GEPm 375 — SB

SA/R01 23/11

Project Planning and Construction Management

↓ Temporary endeavour/evt/activity

↘ Actual steps

↙ A process to deliver something

↘ controlling

What is project

PMI → Project management Institute

PRINCE2 → PRoject IN Controlled Environment

what is tangible/intangible product

(deliverable(s))

↙

identifiable & measurable

PRINCE 2, proj. defⁿ;

...

Characteristics

DAP →

Types of project

Waterfall
Agile
Hybrid

Planning

ECNEC

✡ Construction manager, Project Manager

Project Def "

Key chars of a proj (TUP)

Temporary
Unique deliverable(s)
Progressive Elaboration
} describe

Project phases

1. Initiation
2. Planning
3. Scheduling
4. Implementation / Exec
5. Close up

Additional chars

Purposeful

Logical

...

↓ Proj in a organization

↓ Other pieces of work

proj. in org. defn

other pieces of work

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WBS, PBS

proj. in an org.

- a piece of work

Portfolio — proj and prog

program — onkgula proj ekshathe krle

project —

Task — proj er moddhe kaj easily identifyable, measurable

work package -

unit —

CBS, OBS and matrix

WBS — work break down structure

PBS — product - -

Project management

- application of knowledge, skills techniques to activities to meet the proj requirements

key aspects of proj management

scope to be defined

Deliverable (s) to be identified

Risk to be managed

comm across is established

***WBS

1. organises teamworks into managable section
2. Hierarchical decomposition of total scope of work

***requirement of WBS

**Adv

- cost collection
- risk factor

Comparison between PBS and WBS

↳ that are common. [not differentiate]

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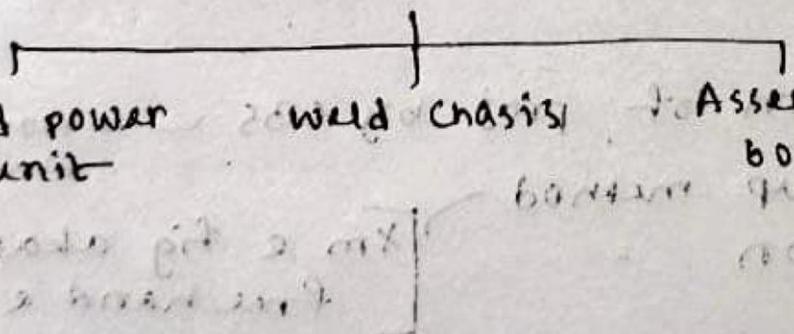
CBS, OBS and responsibility Matrix

1

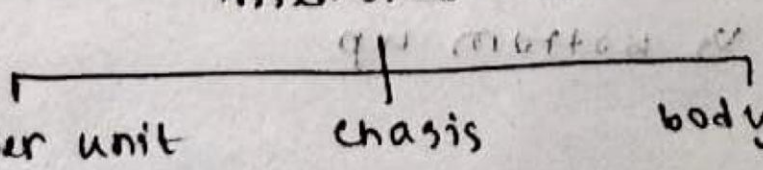
Cost Breakdown structure as per WBS/ PBS

organisation Breakdown structure

WBS



PBS



Comparison betwn WBS and PBS

1. both - hierarchy of stages
2. WBS - work. PBS - product
3. Division to managable section
4. Not like program
   connecting line only for sequential purpose
5. Degree of breakdown depend on project manager

Defn: Breakdown of total cost as per WBS / PBS

* Cost estimation of proj by CBS
  - bottom up method
  - Top down

[Im a big akabo freehand a just]

Top down vs bottom up

OBS

organizational framework gula (memo)

Example - - - - -

Figure

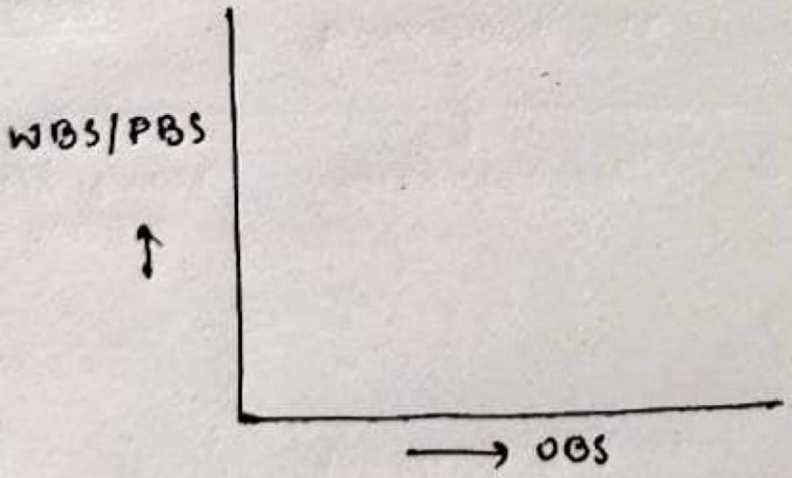
QA manager - quality assurance manager
responsibility of

Diff between OBS and WBS

—

Responsibility assignment matrix (RAM) / RACI matrix

(inform kore rakha kajer bepare



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Responsibility matrix

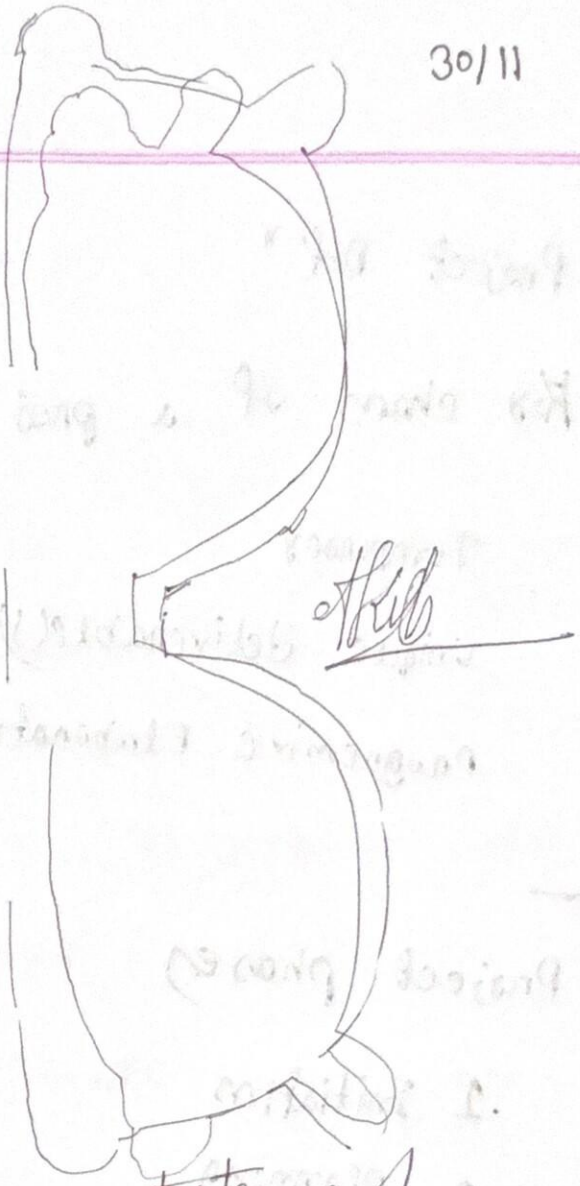
1. RAM

A —
B —
C —

2. RACI matrix

Tips
Efficient

heading starts w/



Reqs of project

Basic things required to complete a project

1. Materials
2. Manpower
3. Technical know-how

ways project can impact country's dev

Perspective - Bangladesh

Rules of proj. management in BD [shortques]

Key aspect of proj. management

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why eff. proj. management is impo

Proj. Defn:

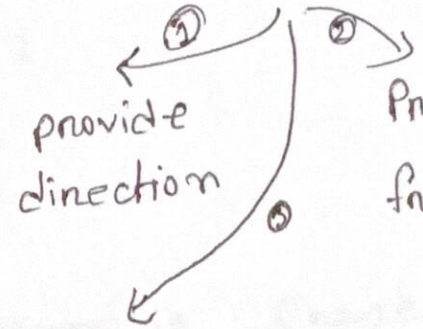
A temporary endeavor undertaken to create a unique product, service, or result under preset conditions.

Project Planning Philosophy

Project phases:

1. Initiation
2. Planning & scheduling
3. Execution — plan into action
4. Monitoring & control
5. closure

What is project plan ~~[PPT]~~



Helps to reveal opportunities & (the opposite)

bpi

1. Bridge btwn experience of past & proposed project.
2. Precaution — can reduce undesirable effect.
3. Involve prior to detect specified factor

Project planning philosophy

done thoroughly & honestly

Clients Stakeholders

Internal threat delaying factor

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Types of proj planning

1. Strategic
2. operational

Proj. construction team

1. Clients / users
2. Consultants
3. Architect / Engrs.
4. Contractor
5. Subcontractor

} incl functions

Proj operations planning - summary

Fast track scheduling

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Project Planning Phase

1. Plan is made
2. Strategies are made
3. considering policies, procedures & rules

w/ example

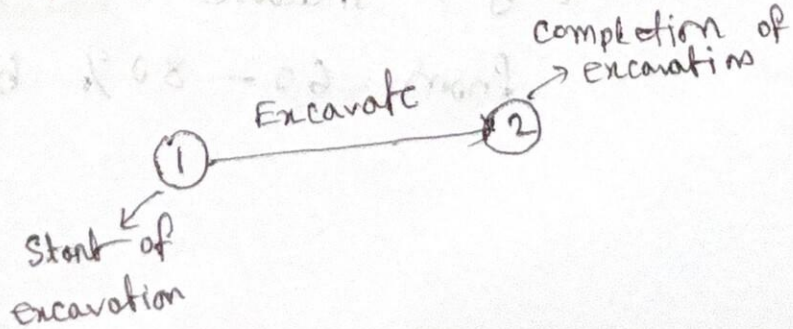
all

Plan is made

Plan: Statement of intent

List of targets & means to achieve

Targets / Events: Important steps



1, 2 → evts

Activity: Actual performance

Different aspects of project planning phase

1. Strategic theme: satisfaction

2. Goal(s): Broad statement

To be considered a trusted partner by our clients

3. Objective: Identifiable & measurable target, time bare

S.M.A.R.T → to be fulfilled

Strategic measurable Achievable

R Time based

e.g., increase client's satisfaction from 60 — 80% by Dec 2026

4. Strategies — means to achieve objective

implementation of annual client's conference

5. Tactics / Evts —

1.1.1 Identify date, time, venue

1.2.3 Develop agenda

1.2.3 Identify speakers

6. Activity

Policies: broad guidelines from an organization

Procedures: Specify how to deal with ~~parties~~ particular situation

~~Rules~~ : Sales man- inspect carefully

manage - get approval



Rules: Even more specific

bring defective item with 3

days w/ voucher

Planning Process

1. Steps
2. Table of contents
3. Important definitions and committees

Previously

Different aspects of project planning phase

1. Strategic theme — satisfaction
2. Goals — Trusted partner of organization
3. Objectives — Increase satisfaction from 70% to 80% by Dec 26

   SMART — Strategic, manageable, achievable, relevant, timely
4. Strategy — 1.1 by implementation of annual client conference
5. Event
6. Activities

---

* * *

Important steps (7)

1. Define objective / goal (s)
2. Establish targets & strategies
3. Develop forecast & means

4. Evaluate resources

5. Determine alternatives

6. Select alternative

7. Decide on plan

Table of contents

1. Introduction
2. Goals & objective
3. Scope
4. Assumptions
5. Constraints
6. Project management approach
7. Attachment & appendices
8. Approval

Appointments

1. P.D → True leader of higher level management
   work on behalf of owner
   Complete the project — on schedule
   within budget
   & scope
2. Program manager
3. Project Sponsor / Stakeholder → Investor
4. Project Manager (P.M)
5. Functional Manager

DPP — Draft → ECNEC

ADP

Physical progress

Financial progress

Committees

1. PSC — Project Steering Committee
2. PIC — Project Implementation Committee
   ↳ implementing organization

PMU → Project Management Unit

ToRs → Terms of Reference

Lec 04

Project: A temporary endeavor undertaken to produce an unique product, service or result under preset conditions.

Project requirements:

1. One specific purpose
2. Starts at specific time
3. Finishes when objectives are fullfilled.

Basic things reqs to complete a proj

1. Materials
2. Manpower / human resources → single determinant factor for accomplishing
3. Technical know-how

Ways project can impact country's dev.

Project turns national strategies into physical reality

1. Economic — generates job
2. Development — w/o implementation of projects, plans can't be realized
3. Infrastructure improvements

Perspective — Bangladesh

1. Scarcity of material resources
2. Unskilled manpower
3. Sociology not up-to date w/ technology

Rules of proj. management in BD

1. Minimize time : Finish as fast as possible
2. Spare resources: Use available manpower & resources as sparingly as possible
3. Minimize investment : Complete w/ minimum budget

increase productivity by balancing technical innovations with human factor

Project Management — Application of knowledge, skill, tools and techniques to project activities to meet project reqs

Key aspects of proj. management

1. Define scope — create outline of all activities
2. Identify deliverables — specific outputs
3. Manage risks — potential unexpected obstacles
4. Eff. communication — ensure team members are aligned

Project management approaches

1 waterfall — traditional method where changes are uncommon, requirements are well defined & stable from the beginning — building construction

2. Agile — iterative, incremental approach allowing for flexibility. Projects w/ high uncertainty where scope in not well defined and change in common throughout Software development.

3. Hybrid — projects w/ varying degree of certainty combines both predictive & adaptive approaches. Large project containing both — construction & software

Core components

1. Reasoning for project
2. Secure requirements (time, resources)
3. Justify investment
4. Secure funding
5. Leading & monitoring

Tips for succesful proj. management →

1. Effective communicatin
2. Set clear goals
3. Create schedules
4. Monitoring & updates
5. Multi talented team member
6. Motivate members
7. Identify & plan for risks
8. Identify & interact w/ stakholders
9. Lead w/ examply

Best project managers — ETT PA

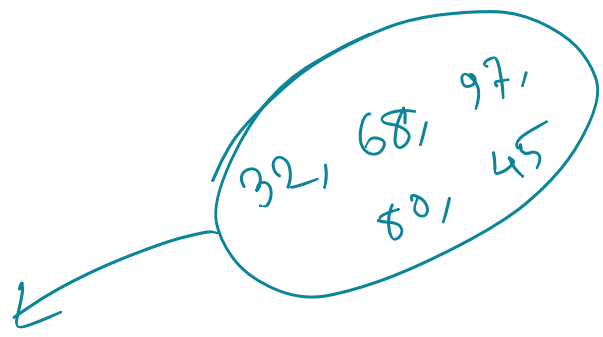
Ethical

Team player

Trustworthy

Proactive

Ask questions.



Why efficient project management is important

1. 32% proj. fail due to poor management →

2. 68% proj fail to meet deadlines, budget due to . . .

3. 97% of businesses beleive eff. proj management is essential

4. 80% of high perf. projects are lead by project managers w/ high qualifications.

5. Large IT projects are run 45% over budgets

Project phases — 5

1. Initiation
2. Planning & scheduling
3. Execution
4. Monitoring & controlling
5. Closing

Project planning

Phase of project management where actual steps required for project completion are determined.

why imp

It,

- Provides direction
- Provides an unifying framework
- Reveals opportunities & threats

It is,

- a bridge between experience of the past and proposed project
- precaution by which one can reduce / avoid undesirable outcomes
- Involves prior determination of specified factors & their relationship to reach the goal.

what is proj. planning

Project planning philosophy

Concept
1. Planning should be done logically, honestly, and thoroughly

Past experience
2. Experience from past projects provide basic logic

Exceptions
3. Differences in experiences help account for,
   i. unusual client demands
   ii. out-of-way locations
   iii. mitigate potential internal/external delaying factors.

Scrutiny
4. Each aspect must be individually scrutinized

Unusual client demands:

- owner wants to build an eco-friendly house using repurposed composite wood
- However after builder has placed the order, owner finds out that HOA allows brick only
- This changes costing and project timeline greatly.

out-of-way locations:

- nice hotel is built
- however it is on a remote place
- guests have nowhere to go for a walk safely

Internal delaying factors:

- Financial solvency: company out-of-money mid proj.
- Equipment shortage: not having required material on hand in time
- Personnel issue: key team member gets sick/quits

External delaying factor

- Nature & society: Bad weather, labor strikes, govt interference
- Theft or accidental damage to equipments
- Cash flow: delayed payments forcing contractors to reduce work-force.

