,000) $**50,000**

Cash Flow Year-5: $ 125,000

Portion period of Year-5 to recover 50,000= 50,000/125,000= 0.4 year

Pay back period= 4+0.4=4.4 years

Problem-2:

A project required an upfront investment of $500,000 with no residual value. The pay back period had a maximum of 5 years. The company expects the following cash inflow from the investment over the next 6 years:

		PV factor for $1 at 10%
Year-1:	$100,000	0.9091
Year-2:	150,000	0.8264
Year-3:	150,000	0.7513
Year-4:	50,000	0.6830
Year-5:	125,000	0.6209
Yea-6:	200,000	0.5645

Using the present value factors provided, what will be the **discounted payback period** for the investment? Should the company accept or reject the project bases on the required payback period?

Solution:

Step-1: PV adjusted cash Flows

Year-1:	$100,000		0.9091	$90,909
Year-2:	150,000		0.8264	123,967
Year-3:	150,000	x	0.7513 =	112,697
Year-4:	50,000		0.6830	34,151
Year-5:	125,000		0.6209	77,615
Yea-6:	200,000		0.5645	112,895

Step-2: PV Accumulated cash Flows

Year-1:	$90,909	$90,909
Year-2:	123,967	214,876
Year-3:	112,697	327,573
Year-4:	34,151	361,724
Year-5:	77,615	**439,339**
Yea-6:	**112,895**	552,234

Step-3: Cash Flow needed for in Year-6

Initial Investment $500,000

(-) Year 5 Cumulative Cash Flow 439,339

=$60,661

Step-4: Portion of year 6 needed,

Cash Flow needed for portion of Year-6 =$60,661

(Divide by) PV for Year 6 Cash Flow (***60,661/112,895)*** = **0.537 years**

Step-6: Discounted Pay back **Period=5+.54=5.54 years** (Reject)

Example-3:

Initial Investment	**$25000**
Cash Flow: Year-1	$4500
Year-2	6500
Year-3	5000
Year-4	6000
Year-5	5000
Year-6	1000

Calculate the payback period.

Solution:

Investment	**$25000**	**Balance=0**
Cash Flow Year-1	4500	(-) 20500
Year-2	6500	(-) 14000
Year-3	5000	(-) 9000
Year-4	6000	**(-) 3000**
Year-5	**5000**	(+) 2000
Year-6	1000	(+) 3000

Payback Period $= 4 \text{ years} + \frac{3000}{5000} \text{ year} = 4.6 \text{ years}$

Thanks

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Cost Benefit Ratio (CBR)

CBR

What Is the Benefit-Cost Ratio (BCR)?

- Ratio used in a **cost-benefit analysis** to s**ummarize the overall relationship between the relative costs and benefits of a proposed project**.

- Can be expressed in **monetary or qualitative terms**.

- If a project has a **BCR greater than 1.0,** the project is expected to deliver a positive NPV to a firm and its investors.

CBR

What Is a Cost-Benefit Analysis?

- A cost-benefit analysis is a **systematic process** that businesses use **to analyze which decisions to make and which to forgo.**

- Cost-benefit **analyst sums the potential rewards** expected from a situation or action and then **subtracts the total costs** associated with taking that action.

- Some consultants or analyst also **build models to assign a dollar value on intangible items**, such as the benefits and costs associated with living in a certain town.

CBR

How the Benefit-Cost Ratio (BCR) Works

- Most often used in **capital budgeting** to **analyze the overall value for money** of undertaking a new project.

- However, **the cost-benefit analyses for large projects can be hard to get right**, because there are **so many assumptions and uncertainties** that are hard to quantify.

- This is why there is usually a **wide range of potential BCR outcomes**.

CBR

- BCR also **does not provide any sense of how much economic value will be created**, and so the BCR is usually **used to get a rough idea about the viability of a project** and **how much the internal rate of return (IRR)** exceeds the discount rate, which is the company's weighted average cost of capital (WACC) – the opportunity cost of that capital.

- BCR is calculated by **dividing the proposed total cash benefit** of a project by the **proposed total cash cost of the project.**

- Prior to dividing the numbers, the **NPV of the respective cash flows** over the proposed lifetime of the project – taking into account the **terminal values (TV)**, including **salvage/remediation costs** – are calculated.

CBR

What Is Capital Budgeting?

- **Process, a business undertakes to evaluate potential major projects** or investments.

- **Construction of a new plant or a big investment in an outside venture** are examples of projects that would require capital budgeting before they are approved or rejected.

- As part of capital budgeting, a company **might assess a prospective project's lifetime cash inflows and outflows to determine whether the potential returns** that would be generated meet a sufficient target benchmark.

- Capital budgeting process is also known as **investment appraisal**.

What Is Weighted Average Cost of Capital (WACC)?

- Represents a firm's average **after-tax cost of capital** from all sources, including common stock, preferred stock, bonds, and other forms of debt.

- WACC is the average rate that a company **expects to pay to finance** its assets.

What Is Terminal Value (TV)?

- Estimated value of an asset or business **beyond a specific forecast period**.

- It's also known as "**continuing value**" or "horizon value".

- Value of an asset, business, or project beyond the forecasted period when future cash flows can be estimated.

- Terminal value assumes a business will **grow at a set growth rate forever** after the forecast period.

- Terminal value often comprises a **large percentage of the total assessed value**.

CBR

What Does the BCR Tell You?

- If a project has a **BCR that is greater than 1.0,** the project is **expected to deliver a positive NPV** and **will have an IRR above the discount rate.**

- Suggests that the **NPV of the project's cash flows outweighs the NPV of the costs**, and the project should be considered.

- If the BCR is **equal to 1.0**, the ratio indicates that the NPV of expected **profits equals the costs.**

- If a project's **BCR is less than 1.0**, the project's **costs outweigh the benefits**, and it should not be considered.

CBR

Example of How to Use the BCR

- As an example, assume company ABC wishes to assess the profitability of a project that involves **renovating an apartment building** over the next year.

- Company decides to **lease the equipment needed** for the project for **$50,000** rather than purchasing it.

- **Inflation rate is 2%,** and the renovations are expected to increase the **company's annual profit by $100,000 for the next three years**.

CBR

Solution:

- **NPV of the total cost of the lease does not need to be discounted**, because the initial cost of $50,000 is paid up front.

- NPV of the projected benefits is **$378,901**, or ($100,000 / (1 + 0.02)^1) + ($100,000 / (1 + 0.02)^2) + ($100,00 / (1 + 0.02)^3).

- Consequently, the **BCR is 7.58**, or **$ 378,901 divided by $50,000.**

- In this example, our company has a BCR of **7.58**, which indicates that the **project's estimated benefits significantly outweigh its costs.**

- Moreover, company ABC could **expect $7.58 in benefits for each $1 of costs**.

CBR

Limitations of the BCR

- Primary limitation of the BCR is that **it reduces a project to a simple number** when the success or failure of an investment or expansion **relies on many factors** and can be undermined by unforeseen events.

- Simply following a rule that **above 1.0 means success** and below 1.0 spells failure is **misleading and can provide a false sense of comfort with a project**.

- BCR must be **used as a tool in conjunction with other types of analysis** to make a well-informed decision.

BCR

What Is the Benefit-Cost Ratio (BRC) Used for?

- BRC is used in cost-benefit analysis to **describe the connection between the costs and benefits of a potential project.**

How Do You Calculate the Benefit-Cost-Ratio?

- Benefit-Cost-Ratio is determined by **dividing the proposed total cash benefit of a project by the proposed total cash cost of the project**.

What Does a Benefit-Cost-Ratio Over 1.0 Suggest?

- A reading **over 1.0** suggests that on a broad level, **a project should be financially successful**; a **reading of 1.0** suggests that the **benefits equal the costs**; and a reading **below 1.0** suggests that the **costs trump the benefits**.

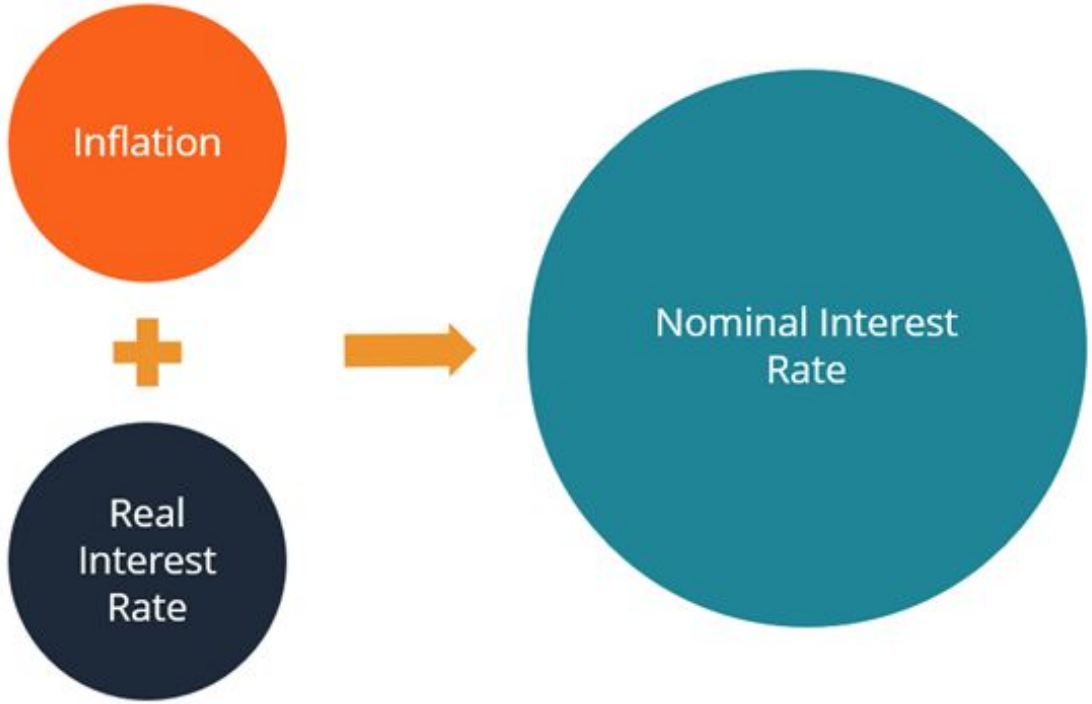
Fisher Rate Equation

What is the Fisher Equation?

•Fisher equation is a concept in economics that **describes the relationship between nominal and real interest rates** under the effect of inflation.

•Equation states that the **nominal interest rate is equal to the sum of the real interest rate plus inflation**.

•Fisher equation is often used in situations where **investors or lenders ask for an additional reward to compensate for losses** in purchasing power due to high inflation.



Concept of Fisher Equation

- Concept is widely used in the **fields of finance and economics.**
- Frequently used in **calculating return on investment** or in **predicting the behavior** of nominal and real interest rates.

Example: When an investor wants to **determine the actual (real) interest rate earned on an investment after accounting for the effect of inflation**.

Fisher equation is **related to monetary policy**.

- Equation reveals that monetary policy moves inflation and the nominal interest rate together in the same direction.
- Whereas, monetary policy generally does not affect the real interest rate.

American economist **Irving Fisher** proposed the equation.

Fisher Equation Formula

- Fisher equation is expressed through the following formula:

  $$(1 + i) = (1 + r)(1 + \pi)$$

  Where:

  i – the nominal interest rate

  r – the real interest rate

  π – the inflation rate

- However, one can also use the approximate version of the previous formula:

$$i \approx r + \pi$$

Fisher Equation Example

Suppose Sam owns an investment portfolio. Last year, the portfolio earned a **return of 3.25%.** However, last year's inflation rate was around **2%**. Sam wants to determine the real return he earned from his portfolio.

Solution:

In order to find the real rate of return, we use the Fisher equation. The equation states that:

$$(1 + i) = (1 + r)(1 + \pi)$$

We can rearrange the equation to find the **real interest rate**:

$$r = \frac{(1 + i)}{(1 + \pi)} - 1$$

Therefore, the real interest rate, or actual return on investment, of the portfolio equals:

$$r = \frac{1+3.25}{1+2} = 1.42\%$$

Real interest that Sam's investment portfolio earned last year, after accounting for inflation, is **1.42%**.

Inflation: Overall increase of prices or cost of living in a country.

Nominal Interest Rate: Interest on investment before taking inflation into account

Real Interest rate: Interest that has been adjusted to inflation.

Causes of Inflation:

- **Cost push inflation**: Production cost increases, Producer raises prices to cover cost.
- **Inflation Expectation**: Expect rise prices and wages also rises.
- **Creeping Inflation**: When supply of money or income increases, prices may rise.
- **Money Supply**: Grows faster than economic growth.
- **Rising wages**: Workers paid more, cost of product increases, passed to consumers.
- **Demand pull Inflation**: Demand increases faster, than economic growth.

Thanks

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Project Planning and Construction Management

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Previous Classes – Fundamental Financial principles

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Project & Project Life Cycles

What we are going to learn today?

- What is Project?
- What is Project life cycle?

Scheduling

- Definition.
- Steps of developing a project schedule.
- Step -1: Plan schedule management
- Step-2: Define activities.

Project: A project is defined **as a specific, finite activity** that **produces an observable and measurable result** under certain **preset requirements.**

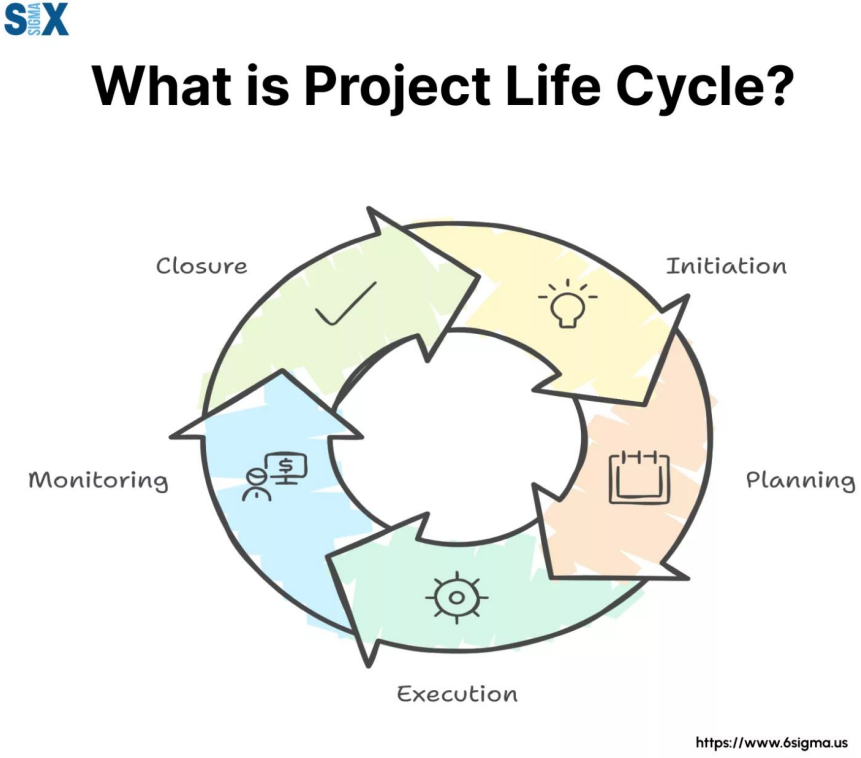
Project life cycle.

- A project life cycle is the **sequence of phases** that a **project goes through** from its **initiation to its closure**.

- Project lifecycle can be **defined and modified** as per the needs and aspects of the organization.

Chronological Perspective of Project Life Cycle

- **Initiation**
- **Planning & Scheduling**
- **Execution**
- **Monitoring and Control**
- **Closure**



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Project Scheduling

Project Scheduling

What is scheduling?

- Scheduling is the **allocation of resources** to project planning.

-Conceptual sense, **resources** are **time and energy**.

-But in practical sense, **resources** are **time, space, equipment and efforts** applied to material.

Definition 1:

- Mechanical process **of formalizing the planned function.**

- **Assigning** the starting and completion **dates** of each part of work (activity); in a such a manner that the **whole work (project) proceeds** in a **logical sequences**, an **orderly and systematic manner.**

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Steps to Process in developing Project Scheduling

Project Scheduling

Definition 2:

- Scheduling is the **laying out of the actual activities of the project in the time order** in which they are to be performed.

And **calculating the manpower and material requirements** (or resource requirement in general) needed in each stage of production/output along with the expected completion time of each activity.

6-Steps: Processes in developing a project schedule. (PDSEED)

Step 1: Plan Schedule Management

Step 2: Define Activities

Steps 3: Sequence Activities

Steps 4: Estimate Activities Resources

Steps 5: Estimate Activities Durations

Steps 6: Develop Schedule

Step 1: Plan Schedule Management:

- **Define the policies, procedures, and documentation which will govern** the formulation of the project schedule.

For small projects, it specifies the **formulation of a Schedule Management Plan**, which is a component of the overall Project Management Plan.

Items to be addressed plan schedule management (CR-TOS)

- **Contingencies:** How big will they be, and how will they be calculated?

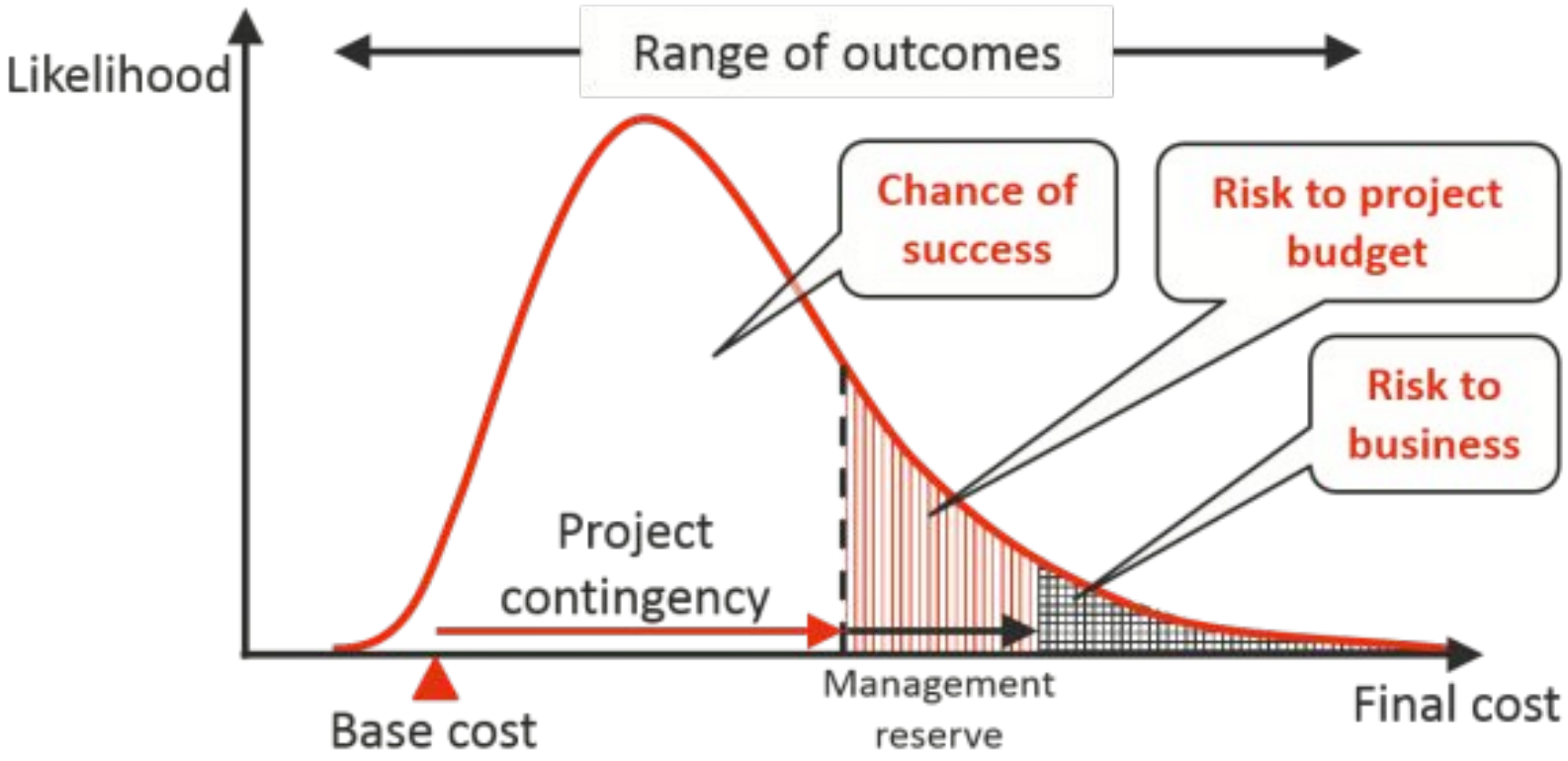
- **Resources:** Are there any resources who's availability **has a major effect** on the schedule?

- **Task Dependencies:** Are there any **major task dependencies**; the project depends on, such as completing the foundation before the framing can start?

- **Organizational Procedures:** May be there is a **certain software** that must be used or standard procedures for updating the schedule.

- **Stakeholders:** Who must **approve the schedule**, or to whom must it be **distributed**?

Schedule Management Plan- **Contingencies**



Steps 2: **Define Activities**

- At this point, **start the activity list which is also known** as a **Work Breakdown Structure (WBS)**.

- It is the **process of identifying and documenting the specific actions to be performed** to produce the **project deliverables**.

Key benefit of this process:

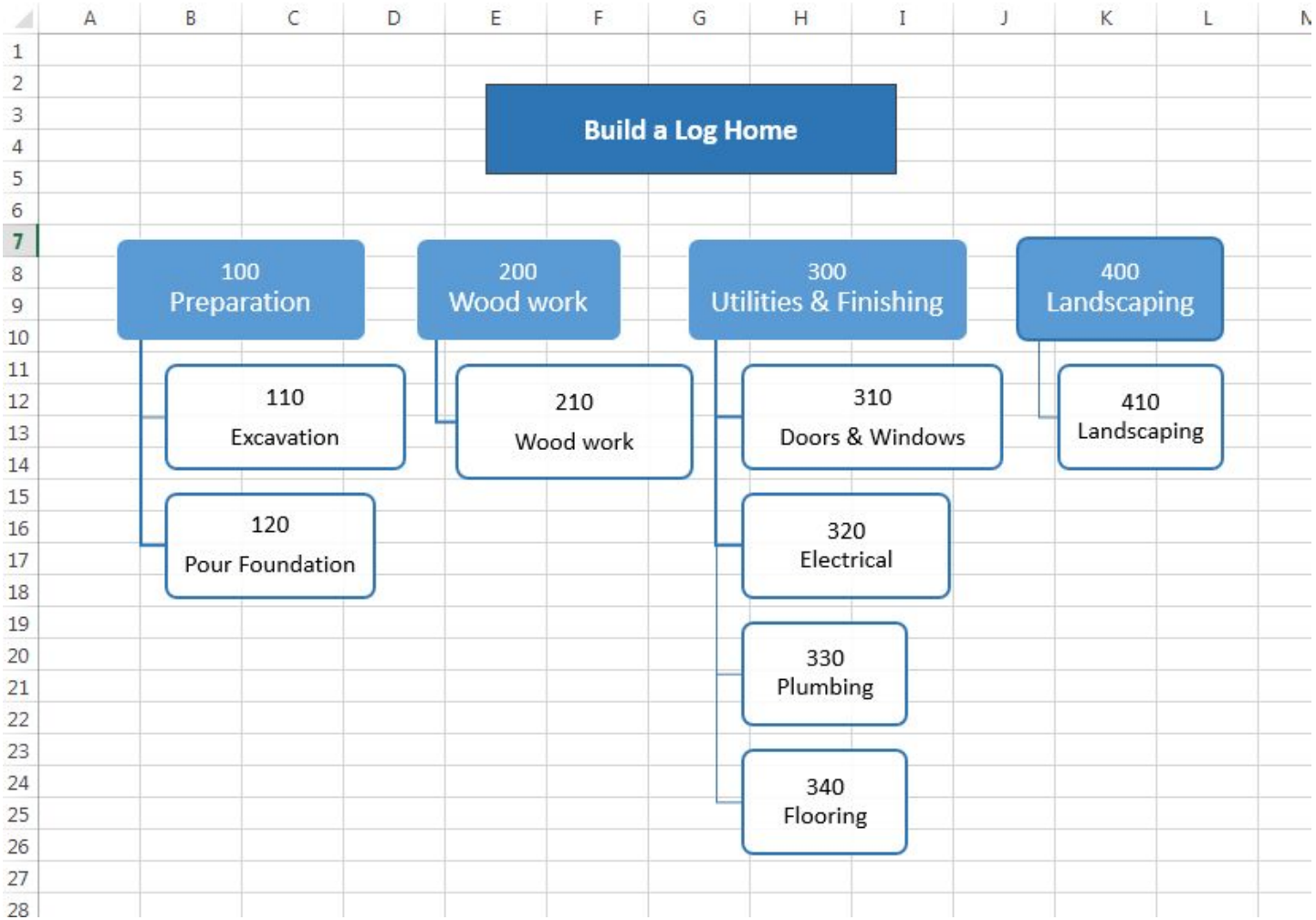
To break down work packages into activities that **provide a basis** for **estimating, scheduling, executing**, **monitoring** and **controlling** the project work.

Steps 2: Define Activities (cont..)

Format of the tasks:

- **Format of the tasks list is irrelevant**, but unless there is a reason to produce something more fancy it should consist of a simple **'List of Tasks'** for Project: **Build a Log Home**.

Task List		
Task ID		**Name**
100 Preparation	110	Excavation
	120	Pour Foundation
200 Wood Work	**210**	Wood work
300 Utilities and Finishing	**310**	Doors and Windows
	320	Electrical & Plumbing
	330	Flooring
	340	Finishing
400 Landscaping	**410**	Landscaping



- **Graphical view is optional** but helps you visualize it to make sure it's all there.
- At this point the **goal is simply to make sure it's all there.** If you missed something, it will almost certainly show up during the project.

Rules of Thumb for Determining the Activity List

Make sure it can be reliably estimated:

- Tasks should be **broken down to a point** where a reliable estimate can be produced.

  If you are still **unsure** about the **cost and/or duration** of the task, consider **breaking it down further**.

Based it on Deliverables.

- Each deliverable should have a **clearly defined task, or set of tasks in place,** to produce it.

Rules of Thumb for Determining the Activity List (cont..)

Have only one Responsible Party:

- When you have **multiple people and/or organizations responsible for the completion of a task,** it is **difficult to control and manage**.

- In the example with the task ***Electrical & Plumbing***, the two independent tasks are grouped together.

- But often these are very well understood tasks and not likely to have major fluctuations.

Match tasks to cost accounts:

- May be your organization has **predefined cost accounts**, such as "Wood work", or "Flooring" that should be used.

Make it measurable:

- It should be **easy to put a percent complete value on a task at any time**. If this is not easy to do, the task should be broken down further.

Rules of Thumb for Determining the Activity List (cont..)

- **Make sure that activity can be reliably estimated**: Tasks should be broken down to a point where a reliable estimate can be produced.
- **Based it on Deliverables:** Each deliverable should have a clearly defined task, or set of tasks to produce it.
- **Have only one Responsible Party**:
- **Match tasks to cost accounts:** Organization has predefined cost accounts, such as “Wood work”, or “Flooring” that should be used.
- **Make it measurable**: Should be easy to put a percent complete value on a task at any time.

Question: Describe the thumb rules for determining the activity lists of a project.

Steps 2: Define Activities (cont..)

Task Length

No universal correct length to a task, **but if you have more than 10 tasks per phase** it becomes difficult to manage and a separate level should be created.

A common yardstick is the 8/80 rule, which states that a **task should be between 8 and 80 man-hours.**

-Project management guideline, work package should take 8 and 80 hrs. of effort to complete.

-Ensure that tasks are **large enough to be meaningful** ($> 8\ hours$) but **small enough to be tracked easily** ($< 80\ hours\ or\ 10\ days$)

If a task requires **less than 8 hours**, it may be too small, causing micromanagement; consider combining it with similar tasks.

If a task requires **more than 80 hours** (10 working days), it is too large to track accurately and should be broken down into smaller components.

Thanks

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Project Planning and Construction Management

Project Scheduling

What we are going to discuss today?

- Sequencing Activities?
- Estimate Activities Resources.
- Estimate Activities Durations.
- Develop schedule.

Previous class:

- Scheduling
- Plan Schedule Management
- Define Activities

Steps 3: Sequence Activities

Process of identifying and documenting relationships among the project activities.

•After the project has been **divided into tasks/activities** the **relationships between tasks/activities must be determined**.

•Most of the time; **a task starts when the previous one finishes**, but not all the time.

*Defines the **logical sequence of work** to **obtain** the **greatest efficiency** given all project constraints.*

Task Dependencies

Four types of dependencies:

- **Finish to Start (FS):** **Most common** dependency. When tasks A and B have an "FS relationship," task B cannot start until task A finishes

- **Finish to Finish (FF):** When tasks A and B have an FF relationship, task B cannot finish until task A finishes.

- **Start to Start (SS):** When tasks A and B have an SS relationship, task B cannot start until task A starts.

- **Start to Finish (SF):** When tasks A and B have an SF relationship, task B cannot finish until task A starts.

Leads and Lags : Specify an offset from the start or finish point of a task.

- **Lead:** Amount of time whereby a **successor activity can be advanced with respect to a predecessor activity**.

  Example: If tasks A and B have an **FS relationship with a lead of 5 days,** task B cannot start until 5 days after task A has finished.

- **Lag:** Amount of time whereby a successor activity **will be delayed** with respect to a predecessor activity.

Example: If tasks **A and B have an FS relationship with a lag of 5 days**, task B cannot start until 5 days before task A has finished.

Steps 3: Sequence Activities

Task List		
Task ID	Name	Dependencies (FS relationship)
110	Excavation	
120	Pour Foundation	110
210	Wood work	120
310	Electrical & Plumbing	210
320	Flooring	**210**
330	Finishing	**210, 310**
410	Landscaping	120

Steps 4: Estimate Activities Resources

Estimate Activity Resources:

- **Process of identifying and determining** the specific types and quantities of **human resources, equipment, materials, and other assets** needed to complete **each individual task** within a project.

- **Identifies** the **type, quantity, and characteristics** of resources required to complete the activity which **allows more accurate cost and duration estimates.**

Major types of **resources:**

- Labor
- Tools and equipment
- Facilities
- Fixed cost items like subcontracting, etc.
- Other resources include financing costs, contingencies, overtime pay, and so forth.

- **Example**: To **build the log house**, need to look at each individual task and determine the resources that are required. We would build a table that looks something like this:

110 – Excavation		
Type	**Average Use**	**Total**
Excavation Contractor	**30 hrs @ $180/hr**	**$5,400**
Mr. Bob	**10 hrs @ $45/hr**	**$450**
	TOTAL	**$5,850**

Points to Note/Consider in Estimating Activities Resources

- Just because a **resource is necessary, doesn't mean it's available.**
- To determine the availability of resources, a **PM consults a document** called a ***resource calendar*.**
- This document **states the availability of a resource**, for example, "**Pervez is at jobsite X from Sep. 1 to Sep 30.**"
- Obviously, the new project being planned **cannot use this worker at that time** (unless arrangements are made with the other project manager, I suppose).

Step-5 Estimate Activity Durations:

- Process of **estimating the number of work periods needed** to **complete individual activities with estimated resources.**

- Provides the **amount of time** each activity will take to complete, which is a **major input** into the **Develop Schedule process.**

Method of Estimating Duration

Analogous Estimating Method:

- In this method one **consult the actual data** from a previous or related project.

- Even **if it has some differences** to the current project, one can **analyze** those differences and **apply a correction factor**.

Parametric Estimating Method:

In this method you **break down the project into its fundamental units** that have well known and **understood unit time**.

- For example, the **square footage** of a house.

Three Point Estimating Method:

- When **no real good data are available**, one can estimate the **highest possible** number (**optimistic**), and the **lowest** (pessimistic) as well as the **most likely**.
- **Average** them, or use a **beta distribution**.
  - ***Normal Distribution:*** *Estimate = (Optimistic + Most Likely + Pessimistic) / 3*
  - ***Beta Distribution:*** *Estimate = (Optimistic + 4 x Most Likely + Pessimistic) / 6*

Example. To build the log home, we would **inspect each resource table** from the previous step and **determine the amount of time** required.

Task ID	Name	Durations	Cost
110	Excavation	6 days	$5,850
120	Pour Foundation	10 days	$4,700
210	Wood work	20 days	$60,850
310	Electrical & Plumbing	10 days	$20,260
320	Flooring	8 days	$18,760
330	Finishing	12 days	$16,760
410	Landscaping	14 days	$7,620
	TOTAL	80 days	$134,800

- Total of **80 days** **is not the final project duration** because we **haven't accounted for the project resources yet.**

- If the **resources are not available** **at the right time**, or more resources are required than available **at a given time**, the **project schedule will need to be adjusted**.

Steps 6: Develop Schedule

- In this step, **the most efficient schedule** for the project will be developed.

- **Defined** as producing the **official start and end dates for each task**

- Used **to direct subcontractors** as to when
  -to **schedule** the work,
  -to **order equipment**, and
  -to **prioritize internal resources**.

- Uses the **CPM to determine** the **shortest possible project completion date** and **which tasks directly affect it**.

- **Issues that arise within those tasks** can then be **dealt with on a priority basis**.

Develop Schedule:

- Process of **analyzing** **activity sequences**, **durations**, **resource requirements**, and **schedule constraints** to create the project schedule model.

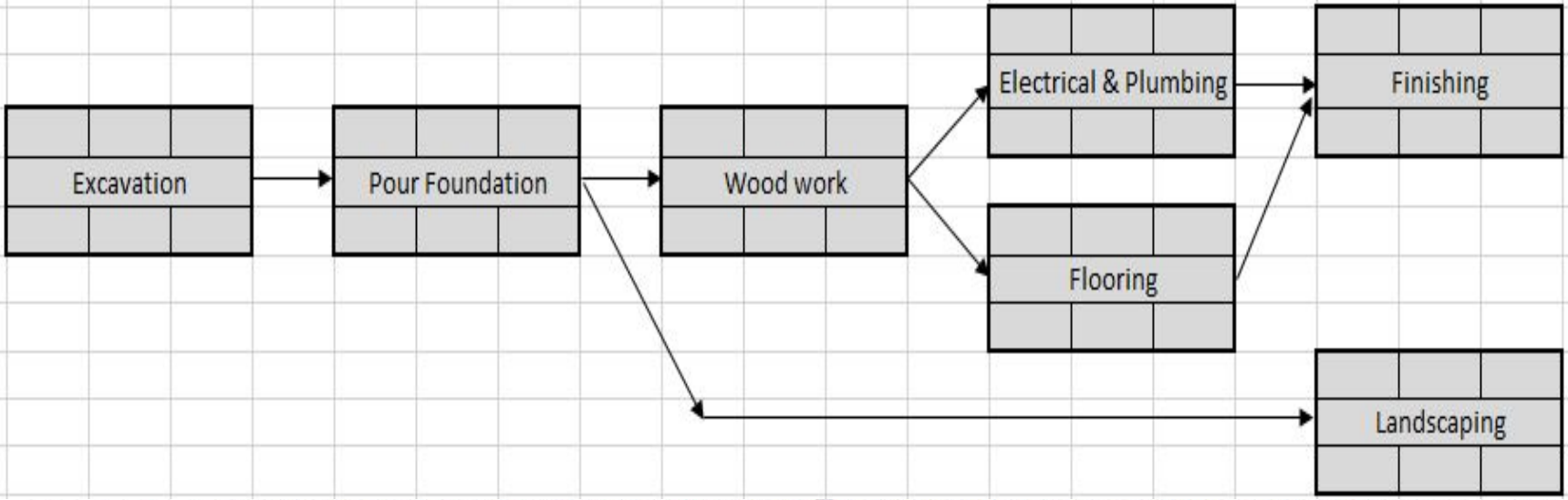
- By **entering** schedule activities, durations, resources, resource availabilities, and **logical relationships** into the scheduling tool.

- To **develop the schedule**, the **critical path method** is used.

- Final step of drawing the **graphical bar chart**, also known as a **Gantt Chart**.

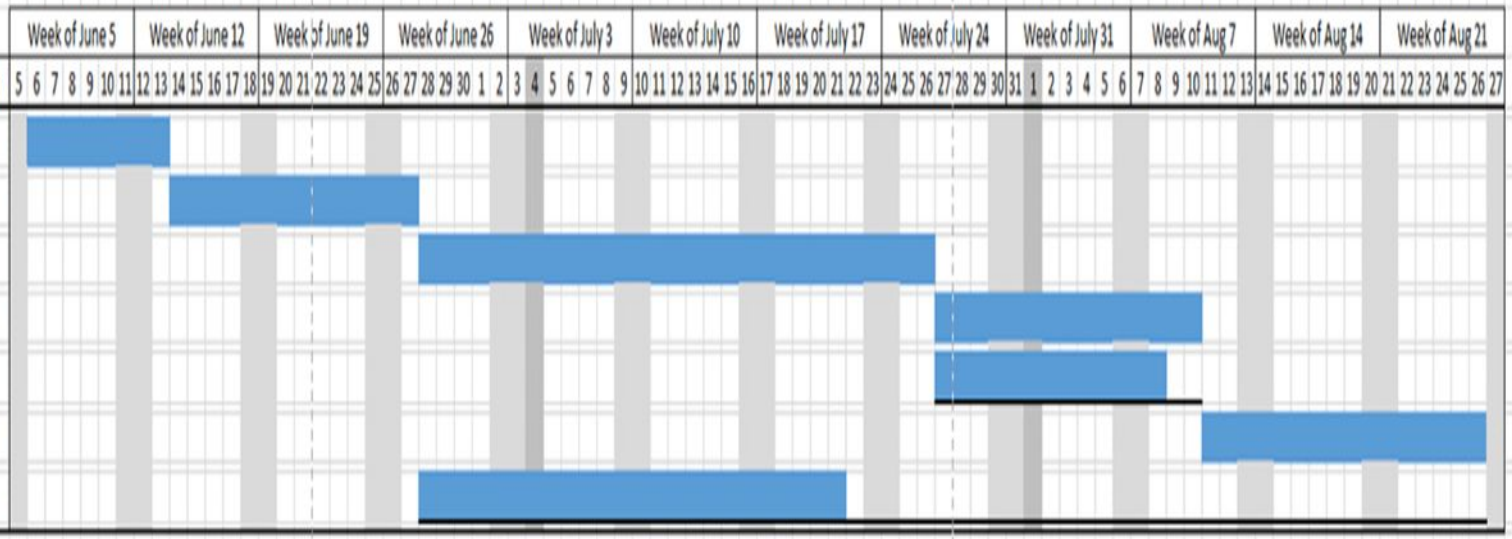
- **Resource leveling** **is done to "smooth"** the overall use of project resources

Original Network



Initial Schedule

Activity	Start	Duration	End	Float
Excavation	1	6	6	0
Pour Foundation	7	10	16	0
Wood work	17	20	36	0
Electrical & Plumbing	37	10	46	0
Flooring	37	8	44	2
Finishing	47	12	58	0
Landscaping	17	14	30	28



Thank You

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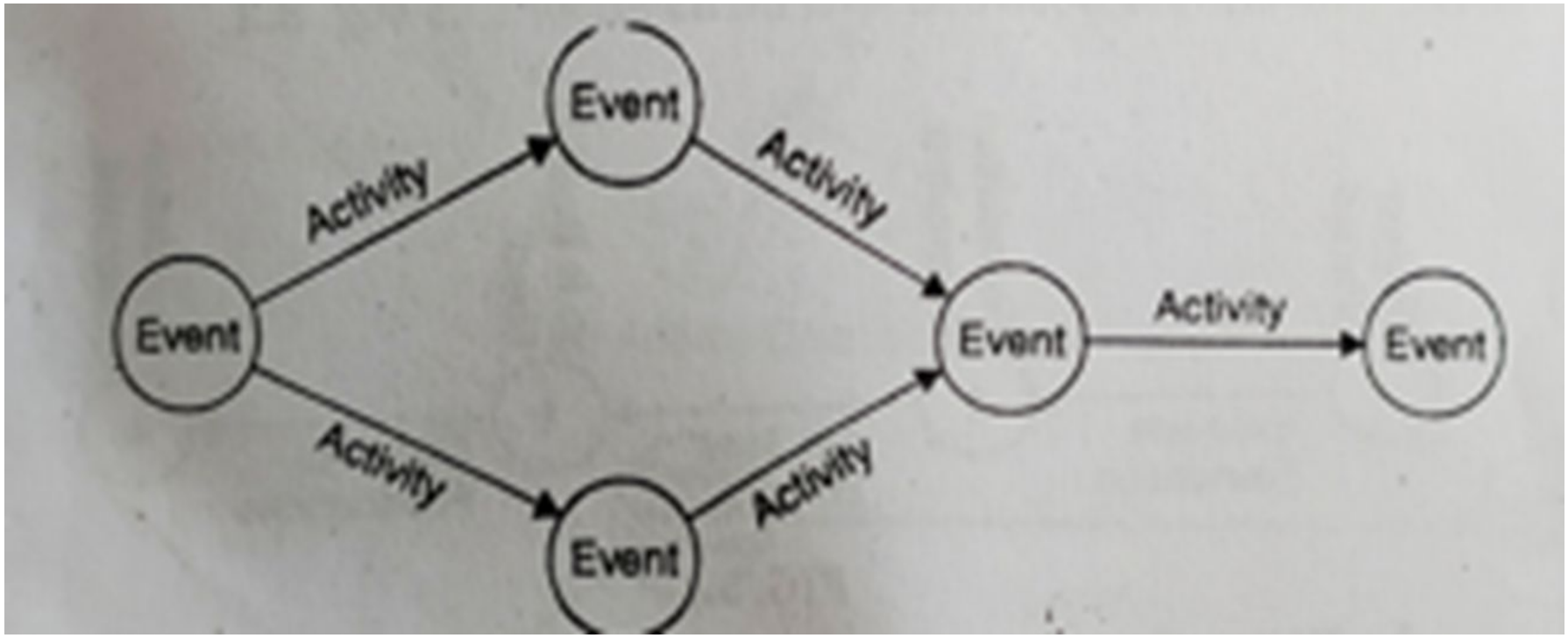
Project Planning and Construction Management

Network in Project Management

What is a Network in Project Management?

- A network is a **flow diagram consisting** of **activities** and **events**, **connected logically and sequentially**.

- Network techniques is one of the **most modern tools** of project management.



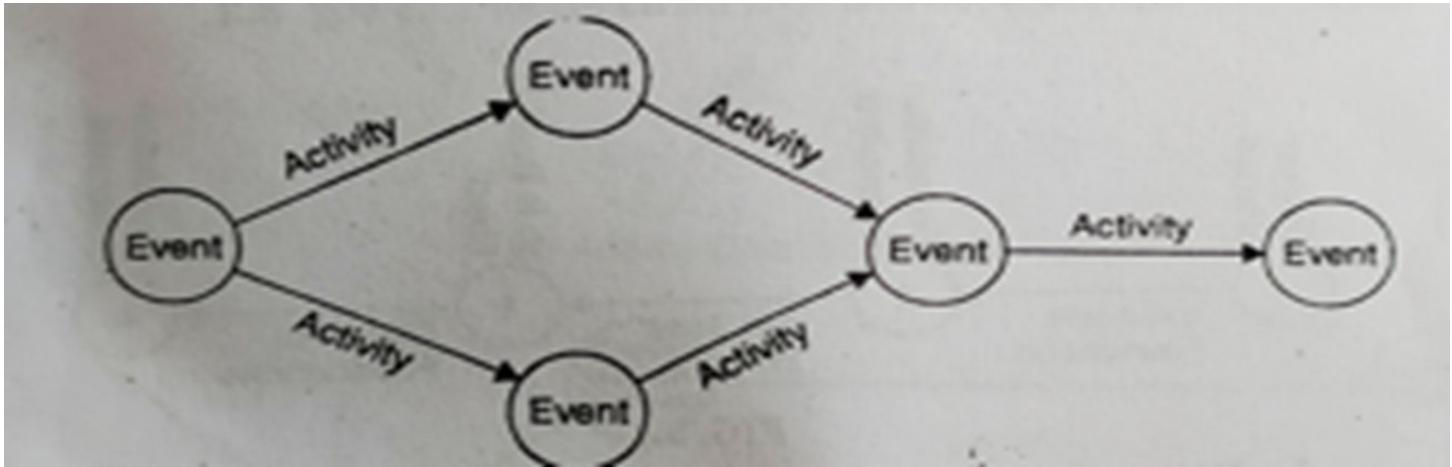
Activities:

- Breaking up of the entire project into a number of **distinct, well defined jobs or tasks**.
- A single, defined unit of work that needs to be completed to achieve a project deliverable

Events:

- **Beginning or end of each** activity constitutes an event of the project.
- Event" refers to a specific point in time that marks the start or completion of an activity.

In the network diagram, an **activity is represented by arrows** while **events are represented, usually by circle**.



Types of Network

Networks are two types:

- **PERT** network: Event oriented
- **CPM** network: Activity oriented

Both networks are **techniques** of project management **involving graphical and diagrammatic representation**, which the authority can use in **planning**, **scheduling** and **controlling of operations** in a project.

Characteristics of Network

- Project to be **planned by network technique** should **consist of clearly recognizable jobs or operations**, usually **called activities**.
- Jobs or operations or activities **must have definite commencement and completion.**
- Start or end of activity is **called event**.
- **Events must occur in a definite pattern** and **activity** must be performed in a **technological sequence**.

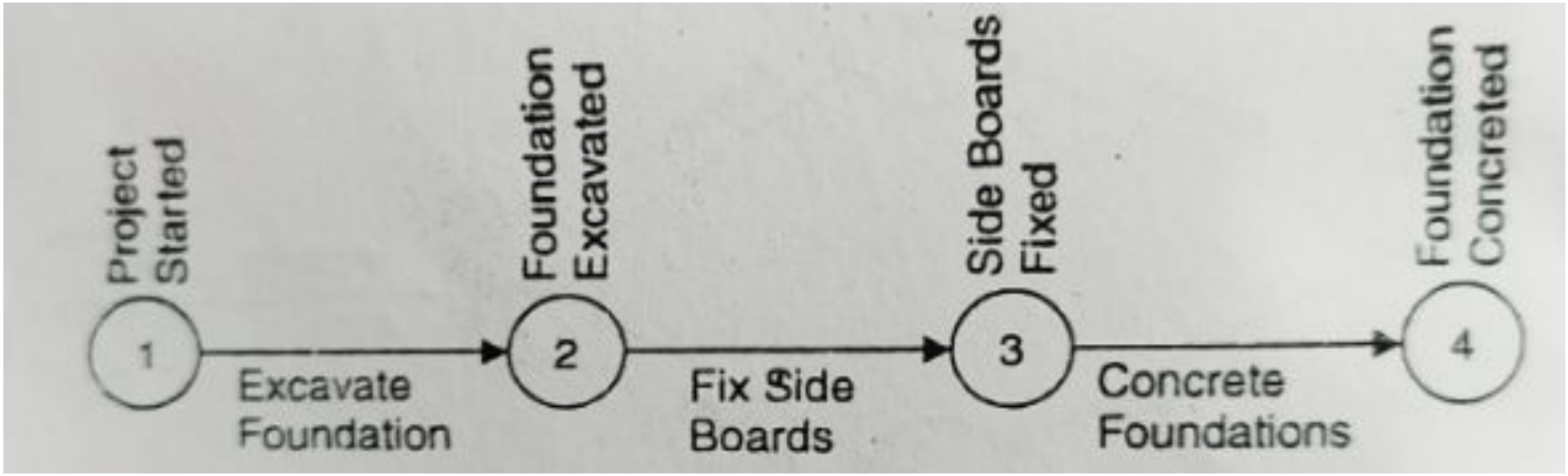
Example of Network

Example: Consider a project of **Laying of structural Foundation**.

Project consists of the following well **defined operations**:

- **Excavation of foundation**
- **Fixing/Laying side boards**
- **Concreting foundation**.

All the three operations are to be **performed in a sequential order.** Simple network follows:



Another Example of Network

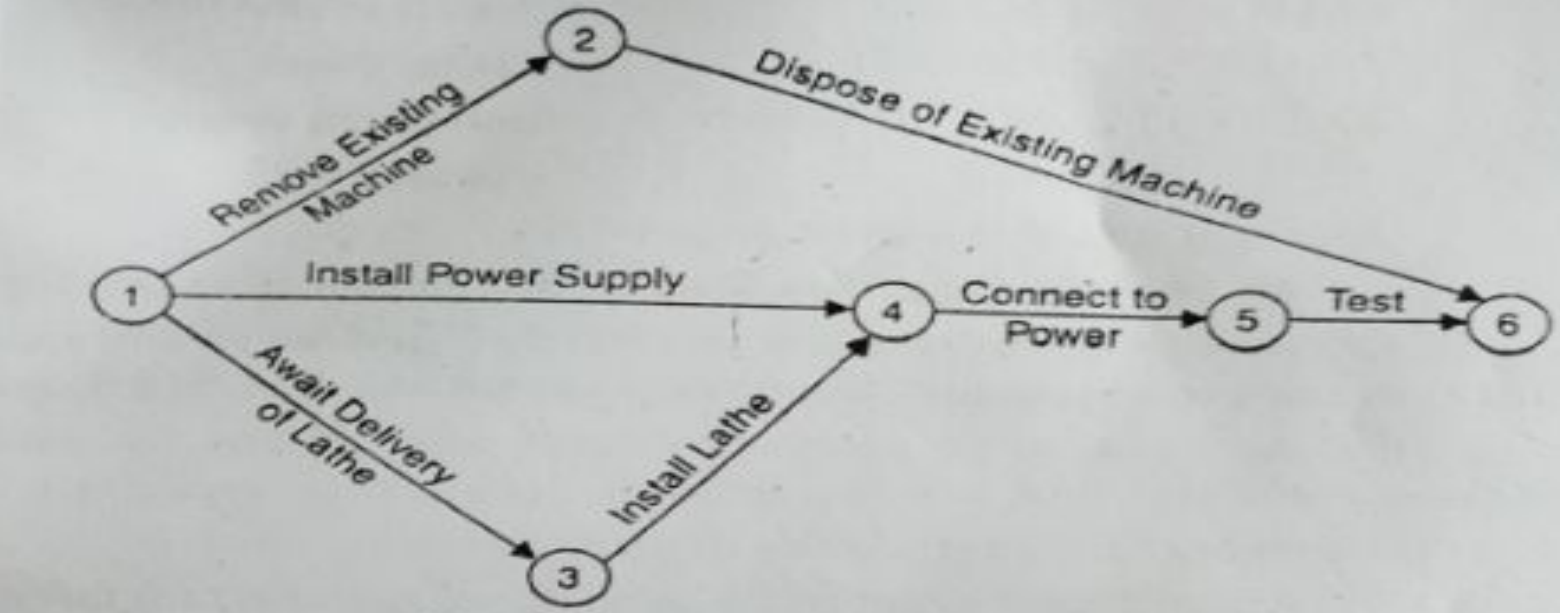
Project consists of "**Purchasing of a new heavy duty lathe and disposing of the old lathe**".

Project consists of the **following activities**:

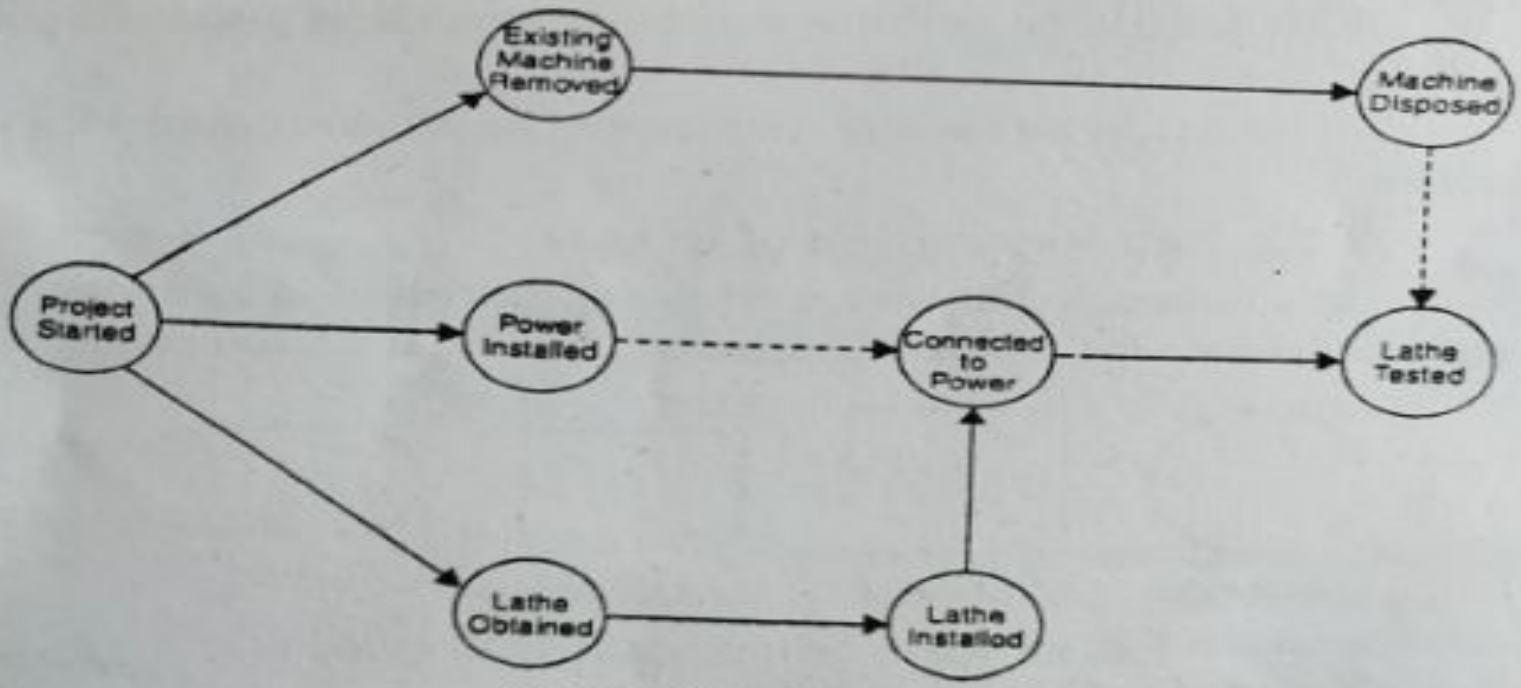
- **Await delivery of lathe**
- **Remove existing lathe**
- **Install power supply**
- **Install lathe Connect to power**
- **Test**
- **Dispose of existing lathe**.



Project can be represented by a network.



(a) Activity Oriented Network **CPM Network**



(b) Event Oriented Network PERT Network

Elements of Network - Event

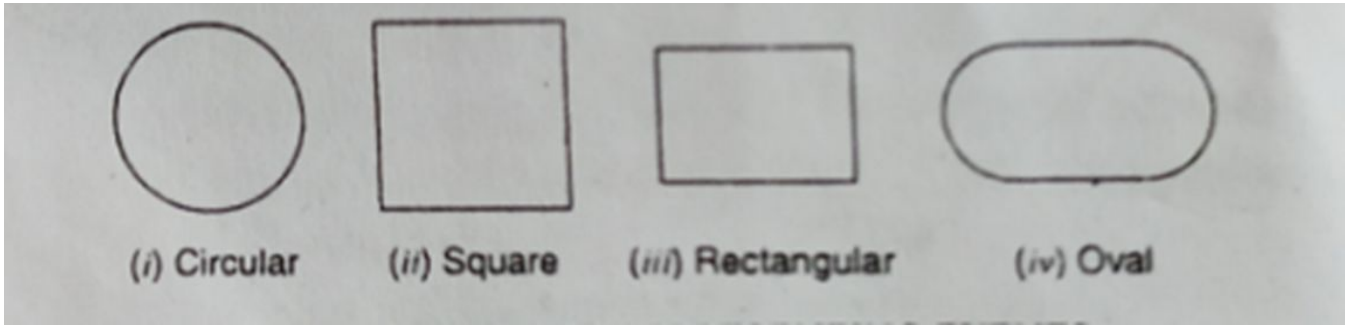
What is an event? Or Define an event.

- **Commencement or completion of an activity** is called an event.
- An event is that **particular instant of time** at which some specific part of a plan has been or is to be achieved.
- An event is a **definable accomplishment** in a project plan, **recognizable** at a particular instant of time.
- **Example**: Design completed.

  : Excavation completed.

Representation of Events:

- **By nodes or Nodes may be any geometrical shape**, usually **by circular nodes**.