Types of project planning

Strategic project planning

- High level planning by corporate planners or owner
- Determines what project to build, overall completion goals, and broad strategic guidelines
- It selects the project construction team

Operational planning

- Planning phase prepared by the project construction team.
- Involves planning of how to do the job and documenting specific course of action to meet specified goals.

Project construction team

1. Client: define needs and specific requirements
2. Consultant: Assess risks on needs and define performance requirements.

3. Architecture (and engineer):
   - Defines performance specs & list products
   - Advised by consultant and subcontractors.

4. Contractors: Interprets the specs and choose subcontractor based on availability, capabilities, and price.

5. Subcontractor: Decides on specific products based on specs and choose suppliers. May also be responsible for the design elements.

Operations planning:

Fast tracking: It is a technique where activities that would've been performed in sequence as per original schedule are performed in parallel.

I.e., activities are worked on simultaneously instead of waiting for each piece to be completed separately.

Project Quality

a. Defn
b. Ensuring quality → end products errors
   ↑ ensure sponsors are willing to use the prod
c. Importance project quality management
   → Quality plan & use throughout

Quality Product

a. Defn
b. Managing → # 1. Improved & committed
                2. Info to be permeated
                3. Works meet quality std
                4. Checks & audit
c. Consistency

Consistency of performance → 7-8 points

Organisations controlling quality

Q. A — ISO, BST
Quality plan

Global firms, local firms on quality control

L10

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Quality Product

1. Quality audit
2. Quality review
3. Causes & effect analysis
    a. Ishikawa diagram / Fish bone diagram
    b. Pareto's law and analysis
4. Trend analysis → 80/20 rule

Consistency of performance for quality product in a project

Functions and actions are necessary

1. Standard — determined
2. Quality requirements — disseminated
3. Eqpt — set up
4. Staff's operative's — trained
5. materials checked
6. Control & audit points — set up
7. Designated components are checked
8. feedback & rectification
9. Quality check & audit

---

1. Quality Audit —— Procedures are setup
    — Carried out
    — Standards are met

2. Quality Review ——

3. Causes and Effect Analysis: Domestic vacuum cleaner

a. Select an item
b. Identify modes of failure
c. Probability, cause & impact are assessed
d. modes of most failures are determined

4. Trend Analysis

1. Log

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Project risks

1. Definition
2. Stages of project risk procedures
3. Sources of project risks

Previously

Causes & effect analysis

Dust collection problem → Domestic vaccum cleaner

1. Identify causes
2. Draw fishbone diagram
3. Subcauses
4. Assess by Pareto Analysis — 80/20 rule

Risk — An event that may or may not occur but if happens, will have significant impact on the outcome of the project. Common in Bangladesh —

1. Flood
2. Cyclone
3. Fire
4. EQ

Risk Analysis :

1. Probability → An evt likely to occur
2. Impact → strong effect

Risk management plan :

Docus prepared at the outset of project

1. Requirement of risk assessment
2. Procedure of risk management

Stages ;

1. Risk awareness
2. Risk identification → may come as long ques
   i) Brainstorming
   ii) Prompt lists
   iii) Check lists
   iv) Delphi method
   v) Asking experts
   vi) WBS

Risks to be considered → memo few ; describe

1. Technical risks → Test failure
2. Environmental → closure of op. due to env. concerns
3. Cultural → multi-culture workforce

4. Financial
5. Legal
6. Commercial
7. Resource
8. Economical
9. Political risk
10. ...

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Project risks (contd.)

1. Stages of project risk management procedures
2. Options available to riskowners / pof to deal with project risks.



Previously.

Stages: Risk awareness, risk identification

Contd.

Stages:

c. Risk assessment → Qualitative assessment of risks

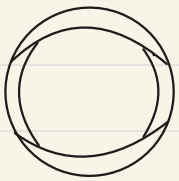
Experience / History / Data / Close up report
- i) Probability — v. low, low, medium, high, v. high
- ii) Impact — " , ", " , ", "

d. Risk evaluation → Quantitative analysis

Exposure rating → multiplication of the two

Prob. (Medium = 3) × (v. high = 5) Imp.

↑high exposure rating → - - -



e. Risk management → what to do

Risk Response Plane ← who will do

Risk owner ←

f. Risk Moniton → register

Options available (to risk owner)

1. Avoidance
2. Reduction
3. Sharing
4. Transfer
5. ...

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Process of dev project in Bangladesh

Procurement Expert

1. Ministry of planning
2. Planning commission → highest ; Chairperson → head of govt
3. ADP & ADP in FY 2025-26
4. Approval authority of dev project
5. Function of IMED and CPTU

Planning Commission

What is the task & rule of planning commission

ADP

NEC

what is council of minister & cabinet

ADP Formulation

1. Resource committee
   - Estimate available resources for ADP
2. Programming div - Allocate resources secton/div-wise
3. " " - place draft ADP
4. Planning div - Final ADP for approval

ADP - FY 25-26

Different Duties of IMED

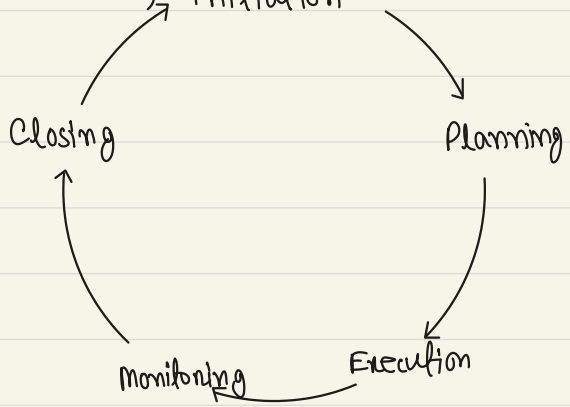
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Project lifecycle [can be defined & modified]

↳ Activities, result, requirements (preset)

Cycle → why

→ initiation



Importance

Sequence of phases of a project

⭐⭐ How many phases [4 criteria]

Uses of project life cycle

milestone

Concurrent Engineering in project life cycle

reduce duration → resources

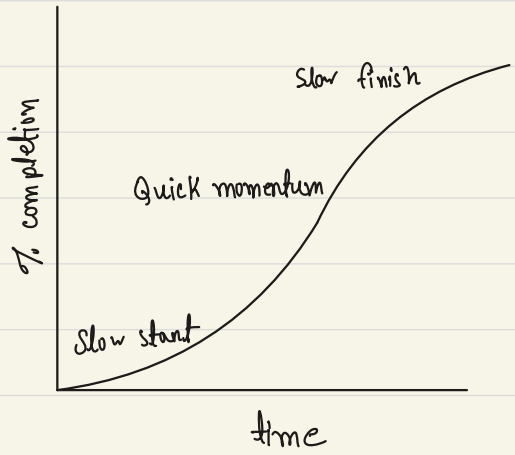
⭐⭐⭐ Basic pattern of proj. life cycle [mid to longe proj]

1. Concept
2. Feasibility
3. Evaluation
4. Authorization
5. Implementation
6. Completion
7. Operation
8. Termination

Management in project life cycle

- Authorization
- Handover
- Shutdown

Life cycle progress curve [extended S-curve]



Generic project life cycle with output (time) cost & staffing
Project's cost, risk, and uncertainty w/ time

Project milestone

GEPM CT-2

Lec ~~12~~, 13, 14

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1. Four stages model of project
2. Conflicts in project

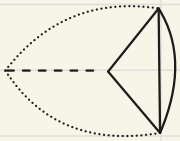
Project Formation

1. Approval of project tentatively / unofficially
2. Some boot-leg works are done

Project Planning Budgeting ; scheduling & aggregation of res

Project Execution ; Plan in action

Termination



Project Manager
Functional manager
Project Team
Team members

Project Conflict

for long duration

A serious disagreement on argument, protracted one, that others are frustrated on about to frustrate.

Sources of conflict



1. Belief
2. Feelings
3. Behavior
4. Goals

Methods of conflict solves

1. Withdrawing
2. Soothing
3. Compromising → lose lose situation
4. Forcing → win-lose situation
5. Confrontation

Confrontation

Facing the problem directly

- negotiation
- arbitration → third party
- rules of law
- brute force

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Conflicts in Projects

Defⁿ: A serious disagreement on argument

Satisfaction of conflict: Maintain status quo. No further action.

Sources: Believe, feelings, behavior, on goals

Methods of solving conflicts: withdrawing, soothing, compromise, (→ lose-lose)
forcing, confrontation (→ win-win)

(win-lose ← forcing, least eff.) (← generally used method in proj.)

Confrontation → facing the problem → methods

(Most eff. →)
1. Negotiation → discussion to reach an agreement
2. Arbitration → solve problem with an agreed upon arbitration
3. Use of laws → organisation's law
→ contract
→ country's law / court

Where conflict prevails:

1. Schedules
2. Priorities
3. Staff & labor requirement
4. Tech matters
5. Admin procedures
6. Cost estimation
7. Personality conflicts

Categories of conflict

1. Goals and expectation conflict
2. Authority conflict — PM & FM
   PM & Sr Management
3. Interpersonal conflict

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Lec 13 Planning process of dev. projects in Bangladesh

- Ministry of Planning: Responsible for socio-economic development planning and statistic management in Bangladesh.

→ Planning Division → PD works as the secretariat of PC

  - Bangladesh Institute of Development Studies
  - Planning Commission
  - National Academy of Planning & Development

→ Statistic Division

  - Bangladesh Bureau of Statistics

→ IMED → Implementation, monitoring & Evaluation Division

  - CPTU → Central Procurement and Technical Unit

Planning commission

  - Institute of Public Finance of GoB
  - Under Ministry of Planning & alongside of Ministry of Finance
  - MoP, PD works secretariat of PC

Planning Commission — Structure

Chairperson ⟶ Vice chairman ⟶ Secretary ⟶ Members of Divisions

Hon'ble Prime Minister | Minister of Planning | Secretary of PD | Div. such as Industries and Energy

PC—Task: Planning of socio-economic development projects of the country

Role (3) **Advisory** → advise govt. on measures toward socio-economic devs. eg., policy change, strategies

Executive → Preparation of plans, processing of dev. projects for approval, preparation of ADP

Coordination → coordinate w/ other plannings

ADP (Annual Development Program)

It is the **operational document of GoB's five year plan.** It is **released annually** (in June) and **includes both govt. funded & foreign aided projects** (of both ongoing & new projs.) Consists of,

- Main investment program
- Technical assistance program
- Self-financed program

NEC (National Economic Council)

Highest policy making body of GoB for economic and development plannings.

It composed of — chairperson (prime minister)
All members of the council of ministries

chief exec body of BD

Also requires — Cabinet secretary, principal secretary
Governor of Bangladesh Bank
All members of PC
Secretaries of ministries/divisions

Functions — Provides guidance on perspective plan, five yr plan, ADP
Finalizes & approves projects, plans, policies
Reviews implementation of dev. projects
Take decisions & actions as situation requires
Appoints committees as required

ECNEC → Executive Committee of National Economic council

ADP Formulation

1. Resource committee — estimates available resources for ADP
2. Programming committee — allocates resources sector/division wise
3. Programming committee — places draft ADP at PC meeting
4. Planning div — submits ADP to NEC for formal approval.

ADP 2025-26

- Total ADP of 2.3 tn tk
- FY 2025-26
- Approved by NEC
- From local res – 1.44 tn & from foreign project assistance 0.86 tn
- Increased 6.58% than revised ADP of 2024-25
- Includes 1183 proj (228 climate, 79 PPPs)
- Emphasized on transport, communication, and power & energy.

Classification of projects:

- Investment proj → minister in charge of planning approves upto 25 cr
  ECNEC approves proj costing > 25 cr
- Tecnical assistance → Sponsoring minister upto 7 cr
  minister of planning for proj. costing more
- Self-financed → Sponsoring minister is the approval authority

Duties of IMED

- cost rationalisation
- Participate in PEC meeting, ADP review meeting
- Comment on time extensions for proj.
- Impart training for diff officials

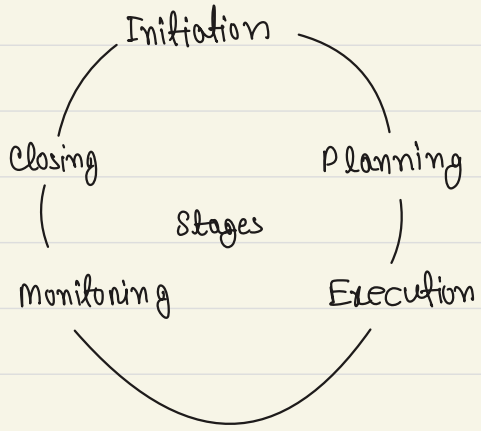
CPTU – All things related to procurement
Proper implementation of PPR, PPA

Lec 14 Project life cycle

Project : A specific, finite activity that produces observable and measurable result under preset conditions.

Project life-cycle: Sequence of phases that a project goes through from its initiation to closure.

can be changed/modified as per requirements.



Importance: Provides the basic foundation of actions that has to be performed.

Has definite start, end, and control points constrained by time.

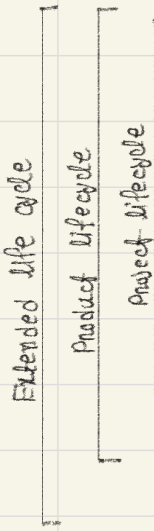
Number and sequence of phases: Determined by management based on factors such as:

1. Needs of the organization
2. Nature of the project
3. Area of application

Uses of project life cycle

- Defines clear phases with start, end, and control points.
- Acts as a decision making & control system for diff stages of project.
- Serves as milestone for progress reporting & payments
- Helps top management to decide whether to continue
- Allows concurrent engineering by overlapping two phases eg, start construction before designing is finished.

Pattern of life-cycle



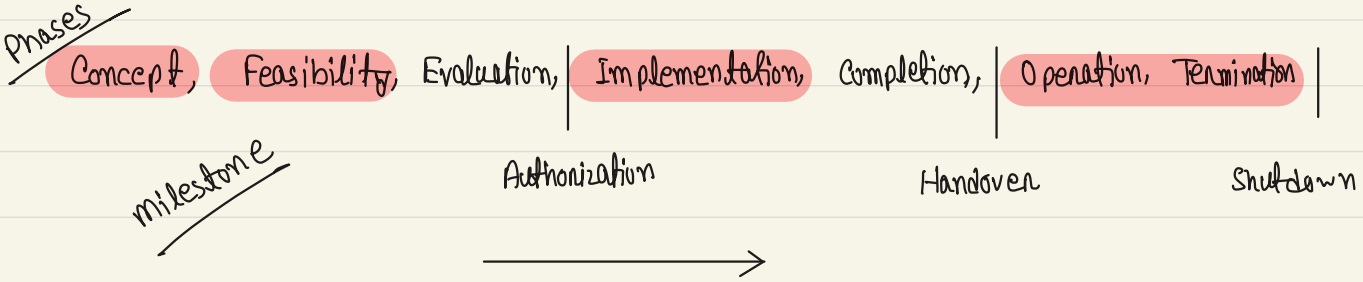
1. Concept – identify need, dev. basic idea, proposal
2. Feasibility – assessment on technical, financial, social feasibility
3. Evaluation – detailed analysis of cost, benefits, risks
4. Authorization – formal approval
5. Implementation – design, planning & execution
6. Completion – perf. testing
7. Operation – use
8. Termination – closure of proj.

Types of project life cycle

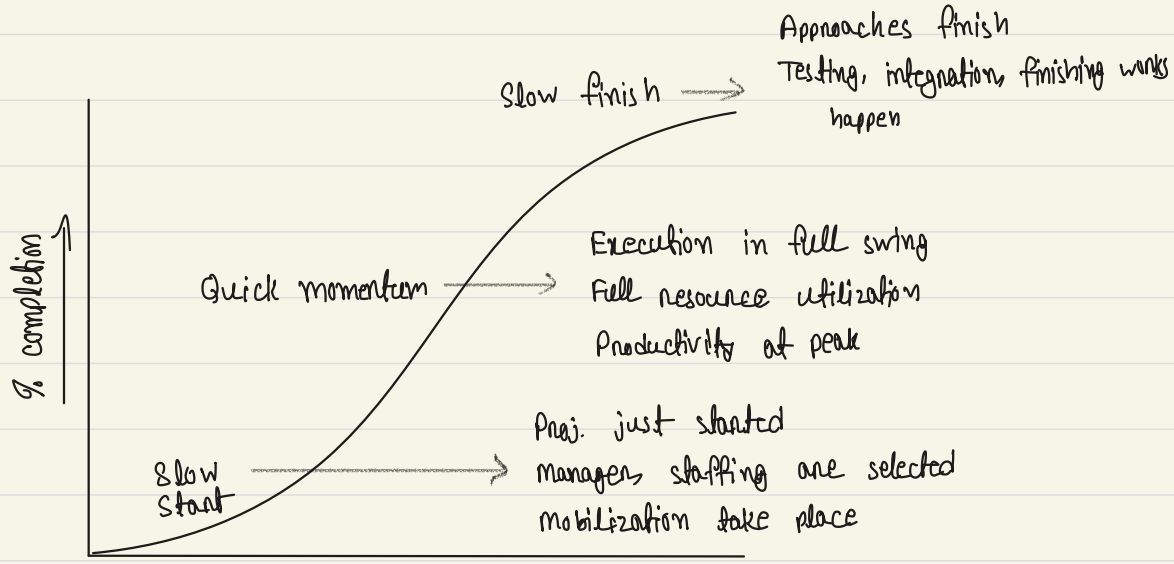
proj. ends w/

1. Normal – issuance of acceptance certificate often perf test successful
2. Extended – two additional phases like operation (maintenance in service) and termination (disposal) included.