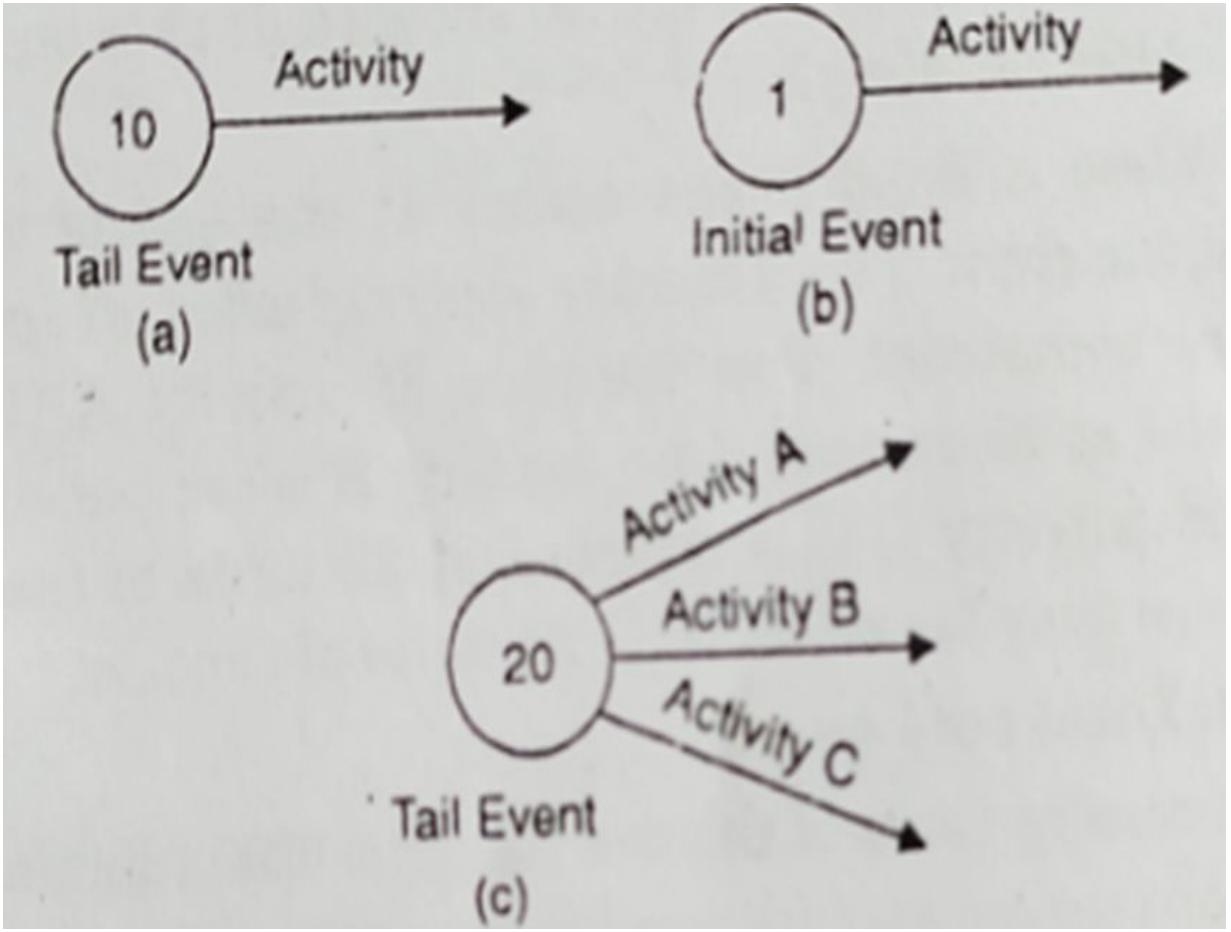
Events

Specifying Events in network diagram:

- **Tail event**
- **Head event**
- **Dual role event**.

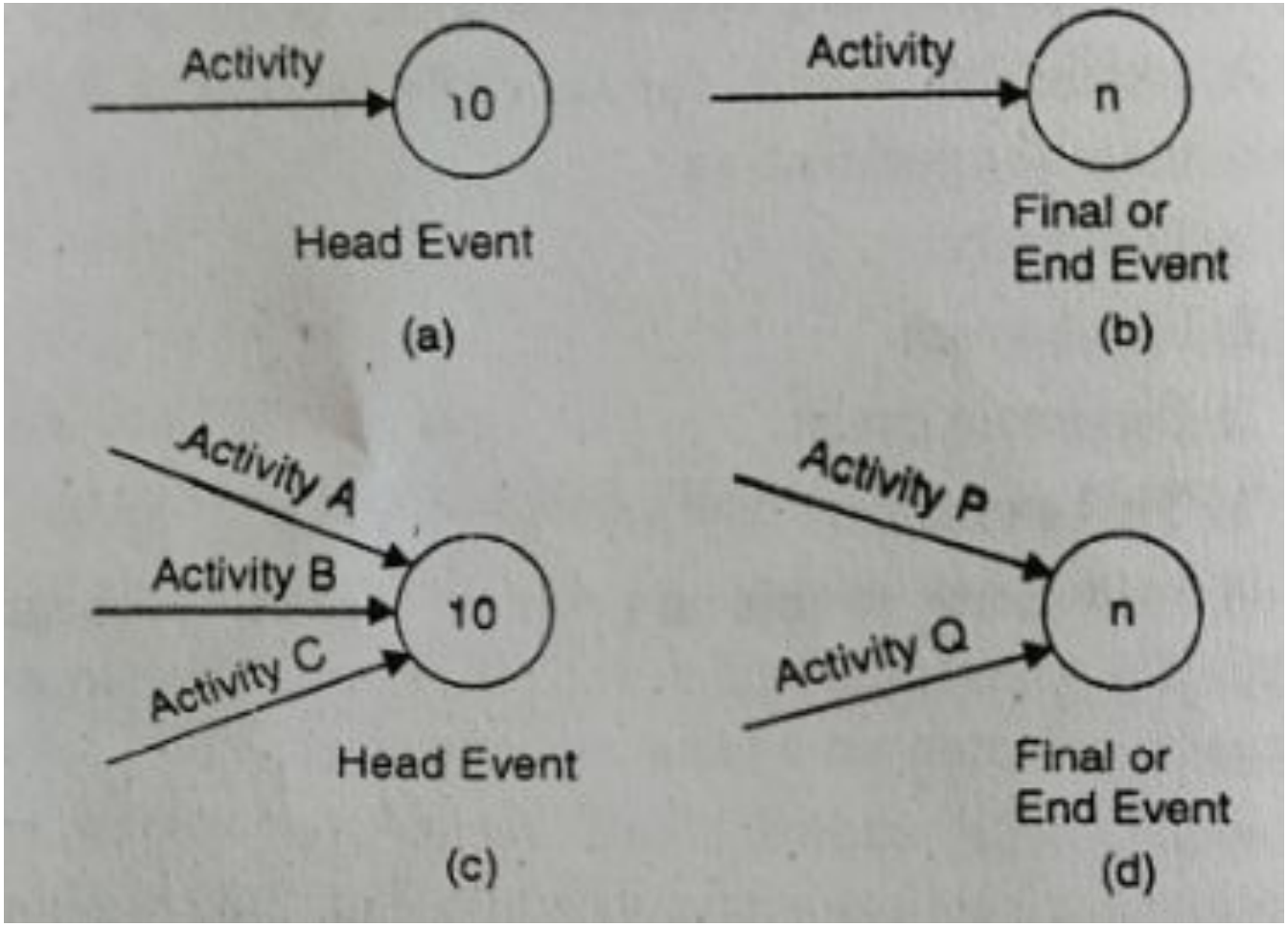
Tail Events:

- Marks the **beginning** of an activity/activities.
- **Commencement** of Project is known as **initial event**.



Head Events:

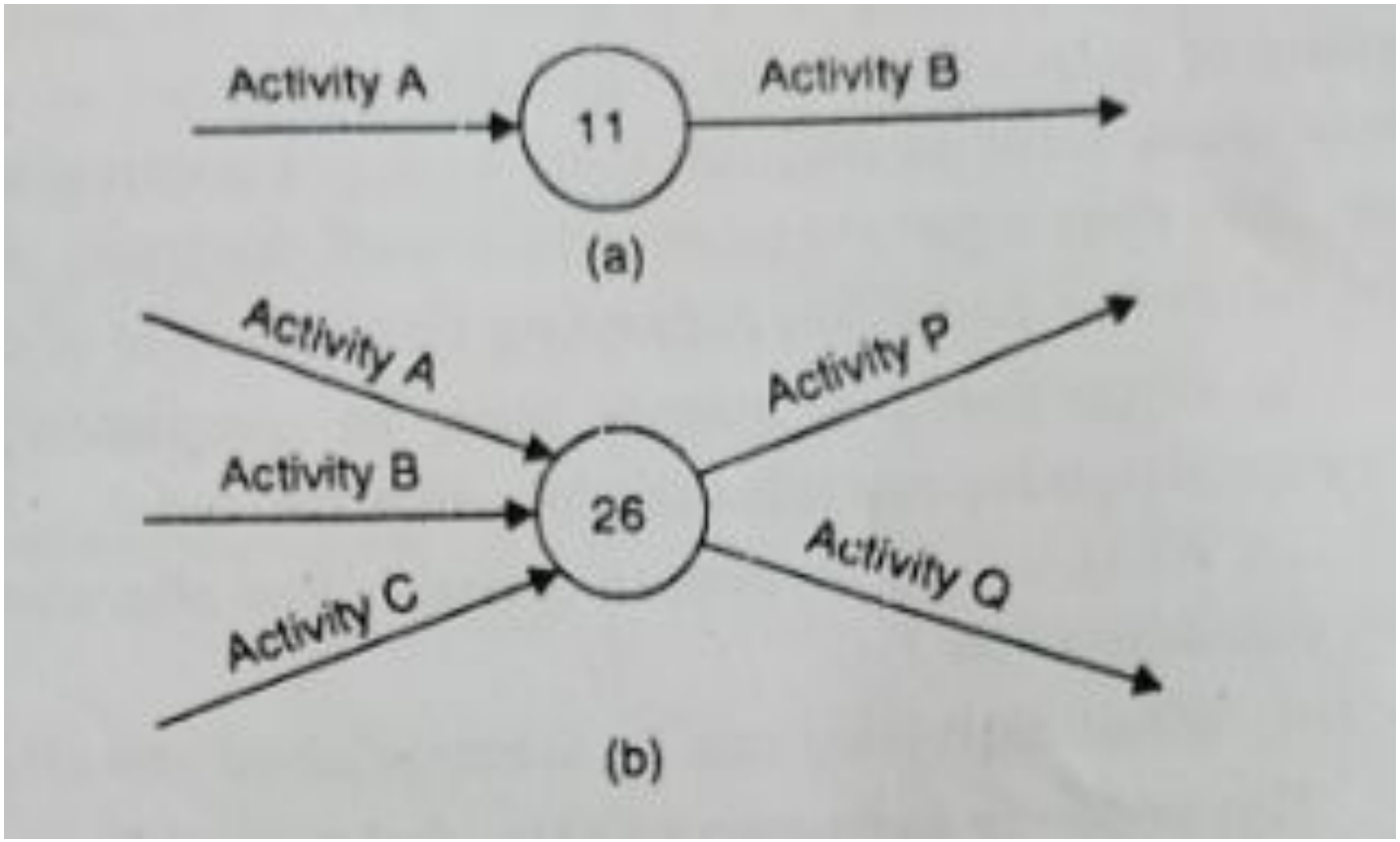
- Activity/activities **ending at a point**.
- Event **marks the completion of a project** is known as Final/End event.



Elements of Network - Event

Dual Role Events:

- Head event to some activity/activities and tail event to other activity/activities.



Interrelationship between Events:

Predecessor events:

- Event/events that **occur before another event** are called predecessor events to that event.

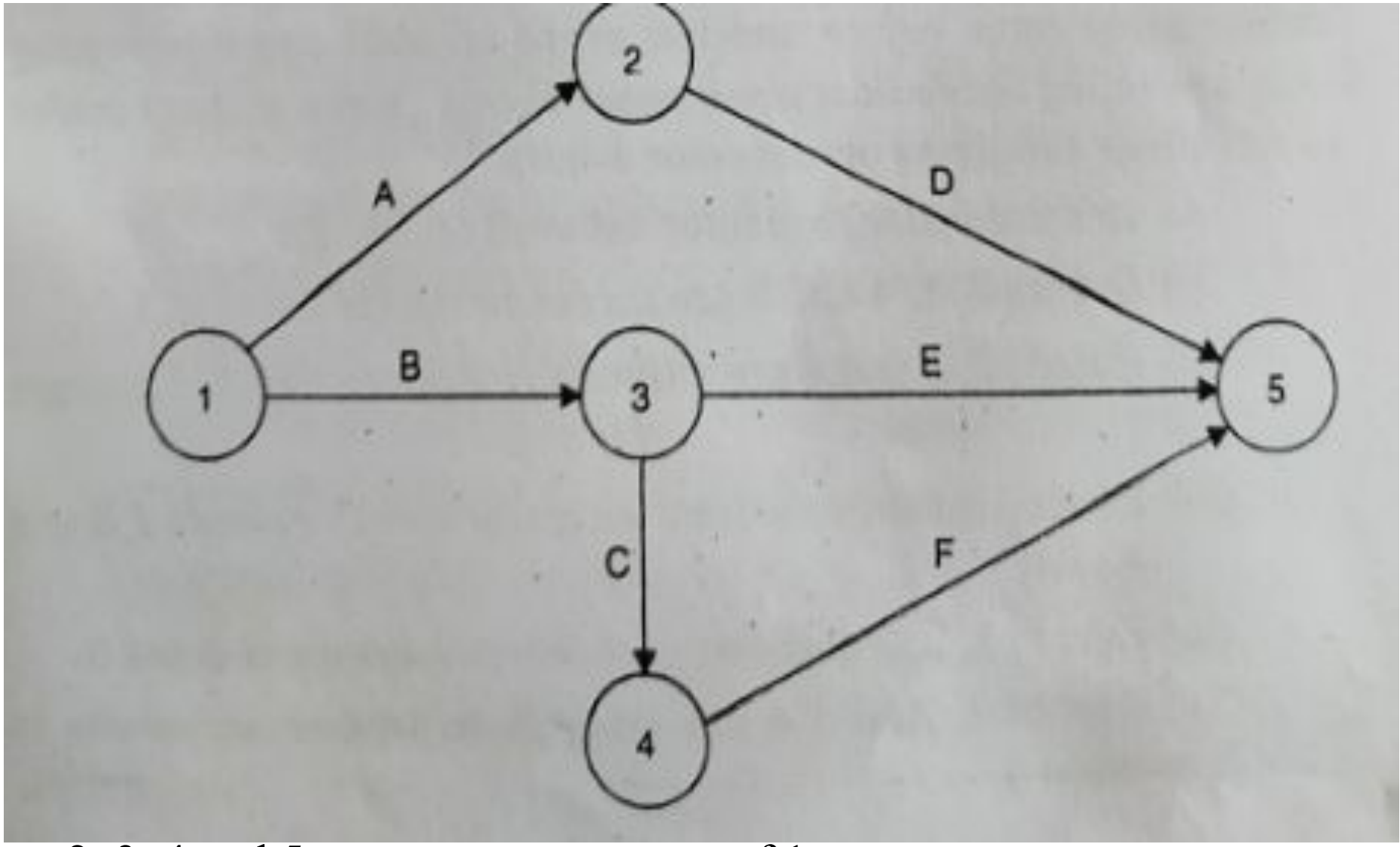
Successor Events:

- Event/events that **follow another event** are called successor events to that event.

Example:

- Events 2,3, 4 and 5 are **successor events** of 1.
- Events 2,3 are the **immediate successor** events of 1.
- Events 1, 2,3, 4 are the **predecessor events** of 5.
- Events 2,3, 4 are the **immediate successor events** of 5.

Interrelationship between Events



- 2, 3, 4 and 5 are **successor events** of 1.

Elements of Network - Activity

Definition of Activity:

- **Actual performance** of a task.
- **Work required** to complete a specific event.
- **Recognizable part of a work** of a project that **requires time and resources for its completion.**

Examples:

- Design of a structure
- Excavate trench

Representation- Activity:

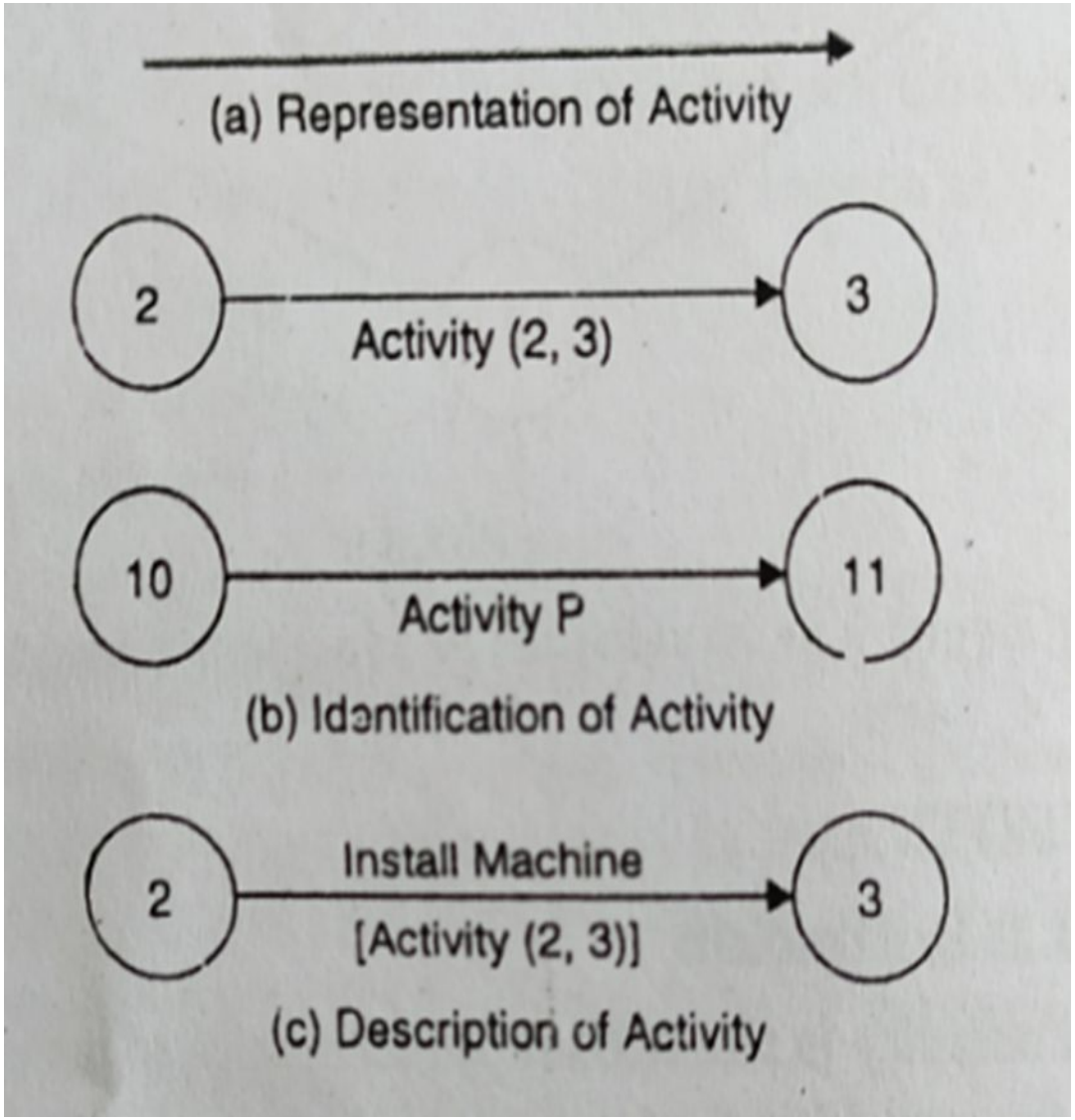
- Represented by **simple arrows**, usually drawn from left to right.
- **Length of arrows** to suit the drafting convenience.

Identification:

- **In terms of the events they connect,** by the use of event numbers.
- **By use of English alphabets**, such as Activity P ie. Excavate trench.

Description:

- Described **by writing actual performance over the arrow**.



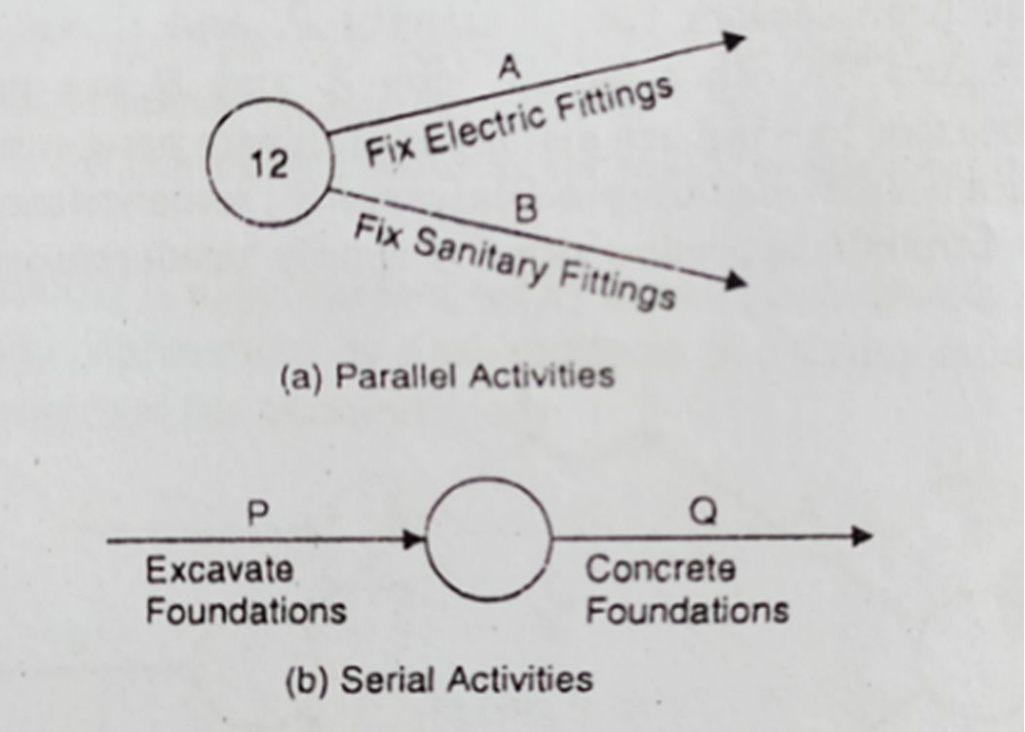
Inter-relationships

Parallel Activity:

- Activities can be **performed simultaneously and independently to each other**.

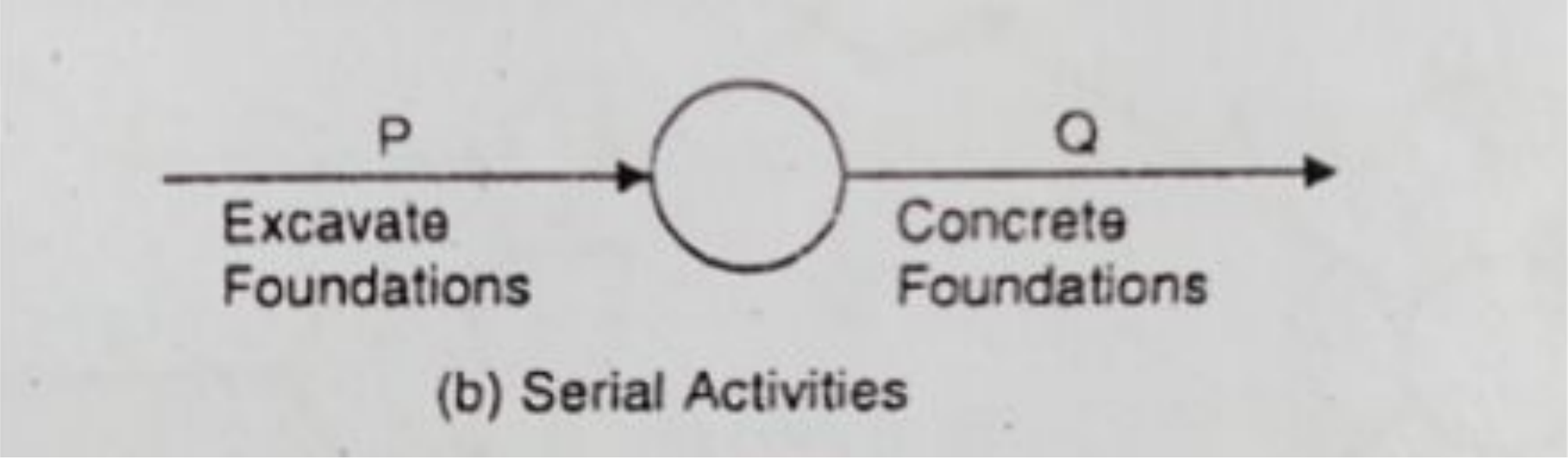
Serial activity:

- Activities those are to be **performed one after another in succession.**
- Activities P & Q in the figure are serial activities.



Interrelationships - **Activity**

- Activity P is known as **preceding activity** or predecessor activity of Q.
- Activity Q is known as **succeeding activity** or successor activity of P.



(b) Serial Activities

Elements of Network - Activity

Dummy:

- **Type of operation in the network** which **neither requires any time nor any resources.**

- Merely **a device to identify a dependence among operations.**

- **Connecting link** for control purpose or

- For **maintaining uniqueness** of activity.

Elements of Network - Dummy

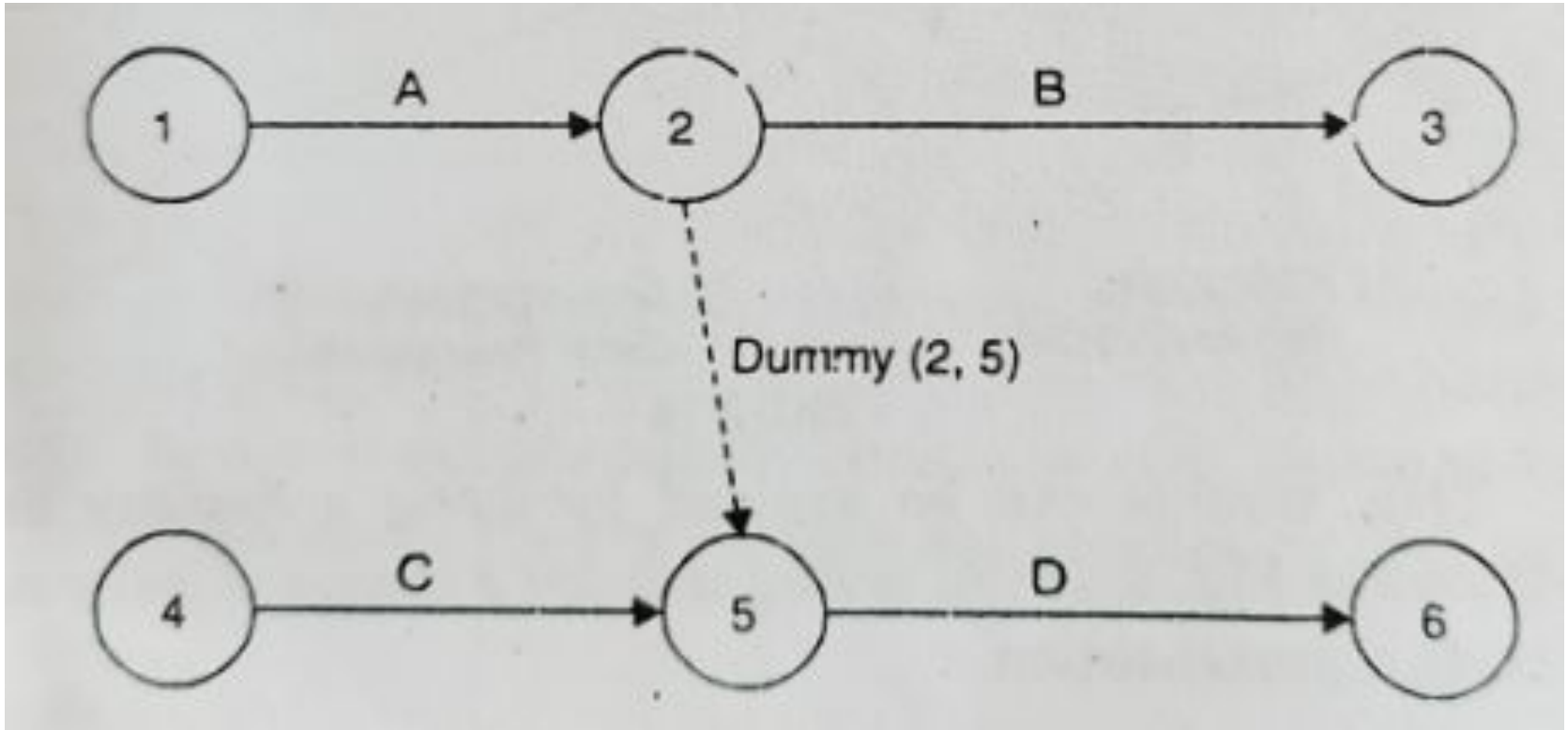
Example:

Set 1: A. **Await delivery of new machine**

B. **Install new machine**

Set 2: C. Remove existing machine

D. **Dispose of existing machine**



Elements of Network - Dummy

Explanation:

- **Activities A and B are to performed serially**.

- Similarly, Activities **C and D are to performed serially**.

- **Both the sets are performed serially.**

- From practical consideration, **activity D (dispose off existing machine) of set 2 can not be performed until activity A (Await delivery of new machine) of set 1 is completed**.