Project management in project life cycle

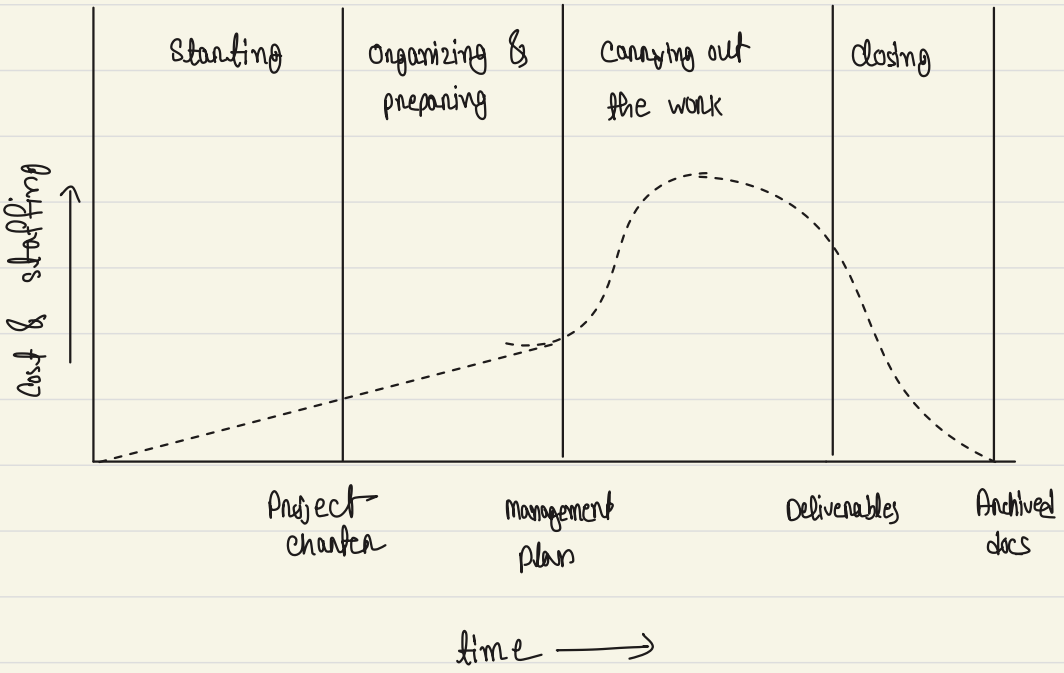


Project Lifecycle Curve:

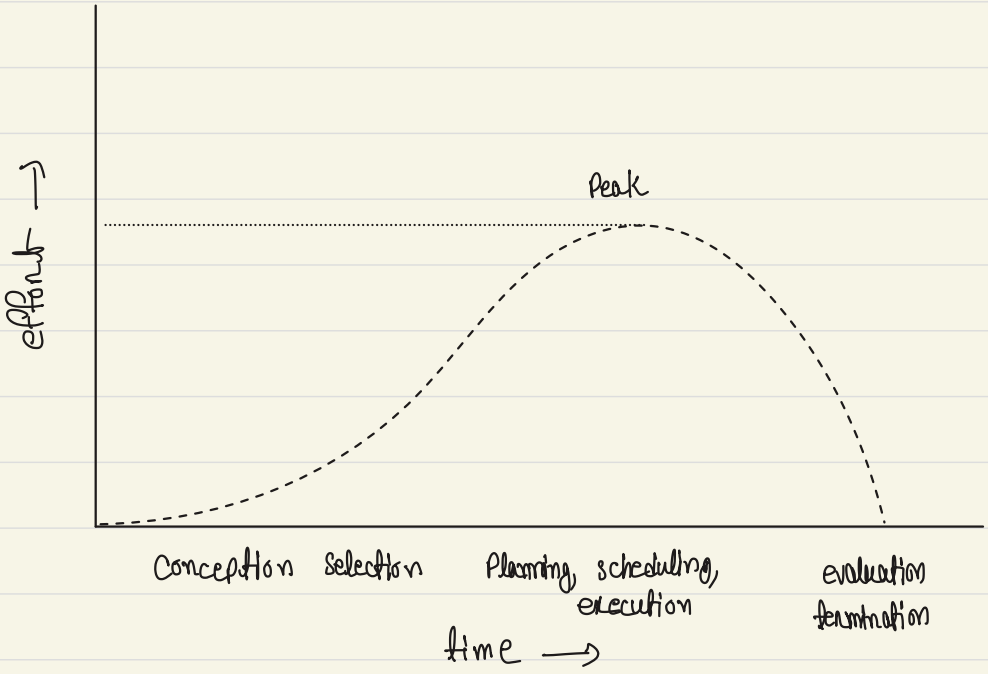


(Extended S-curve)

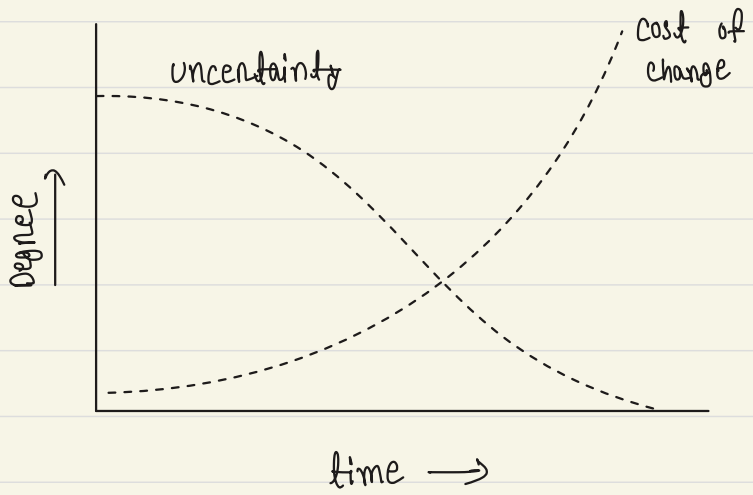
Generic project life cycle with output (time) cost & staffing



Time distribution of project effort



Risk & uncertainty



Project milestone

- key checkpoint on significant events to keep track of project progress
- Helps team stay aligned & manage complex works by focusing on critical goals
- Act as signpost.

L17 04/01

Conflicts in chronological stages in project life cycle

Model stages

1. Evaluation stage
2. Buildup "
3. Main "
4. Phase out "

Evaluation stage

1. Technical objective
2. Resources allocation
3. Priorities of projects
4. Solving conflicts

Fundamental issues must be resolved before transitioning from evaluation to buildup stage

Clarification of pm and fm rules in project

Critical measures that underlines four fundamental issues in solving conflicts

Conflicts in project main program (2 types)

1. Schedules
2. Technical issues

Conflicts in project phase-out

Schedules

Technical

Personnel conflicts

L 18 05/01

Conflicts in Project

1. Conflict negotiation
   a. To reduce on resolve conflicts to support project objective
   b. Primary tools
2. Negotiation – discussion to reach an agreement
   - favorable technique
3. Paneton's optimal solution solving conflicts
   - no party better off & no party worse off
   - outcome in terms of organization goal
   - no win, no loss situation

   no win no loss
4. Ethical Aspects in Negotiation
   - both parties to be honest
5. Negotiation's critical technique by
   a. Partnering
      → PPP Project
      Select partner rather contractual agreement
      Avoid litigation
   b. Chartering
      1 Partnering company sign on
   c. Project scope
      works needed to accomplish

why partnering is done?

→ Diversification of tech risks

→ Avoidance of capital investment

→ Reduce political risk [international mostly eg→ manufacture where labor cost]

→ Shortening duration

→ Pooling complementary knowledge

→ situation prevail both contractor & owner

Multistepped Approach

Step-1: Make firm commitments

step-2: Agreement on: Joint evaluation
methods to solve problem

step-3: Acceptance goals of continuous improvements

Step-4: continuous support

Step-5: Joint review

Causes of scope change

L19 06/01

Negotiation Method

1. Requirements of negotiation method
2. Negotiation techniques
3. Phases of negotiation methods

Requirements

1. Allow to settle/solve conflicts
2. Foster honesty among negotiators
   ↓
   truthful, fairness, & sincere in words & actions
   involving integrity
   avoiding deceit
   being trustworthy
3. Seek solution win-win solution

Techniques

1. Seperate people from the problems
2. Focus on interest not positions
3. Invent options before trying to reach agreements
4. Insists on objective criteria

- Substantial problems to be defined
- Not allow egoism
  Talk about schedules
- Finding mutual gains; Reinforces win-win solution
-

explain

The key to finding negotiator's interest & concern is to ask 'why'

Phases

1. Preparation
2. Planning
3. Opening proposal
4. Bargaining
5. Agreement
6. Finalization

degree of compromise
limits concessions

veiled threat

(I) Further negotiation
(II) → Adjugadition → Legal process
→ Arbitration
(III) Litigation

Ratification

Linear Programming

A simple way to perform optimisation (way of life)
(max output w/ limited res & time)

1. Inventory – stocking
2. warehouse

Real life problems to give mathematical model for linear eqn by simplifying assumption

Define LP w/ examples

Formulating real life problems into LP

	milk	Choco	
Type A	1	3	6₹
Type B	1	2	5₹
Kitchen	5unit	12unit	

A – X (nos) Max^m $Z = 6X + 5Y$

B – Y (nos)

milk $X + Y \leq 5$

choco $3X + 2Y \leq 12$

$X \geq 0$

$Y \geq 0$

Parametens used in LP

Decision variables: X, Y ...

Object functions

constraints

Non-negativity restriction

Process or steps to define a L.P problem

L21

19/01

1. Process/steps in formulating real life problems into LP problems

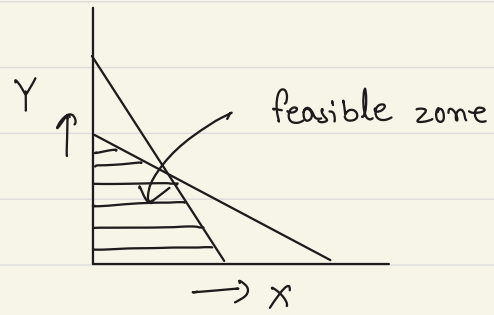
i) Identify the decision variables
ii) Write down the obj. functions
iii) Mention the constraints
iv) Explicitly state the non-negativity restrictions

with example
— choco milk one

Methods of solving LP problems

i) Graphical method
ii) Open solver method
iii) Simplex method
iv) North-west method
v) Low cost method

Graphical method



Example

110 ha

10,000 $

1200 man-day

1. Decision making var

   wheet = X hecton

   Beetocy = Y hecton

2. $z = 50X + 120Y$

3. constraints

$$100x + 200Y \leq 10000 \Rightarrow X + 2Y \leq 100$$

$$10x + 30Y \leq 1200 \Rightarrow X + 3Y \leq 120$$

$$X + Y \leq 110$$

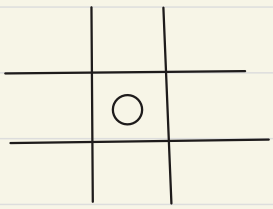
$$X \geq 0 \quad Y \geq 0$$

L22 20/01

Methods

1. Graphical method
2. Open solver method — MS Excel
3. Simplex method
   - Std method
   - Popular
   - One objective function & a number constraints
4. N-W corner method
   - Solve transportation problem

Start from top left corner aggressively meet demand from supply



5. Least cost method

Start from least cost to following least cost

	D	E	F	Supply
A				50
B				40
C				60
Demand	20	95	35	150

L23

26/01

Cash Flows in a Project

1. What it is?

Net amount of CCE being transferred in and out of project within a period of time

Cash & cash equipments

Cash inflow = cash received (+ve)

Cash outflow = " spend (-ve)

working capitals

2. Importance

a. Indicates financial sensitivity & liquidity

b. Indicates credit worthiness and borrowing capacity

c. Helps — business growth & involvement

d. Helps decision making and financial planning

e. Helps to create valuation & investing confidence

3. Sources of money

- Sales as revenue
- Interest
- Investment
- Royalties & licensing agreement

FCF - Free Cash Flow

4. Financial report / Financial Statement

- Cash flow statement
- Balance sheet — P&L report
- Income statement

5. Cash flow does not show all expenses

** why? ⟶ on the process payments

1. Accrual accounting | accunes are paid nightway

6. Types of cash flow

a. CFO — cash flow from operation

b. CFI — " " from investing activities

c. CFF — " " from financing debt, equity, dividends

7. Profitable company may fail:

a. If do not generate enough cash to stay liquid

b. Profits are (i) tied up with AR (Accounts Receivable)

(ii) Overstocked inventory

(iii) Spend too much in capEap

8. Example of cash flow statement

L24 27/01

Prev

Cash Flow Statement and points to be covered

Financial statement the aggregates in project inflows and out flows from

a. operation CFO
b. Investing CFI
c. Financing over time CFF

Net Present value (NPV)

1. NPV – How much values a project will produce in a set period of time.
   – Diffenence betw^n present values of cash inflows and present values of cash out flows
   – Use in capital budgeting project and investment planning to analyze profitability of project

2. Implications – a. Compare rate of returns (R of R) of different proj.
   b. " projected R of R
   c. +ve NPV ≥ 0 project profitable
      -ve NPV
   d. Sometimes called DCF in Discounted rate

Payback period

I.R.R - Discount in which NPV = 0

Example :

	1 year	
$100	$100	
$100	$100	risk, business
$100	$108	no risk

3. NPV calculation

$$NPV = \sum \frac{\text{Cash flow } t}{(1+i)^t} - \text{Initial investment};$$

i = discount rate

t = time / period

Example 1

$t = 5 \text{ yr} \times 12 = 60$ months

$\$1\text{m} = \$1,000,000$

$$NPV = \sum \frac{\text{cash flow}}{(1+i)^t} - \text{init investment}$$

$$\text{Discount / predicted rate} = \left(1 + \frac{8}{100}\right)^{1/12} - 1$$

$$= 0.0064$$

$$= 0.64\%$$

$$\therefore NPV = \frac{25000 \times 60}{(1+0.0064)^{60}} - 1,000,000$$

$$= \$22,940$$

Example 2:

0 yr — 1,000,000

1 yr — $\frac{30,000}{(1+0.10)^1}$ = [1]

2nd yr — $\frac{30,000}{(1+0.10)^2}$ = [2]

3rd yr — $\frac{30,000}{(1+0.10)^3}$ = [3]

4th yr — $\frac{30,000}{(1+0.10)^4}$ = [4]

$1 mil − ([1] + [2] + [3] + [4])

Example 3:

conv. $250 mil

Rough / midterm 27/01

Lec 19 Negotiation Methods

Requirements

1. Allow the conflict to be settled w/o irreparable damage to project obj.
2. Foster honesty between negotiators
   I.e., truthfulness, integrity, fairness, sincere in words & actions
3. Conflicting parties to seek win-win solutions, i.e, that
   i) Satisfy own needs
   ii) Needs of other parties and
   iii) Organizational goals.

Techniques for win-win solutions:

1. Separate people of problem
   - Minimize likelihood that a problem will become interpersonal
   - Problems should be clearly and explicitly defined
2. Focus on interest, not position
   - Avoid egoism
   - otherwise problems never focuses on real interests and concerns on conflicting parties
   - Parties should talk about their interests
3. Invent options before trying to reach agreements
   - Parties are often blind to other outcomes
   - Problems should be spelled out and efforts should be given to find out creative solutions
   - Solutions that produces mutual benefits reinforces win-win negotiations.

4. Insists on using objective criteria
   - Effects should be given to finding standards that can determine the quality of an outcome.