- Hence, **a dummy link is used**, joining node 2 to node 5, indicating that **activity D can not be started unless event 2 is over.**

Uses of Dummies

Dummies serve two purposes in a network:

- Grammatical purpose
- Logical purpose

Grammatical purpose:

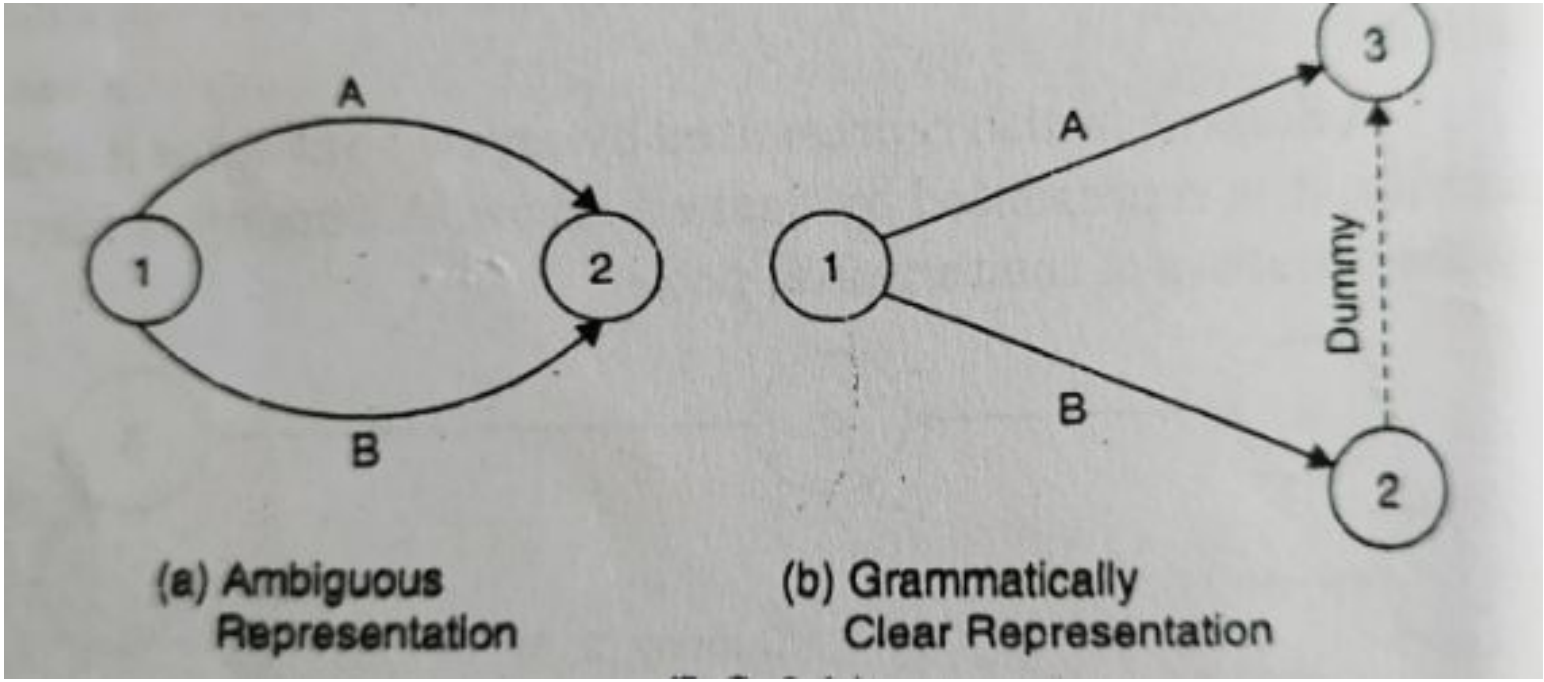
- Used to **prevent two arrows having common beginning and end points**.

Example:

- Arrows of Activities A and B, both start from node 1 and end at node 2.
- **Caused inconvenience** when net work is used for computation.

Uses Dummy

- Inconvenience frequently **leads to mistakes**.
- **Trouble can be avoided** by using a **dummy link**, given thereby a **grammatically correct and clear representation**.



Elements of Network – Uses of Dummies

Logical Purpose:

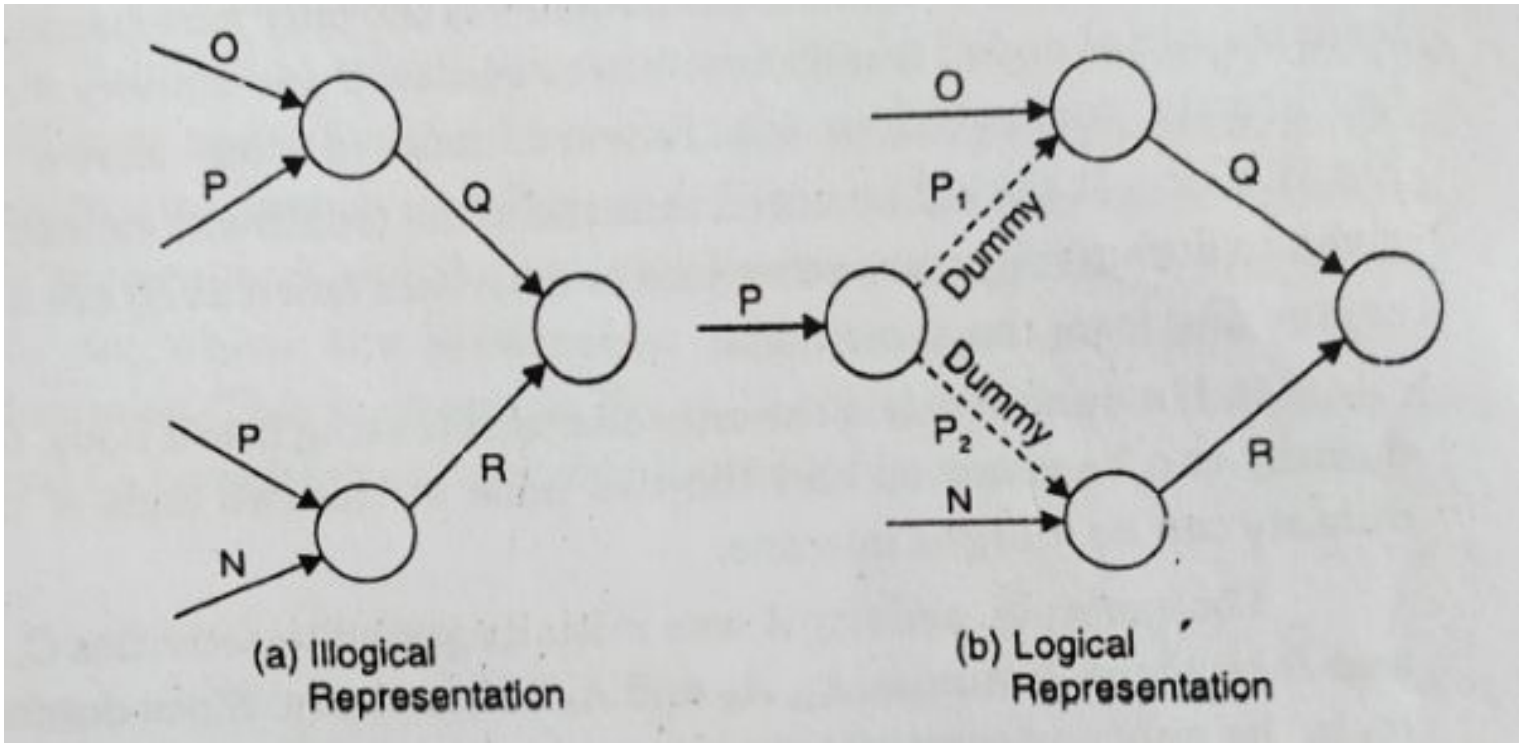
- Dummies are also used to give **logical clear representation in a network having an activity common to two sets of operations running parallel to each other.**

Example:

- Consider, two activities **Q and R having common end** node (event).
- Activity **Q has O and P as successor activities**, **activity R has P and N as successor activities.**
- Figure shows the **illogical representation of the activities**.

Elements of Network – Uses of Dummy

- Because, activity **P can not have dual identity**, it should have unique identity.
- Uniqueness can be maintained by **introducing two dummies P1 and P2 as shown.**



Thanks

GEPM 375

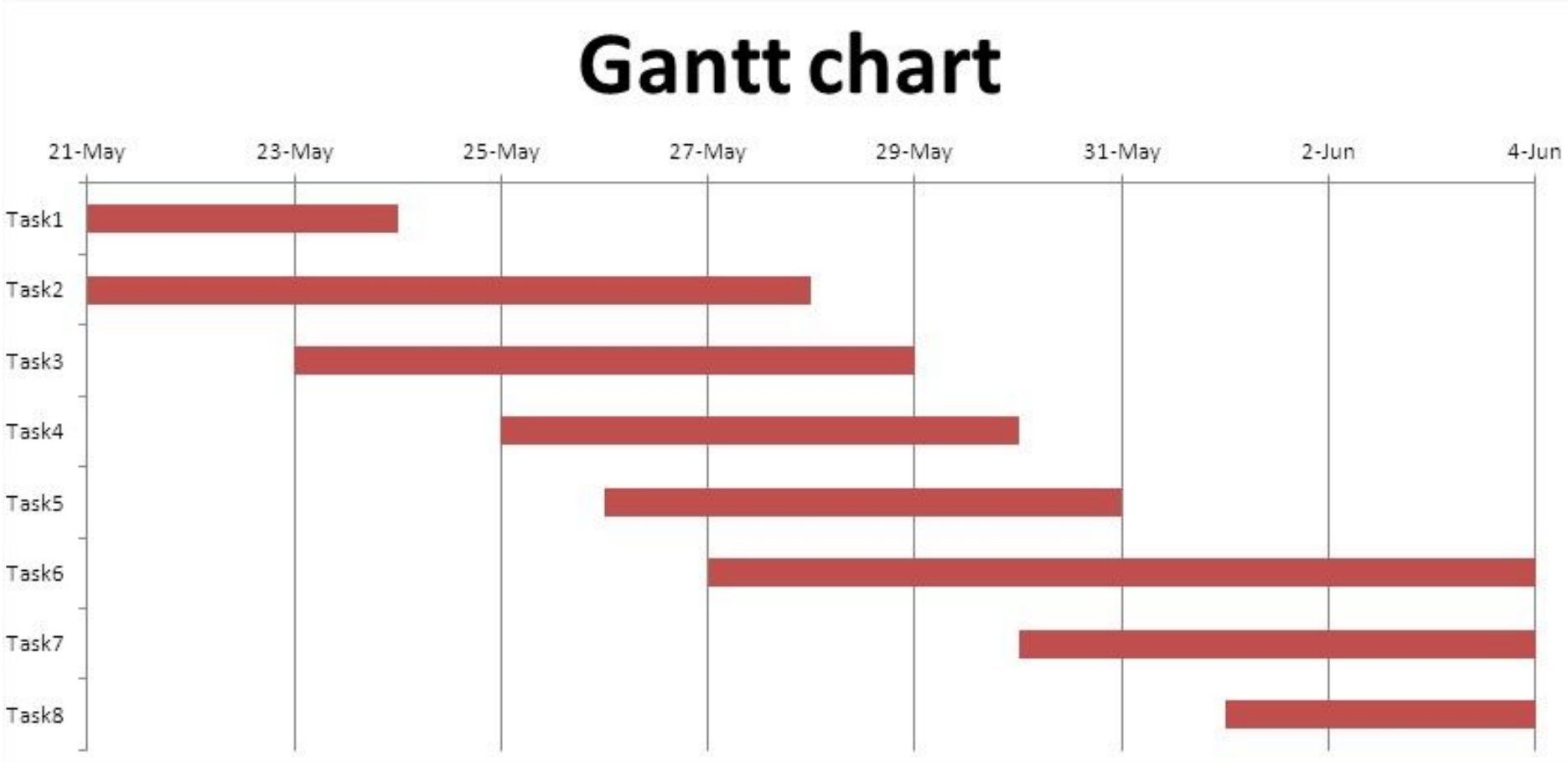
Project Planning and Construction Management

Gantt Chart

To be discussed:

- **Gantt Charts**
- **Stages of Development of Gantt chart**
- **Short comings and remedial measures**

Bar/Gantt Chart



Gantt/Bar charts:

- Earliest techniques **or tools of project management**.
- Introduced by **Henry L. Gantt** around 1910 AD.
- Used in many projects of **moderate magnitude**

Consists of:

- **Two coordinate axes**
  - -Horizontal axis, representing the **time elapsed**.
  - -Vertical axis, represents the **activities to be performed**.
- **Each bar** represents one specific activity**.**

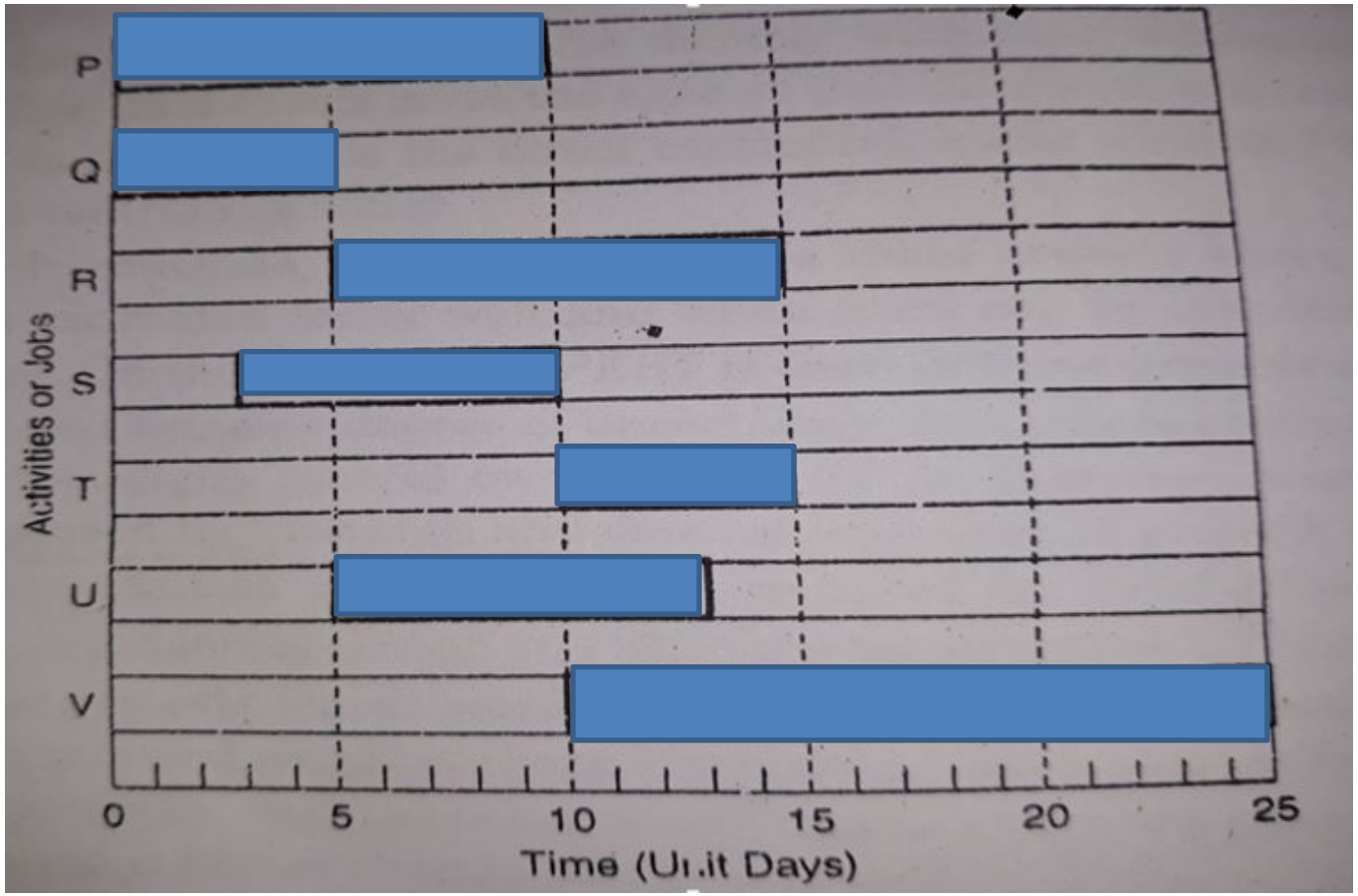
- **Beginning and end** of each bar, represents the **time of start and time of finish of the activity**.

- **Length of bar**, represents the **time required** for completion of the jobs/activities.

Gantt Bar charts

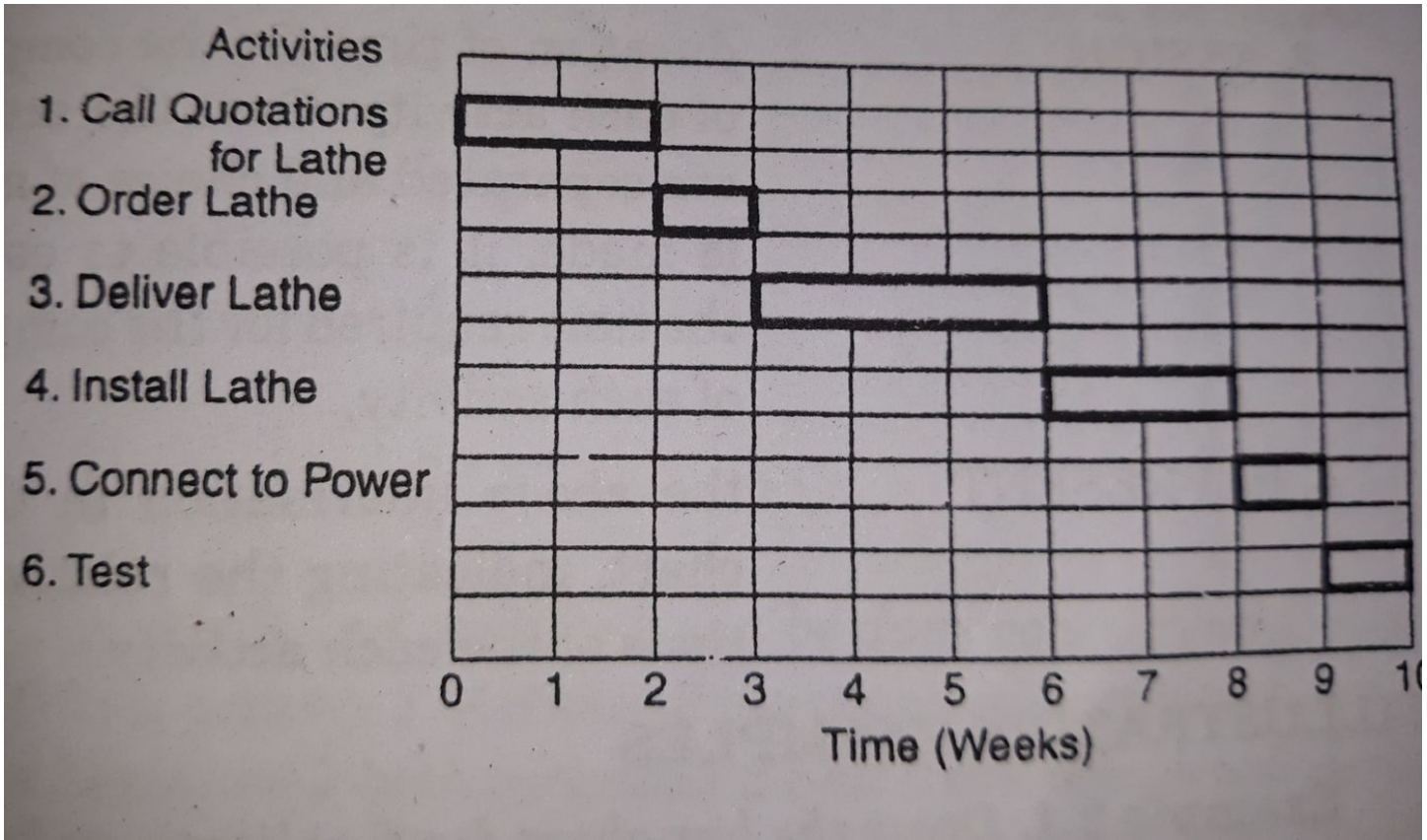
Figure Shows-Bar charts of projects.

- Projects has **7 distinct activities** to be performed for its completion.
- Time required 10, 5, 10, 7, 5, 8 and 15 days.



Examples: **Purchase and installation of a lathe machine**.

- Consists of **6 distinct activities**
- Dependency **FS relations**
- Some activities can take place concurrently
- Some succeeds a preceding activities.



Important Stages of Developing Bar Charts (BDAR)

- **Breakdown** the projects into its various activities/jobs/operation.

- **Decide the methods** for execution of activities/projects and **sequence the activities**.

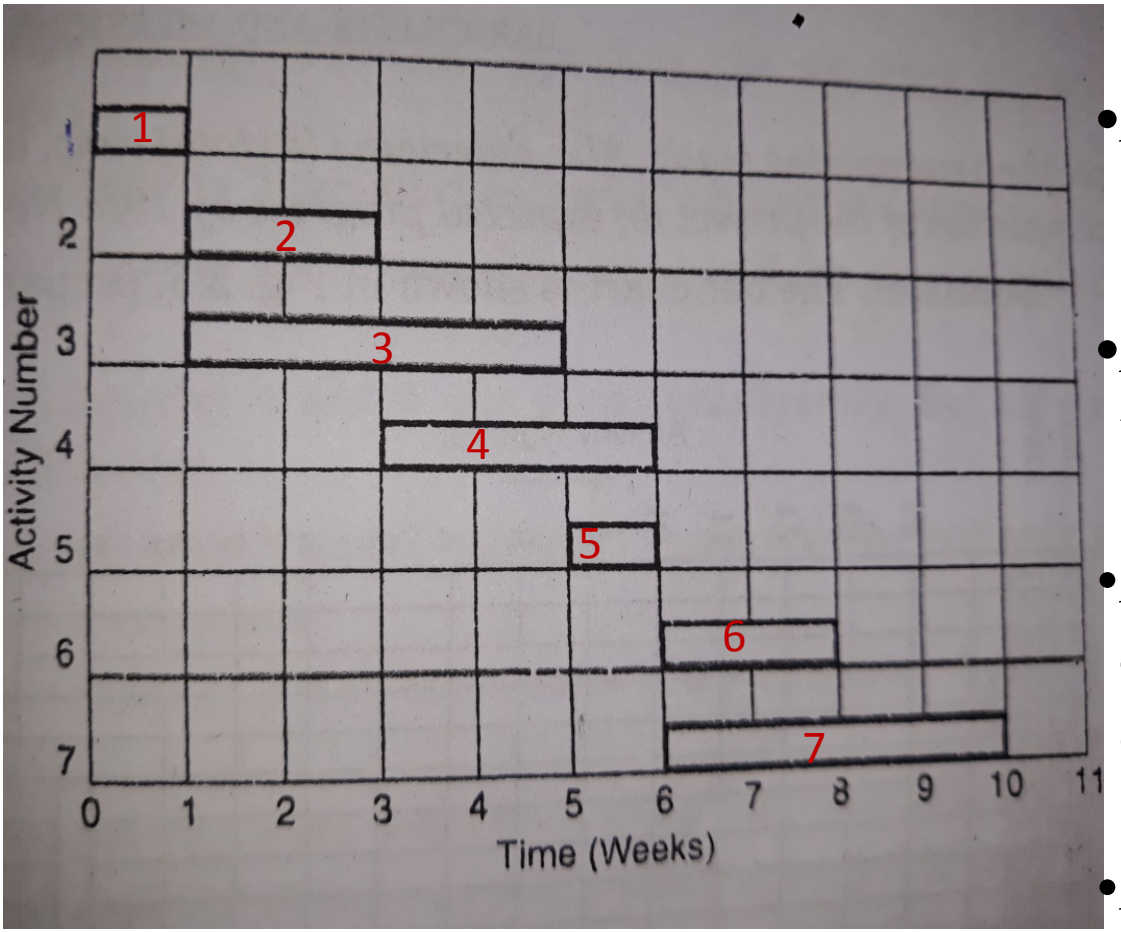
- **Assign duration of time** for each activities.

- **Represents** above information **into Bar Charts**.

Example: The activity breakdown of a certain projects is as under:

Activity No.	Duration(wks)
1	1
2	2
3	4
4	3
5	1
6	2
7	4

Activity Breakdown-Example

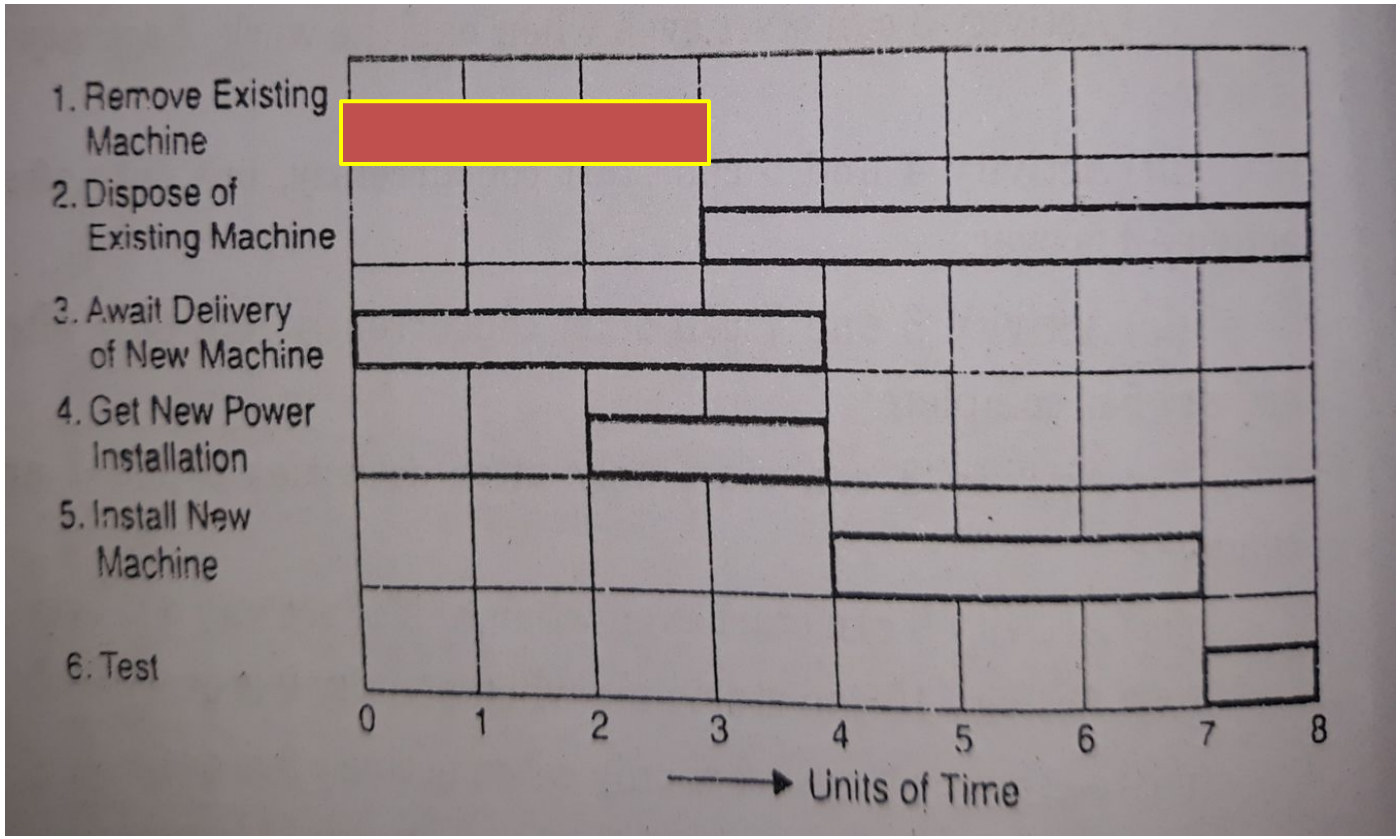


- **Activity 2 & 3 can be started concurrently**, and both must **follow activity 1.**
- **Activity 2 must precede activity 4.**
- **Activity 5 can not begin until 3 are completed**
- Activity **6 can be started only after 4 & 5 are completed.**
- Activity **7 is the last activity which can be started only after completion of 5.**

Short comings of Gantt Chart and remedial Measures

Short Comings are:

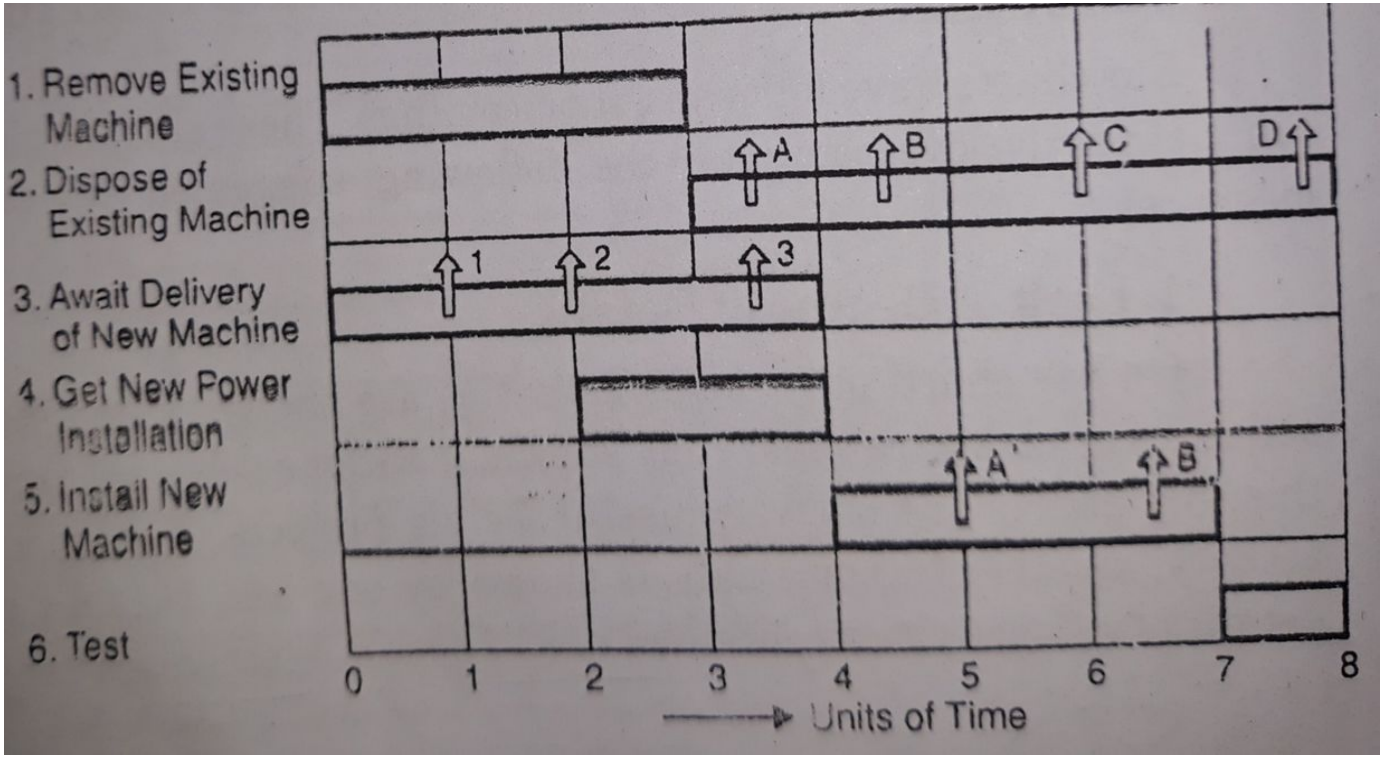
- **Lack of degree of details** (ie. Sub activities)
- **Review of project progress** is difficult.
- **Activity Interrelationship can not be shown**.
- **Time uncertainties** shall remained



Lack of degree of details -remedial Measures

Remedial Measures (by milestones/stages):

- **Sub activities can be shown** effectively by marking **stages** on the activity bar.
- Stages of sub activities are called **milestones.**



A. Dumping Machine in store

B. Notice inviting biding

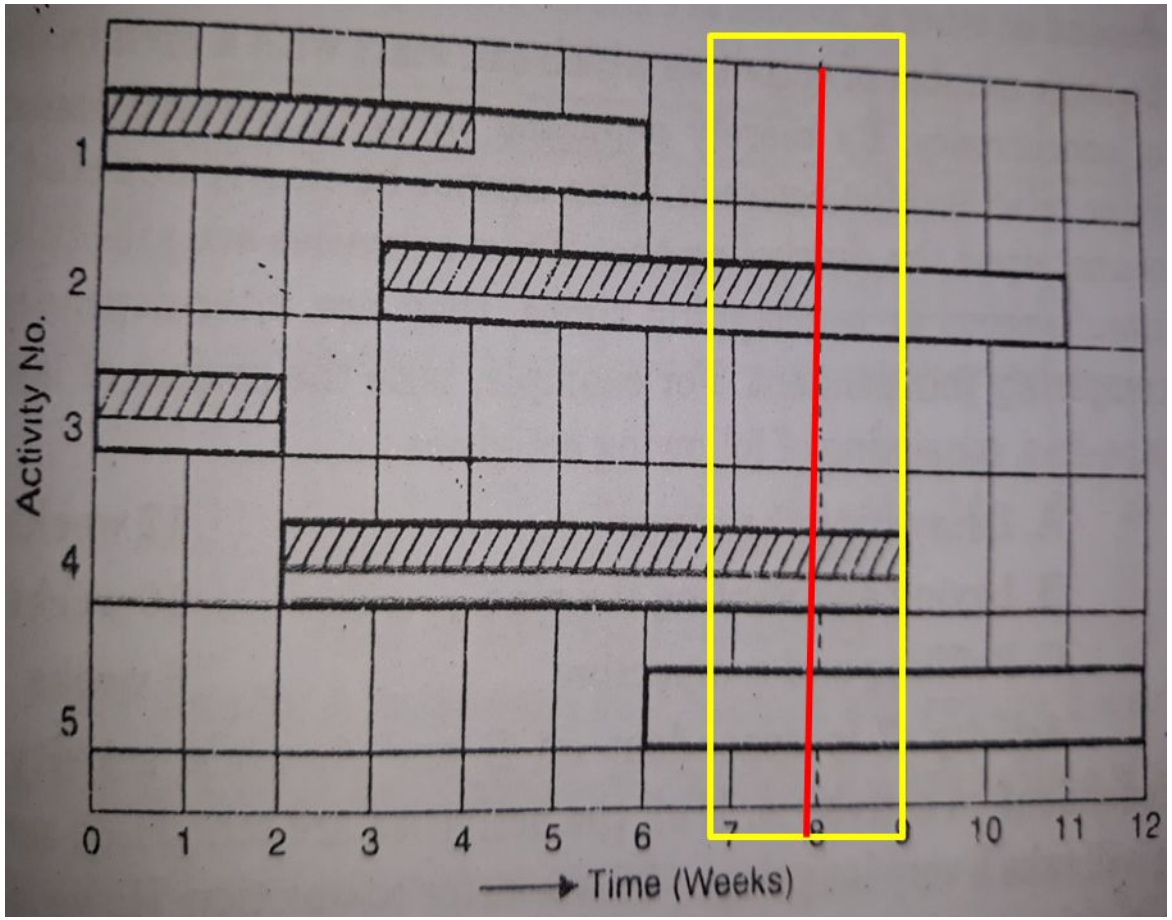
C. Finalization of highest bid

D. Final disposal of the machine

Review of Projects progress- remedial Measures

Remedial Measures:

- Existing bar charts **can be modified** to depict the progress made.
- Showing progress by **hatched lines**.



Progress after 8 wks.

Activity 1, only 4 wks works are completed, which has 6 wks time. Hence **4 weeks behind the schedule**.

Activity 5, was **fully dependent** on completion of Activity 1, now **delayed by 4 weeks**.

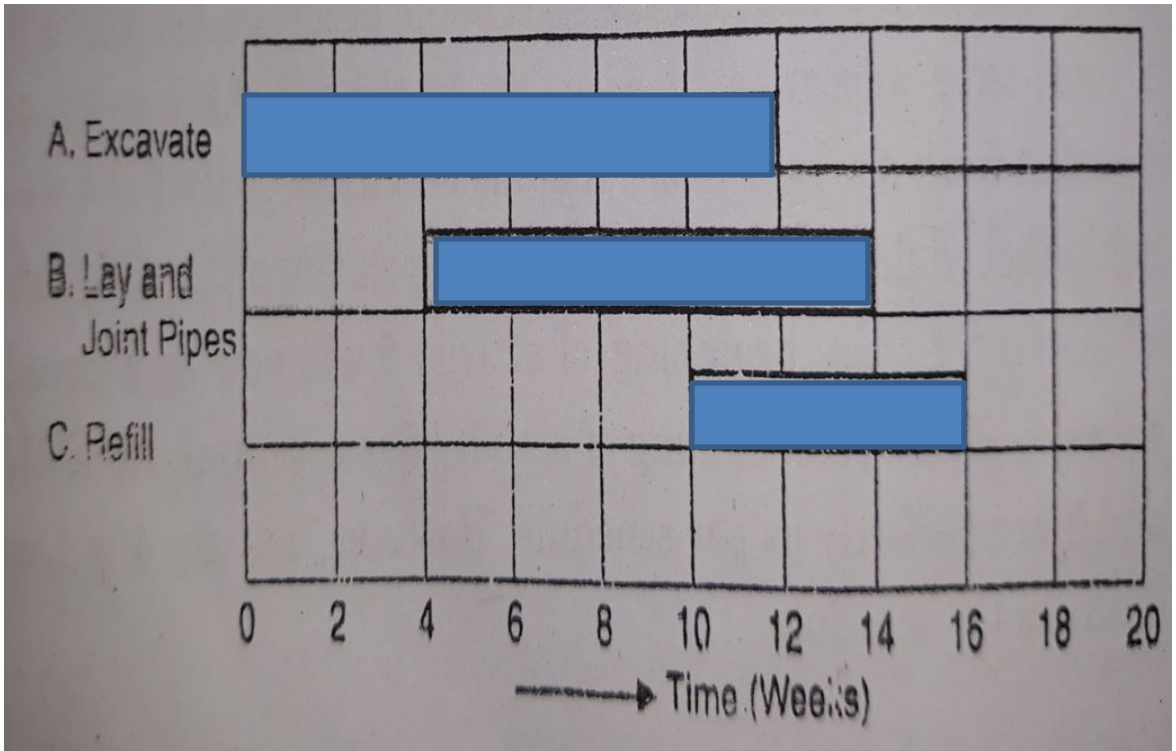
Hence, **rescheduling of Activity 5 is essential**

Limitation of Bar Charts: Activity Interrelationship

Activity Interrelationship:

- By **merely depicting** the concurrent activities by parallel lines of bars in a project, the inter **relationship between the activities cannot be depicted clearly.**

- If due to some reasons, time of completion of Activity **A is delayed by 1 or 2 weeks, how will B and C will be affected?**
- This not correctly depicted by bar charts.



Remedial:

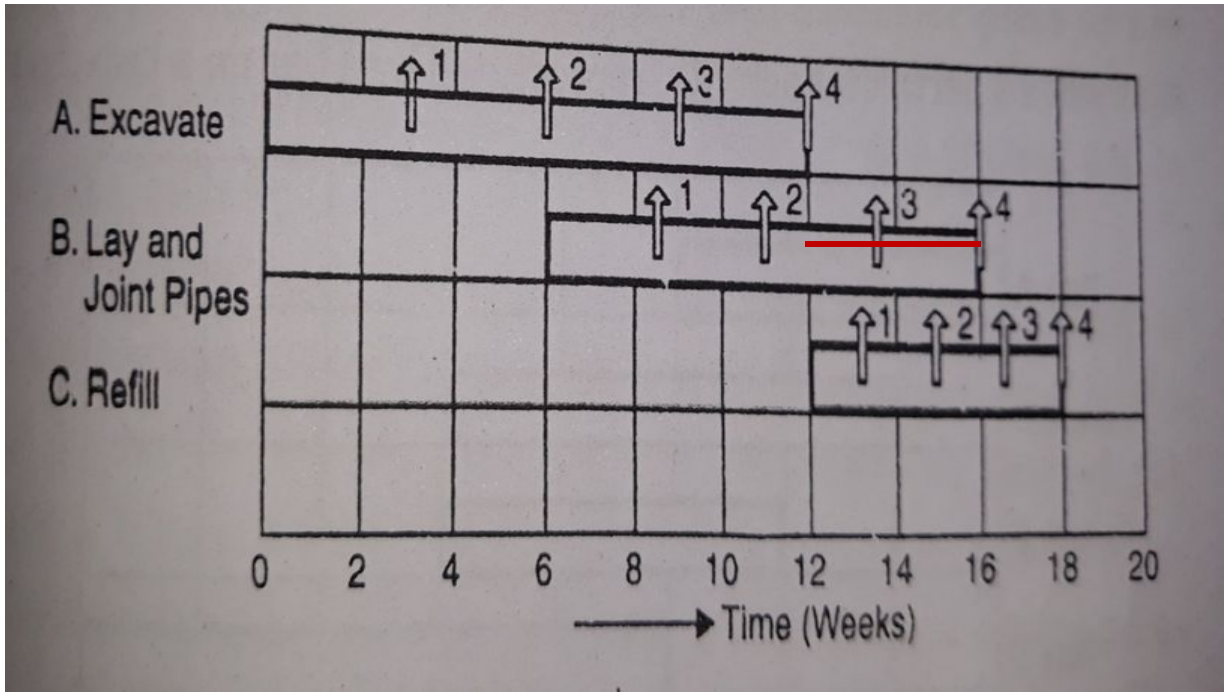
- By breaking of each of the **activities into number of sections** so that the **corresponding sections** of **various activities are precisely depicted interdependency.**

  Activity A -> each section has 3 weeks

  Activity B -> each section has 2.5 weeks

  Activity C -> each section has 1 weeks

- If activity B started after 6 weeks of A, it means that Activity **B will start after Sec 2 of A** is already completed.
- B will **require 4 weeks time** after completion of **Sec 4 of A.**



Limitations of Bar charts: Time Uncertainties

Time Uncertainties:

- Gantt Charts are **not useful in those projects where there are uncertainties in determination or estimation of time.**

Examples-Research and Development Projects, Space vehicle launch projects.

- Are **useful for small projects.**

Milestone Charts:

- **Modification** of original Gantt Bar charts.

What are the milestones?

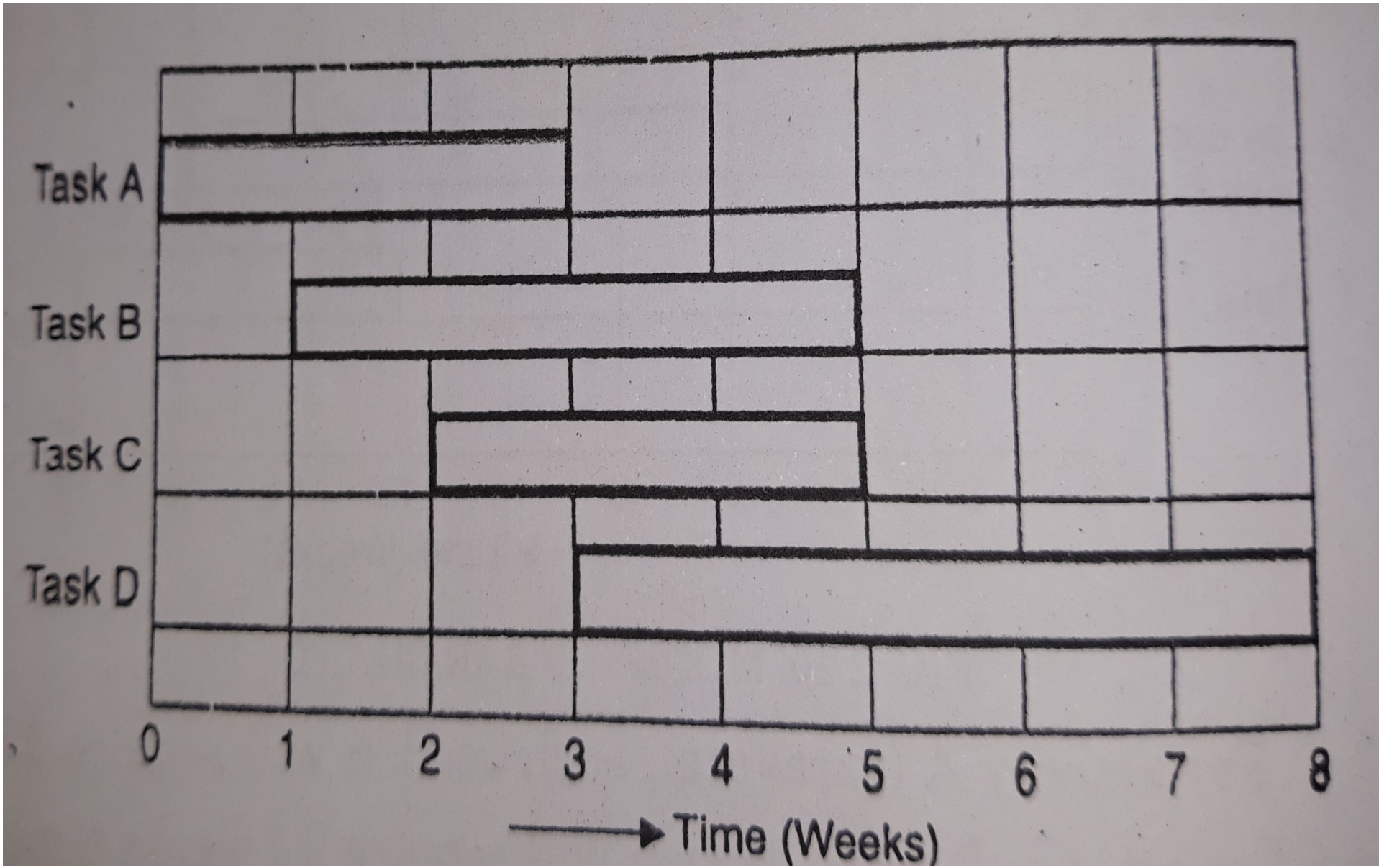
- **Milestones are Key events of main activity,** in which activity is represented by a bar.

- **Milestones are Specific points in time** which **mark the completion of certain portions of the main activity**.

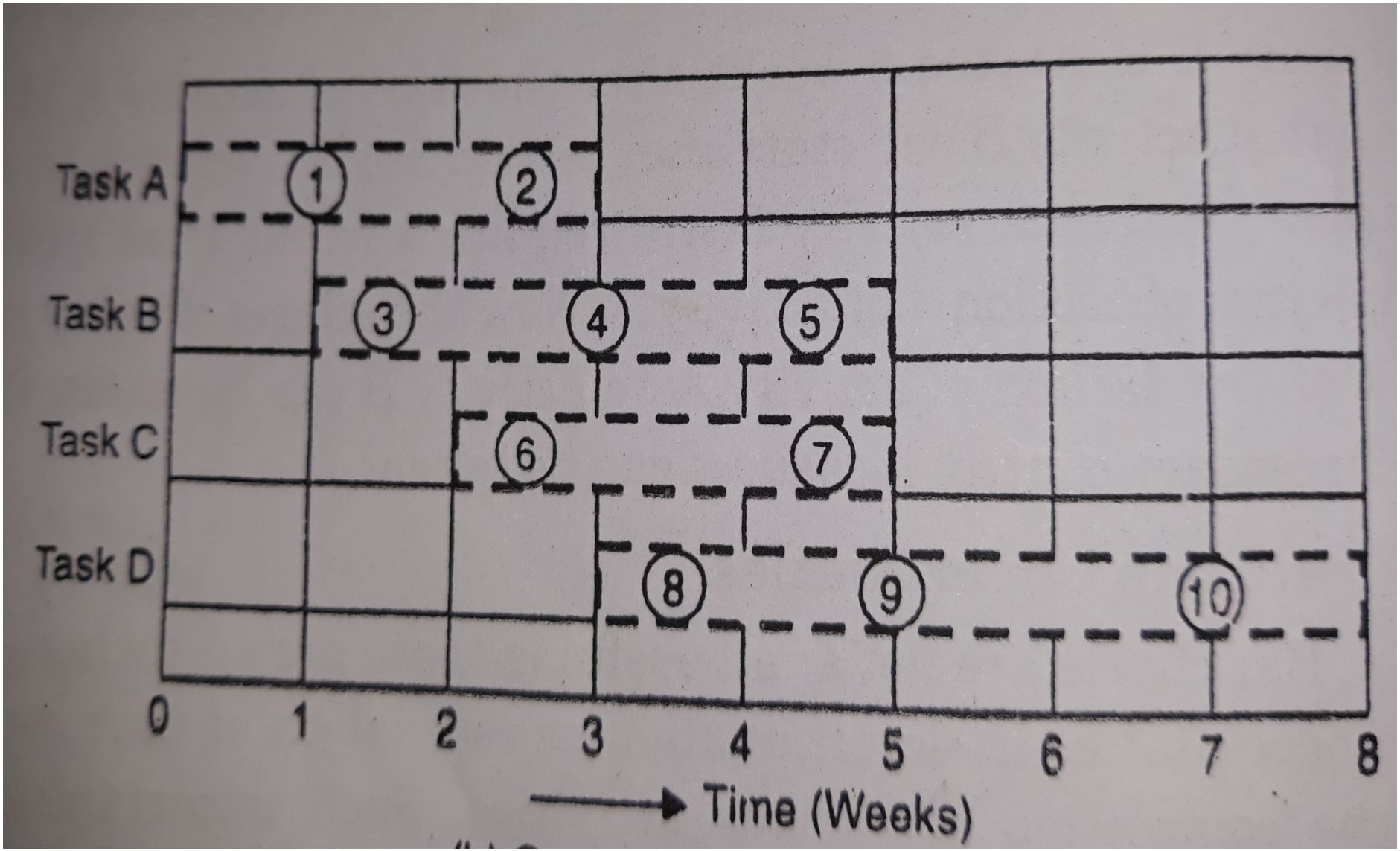
- Specific points **can easily be identified over the main bar.**

Question: What is milestone charts? How do you overcome the shortfall of Gantt Bar Charts in Milestone Charts?

Gantt bar Charts



Gantt Milestone Charts



Gantt Milestone Charts

Short fall of Gantt Bar Charts:

When a **particular activity, represented by a bar** on a Gantt chart, is **very long and lack of details**.

How to Overcome?

If the **Activity is broken** or subdivided into **number of sub activities,** then

- **Each of** sub activity can easily be **recognized** during progress of the project;
- **Controlling** can be easily be done;
- **Inter relationship** between other similar activities can easily be established.

Milestone Charts

- **Milestones**: B**eginning and the end of the of sub activities** of main tasks.

- Sub tasks **contains some specific points of time**, which can be recognized.

- Through the **specific points controlling can be achieved.**

- Each milestones **are represented either by square or circle and is serially numbered.**

Question: What are the milestones in milestone charts in Project Management?

Milestone Charts to PERT Network

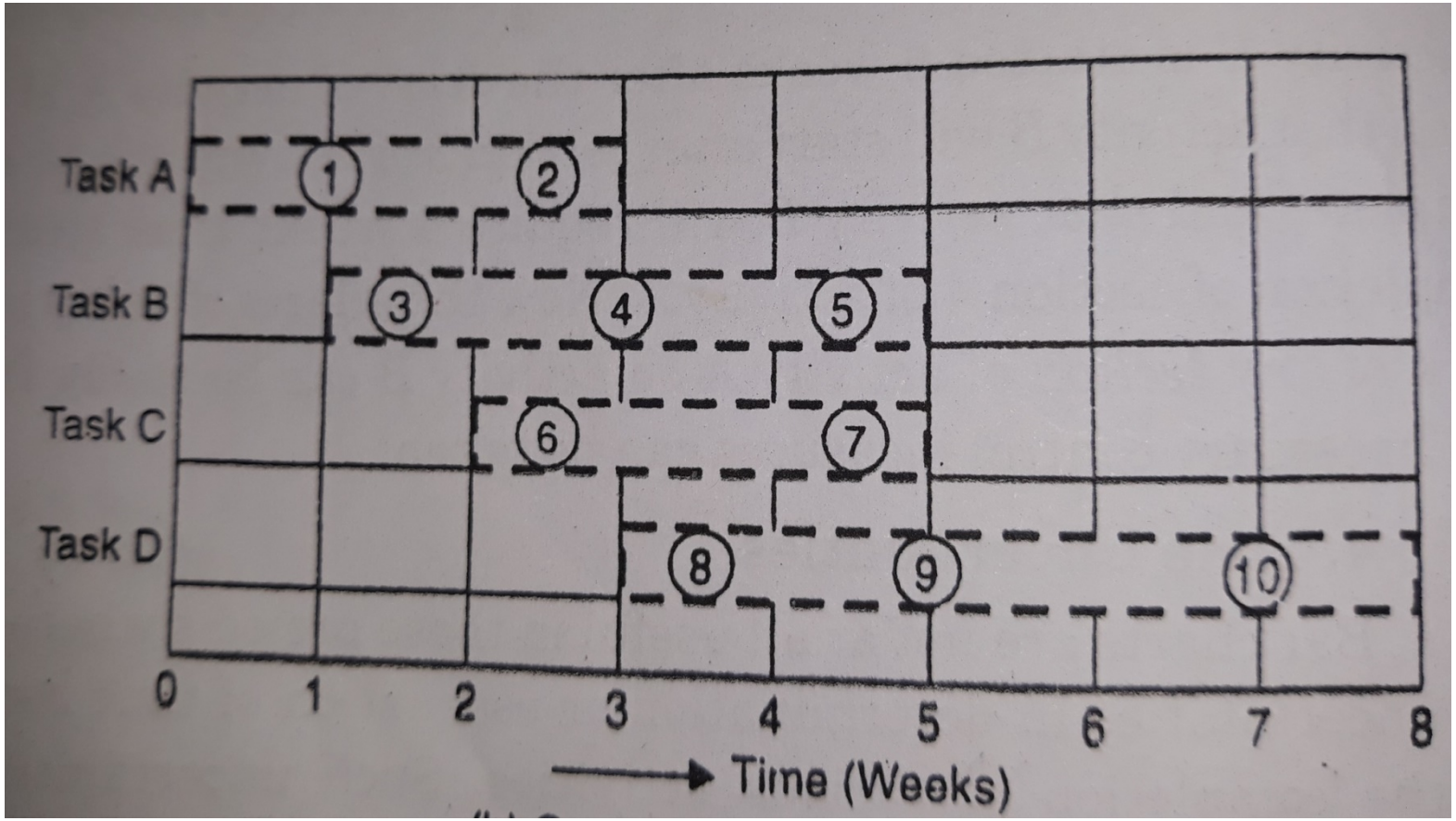
Development/Formation of Network:

Milestones charts with arrows:

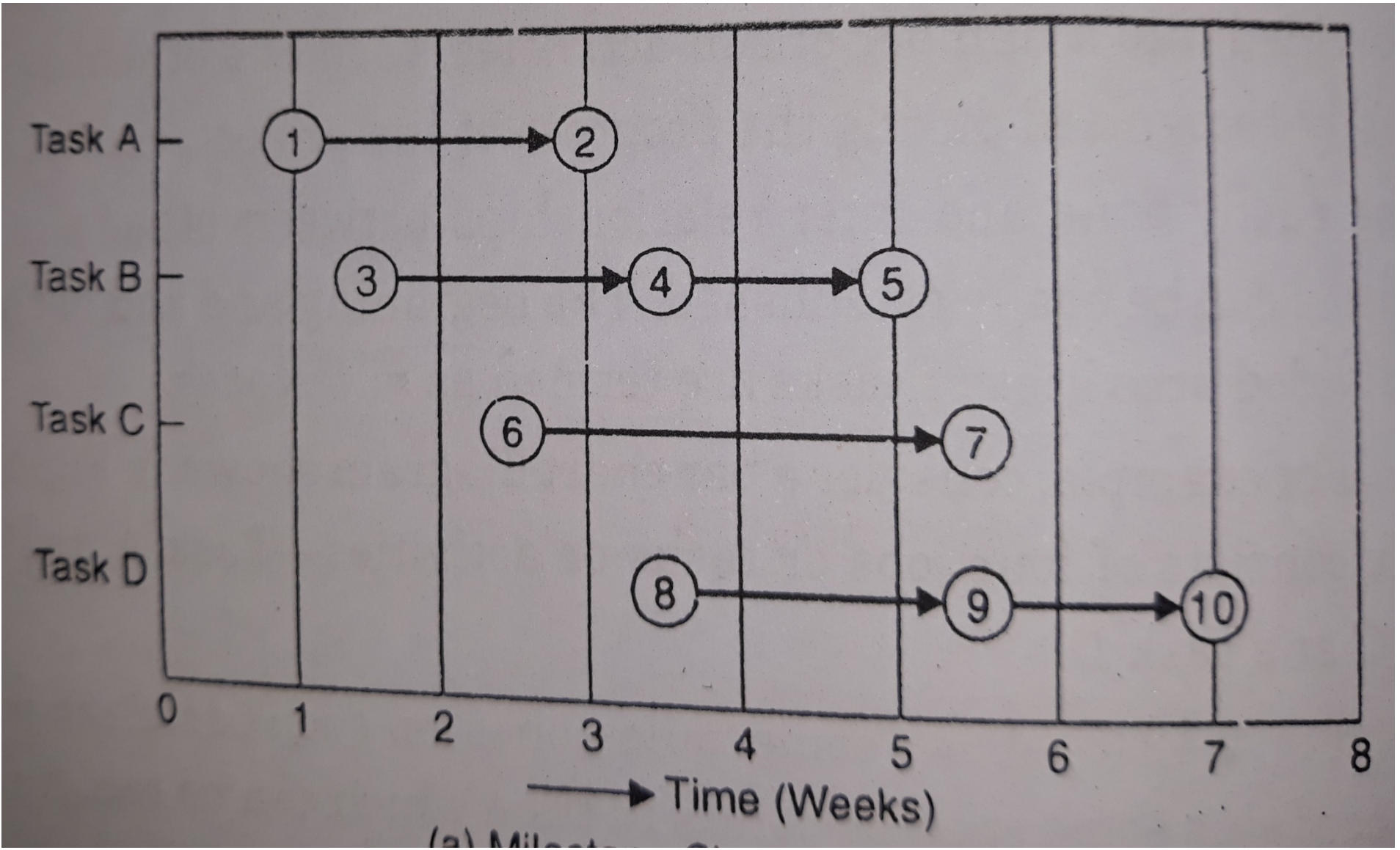
- **Milestones of each bar** have been **joined serially by arrows**, since **these have to be completed one after another serially**.