The key to finding negotiator's interest is to ask "why":

- A position is what a negotiator demands, but it doesn't explain why that demand exists.
- The underlying interests and concerns are the actual reasons behind that position
- Asking "why" moves the discussion from positional bargaining to interest based negotiation
- It helps reveal hidden constraints (time, resources), identify real problem instead of surface demands, create opportunities for alt solutions promoting win-win situations.
- Example: Negotiator states test cannot be done before a certain date. Asking "why" may reveal required materials not available. If they can be sourced elsewhere, test may continue.

Phases of negotiation:

1. Preparation
   Collection & analysis of data, facts. Identify clear objective and supporting data.
2. Planning
   Determine intention to negotiate, level of compromise (concession boundaries), and strategy incl. location.
3. Introduction
   Establish a coopenative environment. Common goals and key issues are briefly outlined.
4. Opening proposal
   One party presents the initial offer, indicating flexibility and needs. Information exchange begins.
5. Bargaining
   Discussion, concession, and trade-offs take place. Parties negotiate to bridge gaps. Goal is to reach an agreement between initial extreme positions taken by the parties.
6. Agreement
   A mutual understanding is reached and terms are finalized in principle
7. Finalization
   Agreement is documented, signed and if required, ratified by higher authority.

Lec 20 — Linear Programming (LP)

Defn: A simple technique where we depict complex relationships through linear functions (i.e, simplify real relationships to mathematical model of linear relationship) and then find optimum solutions.

Example: Delivery man to deliver 6 packages. He will calculate different routes for going to all 6 places and come up w/ a shortest route.

Concept:

i) obtaining the most optimal approach w/ given constraints
ii) Formulation of real-life problem into mathematical models.
iii) Involves objective function, linear inequalities with subject to constraints.

Formulation of real problem into LP: Chocolate manufacturing company to produce two variants of chocolate — A & B.

1. A requires 1 unit of milk, 3 unit of choco
   B " 1 " of " , 2 " of "
2. Total milk 5 units
   choco 12 units
3. A profits 6/unit
   B " 5/unit

Mathematical model,

Variant	Milk	Choco	Profit/unit
A	1	3	6
B	1	2	5
Total	5	12	

Objective → how many units of A (X), and B (Y)

Relationships,

i) $6X + 5Y = Z$ [obj. func^n]
ii) $X + Y \leq 5$ [milk constraint]
iii) $3X + 2Y \leq 12$ [choco constraint]
iv) $X \geq 0$ & $Y \geq 0$ [non-negativity]

Parameters used in LP

i) Decision making variables
   - which defines the output
   - Represents ultimate solution
   - E.g., total number of items to produce

ii) Objective functions
   - Objective of making decision
   - E.g., wish to maximize profit

iii) Constraints
   - Restriction or limitations on decision making vars
   - E.g., limit on the availability of resources

iv) Non-negativity restriction
   - Ensures decision making vars cannot take negative values

Steps to define LP problem:

i) Identify decision making var
ii) Write obj functions
iii) Mention constraints
iv) State non-negativity restrictions

Lec 21-22 Methods of solving LP problem

Methods:

i) Graphical method
ii) North-west corner method
iii) Least cost method
iv) Open solver method → open-source linear & optimizer for MS Excel
v) Simplex method → one obj fun^{c} & number of constraints

Graphical method:

Example: Budget $10,000; 1,200 man-days; total area 110 ha

Variety	Cost/hec	Net prof/hec	Man-days/hec
Wheat (X)	100	50	10
Barley (Y)	200	120	30
Total	10,000		1200

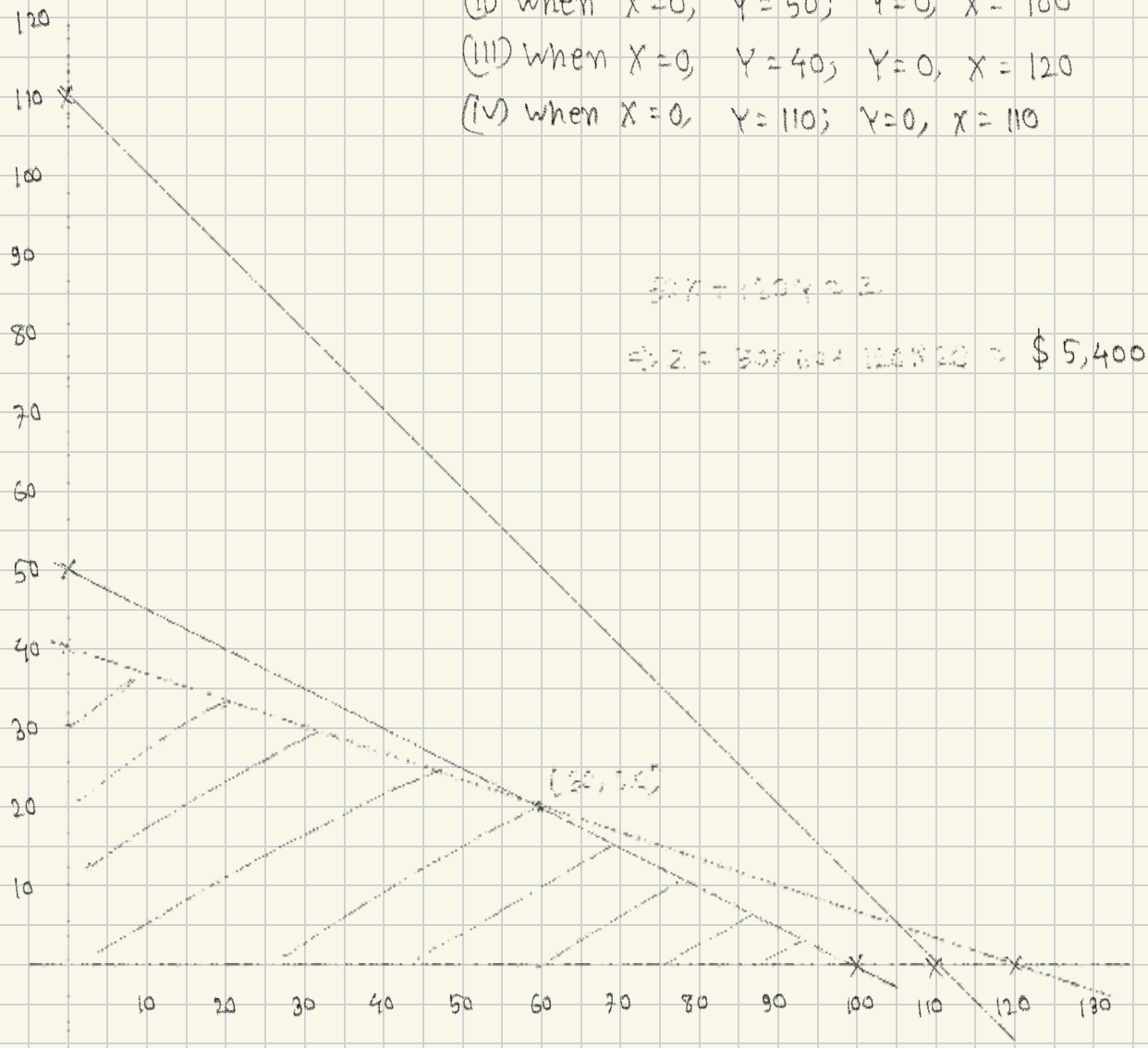
Relationships:

(i) $50X + 120Y = Z$
(ii) $100X + 200Y \leq 10,000 \Rightarrow X + 2Y \leq 100$
(iii) $10X + 30Y \leq 1200 \Rightarrow X + 3Y \leq 120$
(iv) $X + Y \leq 110$
(v) $X \geq 0$ & $Y \geq 0$

(II) when $X = 0$, $Y = 50$; $Y = 0$, $X = 100$

(III) when $X = 0$, $Y = 40$; $Y = 0$, $X = 120$

(IV) when $X = 0$, $Y = 110$; $Y = 0$, $X = 110$



$\Rightarrow$ Z = [illegible] = $ 5,400

Northwest corner method:

To / Source	D	E	F	Supply
A	5^{20}	8^{30}	4	50^{30}_{0}
B	6	6^{40}	3	40^{0}
C	3	9^{25}	6^{35}	60^{35}
Demand	20^{0}	$95^{65}_{25}_{0}$	35^{0}	150

Total cost: $20\times5 + 30\times8 + 40\times6 + 25\times9 + 35\times6 = 1015$ /-

Least cost method:

To / Source	D	E	F	Supply
A	5	8^{50}	4	50^{0}
B	6	6^{5}	3^{35}	40^{5}_{0}
C	3^{20}	9^{40}	6	60^{40}
Demand	20^{0}	$95^{90}_{40}_{0}$	35^{0}	150

Picked cell BF instead of CD, because "Cost where max quantity can be assigned should be chosen..."

Total cost: $3\times20 + 8\times50 + 6\times5 + 9\times40 + 3\times35 = 955$

Cash Flow : Net amount of CCE tranfered in and out of projects/ business within a time period.

Tvm → Time Value of Money

1. what it is?

a) Fundamental financial principles
b) Money today is worth more than it would be in the future

Importances

1. Decision of investment
2. Compane projects
3. calculate retirement value
4. External ...

GPV 7-8%

Decision

$10,000 today
$10,000 after 3 yrs

$10,000
Rate : 4.5%
After 3 yrs : $10,000(1+0.045)^3 = 11,411$

Net profit = 1,411 → FV

$PV = \frac{10000}{(1+0.045)^3} = 8763$

Net loss = 1237

Today $15,000
After 4 yrs $18,000

Aftn 4 yrs = $15000(1+0.04)^4$
= 17,547

Annual rate 4% & discount 4%
Present value of $18,000 after 4 yrs = $\frac{18000}{(1+0.04)^4} = 15,386$

Basics of Present value (PV)
Basics of Future value (FV)

whenever money is coming and going at some points of time, TVM should be considered

1. Cash Flow
2. TVM
3. NPV — Net Present value
4. IRR — Internal rate of return
5. Payback period / break even period

L27 17/02

IRR

1. What is IRR
2. Importance of IRR
3. Uses of IRR
4. Considerations for financing based of IRR
5. Problems

To analyze the profitability of projected investment

Cash flow
TVM
NPV
] Fundamental financial principals

IRR
Payback period
BCR etc

$$NPV = \sum \frac{CF_t}{(1+i)^t} - C_0$$

CF_t ← Cash flow in time
C_0 ← Initial investment
i ↑ (IRR)

Discount rate : Rate at which future value is discounted to present value

Handle rate → : cost of capitals (min rate expected by stake holders)

min rate for proj. appr → : IRR – Internal rate of return

Importance :

1. Analyze profitability
2. Higher value, better profitability
3. Rank multiple projects
4. If uniform IRR, analysis by other principle

Uses of IRR :

1. Compare profitability
2. Making financial decision for investment
3. Analyse the investment return

Considerations for financing based of IRR

a. IRR rules in a guideline for proceeding w/ project
b. IRR > RRR on cost of capitals
   ↓
   Required Rate of Return
c. IRR < RRR → Project reject

Limitations of IRR

a. May be misinterpreted
b. Not to be used alone
c. To be studied WACC & RRR
   ↓
   Weighted Avg cost of capitals

A project has an initial investment of $100,000 /=
The cash flow by the end of each yr is given below

Year — 1: 20,000 Find out IRR
2: 35,000
3: 25,000
4: 30,000
5: 10,000

$$0 = NPV = \sum \frac{CF_t}{(1+IRR)^t} - C_0$$ ← Trial & error
2 trials on exam

↖ 5%, 10%

5%: $CF_1 = \frac{20,000}{(1+0.05)^2} =$

$CF_2 = \frac{30,000}{(1+0.05)^2} =$

...

$CF_5 = \frac{10,000}{(1+0.05)^5} =$

Σ 120,000 − C_0 ← 100,000

NPV = 20,000

L28

22/02

Payback period

Fundamental Financial Principle for Investment of proposed project

1. Defn
2. Importance
3. Limitations
4. Payback period & breakeven point
5. Problems

Defn: Time taken to recover the initial cost of investment

: Shorten → more attractive

: Time when investment reaches the breakeven event

Price/val at which investment must rise to recover initial cost of investment

Example: Project 1 $1m

Save each year = $250,000

Payback period = $\frac{1\,m}{250,000} = 4$ yrs

Annual in

. . .

[math]

Importance: Uses by investors & financial experts

i) To calculate investment return

ii) " " time to recover init cost

iii) To take decision

Limitations:

1. Ignores TVM
2. " overall profitability
3. Do not tell what happen after payback period

Upfront investment = $500,000

Following cash save

year 1:	100,000	——	year 1: -400,000
2:	150,000		2: -250,000
3:	150,000		3: -100,000
4:	50,000		4: -50,000
5:	125,000		5: +75,000

$$\frac{50,000}{125,000} = 0.4 \text{ yr}$$

∴ Payback period = 4 + 0.4 = 4.4 yr

Upfront investment = $500,000

yr 1 : 100,000
2 : 150,000
3 : 150,000
4 : 50,000
5 : 125,000
6 : 200,000

PV factor for 1$ at 10% discount
what will be the discounted payback period

				Accumulated
yr 1 :	100,000 →	$100,000 * \frac{1}{(1+0.1)^1} = 90,909$	→	90,909
2 :	150,000 →	$150,000 \times \frac{1}{(1+0.1)^2} = 123967$	→	214876
3 :	150,000 →		→	327573
4 :	50,000 →		→	362724
5 :	125,000 →		→	439391
6 :	200,000 →	$200000 \times \frac{1}{(1+0.1)^6} = 112895$	→	552233

500000 − 439391 = 60661

$\frac{60661}{112895} = 0.54$ yr

1. Cash flow
2. NPV
3. IRR
4. TVM
5. Payback period

L29 23/02

BCR and FR Equations

→ Fishen rate eqn

→ Benefit Cost Ratio

1. BCR: Relationship betwn benefits & costs of projected investment

BCR > 1, project will produce +ve NPV

Expressed in terms of money and qualitative value

why BCR analysis is required:

L9

1. Systematic process to analyze benefit to cost to decide to make on forgo
2. Analysts sum of potential reward & cost
3. Analysts assign monetary value to intangible items

what BCR tells you!

1. BCR > 1 → +ve NPV or IRR beneficial
   < 1 → --
   = 1 → ...

Assess the profitability of a project, renovating an apartment building

Authority decided to lease equipment needed for 50,000, rate purchase installation rate = 2%

Renovate expected to profit 100000/year for 4 yrs

Discounted Cash Flow

year 1 → $\frac{100,000}{(1+0.02)^2} = 98039$

year 2 → $\frac{100,000}{(1+0.02)^2} =$

year 3 → $\frac{100,000}{(1+0.02)^3} =$

year 4 → $\frac{100,000}{(1+0.02)^4} =$

378901

$$BCR = \frac{378,513}{50,000} = \frac{\text{Cash income}}{\text{Cash cost}}$$

$= 7.5\%$

Irvin Fisher, an economist of USA

Defn: Describe the relationship between nominal and real invest rate under effects of inflation.

$$\text{To calc ROI} = \frac{\text{Net income}}{\text{Investment}} * 100$$

$$1 + i = (1 + r)(1 + \pi)$$

i = nominal rate of investment
= advertized rate
= before the adjustment of inflation

r = real rate
= with consideration of inflation rate

π = inflation rate

Siam owns a business portfolio, portfolio earns a return of 3.25%. However, last year inflation rate was 2%. Siam wants to determine the real return rate.

Portfolio ⟶ Program + project
↓
Program
→ work Package
→ work unit

$$1 + i = (1 + r)(1 + \pi)$$
$$\Rightarrow i \simeq r + \pi$$
$$\Rightarrow 1 + r = \frac{1 + i}{1 + \pi}$$
$$r = \frac{1 + i}{1 + \pi} - 1$$
$$= \frac{1 + 3.25\%}{1 + 2\%} - 1 = 0.012 = 1.2\%$$

CT ⟶ Payback period + today + next class
⟶ Payback period + BCR & FR + Scheduling (1st class)

L30 24/02

Project Schedule

1. What it is?
2. Steps in developing schedule
3. Step 1: Plan schedule Management
4. Step 2: Define activities

Previously

1. Project
2. Professional communication
3. Risks
4. Conflicts
5. Fundamental financial principles

1. Cash Flow
2. TVM
3. NPV
4. IRR
5. Payback period
6. BCR & FR

Schedule — ~~তফসিল~~ / ~~সময়সূচি~~
Plan to be executed

Project — Specific & finite activities to be completed to produce a result, under preset requirements.

Project Lifecycle — Sequence of phases
Can be modified
Phases — Initiation, planning & scheduling, execution, monitoring & control, closure

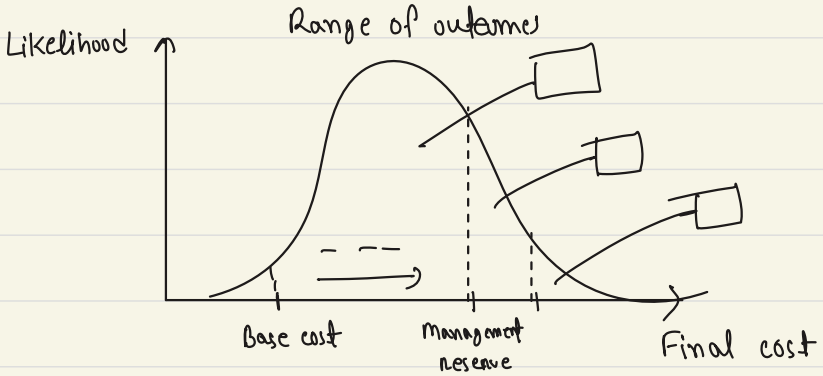
Scheduling — 1. Allocation of resources to project planning
2. Formalized planned action
3. Layout of actual work

Steps — 1. Plan schedule management
2. Define activities
3. Sequencing activities
4. Estimate activity duration
5. " " resources
6. Develop schedule

} briefly describe each step

1. Plan schedule management
   - Define policy, procedure & documentation to govern formulation of schedule
   - Items to be addressed : CR-TOS
     a. Contingencies
     b. Resources
     c. Task dependencies
     d. Organization procedure
     e. Stakholdens

Contengies:



2. Define activities
   Process of identifying and documenting specific action to be performed
   Task list — w/ coding

Build a Log Home

Thumb rule to define activities

- Ensure activity can be reliably estimated — WBS
- Based it on deliverables
- Have only one responsible party
- - -
- - -

Task Length — 8/80 rule

workpackage should take 8 to 80 work hrs

Project Scheduling

Steps:

1. Plan schedule management
2. Define activities
3. Sequence activities
4. Estimation of resources
5. " of duration
6. Develop schedule

Process of identifying & documenting relationships among project activities

FS → Finish to Start Relationship
Logical sequence → to obtain greatest efficiencies

Example: Task — A110 Excavation
Task — B120 Pour foundation 110 FS

Task dependencies

Task A & Task B
FS: Finish to start — A cannot start until B finishes
FF: Finish to Finish
SS: Start to start
SF: Start to finish

Leads & Lags

FS w/ 5 days Lead: B can't start until 5 days after A finishes

FS w/ 5 day Lag: ——————— before A finishes

Estimating activity resource: Identify & document types, quantities, & characteristics of resources for each activity

Excavator – 30 hrs @ 180 tk/hr — 5400 $
M. Rotul – 10 hrs @ 45 tk/hr — 450 $
5850 $

Some points to be noted

1. Resource is necessary doesn't mean resource is available
2. PM determine availability of resources, from RC (Resource Calendar)
3. Miss X involves in job title Y from march 26.

Estimation of Activity Duration
Method of " "

1. Analogous Method – Consult actual data from previous similar projects
2. Parametric " – Break down activity into fundamental unit & take unit time.
3. 3-point Estimating Method – avg { Pessimistic time, Optimistic time, Most likely time

Normal distribution

Beta distribution

Pessimistic + Optimistic + most likely
3 → 4 → ...

Develop schedule: efficient

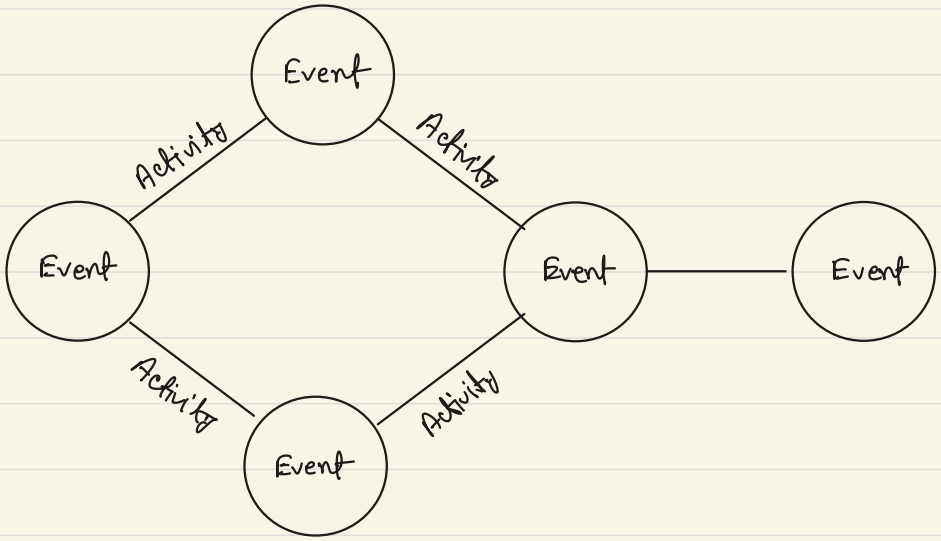
1. Develop official start & end time
2. Direct subcontractor
3. To determine total duration by CPM (critical path method) network. Analysis
4. Dealt w/ tasks that affects the project

L32 02/03

Network analysis

1. Network:

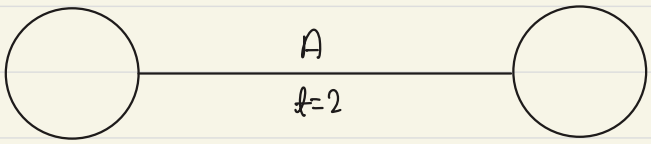
Flow diagram consisting of Activity and events connected logically and sequentially.



Activity:

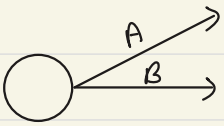
- well defined task
- Small unit of work
- Require time & resources
- Represented arrow head

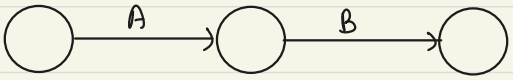
A = Excavation



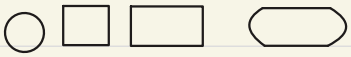
Types: Parallel activity

Series activity





Events:

- Begining & end of an activity
- mark the stant & completion of a project
- Require neithen time nor resources
- Represented by usually circle 

Types

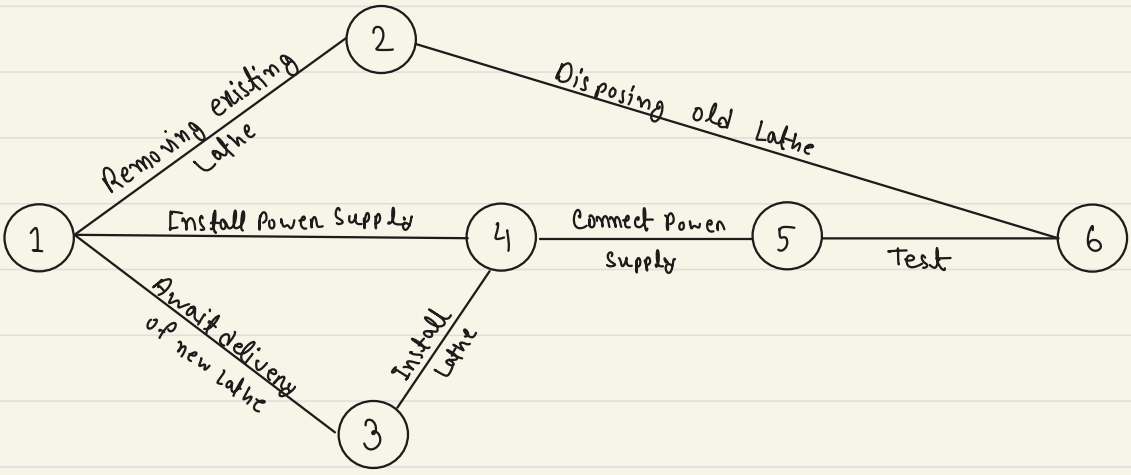
- Tail event
- Head "
- Ouel "
- Predesson "
- Successon "

Types of network

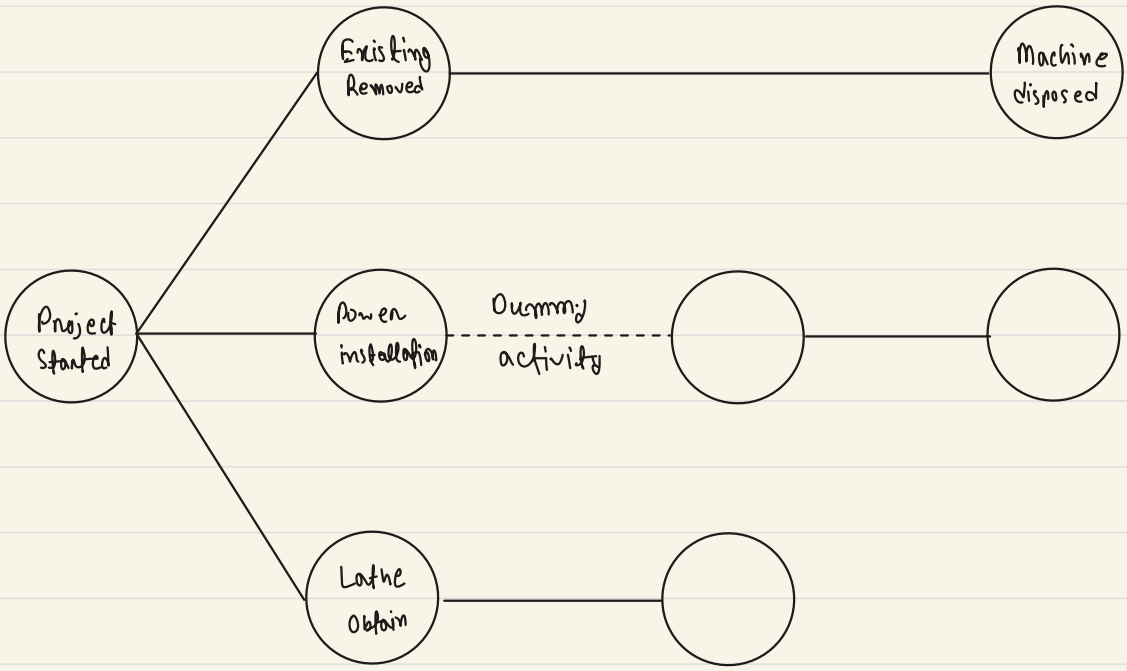
1. PERT method
2. CPM method

PERT - Project Evaluation & Review Technique
Event oriented

CPM - Critical Path method
Activity oriented



CPM Network



Dummy activity

- Type of activity require neither time nor resources
- To identify & dependence of operation
- Only a connecting line

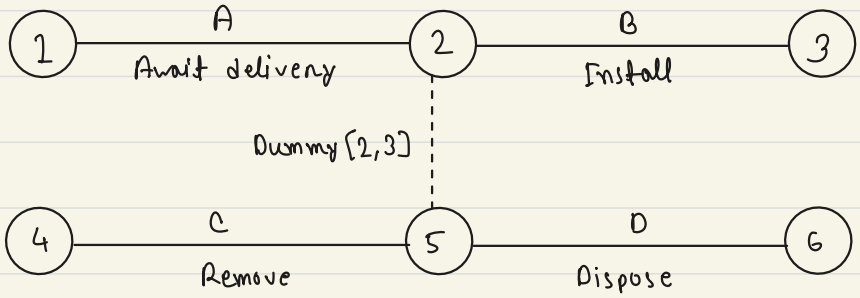
Set - A :

A : Await Delivery

B: Install

Set: C — Remove the existing

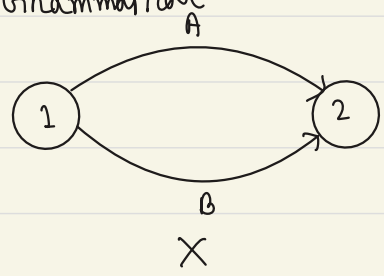
D - Dispose



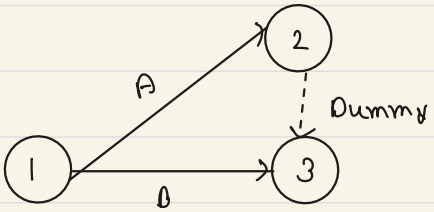
Purpose of using dummy:

1. Grammatical
2. Logical

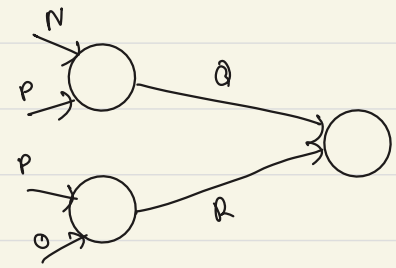
Grammatical

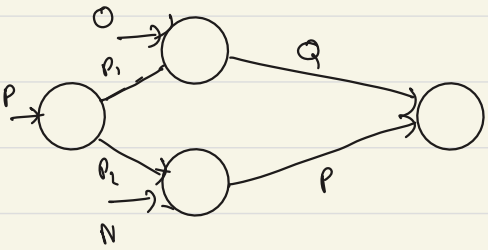


X



Logical





L33 03/03

Gantt Charts & Milestone Charts

Henry L. Gantt (1908)

1. Gantt Chart

FS – Relation

a. Pictional / Graphical
   nepresentation of duration and activities of project.
b. Two coordinates – vertical — Tasks
   - Horizontal – Duration
c. Each bar
   nepresent an activity
d. Begining & end of bar
   nepresent time start & end of each activity
e. Each bar nepresent
   time required to complete activity.

2. Stages of dev Gantt chart

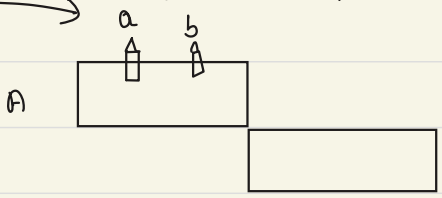
a. Breakdown of project into activities
b. Decide methods & sequence
c. Assign duration

Gantt — Milestone — Network

3. Limitation & Remidial measures

a. Lack of degree of details
   ↳ by breaking into sub tasks — milestone
b. Review of project progress
   ↳ by hatched lines

A = Removing existing lathe
a. Dumping in stone
b. Final disposal



c. Interrelationship among subactivities of different activities cannot be shown.