Question: Describe the development of PERT network from the Gantt Milestone Charts.

Gantt Milestone Chart



Milestone Charts with Arrows



Milestone Charts to PERT Network

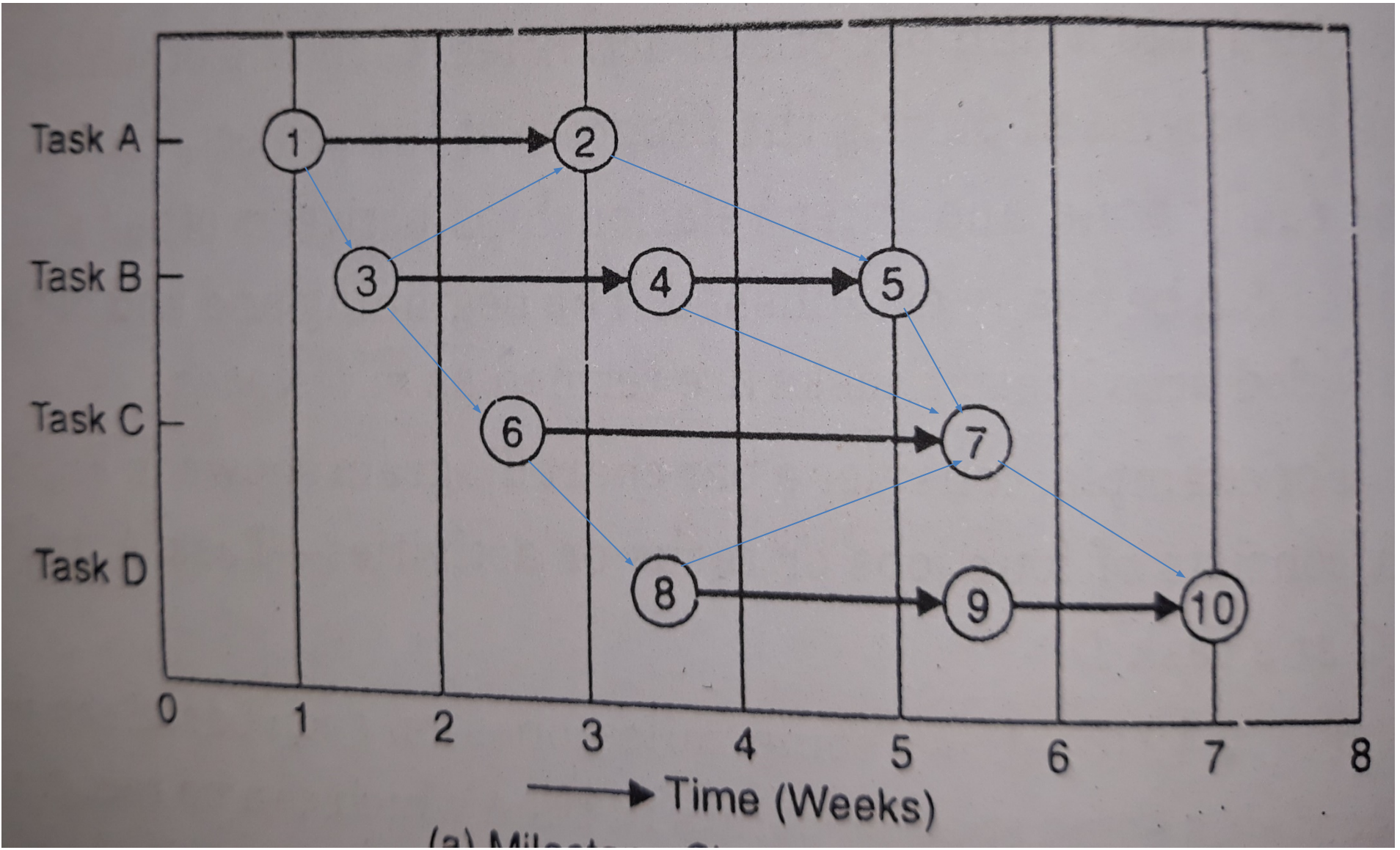
Formation of Network (cont..):

Milestone Charts with Networks:

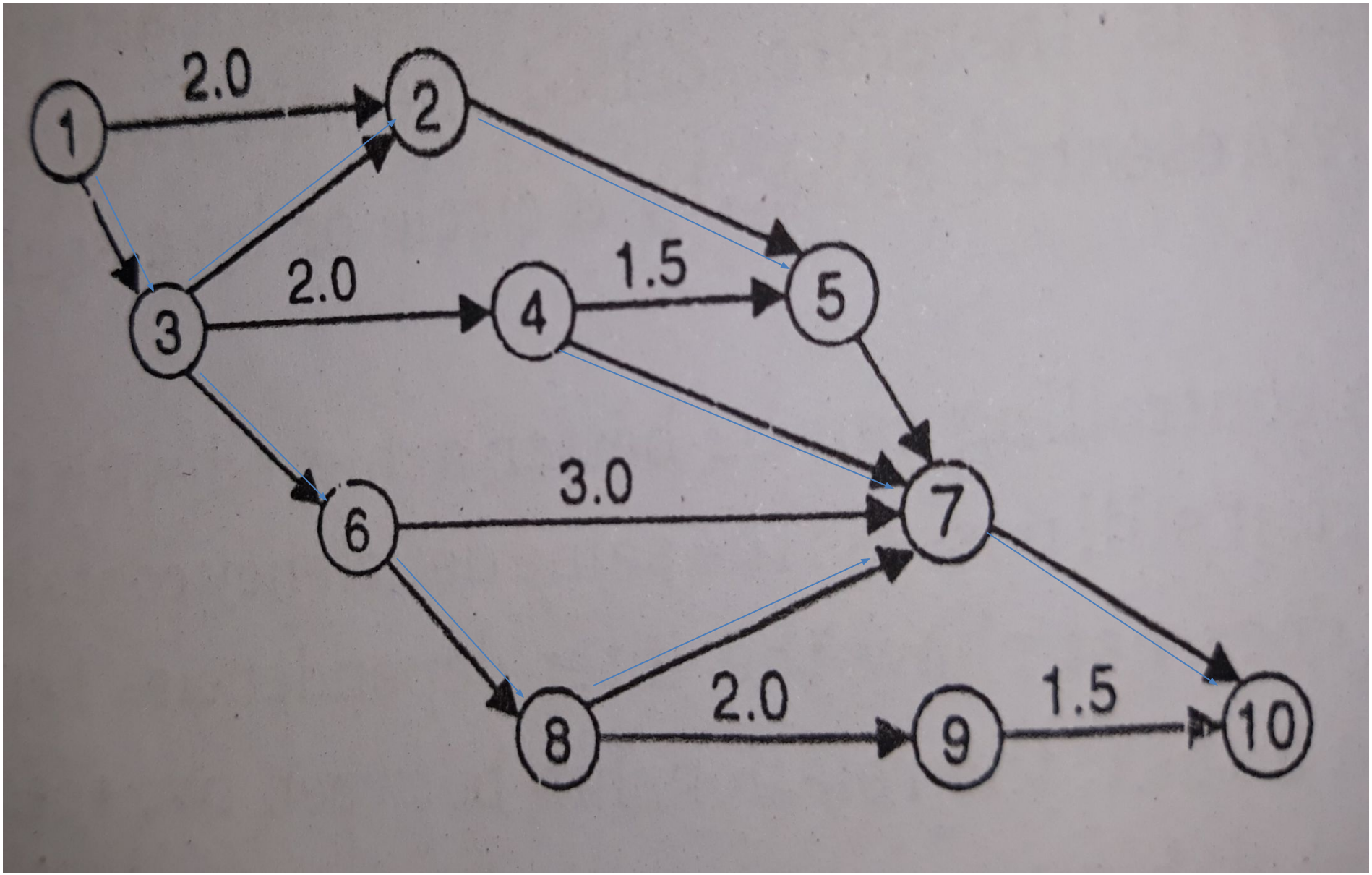
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- Shows the **necessary flow of works**.

Milestone Charts with Arrows



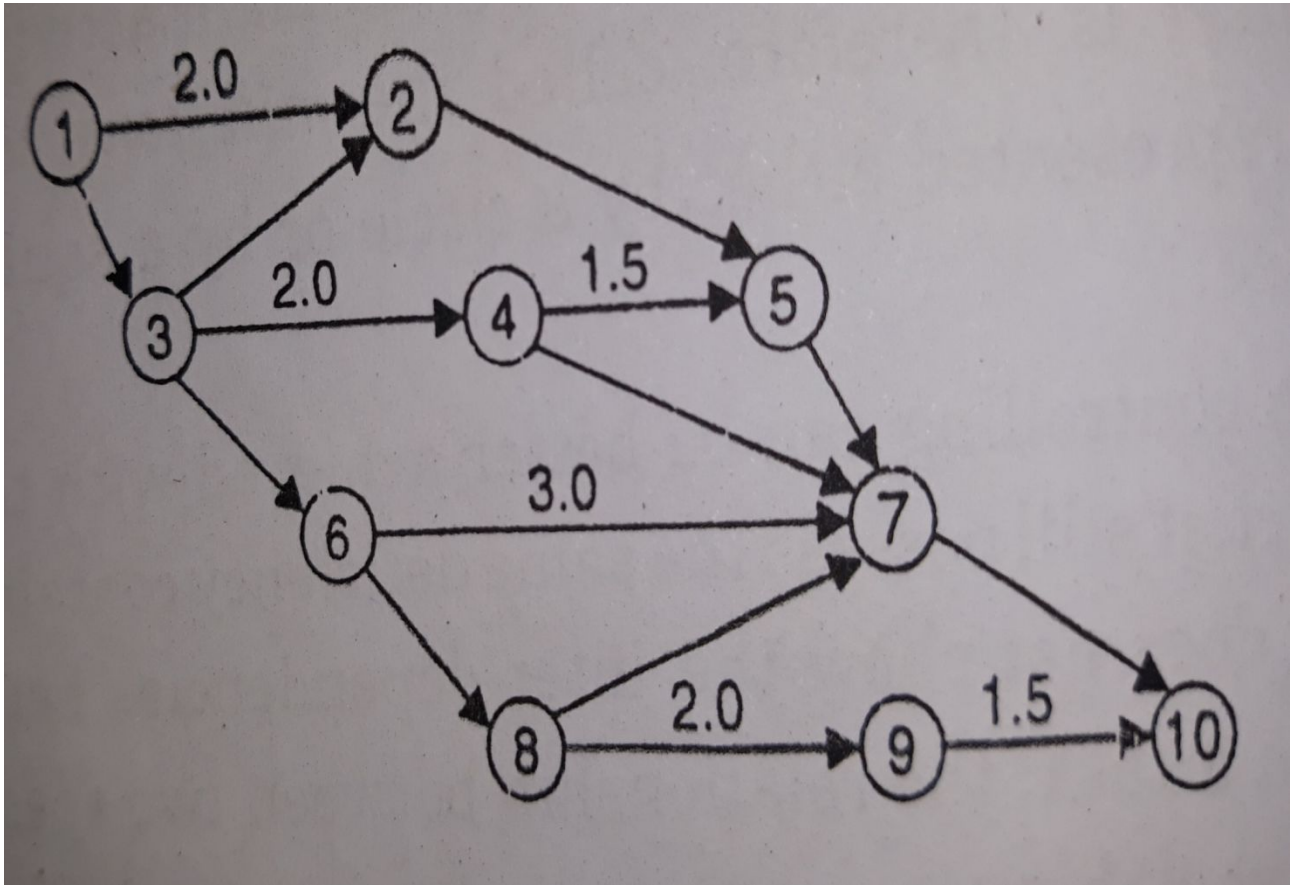
PERT Network (Interrelation with Arrows)



Network

Explanation of Network:

- **Milestone 4 is dependent on milestone 1** because: 4 cannot be started unless 3 is completed and 3 cannot be started unless 1 is completed.
- Similarly, **7 is dependent on 4, 5, 6 and 8.**



Network

Explanation of Network (cont..):

- Thus **interrelationship** between and among all the milestones **can be established** in network diagram.
- **Tasks bars are omitted**, because milestones get interrelated.
- **Time scale is omitted**, because the time between the milestones (called events), are indicated on arrows between them.

Network

Advantages of network Diagram:

- Shows the **interrelationships** between milestones (events).
- Designation of tasks becomes redundant and the **project is viewed as a whole**, consisting number of milestones (events) and not on a number of tasks.
- This helps very much in **controlling** the projects.

- Network can be **used even for highly complicated projects** consisting a large number of activities.

- It directly indicates the **time required in between two milestones or activities.** This is **helpful in rescheduling if required.**

Thank you

GEPM 375

Project Planning and Construction Management

To be discussed:

- Gantt Charts
- Stages of Development of Gantt chart
- Short comings and remedial measures
- Milestone chart
- Deficiencies of milestone charts
- Development PERT Network
- Advantages of Network Diagram

Discussed in Previous Class:

- **Gantt Charts**
- **Stages of Development of Gantt chart**
- **Short comings and remedial measures**

Milestone Charts
Or Gantt Milestone Charts

Milestone Charts:

- **Modification** of original Gantt Bar charts.

What are the milestones?

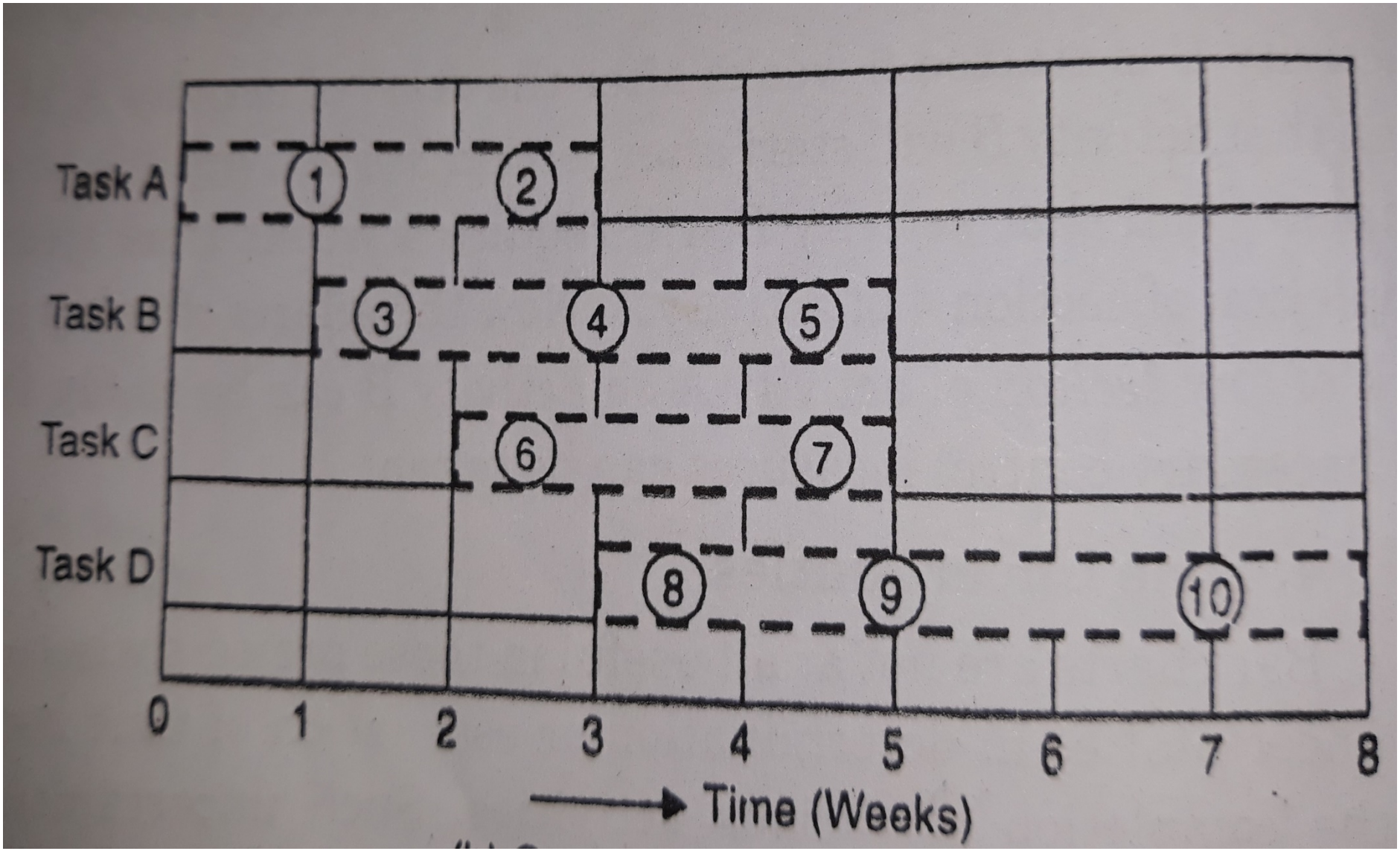
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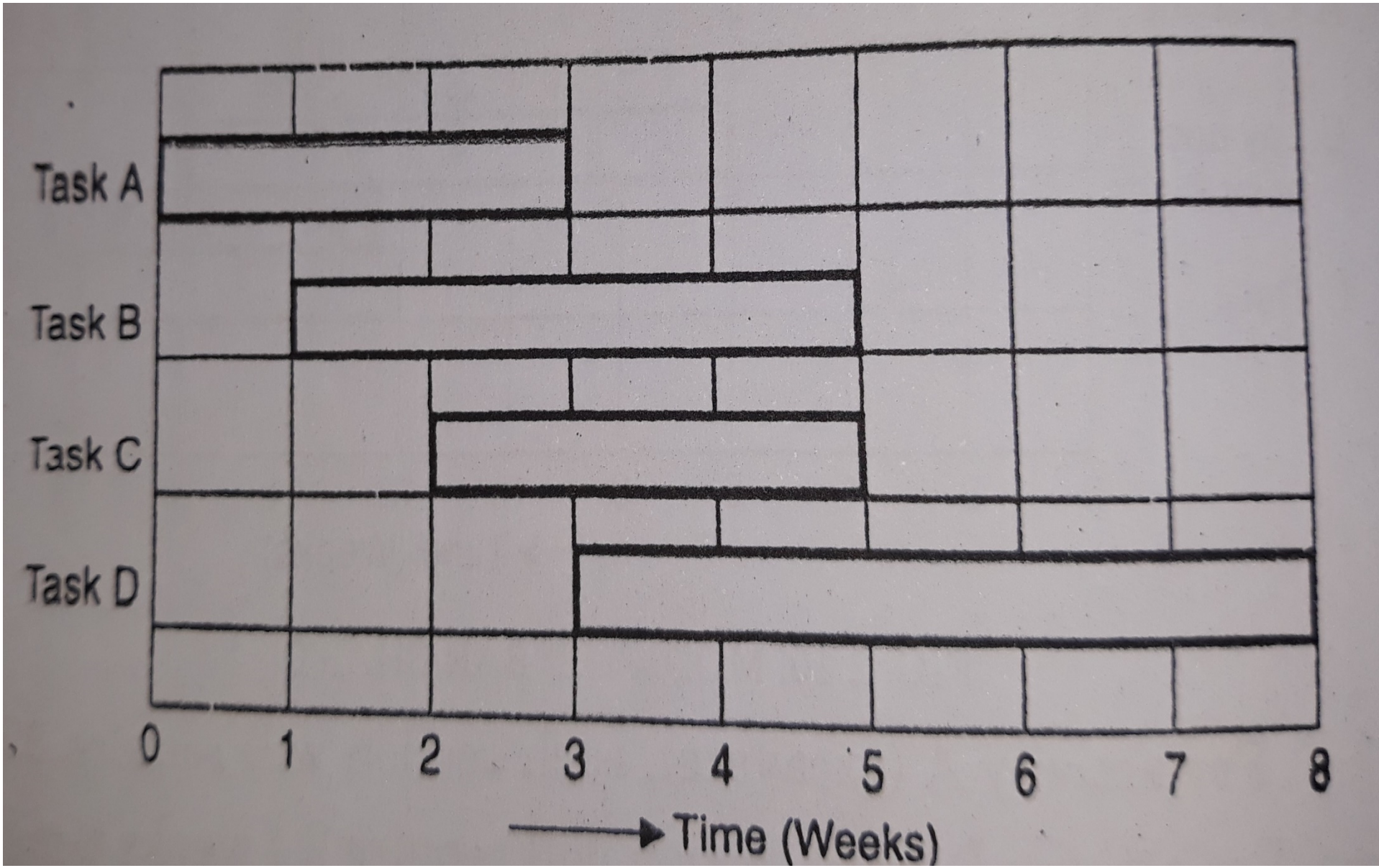
- Specific points can **easily be identified** over the main bar.

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Gantt Milestone Charts



Gantt bar Charts



Gantt Milestone Charts

Short fall of Gantt bar charts:

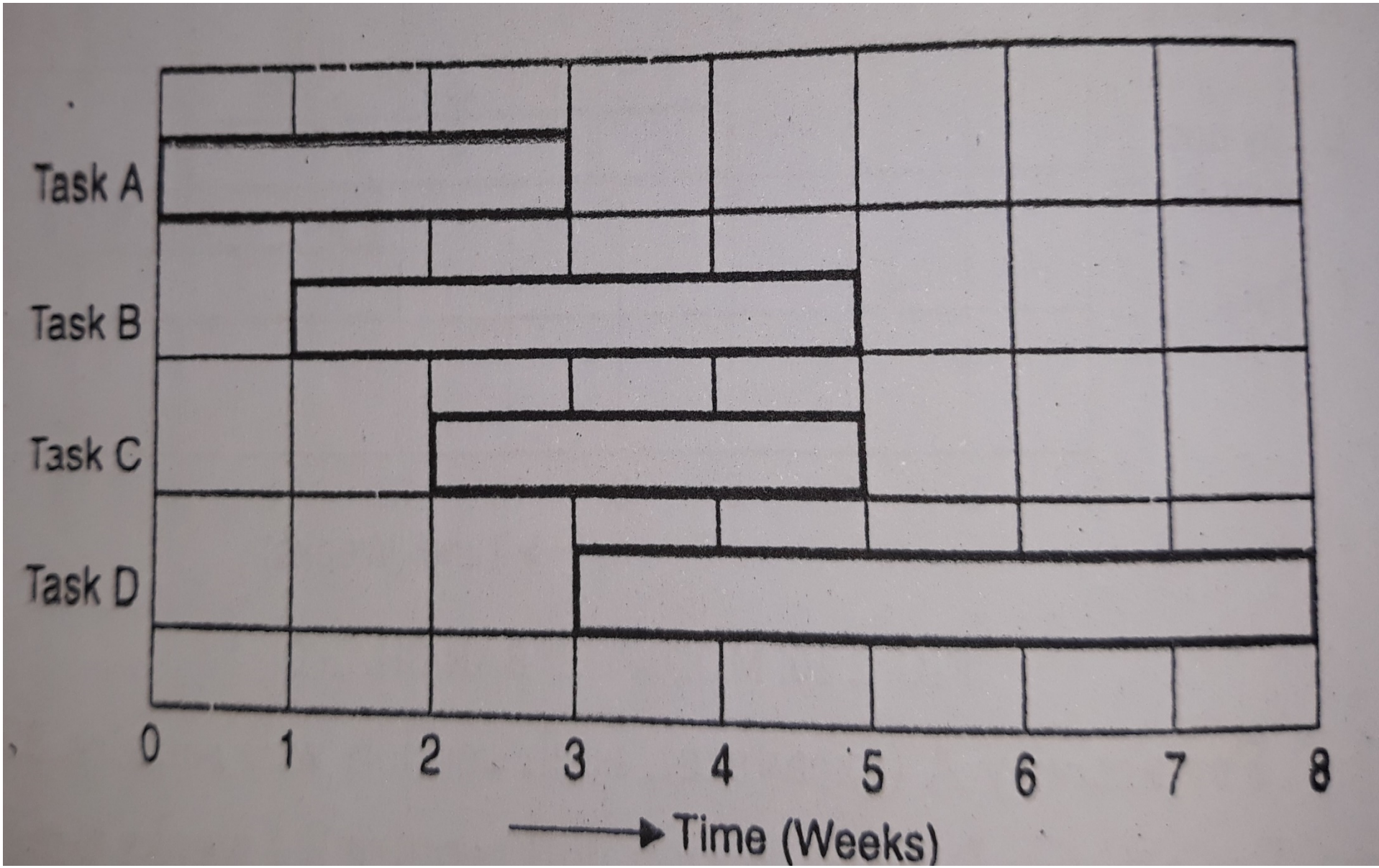
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How to Overcome?