d. Time uncertainties

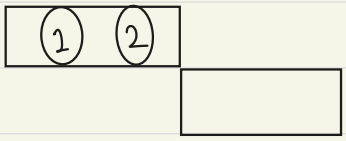
4. Milestone Chart

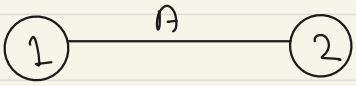
a. Key events of main activities

Benefits

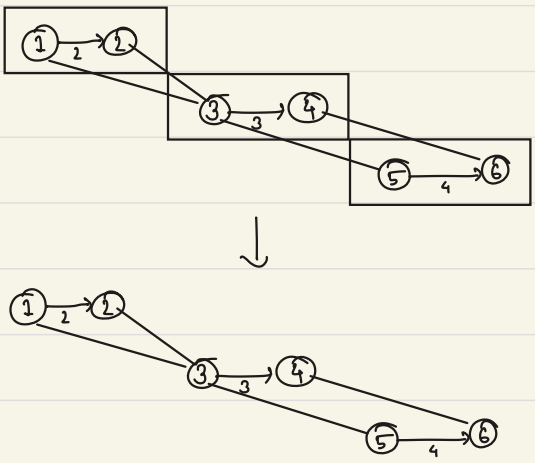
Shortcomings

1. Dumping in stone
2. Final disposal





Development of PERT Network



Advantages of network diagram

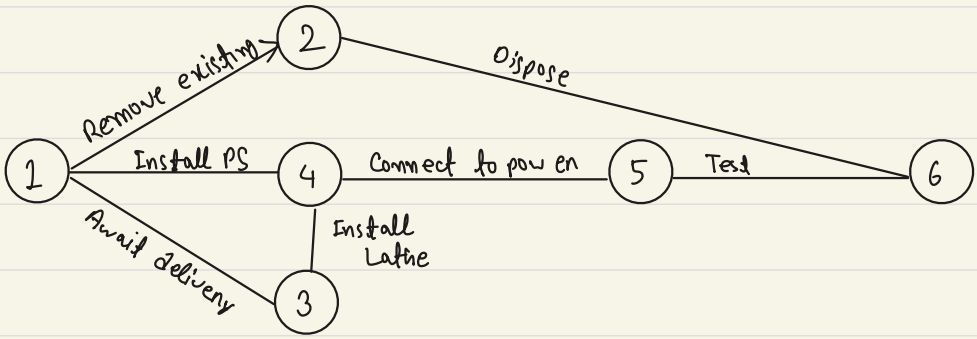
L34

08/03

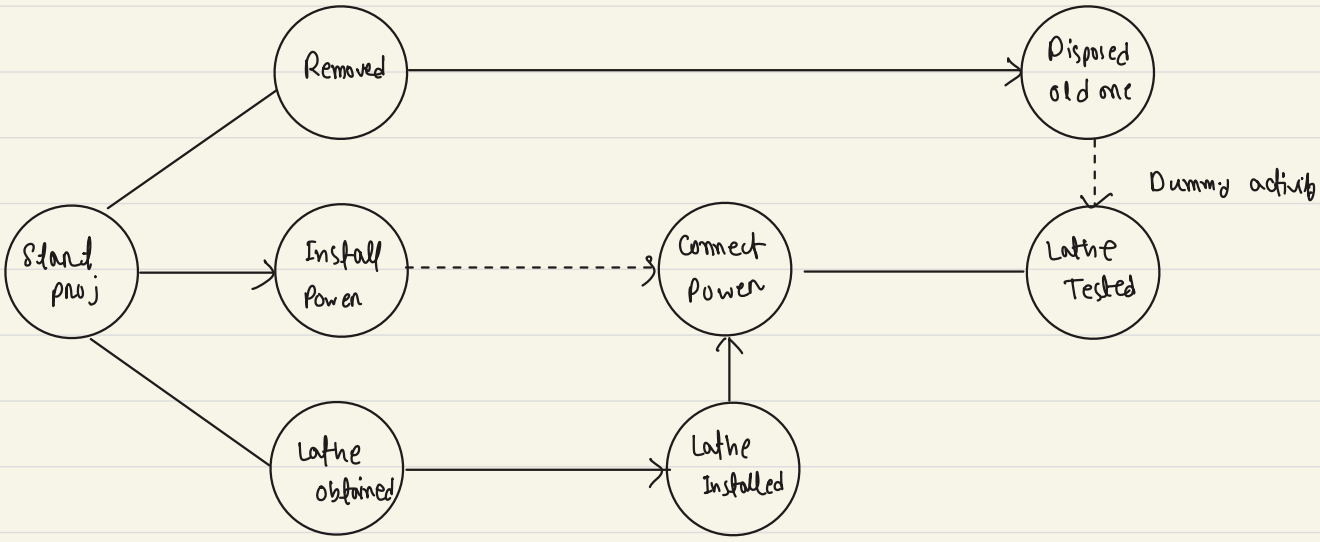
Network analysis

1. Await delivery
2. Remove existing
3. Install power
4. Install lathe
5. Connect to power
6. Test
7. Dispose of old lathe

CPM — Critical Path Method — Activity oriented network



PERT - Project Evaluation and Review Techniques — Event oriented Network



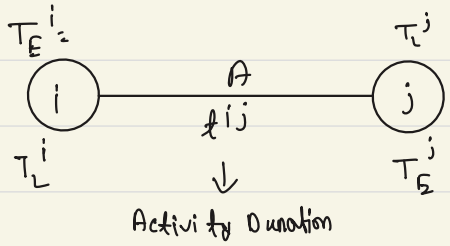
Application of CPM network

1. Repetitive project
2. Time estimation is fairly accurate
3. Cost estimation is a fair degree of accuracy
4. Effective for planning
   scheduling
   controlling

A = Delivery of goods

T_E = Earliest occurence time for tail event

T_L^j = Latest event time for succesor event



Critical path

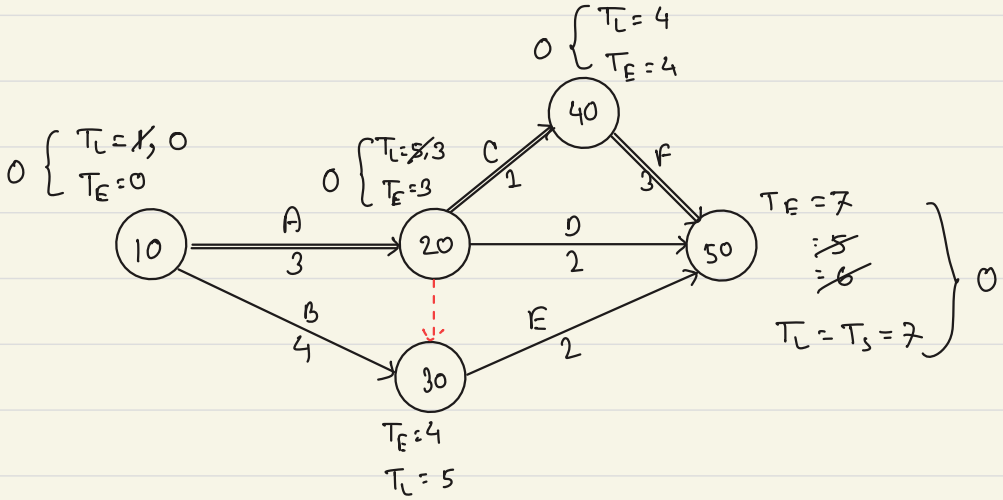
$$\text{Float} = T_L - T_E = 0$$

$$T_E^i = (T_E^j + t^{ij}) \text{ or } (T_E^j + t^{ij})_{max} = T_s$$

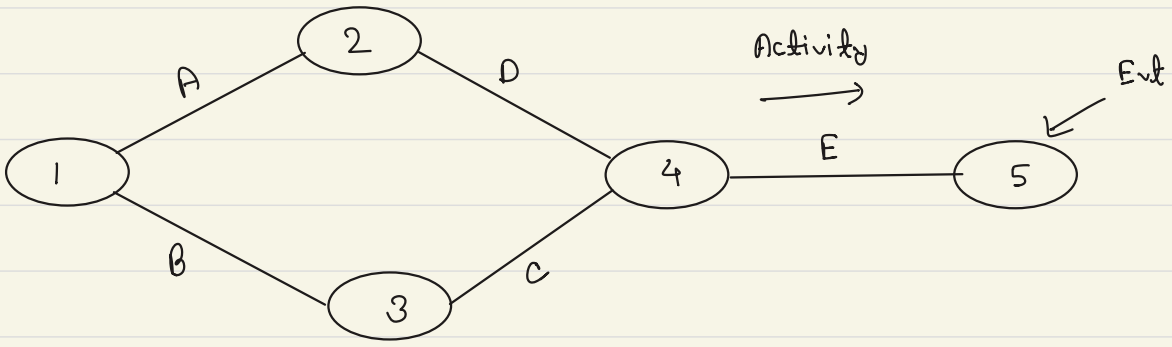
$$T_L^i = (T_L^j - t^{ij}) \text{ or } (T_L^j - t^{ij})_{min} = \text{Project scheduled time}$$

or completion time

or contractual obligation time


0
$T_L = 1, 0$
$T_E = 0$
10
A
3
0
$T_L = 3$
$T_E = 3$
20
B
4
30
$T_E = 4$
$T_L = 5$
C
2
40
$T_L = 4$
$T_E = 4$
D
2
E
2
F
3
50
$T_E = 7$
$T_L = T_S = 7$
0

Project Network



2. Types

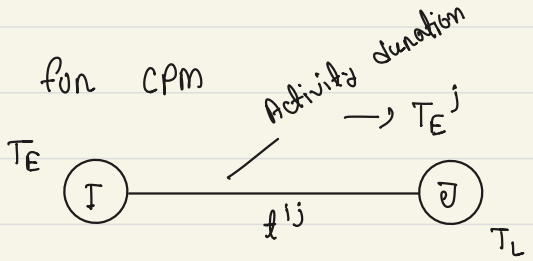
a. CPM – Critical Path Method (Activity oriented)
b. PERT – Project Evaluation & Review Technique (Evt oriented)

3. Diffference btwn CPM & PERT

CPM:

1. Time estimation is done as accurately as possible
2. Cost is controlling factor
3. Critical path – calculated by Float philosophy

Time for CPM

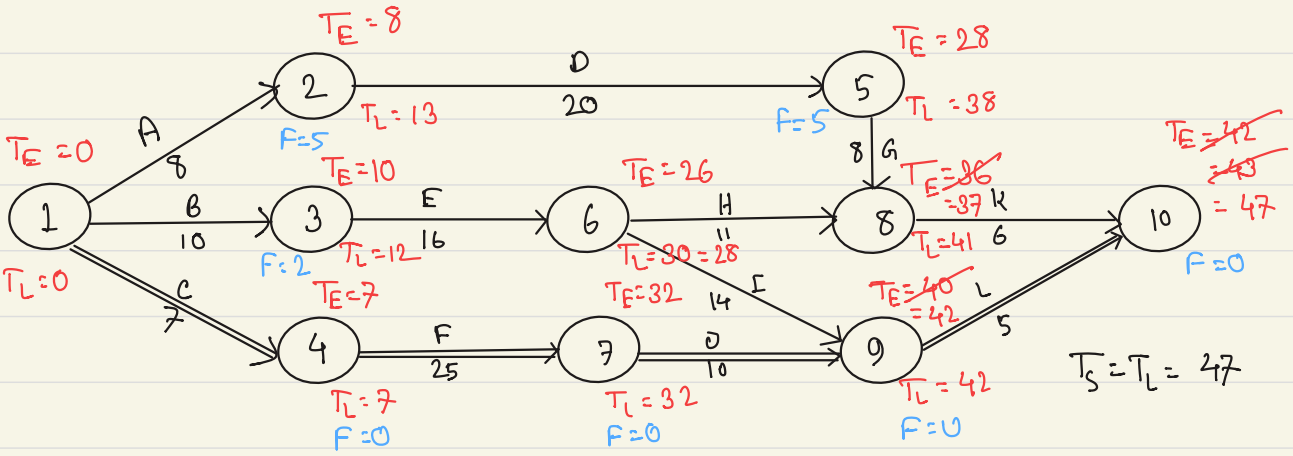


T_E = Earliest occurance time of an activity

T_L = Latest allowable time of an activity

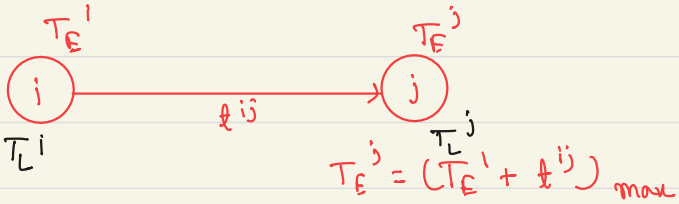
$$T_E^j = T_E^i + t^{ij}$$
$$= (T_E^i + t^{ij})_{max}$$

T_E of last activity of last event | $T_E = T_L = T_S$ = scheduled project completion duration



CPM

Float = 0



PERT

Slack = $T_L - T_E = 0$

$T_L^i = (T_L^j - t^{ij})_{min}$

Float → F

Critical path: Line joining the float zero
Longest path through network
Indicates project duration

Float → 3 possibilities

→ -ve, time availability is less than actual duration
supercritical activity
needs special attention & action

→ 0, time availability equal activity duration
critical activity
Need above normal attention & action
No freedom of action

→ +ve, time availability is more than activity duration
Subcritical activity
Need above normal attention & action
Some freedom of action

L35

07104

Rough / Final 02/05

Lec 01

Project: A temporary endeavor undertaken to produce an unique product, service, or result under preset conditions.

Characteristics:

1. Temporary nature ← most impo char
2. Definite duration
3. Produces output

Project ends when:

1. Objective is attained
2. Funding is exhausted
3. Resources are no longer available
4. No longer necessary
5. Legal issues
6. Government policies

Types of project

1. waterfall: Traditional form
   Scope of work is fixed, well defined
   Construction is an example
2. Agile: Scope of work is not well defined
   Newer form, e.g. soft dev
3. Hybrid: Large proj requiring both construct. & soft dev.
   Combination of both

Project planning: Phase of project managent in which one determines the actual steps of completing project.
They include:

i) Laying out timeline
ii) Budgeting
iii) Setting milestone
iv) Assessing risks
v) Assignment of tasks

Full project cycle: Initiation → planning → execution - Closing

Components of project plane: Task, milestone, people, documetation, and time

Task → activity
milestone → points within schedules indicating progress

Construction

Construction management — a professional service that provides owner w/ effective management of the project's schedule, scope function, quality, safety, etc.

owner — who commissons the project + funds
Architect — designs
General manager — oversees day-to-day task

Construction manager — protects owner interest.
oversights the entire project
Delivers the project within budget, time w/ expected quality
Saves money, industry standard

Project chars (mone)

- Temporary
- Unique deliverables
- Progressive elaboration → adds detail incrementally

- Purposeful
- Logical
- Structured
- Conflicts, risks, limited

Lec 02

Project management — Application of skill, knowledge, techniques to project activities to meet requirements.

Work Breakdown Structure — Hierarchical arrangement / breakdown of total scope of work to be carried out by project team

Elements of WBS — Program
Projects
Tasks
work package
work units

Requirements of WBS:

i) main task
ii) Divide into subtasks
iii) Establish relationship among each task to the whole
iv) Graphical representation
v) Advertising information to all stakeholders
vi) Reporting information / updates upward to seniors

Advantages of WBS

i) Allocate budget for individual task
ii) Assign risk factor for " "
iii) Build up budget from bottom
iv) Able to register risk for subsequent tasks

Objective of WBS

Be able to control project by allocating resources and time constraints to individual tasks

Always easier to control a series of small tasks than a giant one

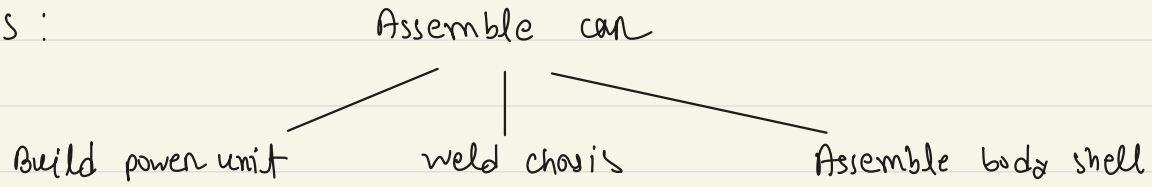
Product Breakdown Structure (PBS)

Hierarchical structure of a product that the project will make.
Decomposes main product into its constituents or parts

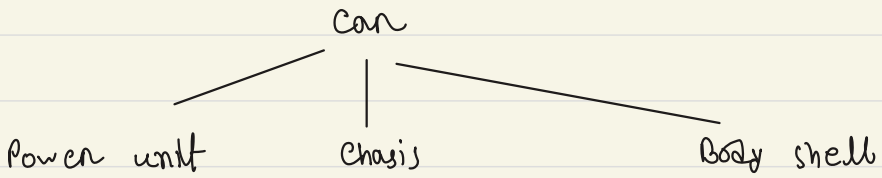
PBS & WBS

i) Both are hierarchical stages of project
ii) PBS is hierarchical diagram of product
WBS " " " " work
iii) Both on the principal of subdividing project into manageable units
iv) Though interrelation exists, then not necessarily mean subsequent
v) Project manager decides to which degree each to be broken down

WBS :


Assemble car
Build power unit
weld chasis
Assemble body shell

PBS :


Car
Power unit
Chasis
Body shell

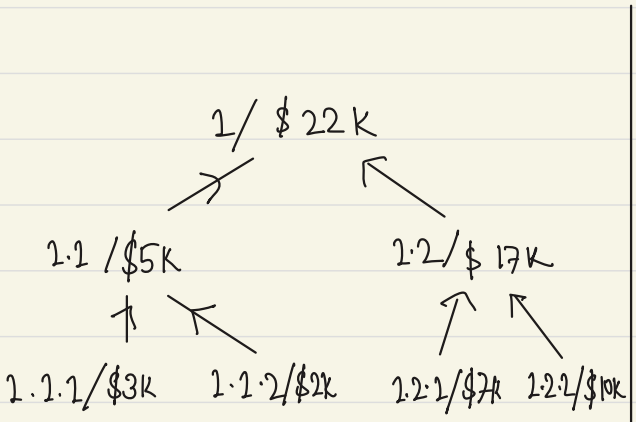
Lec 03

Cost Breakdown Structure (CBS)

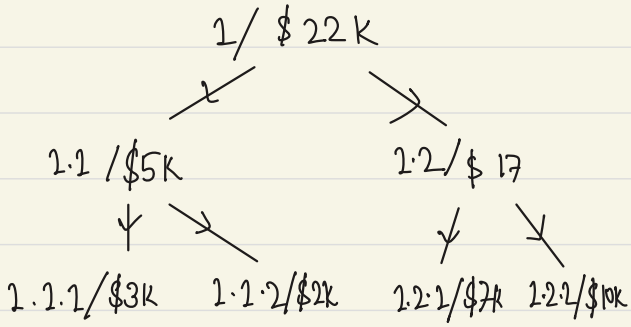
Breakdown of cost of various components of WBS or PBS
-> associates cost to the comp. on above
It monitors actual cost to budget

Two types of breakdown strategy

1. Bottom up cost est
2. Top down cost est.



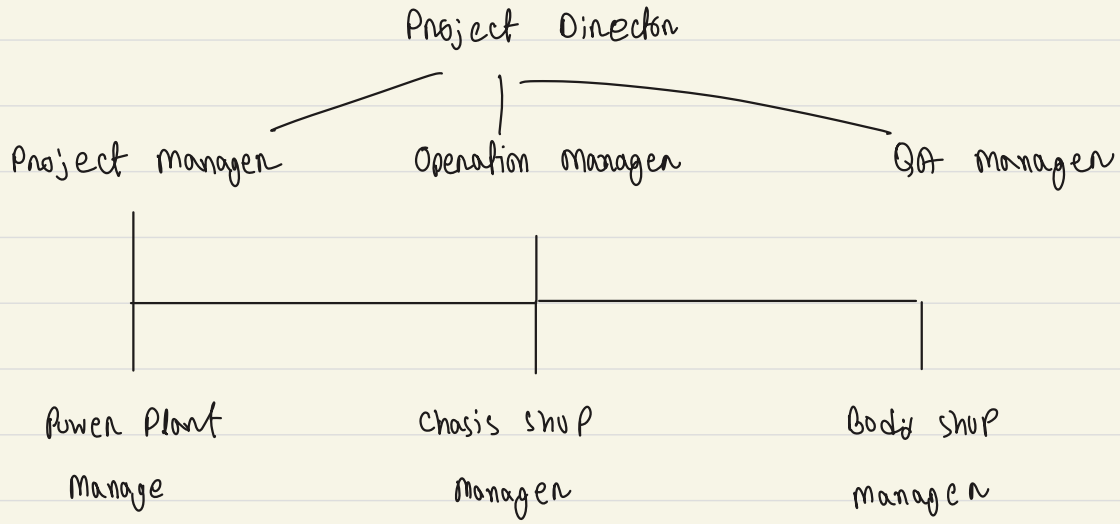
Bottom up



Top bottom

Organization Breakdown Structure (OBS)

2. Project planning
2. Resource management
3. Time & cost tracking
4. cost allocation
5. Revenue & profit report
6. work management



Proj. director → responsible for completion of multiple major op.

Proj. manager → plans, organizes exec project within constraints

Op. manager → day to day task

QA manager → Assures quality ← Reports directly to proj. dir. to ensure independence

OBS v. WBS

Define proj. scope
Think action
↳ composed of deliverables & phases

↳ composed of people
Think people
Define accountability

Responsibility Assignment matrix / RACI matrix

R A C I
↳ Informed
↳ Consulted
→ Accountable
→ Responsible

matrix
vertical → PBS/WBS
hor. → OBS

Links WBS task with people (OBS)

Describes roles & responsibilities of every person in completing task

WBS:

0.0 Building construction:

1.0. Substructure

1.2. Site clearing
2.2. Excavation
1.3. Foundation work

2.0. Super structure

2.1. Column casting
2.2. Beam casting
2.3. Brick masonry

3.0. Finishing work

3.2. Flooring
3.2. Plastering
3.3. Painting

4.0. Services

4.1. Electrical work
4.2. Plumbing work

2.0. Foundation system

1.1. Footing

2.0. Structural el.

2.1. Column
2.2. Beam
2.3. Slab

3.0. Building el.

3.1. wall
3.2. Door, window
3.3. Roof

4.0 Finishes

4.1. Plumbing sys
4.2. Electrical sys.

RACI Matrix: Proj. dir, Proj. mang, Site Eng., Quality Eng, Contractor

Task	PD	PM	SE	QE	CT
Site clearing	I	A	R	C	R
Excavation	I	A	R	C	R
Foundation work	I	A	R	C	R
Structural work	I	A	R	C	R
Finishing work	I	A	R	C	R
QA inspection	I	A	C	R	C
Handover	A	R	C	C	I

Lec 04

Proj. to have:

i) one specific purpose
ii) specific time to start
iii) Ends when obj is obtained

Things req to complete proj:

i) material
ii) manpower ← single determinant factor
iii) Technical know-how

Impact of proj. on countries dev.

i) Economic growth — employment op.
ii) Infrastructure improvement
iii) Development — w/o implementing proj., plans can't be realized

Proj. in country perspective — Bangladesh

i) scarcity of materials, limited financial cap
ii) unskilfull manpower
iii) Backlogged socio-economic in terms of technology

Bangladesh is not in a position to utilize technology for maximizing project efficiency.

Project must balance time, cost, resources

Efficiency increases through technilogical advances, taking into account human factor.

Project req.

i) complete w/ minimal time
ii) use available manpower as sparingly as possible
iii) minimum capital investment w/o delay.

Aspects of project management:

i) Define project scope
ii) Identify deliverables
iii) manage risks
iv) Ensure communications

Project management approaches

i) waterfall: Scope well defined
well detailed execution
ii) Agile: Scope not well def
Iterative process
iii) Hybrid: . . .

Tips for eff. project management CGS - MTM - RSL

- Eff. communication
- set clear & focused goals
- create schedules
- monitoring tool
- multi-skilled team member
- motivate members
- Risk assessment & contingency planning
- Involve stakeholders
- Lead

Best proj. leader:

- Ethical
- Team player
- Honest & true to their word
- Proactive
- Ask question

Efficient proj. managent is impo because:

i) 32% proj fail due to poor mana-
ii) 68% " " to meet deadline due to
iii) 97% business believe efficient proj. management is impo
iv) 80% high performing businesses are run by managers w/ professional qualifications
v) On avg, a large IT proj. runs 45% over bud.

Alt:

i) Ensure proj. success — on time, within budget
ii) Improve resource utilization — mats, manpower
iii) Control costs time, quality
iv) Enhances communication
v) - -

Lec 05 Project Planning & Construction Management

Phases (5):

i) Proj. initiation
ii) Planning & scheduling
iii) Executing
iv) Monitoring & controlling
v) Closing

Project plan: Impo aspect of project that,

i) Provides direction
ii) Provide an unifying framework
iii) Helps reveal risk & opportunities

Project planning philosophy:

i) Done logically, honestly, thoroughly
ii) Past experiences provide logic
iii) Differences in experiences accounts for,
   a. Unusual client demands
   b. Internal / external delaying factors
   c. Out of way locations
iv) Each aspect to be individually scrutinized
v) Potential problems to be tackled

Unusual client demands:

Owner wants to build eco-friendly house w/ repurposed
However, after placing order, found out HOA allows brick only

Out of location:

Nice hotel is build, but no nearby coffee shops/ restaurants to go.

Internal delaying factors:

i) Financial solvency
ii) Equipment shortage
iii) Personnel issues

External delaying factors:

i) Nature & society: Bad weather, strikes
ii) Government interference
iii) Untimely payments forcing contractors to reduce labor
iv) Theft or accidental damage to equips.

Lec 05

Types of project planning

i) strategic — think long term
ii) operational planning — think on-going project activities

Strategic planning:

i) Involves high level persons — owner's corporate planners
ii) what project to be built
iii) what will be the end date
iv) sets strategic guidelines
v) selects project construction team

Operational planning:

i) Prepared by project construction team
ii) Documents how to do the job & specific course of action to be taken to reach goal

Project construction team:

i) Client
ii) Consultant
iii) Architect & engineer
iv) Contractor
v) Subcontractor

Fast track scheduling

Technique to perform tasks in parallel, which were originally meant to be done in sequence

Points to be considered during preparing operational plan:

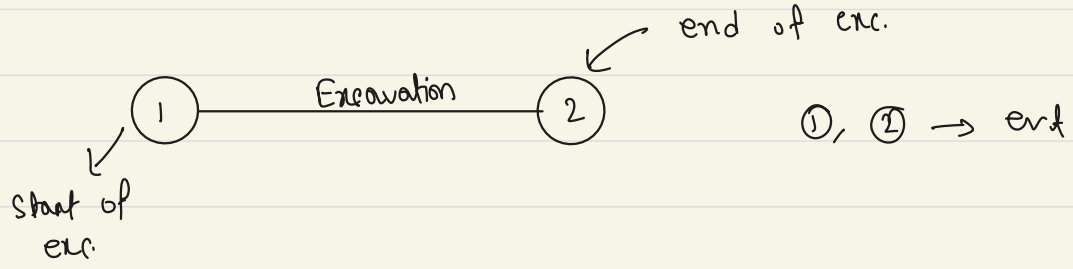
i) Strategic target date
ii) Availability of company resources & manpower
iii) Company policies that may prevent to meet target date
iv) Long delay delivery of resources
v) Resource availability
vi) Impact on top of existing workload
vii) Fast track scheduling approach

Lec 07 Project planning phase

Plan : Statement of intent
what is to be done to the resources to achieve the intent

Plan lists the target (event) & means of achieving (activity) them

Event: step; before or after start of an activity
Activity: Actual performance of the task
↳ take time & resources
↳ doesn't take time/ resources



Aspects of project planning:

i) Strategic theme: Broad area of focus
E.g., satisfaction

ii) Goal: Statement translating organization vision
E.g., be trusted partner of clients

(iii) Objective: Focused and measurable target
Increase customer satisfaction from 70% to 80% by Mar 26.

(iv) Strategy: Means of achieving the objective
E.g., setup conference w/ clients

(v) Events: (a) Select date & venue
(b) Develop agenda
(c) Invite speakers
(d) Dev social evt
(e) Dev. menu
(f) Send out invitations

(vi) Activities: Time & resource allotment

Policy: Guideline
Rule: specific action under circumstances

Lec 08

Steps in project planning : DED-EDT-CO

1. Define final goal
2. Establish targets & strategies to attain the goal
3. Develop forecast & means of achieving those targets
4. Evaluate org resources
5. Dev alts
6. Test against org. policies
7. Choose an alt
8. Decide on a plan

Important appointments

Project director: True leader at strategic level
Responsible for the completion of all projects
Handles day to day op on behalf of owner

Program manager :

Responsible for all projects under a program
Monitors budgets and ensures benefits as program progresses
Proj managers are accountable to prog. manager

Project sponsor :

Investor : has ultimate say
Ensures proj. produces the agreed benefits

Project manager:

- Handles day-to-day op of project
- Ensures team members are capable
- Necessary resources are present
- Monitors, communicate w/ stakeholders

Functional manager:

- Directly affiliated to an org. unit
- Communicate w/ team and ensure everyone knows what is expected of them
- Eval. overall performance

Project steering committee:

- Made up of high level stakeholders
- Provides guidance
- Highest decision making body
- Head is usually a chairman

Project implementation committee

- Made up of seniorest members of the org.
- Head of org. chair the committee
- Outside of company people may also be present.

03/05

Lec 09

Project Quality

Ensuring that end product not only meet customer spec but also what sponsor and key business personnel wanted.

Striking a balance between time, cost, and quality.

Quality product

If a product meets the specified permission criteria for a minimum specified time then its said to be a quality prod.

It has to be – defined, planned, designed, manufactured and commissioned to a set of standards

managing product quality

Everyone involved should be committed to ensuring product quality

Quality, a state of mind, it should be permeated through org from board to operator of the bo

Everyone should do their part effectively ensuring their work meets the standard specified

QA audits should be done frequently

Consistency of performance:

i) Quality standards have been defined
ii) Quality req is advertised
iii) Correct machines are set
iv) Staff & operatives been trained
v) Materials are checked
vi) Adequate control points are set
vii) Product is checked at designated spots
viii) Feedback & rectification process has been set
ix) Regular quality audits

QA: Planned and systematic actions necessary to get the confidence that product will meet required standards.

QA actions provide means of quality control

Quality plan: control document that sets applicable quality standards inspecting methods, and inspecting authority.

- Standard to be applied
- method of inspection
- % items to be checked
- Ins. authority
- Acceptance criteria for checks

Lec 10

Quality audit: A periodic check that a quality set procedure is still being carried out.
Org registers as being in compliance with a quality standard such as ISO 9000, then an ~~independent~~ check, annual audit may be carried out by an independent authority

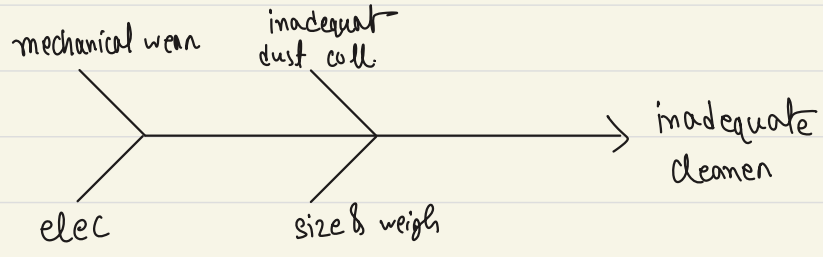
Quality review: Check of the quality standar, procedure to determine if they are up-to w/ current reqs.

Causes & effect:

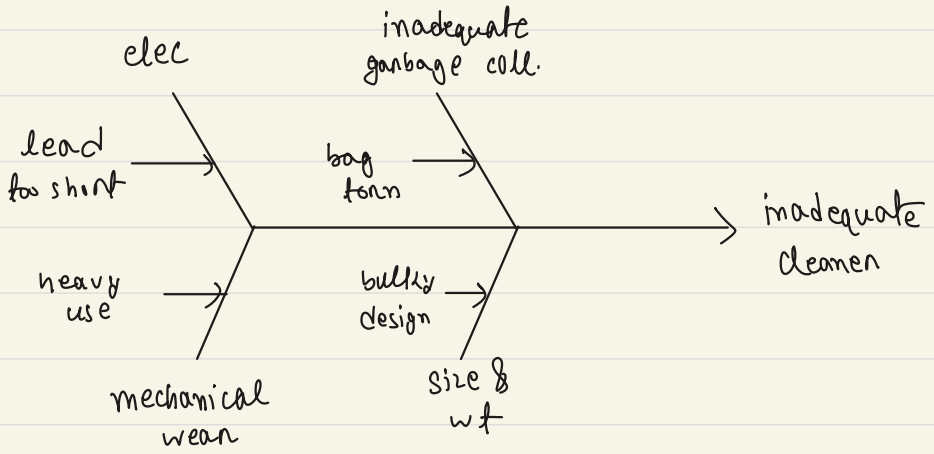
- Select a critical item
- Identify all possible mode of failure
- Rectify by iteration process set in place

Ishikawa / fishbone diagram — A cause & eff diagram used to identify all possible causes of failure and its effect

1. List down the main causes a product may fail.
   E.g., for domestic vacuum cleaner, it may be mechanical, physical, electrical, suction
2. Draw fishbone diagram:



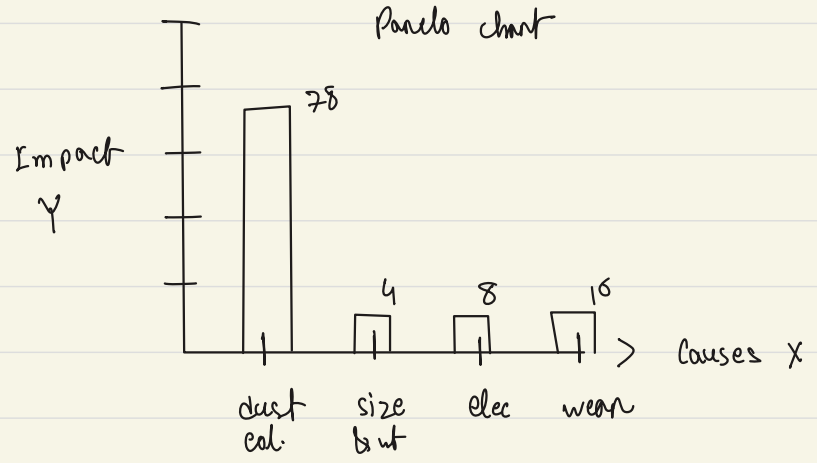
3. Draw sub causes:



4 Test over a period of time which of these failure mode happens the most, and concentrate on them
Assess by Pareto Analysis

Pareto's Law: Small fraction of elements accounts for large fraction in terms of effect

80/20 rule



78
4
10
8

Trend analysis :

By logging, (i) Non conformance
(ii) Non accepted variance
(iii) Delays
(iv) Cost overrun
(v) other

Then check for trend, address by measures

Lec 11

Project risk: evt that may or may not happen, but if it happens the may have significant impact on outcome

Analysis: 1. Defn probability of occurance – e.g., 50% chance in sponson changing
2. Defn its impact on project
3. Identify highest risks and develop mitigation plan

management plan: 1. Develop respond plan docs at begining of project
2. Also dev draft of response before tender to ensure budget is available

Stages of risk management:

1. Risk awareness
2. Risk identification
3. Risk assessment
4. Risk eval.
5. Risk management

Method of risk identification:

1. Brainstorming

   Collective effort by team members, covers wide range of topic
   Can be time consuming, effectiveness relies on facilator

2. Prompt list

   Helps from past projects; saves time by focusing on real possibilities.
   Limited scope; may not be applicable to current proj.