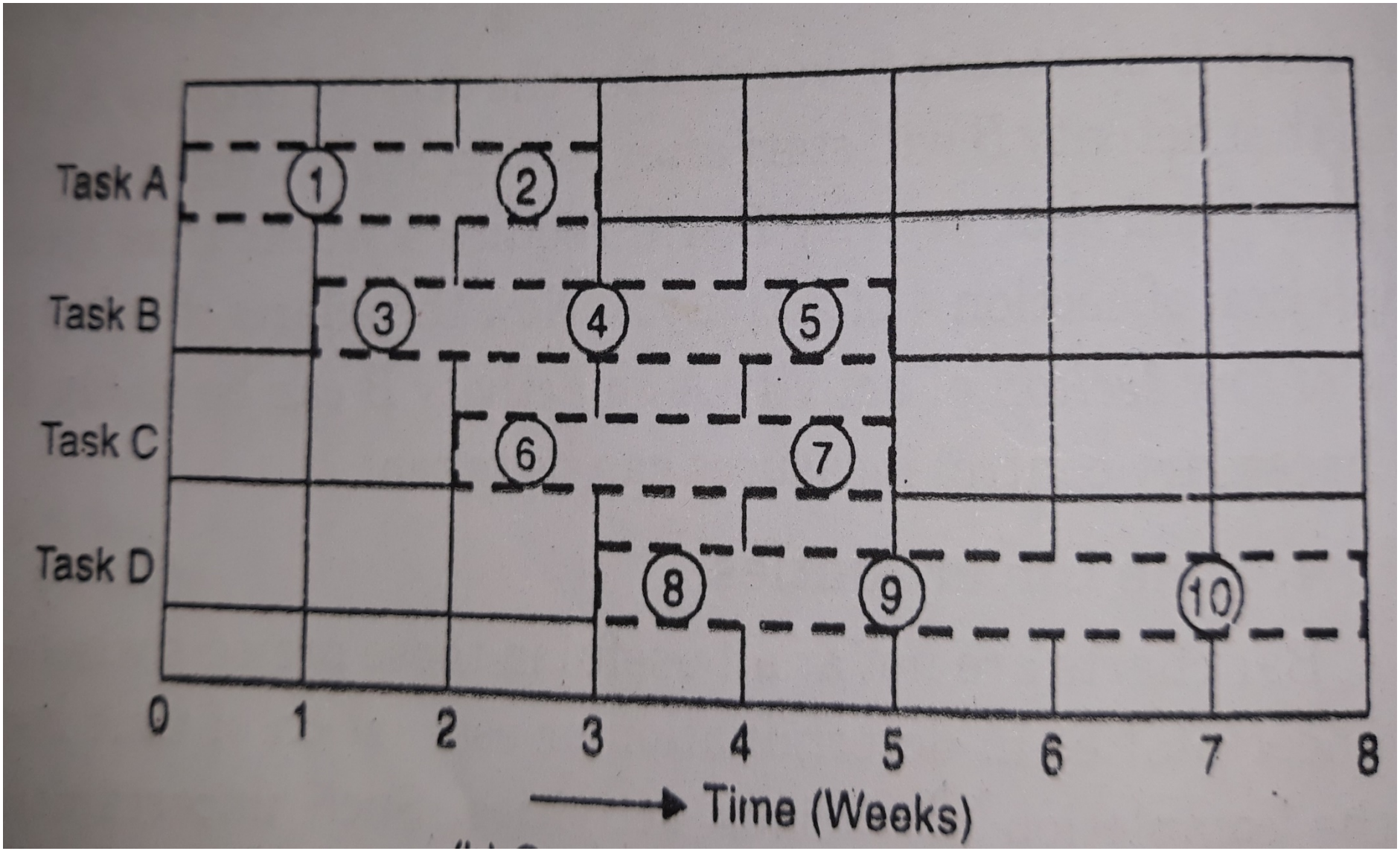
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Gantt bar Charts



Gantt Milestone Charts

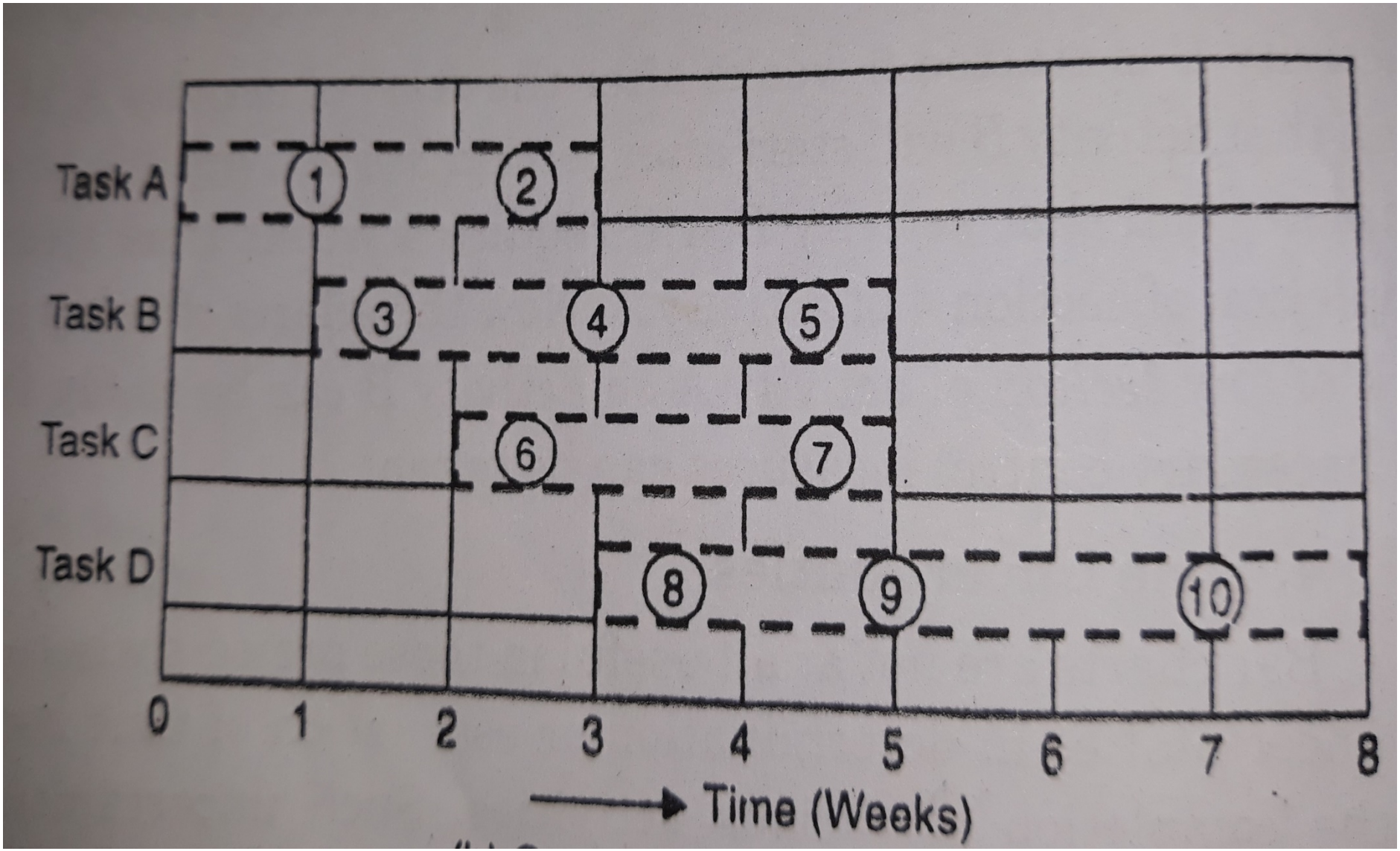


Milestone Charts

- **Milestones**: B**eginning and the end of the of sub activities** of main tasks.
- Sub tasks **contains some specific points of time**, which can be recognized.
- Through the **specific points controlling** can be achieved.
- Each milestones are represented either by **square or circle and is serially marked.**

Question: What are the milestones in milestone charts in Project Management?

Gantt Milestone Charts



Gantt Milestone Charts

Benefits:

- **Controlling** can be better achieved.
- **Relationship** between two milestones within a task is revealed.

Example:

- **Task A->** Remove existing machine

  Milestone 1-dumping in store

  Milestone 2- final disposal

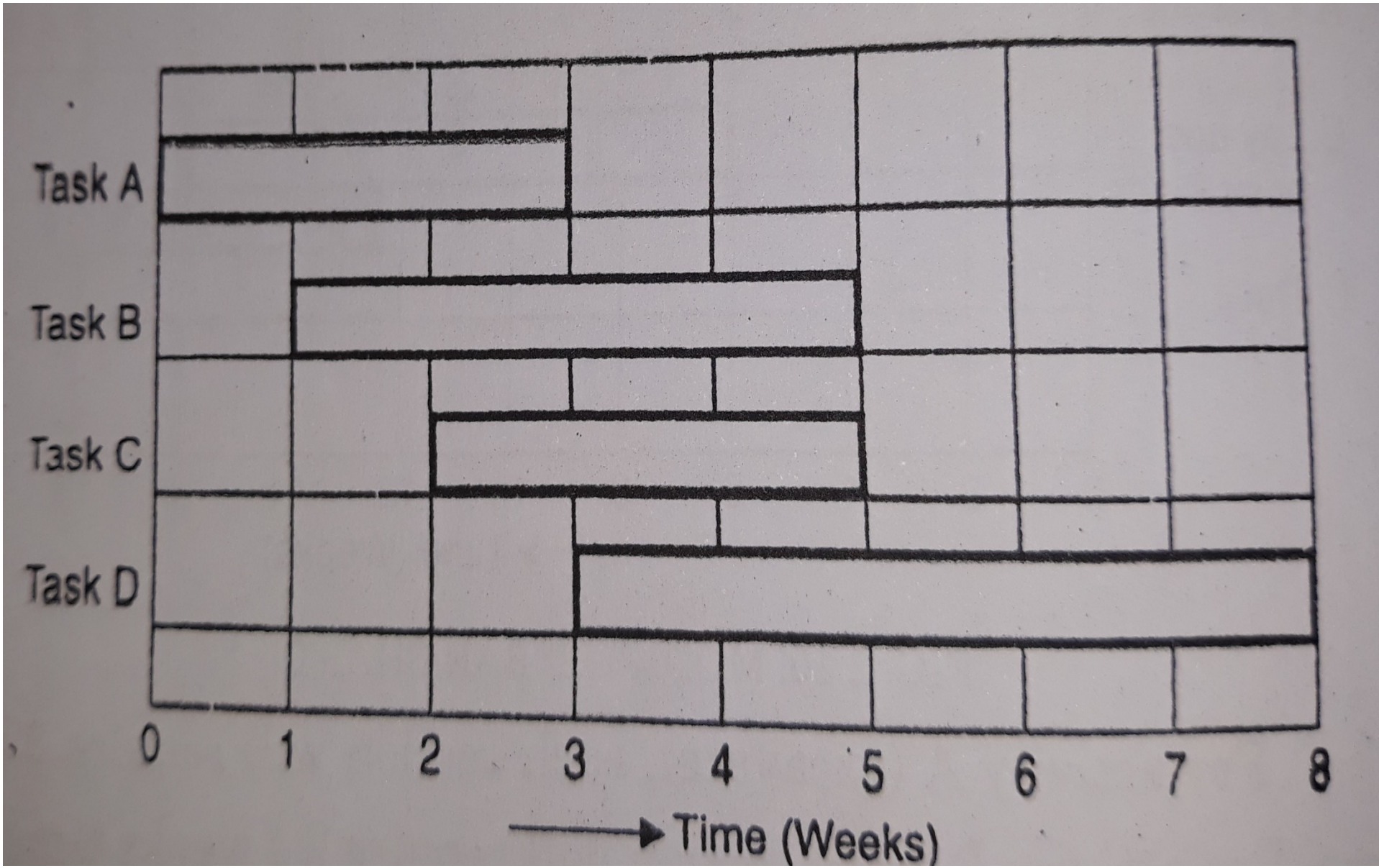
Controlling and relationship.

- Task B -> Await delivery of new machine

  Milestone 3- Tendering is complete

  Milestone 4- Work order issued

Gantt bar Charts



Gantt Milestone Charts

Task A-> Remove existing machine

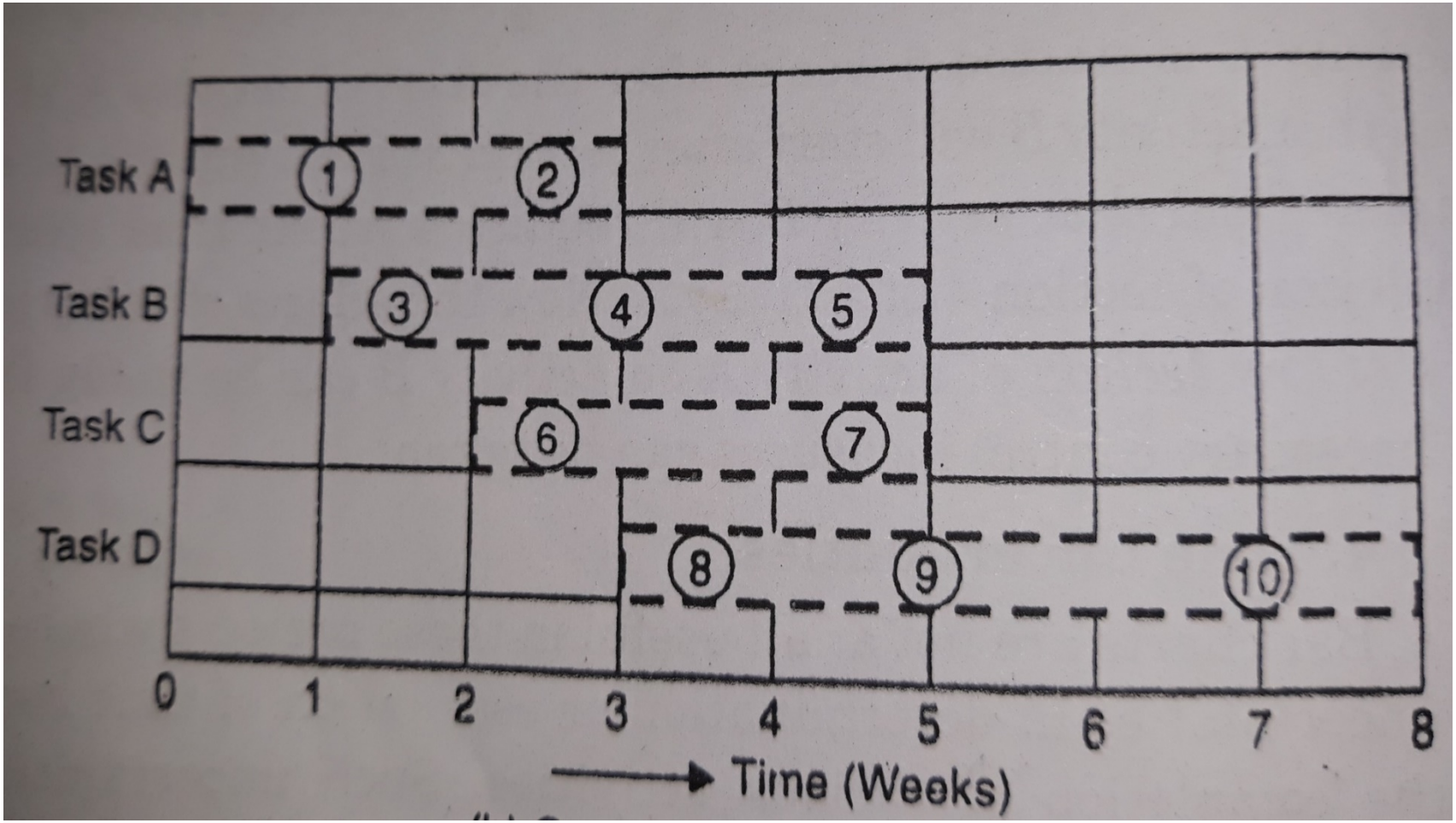
Milestone 1-dumping in store

Milestone 2- final disposal

Task B -> **Await delivery of new machine**

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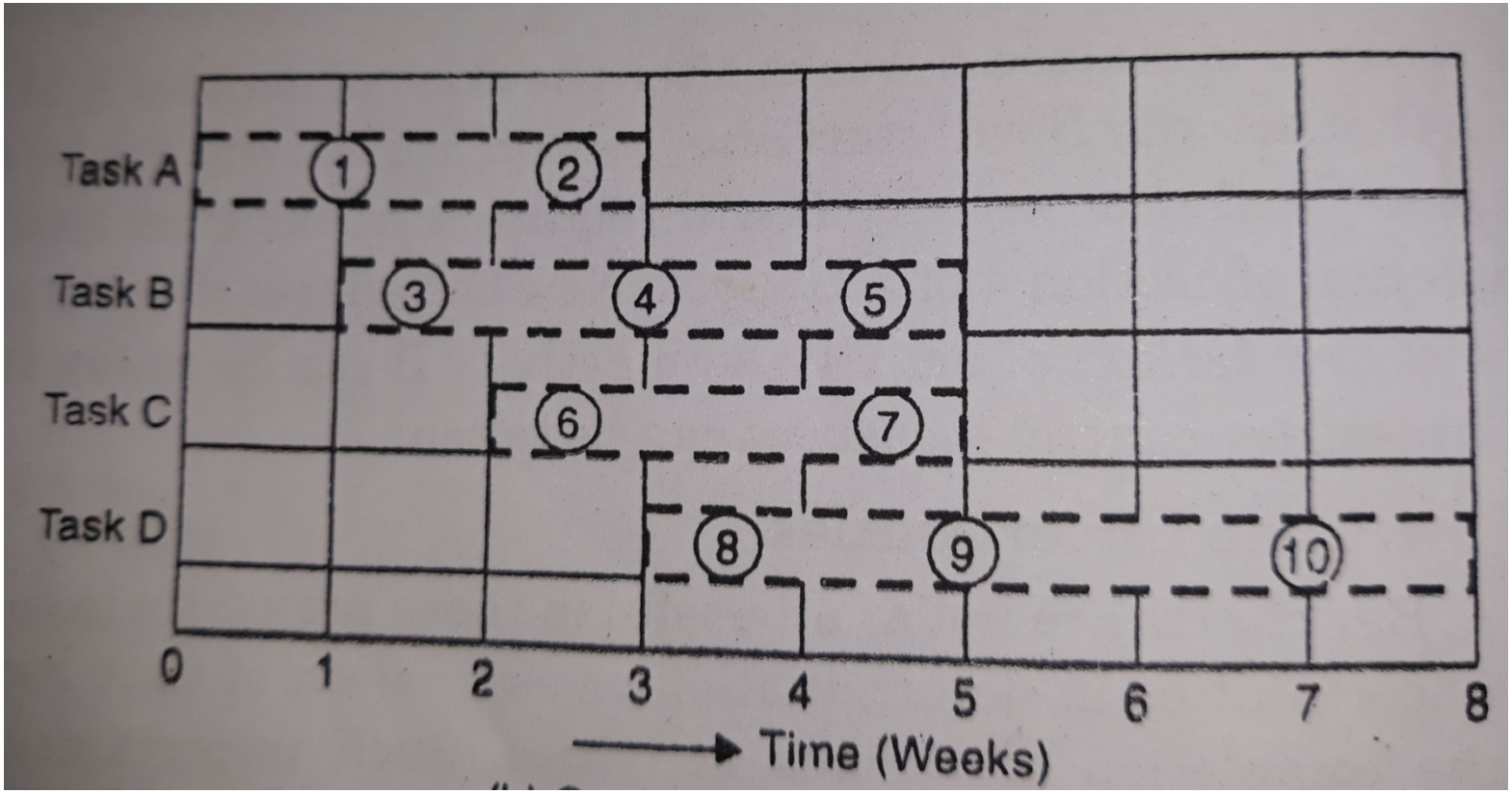
Question: Explain the benefits of using Gantt Milestone Charts in project management.

Gantt Milestone Chart – Short Comings/Deficiencies

Gantt Milestone Chart

Short Comings /Deficiencies:

- **Does not indicate** whether **Milestone 6 can be started before Milestone 2 has been completed**.
- Whether **Milestones of Task C (6 & 7) are at all dependent on Milestones of Task A (1 & 2).**



Question: Briefly explain the short comings of Mile stone charts used in project management.

Development of Network

Development of PERT Network:

- **Deficiencies of milestone charts-its inability to depict the relationship** between milestones of different tasks.
- Deficiency has been **removed effectively** by **developing the milestone chart into Network Diagram.**
- **Milestones are the Events along main tasks** and PERT Network is **event oriented network**.
- Resulting network diagram is called **PERT network**.

Milestone Charts to PERT Network

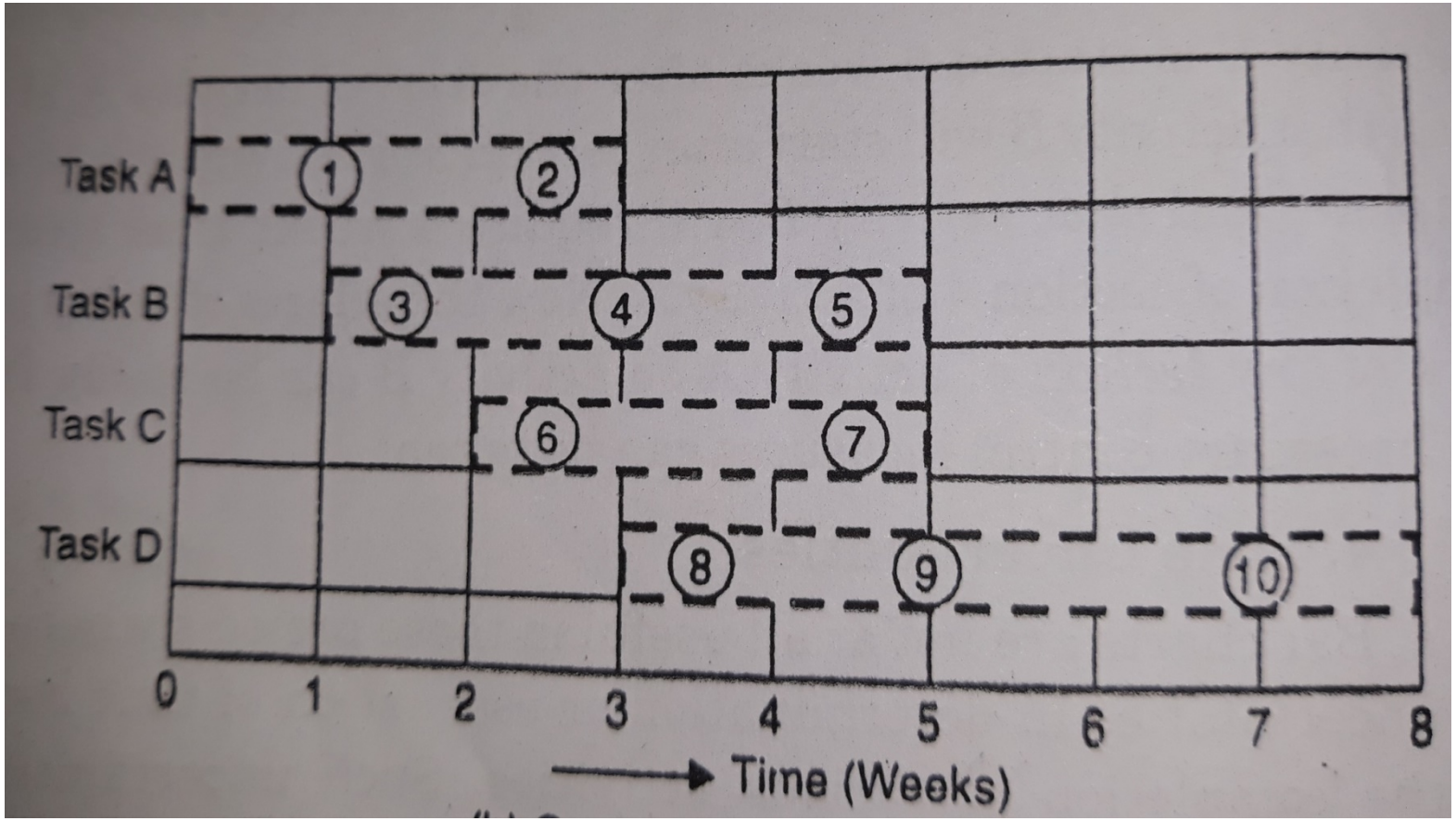
Development/Formation of Network:

Milestones charts with arrows:

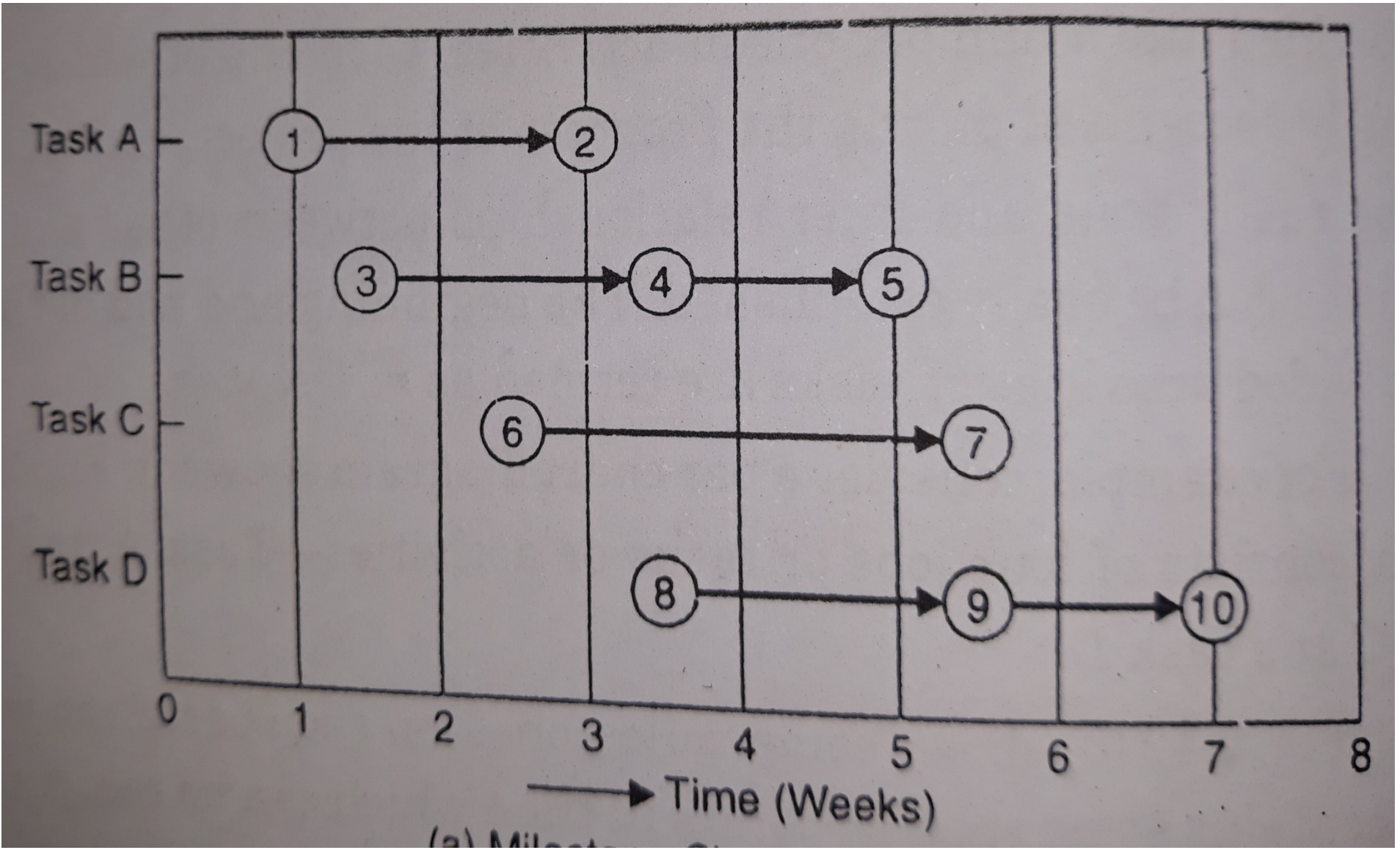
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Gantt Milestone Chart



Milestone Charts with Arrows



Milestone Charts to PERT Network

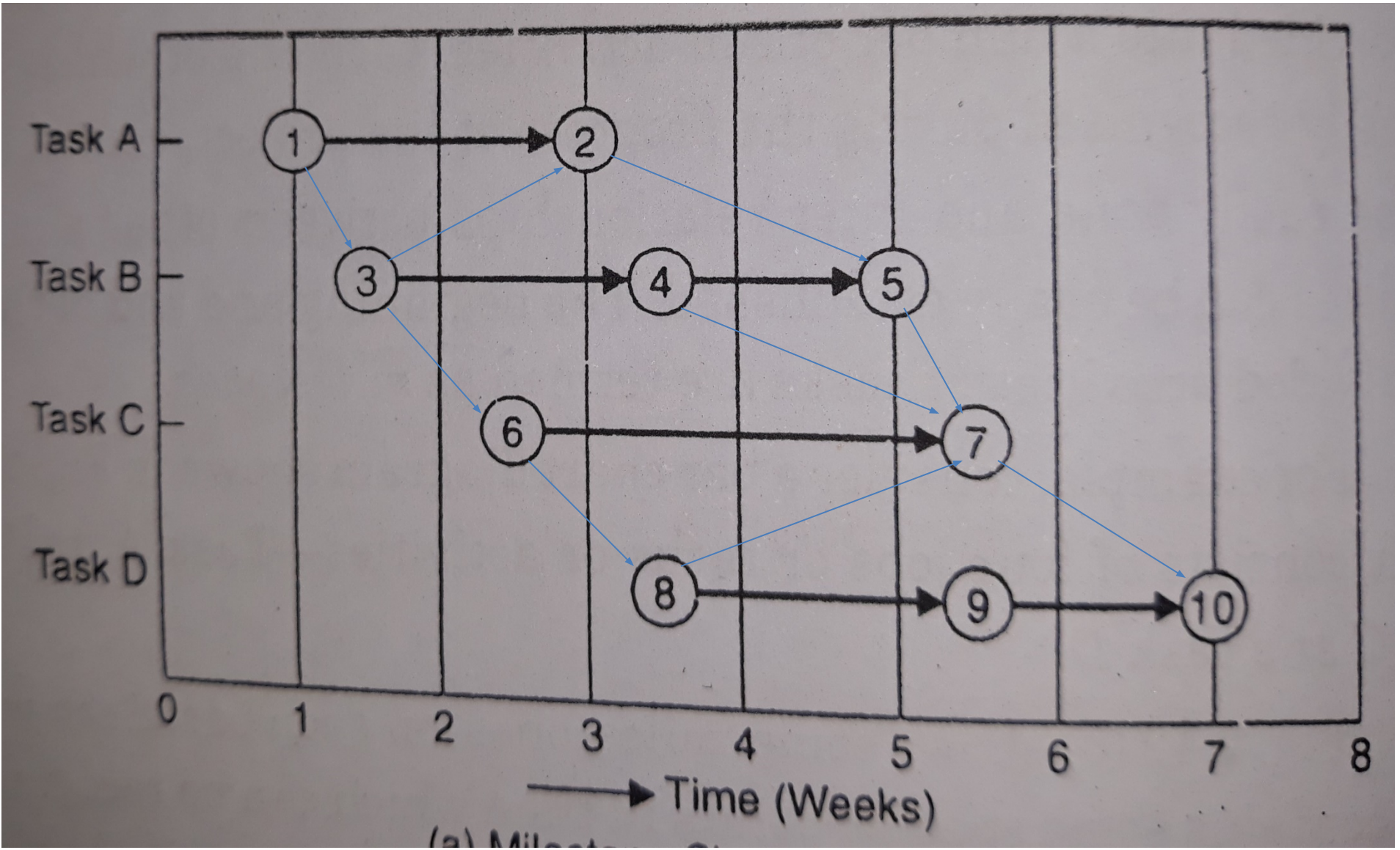
Formation of Network (cont..):

Milestone Charts with Networks:

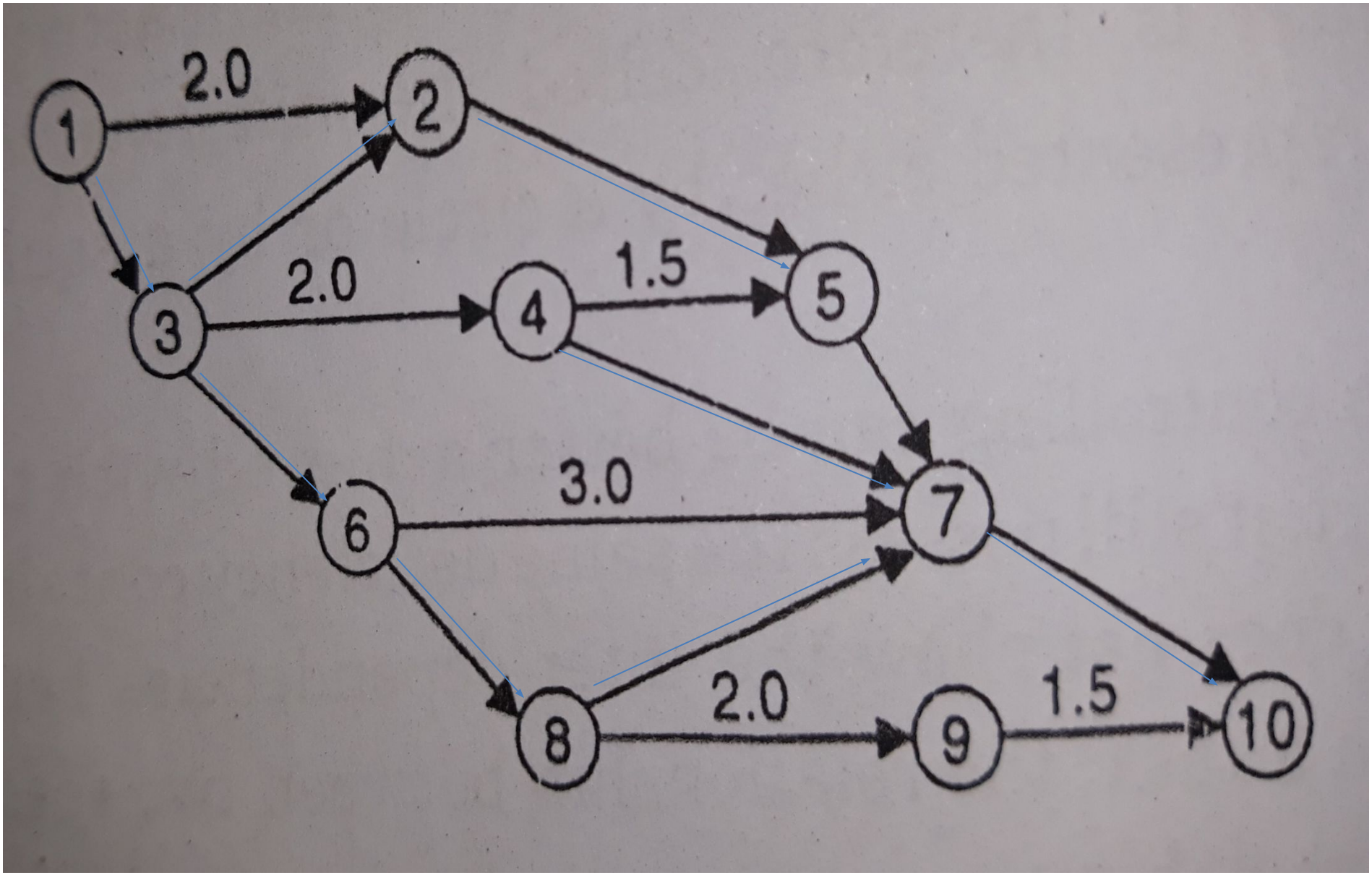
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- Shows the **necessary flow of works**.

Milestone Charts with Arrows



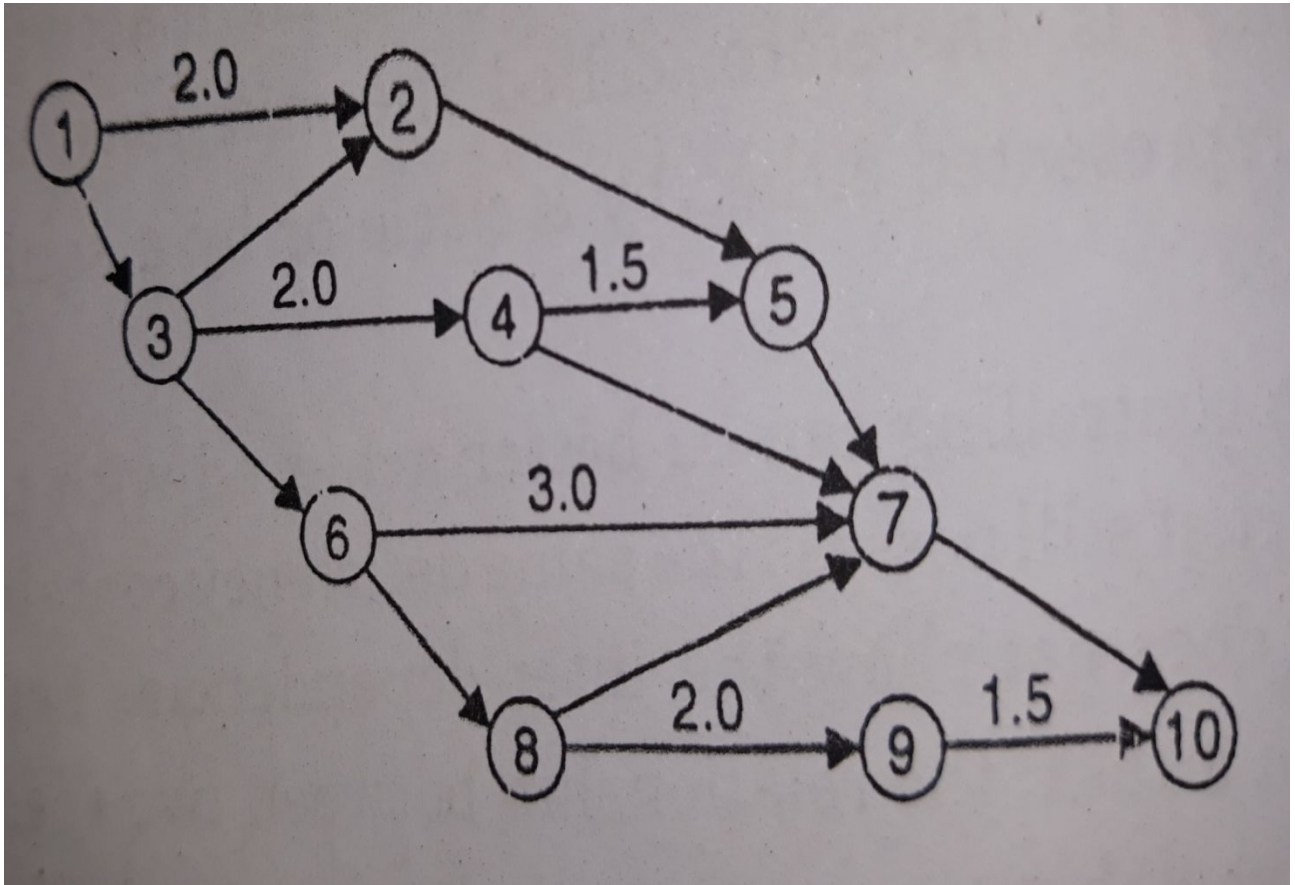
PERT Network (Interrelation with Arrows)



Network

Explanation of Network:

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Network

Explanation of Network (cont..):

- Thus **interrelationship** between and among all the milestones **can be established** in network diagram.
- **Tasks are omitted**, because milestones get interrelated.
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Network

Advantages of network Diagram:

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- Designation of tasks becomes redundant and the **project is viewed as a whole**, consisting number of milestones (events) and not on a number of tasks.
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Network

- Network can be **used even for highly complicated projects** consisting a large number of activities.

- It directly indicates the **time required in between two milestones or activities.** This is **helpful in rescheduling if required.**

Thank you

GEPM 375

Project Planning and Construction Management

CPM Network

Application of CPM Network:

- Used/suitable for **repetitive** of project.

- For those projects for which **fairly accurate estimation of time for completion** of each activity can be made.

- For which **cost estimation** **can be made with fair degree of accuracy.**

- **Not suitable** for research and development project.

- Plays an **important role** in planning, scheduling and controlling of the projects.

Difference between CPM and PERT

- **Time estimation**:
  -**CMP**: with fair degree of accuracy.
  -**PERT**: Not so accurate and definite

- **Cost and Time**:
  -**CPM**: Cost is directly controlling factor.
  -**PERT**: Time is controlling factor.

CPM -**Optimization of cost** is given prime importance.
-**Time duration** for completion of the project depends on cost optimization.

PERT - Assumed that **cost varies with time**.
- Attention given so that **minimum cost results.**

Difference between CPM and PERT

Critical Path:

- **CPM**: Critical path is determined on **activity oriented float philosophy**.

F_T = **LST** – EST or **EFT** –LFT

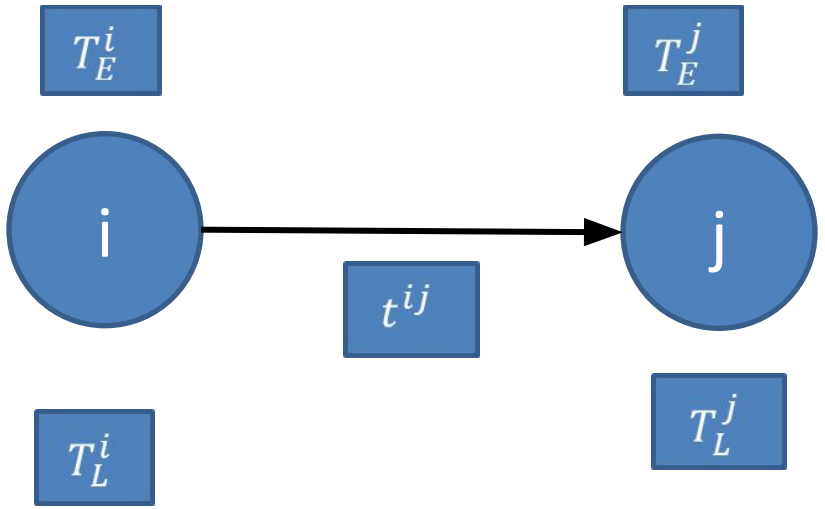
LST= Latest start time

$T_L^i = T_L^j - t^{ij}$ or $(T_L^j - t^{ij})_{min}$

EFT=Earliest Finish Time

$T_E^j = T_E^i + t^{ij}$ **or**

$= (T_E^i + t^{ij})_{max}$



Difference between CPM and PERT

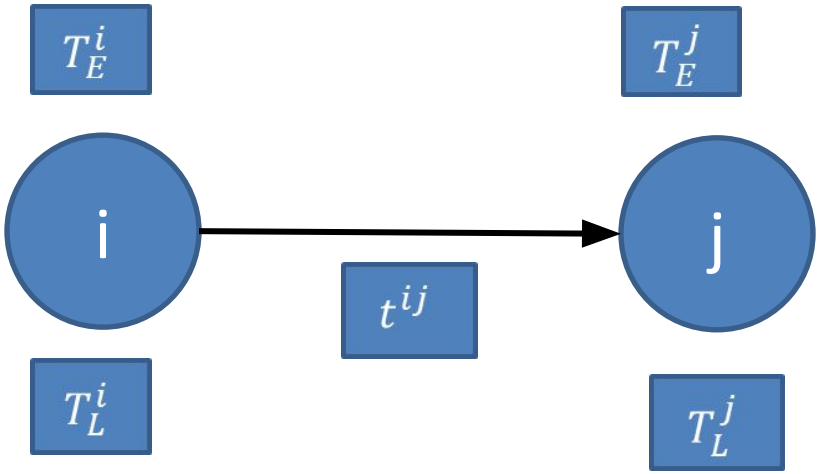
Critical Path:

- **CPM**: Critical path is determined on **activity oriented float philosophy**.

$$F_T = \text{LST} - \text{EST or EFT} - \text{LFT}$$

EST= Earliest start time=T_E^i

LFT=Latest Finish Time=T_L^j



Network

T_E^i=Earliest occurrence time for tail event.

T_E^j=Earliest occurrence time for Head event

$$T_E^j = T_E^i + t^{ij} \text{ or } = (T_E^i + t^{ij})_{max}$$

T_L^i=Latest Event Time for predecessor event

T_L^j=Latest Event Time for successor event

$$T_L^i = T_L^j - t^{ij} \text{ or } (T_L^j - t^{ij})_{min}$$

Float= $T_L^i - T_E^i$

- Difference between the **earliest event time** and **latest event occurrence time.**
- Range within which an activity start time or its finish time may fluctuate without affecting the completion of the project.

Difference between CPM and PERT

PERT: Critical path is determined on **event oriented slack philosophy.**

$$S = T_L - T_E$$

T_E=**Earliest Expected Time** –time when an event can expected to offer.

T_L = **Latest Allowable Occurrence Time** –Latest time by which an event must occur, to keep the project on schedule.

T_S=Completion time of the project/Scheduled completion /Contractual obligation time.

$T_S = T_L$, latest time of the last event

CPM Process

CPM process has several applications in project management:

- Planning,
- Scheduling and
- Controlling

Planning:

- **Logical sequence** in which the jobs/activities is **formalized**.
- Logic to **be reviewed** for corrections.
- Ascertain that **all activities** are shown.
- **Resources** required for performing each activity/jobs are applied.

CPM Process

Scheduling:

- **Mechanical process** of **formalizing the planned functions.**
- **Assigning the start and completion dates to each part** (or activity) of the project.
- So that project **proceeds in a logical sequence**, **in orderly** and **systematic manner.**

Controlling:

- Process in which the **differences or deviations between the plan and the actual performances are reviewed.**
- **Analysis and corrections form t**he basic aspects of controlling.
- **Re-planning and rescheduling** is done to compensate the deviations.

Steps of CPM process

- **Describe projects** in terms of **dependencies among activities**.

- **Determine** the **schedule** of the activities.

- **Predict** those **activities which control significant target dates** of the project.

- **Analyze** the **schedule developed**.

- **Re-plan** the project **if analyses so indicate.**

- **Allocate or make**: **resources to project** in an efficient manner for the schedule developed.
- Schedule changes are required **by resource limitations**.

- **Develop time-cost relationship** for activities and **optimize the total project cost by selecting suitable project duration**.

CMP Networks

What is CPM Networks?

- **Activity** oriented network.
- Arrows representing activities are **labeled with some description** of the activities.

Activities: Operations which **take time** to carryout and on which **resources are expended** to achieved the desirables.

Event: is a **point in time**, a milestone representing the **beginning or the completion of some activity** or group of activities.

- When project falls behind the schedule, it is the **critical activities** which need managerial attentions.

CPM Network

Process of Drawing CPM Network:

- **Listing the activities** of the projects.

- **Placement of activity arrows** with respect to other activities is done by answering **THREE questions**:

✔ What activity/activities **must immediately precede** this activity?
✔ What activity/activities **can not be started** until after completion of this activity?
✔ What activity/activities can be **performed concurrently** with this activity?

- **Drawing the network by answering these three questions.**

- **Interdependencie**s can be represented **by suitable use of dummies.**

CPM Network

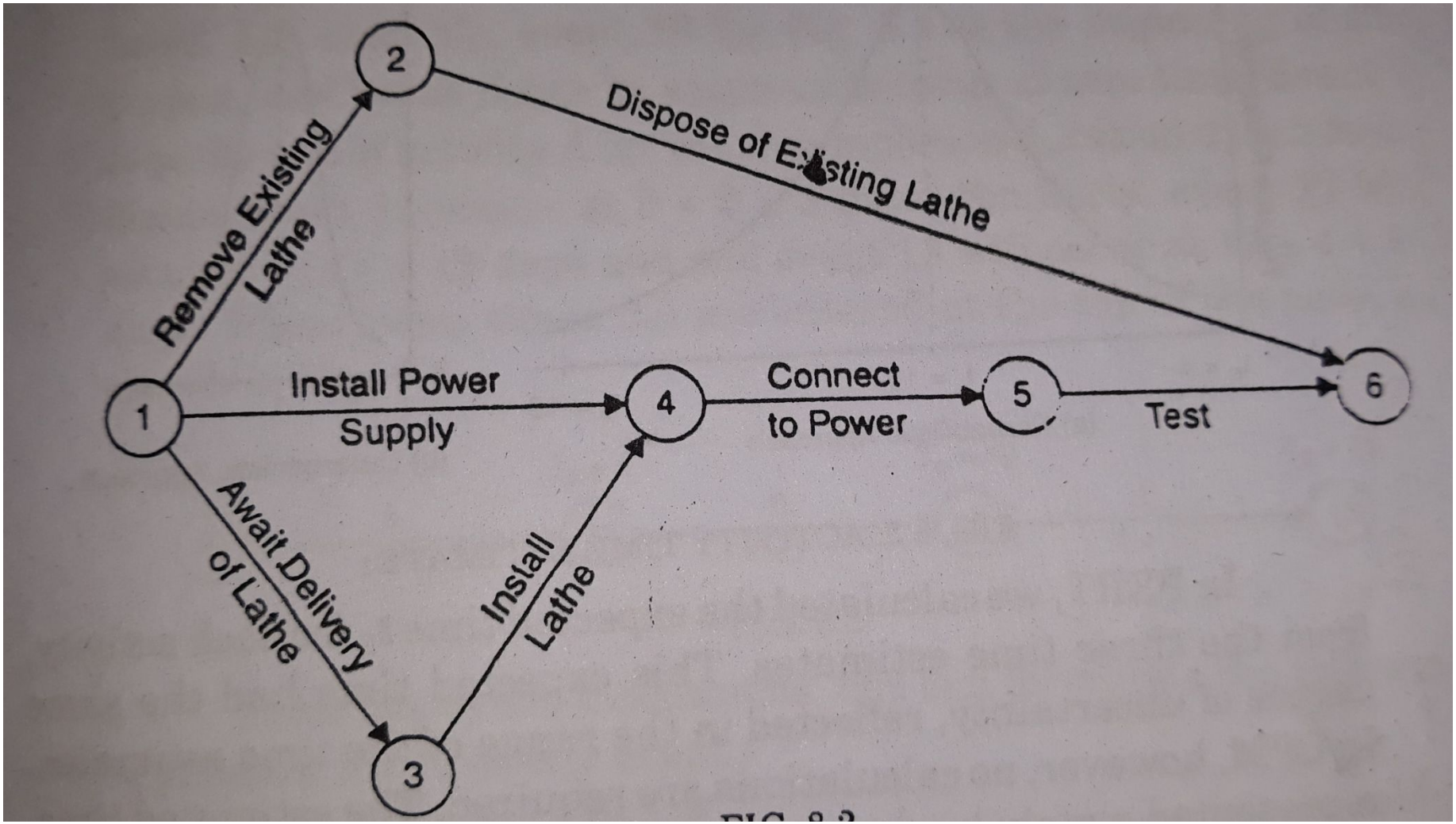
Example: Project of 'Purchasing a new heavy duty lathe and disposing the old lathe'.

Solution:

Project consists of following activities:

- Await delivery of lathe.
- Remove existing lathe.
- Install power supply.
- Install the new lathe.
- Connect power supply.
- Conduct test.
- Dispose of existing lathe.

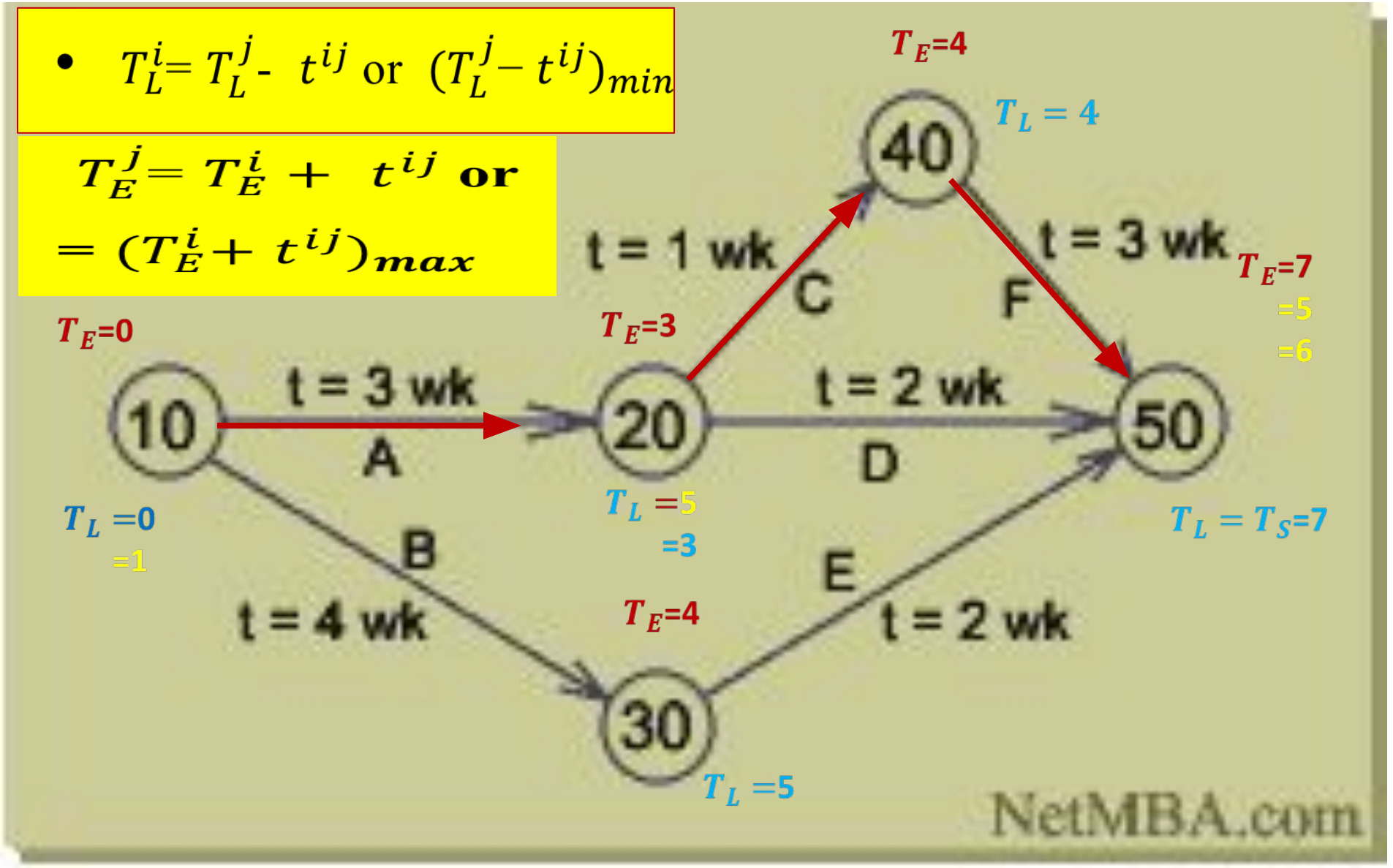
Network of the Project



- $T_L^i = T_L^j - t^{ij}$ or $(T_L^j - t^{ij})_{min}$

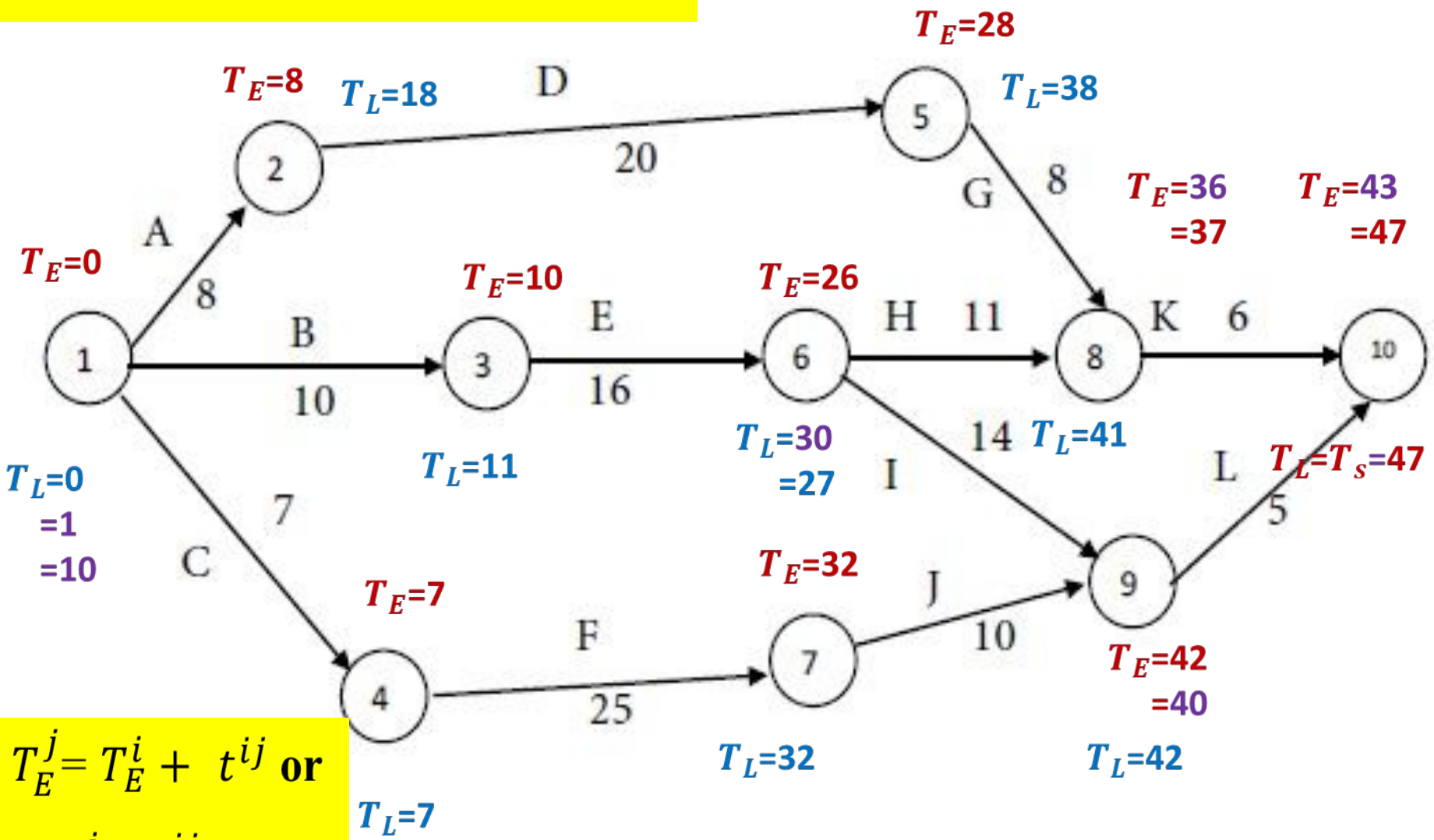
$T_E^j = T_E^i + t^{ij}$ **or**

$= (T_E^i + t^{ij})_{max}$



CPM Network of the Project

- $T_L^i = T_L^j - t^{ij}$ or $(T_L^j - t^{ij})_{min}$



$T_E^j = T_E^i + t^{ij}$ **or**

$= (T_E^i + t^{ij})_{max}$

CPM Network

Critical Activity and Critical Path:

Total float is the **difference** between maximum available time and the activity duration.

There are three possibilities:

- May have **Negative** value, if time availability is less than activity duration.
- May have **Zero value**, time availability is equal to the activity duration.
- May have a **Positive** value, availability exceeds the activity duration.

CPM Network

Degree of total float is very useful as regards the criticality of the activity:

- **Super critical Activity**: Float activity is –ve. Activity demands special attention and action.
- **Critical activity**: Float is zero. Activity demands above normal attention, with no freedom of action.
- **Sub Critical Activity**: Float is +ve. Demand normal attention, but allowing some freedom action.

CPM Network

Critical Path:

- The **longest path** through the network and **time along** this path gives the project duration.

- Joins **those activities** which are critical.

- Determined by the **total float** calculations.

- Activities on the critical path are those activities that have total float equal to zero.

- Activities that control the project duration are the ones that have zero total float; form the continuous chain or path starting at first node and ending with last node.

Thanks