3. Check list

   Similar to prompt list; company specified list

4. WBS

   Derived directly from project scope; fast, economic
   Limited scope; everything may not be considered in WBS

5. Delphi method

   Systematic method by sending out questionnaires to individual experts
   Prevents single dominance

6. Asking experts

   Interviewing expert on this field

Risk owner: who is the best to manage each risk
in charge of monitoring & managing

Risk to be considered:

1. Technical
2. Financial
3. Environmental
4. Cultural
5. Political
6. Legal
7. Operational
8. Resource

Lec 12

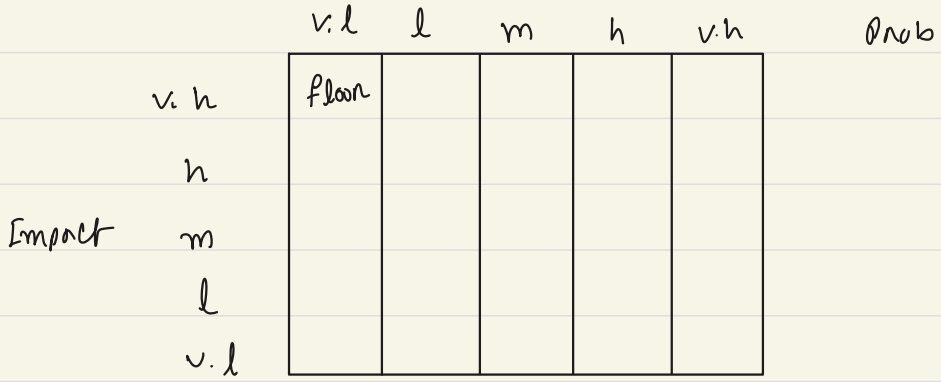
Qualitative stage

Risk assessment: Screening of most probable + impactful risks from the long list of potential risks.

Each risk is given a score of probability & impact

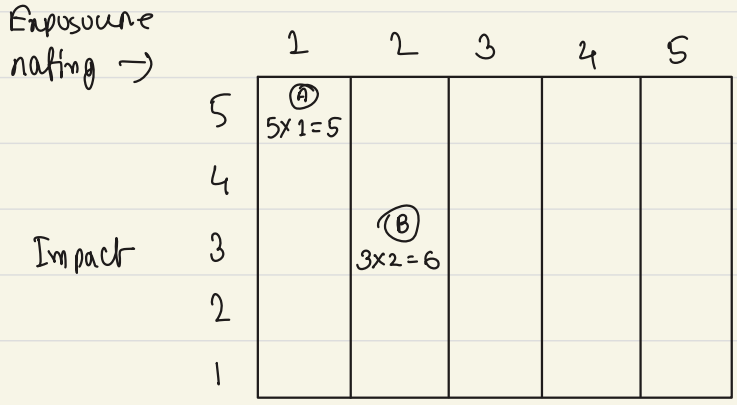
v. low, low, med, high, v. high

Taken into account: Past exp.
Statistical data
Exp. opinion
Closeup report



Risk evaluation: Quantitative analysis

Establish an order of importance or priority



Still look out for minor ones

Risk management:

1. what to do → Risk response plan
2. who will do → Risk owner

Options available to risk owner

1. Reduction
2. Mitigation
3. Insurance
4. contingency
5. Transfer
6. Sharing
7. Defenence
8. Avoidance
9. Acceptance

Risk monitoring

Risk register should be implemented which lists all possible risks and their management

Periodic checking, ammendments

Lec 13

Ministry of Planning → Planning div → Planning commision
→ BIDS
→ NAPD
→ Statistic div → BBS
→ IMED → CPTU

Planning Commission (PC)

Under ministry of planning
Tasked w/ socio-economic dev. of the country
Three-fold role: Advising govt
Executive: preps ADP, process dev proj for approval
Coordination
works through NEC & ECNEC

ADP: Operational document of the GoB's five year plan.
It includes, govt. funded proj
Foreign aided proj
Published on June
It consists of, main investment program
technical assistance
self-financed programs
} classification of proj.

NEC — National Economic Council

Highest policy making body of GoB on economic & dev.

Its functions: provides guidance on 5y plan, ADP
Approves proj, policies
Review implementations
Take decisions
Appoints committees

ECNEC — Executive committee of Nat. Eco. Council

ADP formulation
1. Resource committee estimates available resource
2. Programming div. allocates res sector-wise
3. Prog. div. prepares draft ADP at PC meeting
4. Planning div. submits final ADP to NEC for formal approval

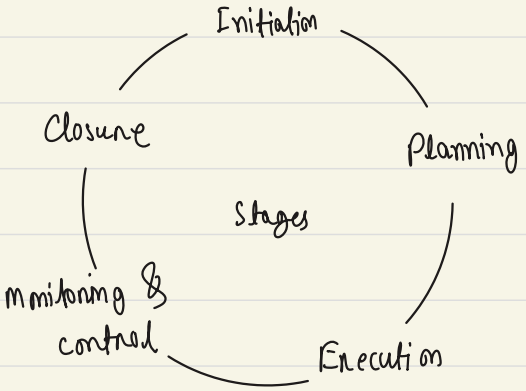
ADP 2025-26: Approved 2.3 tn tk for fiscal yr 2025-26 by NEC
1.44 tn local, 0.86 tn foreign aided
1183 proj (228 climate, 79 PPP)
Emphasized on transport, comm., power, infrastructure
Increased 6.58% than prev

Duties of IMED — cost nationalization, import, training of officials, participate in meetings

CPTU — procurement

Lec 14

Project life cycle : Sequence of phases a project goes through from its initiation to closure



Number of phases are determined by management based on,

i) needs of the org
ii) nature of the proj.
iii) area of application

Pattern of proj. life cycle :

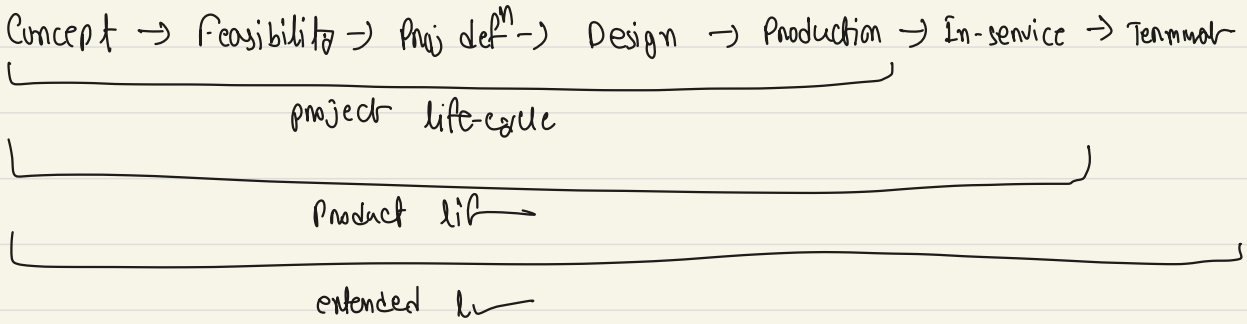
i) concept
ii) feasibility
iii) Evaluation
iv) Authorization
v) Implement
vi) completion
vii) Operation
viii) Decommisim

normal life cycle
Product life
extended life cycle

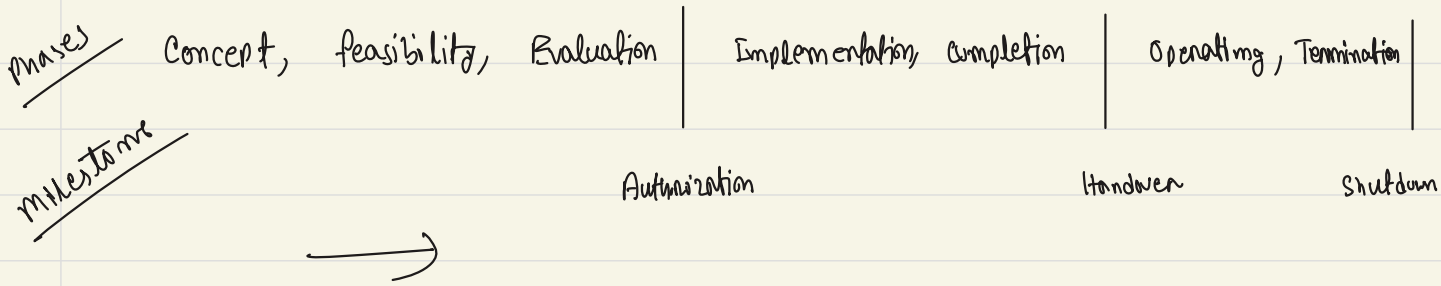
Type of proj. life cycle:

1. Normal proj. life cycle: Proj ends w/ issuance of acceptance letter after perf. test is successful
2. Extended life cycle: Two additional phases — operational phase
   termination phase

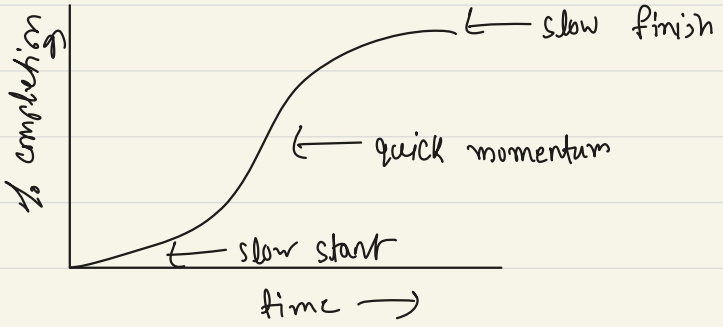
Life-cycle of mod proj:



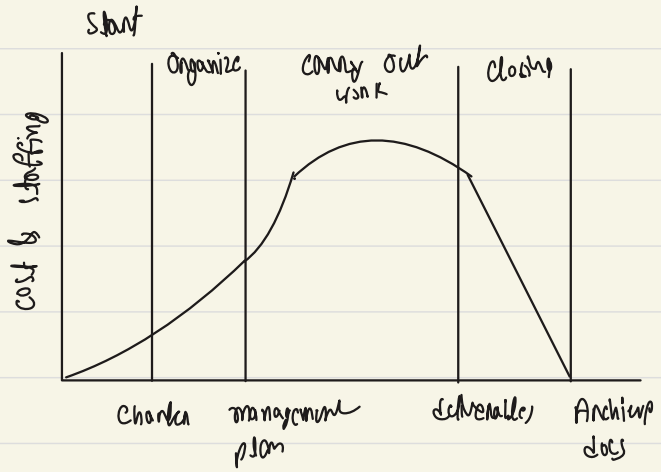
Project management in proj. lifecycle



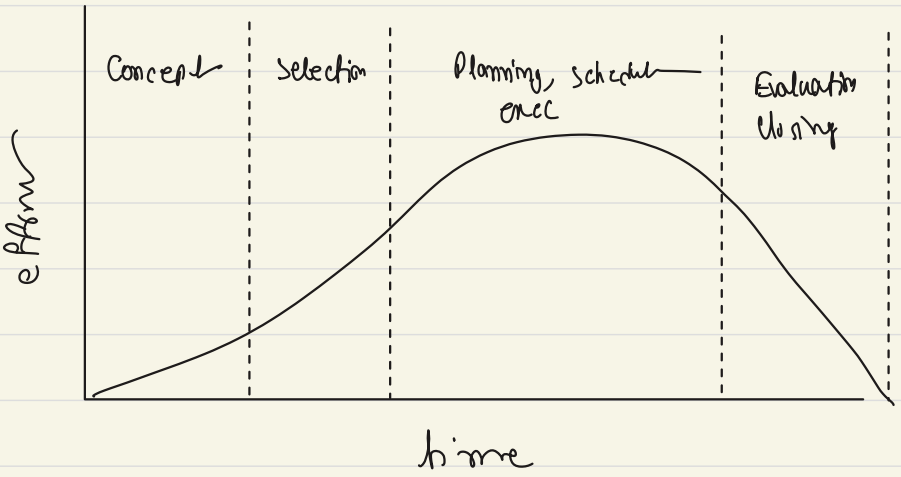
Projected life-cycle curve: (Extended S-curve)



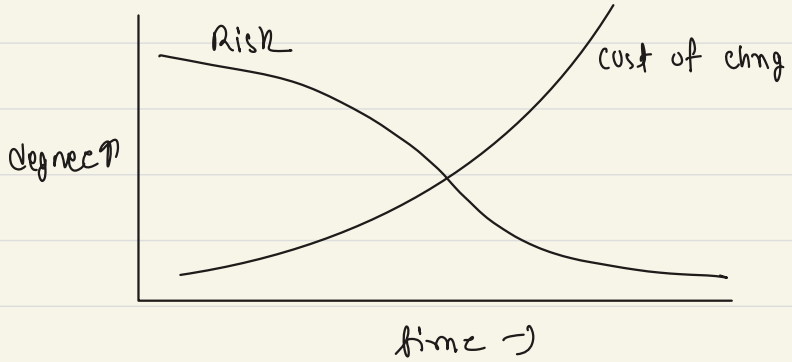
Project lifecycle w/ output (cost) & staffing



Time distribution of proj. effort



Risk & uncertainty



Project milestone: Key evt. at project timeline

Lec 15

Four stage model of project:

1. Formation: Tentative initiation
   bootleg works are done
2. Detailing: Planning, budgeting, allocating
3. Execution
4. Termination

PM: Responsibility, authority, accountability to complete proj safely and in-time within budget

FM: management authority within department

Proj team: PM & group of individual working on the proj.

Project conflict: A serious disagreement/ argument, protracted one, over which people are frustrated on about to frustrate.

Methods of conflict resolve:

(i) withdrawal — silence
(ii) Smoothing — play-down diff
(iii) Compromising — no winner, no loser
(iv) Forcing — win-lose ← least eff
(v) Confrontation — can be win-win

Confrontation: Facing the problem directly

1. Negotiation ← most eff.
2. Arbitration
3. Use of law
4. Forcing

Arbitration: Use of arbitrator to settle a dispute

Arbitrator: Independent person/body appointed to settle dispute

Contracts may fail to settle disputes:

Ambiguity of law: different party understood different meaning
No contract can cover all possible circumstances

Lec 16

Categories of conflict:

1. Goals & expectation confl.
2. Authority confl (locus of authority)
3. Interpersonnel confl.

Conflict between PM & FM:

conflict of authority; who makes which decision

- resource allocation
- technical choices
- communication
- admin processess

Ideally, PM controls scheduling, flow, timing
FM controls staffing, technical choices

Practically, they overlap

Interpersonnel conflict:

conflict btwn people at the project
over-time they may develop
E.g., btwn senior management & PM
PM & client

Lec 17 Conflict in chronological stages

Stages of proj:

1. Evaluation stage
2. Build-up stage
3. Main stage
4. Phase-out stage

Conflicts in evaluation stage:

Almost nothing is decided; not even objective
Confusion into people

Fundamental issues:

(i) technical obj to be defined
(ii) Priorities to be set
(iii) Resources must be committed

} must be addressed before moving into build-up stage

Clearification of PM (authorative), FM (functional) roles

Conflict in build up stage

Schedules
Technical issues
Authority
Priorities

Conflicts in main phase

1. Scheduling – delay in one task:
   PM wants faster progress on followup task
   FM req more resources
2. Technical conflicts

Conflicts in phase-out stage

1. Scheduling
2. Technical
3. Interpersonnel stress
   ↳ second ranked source of conflict
   stress of completing the proj fast
   nature of anxiety on leaving the proj and return
   Also, may be on the distribution of capital equips & supplies
   on with the new team

Lec 18

Conflict negotiation

Ability to reduce & resolve conflict in such a way that supports proj goal

Negotiation — discussion to reach an agreement

Pareto optimal solution

A solution where no one party can be made better off w/o making the other party worse off by same amount.

Outcome in terms of org. rule

No-win, no-loss situation

Situatuations that require highest lvl of negotiating skill

1. Use of subcontractor
2. Use of input
3. Management changes

Negotiating technique

select partner rather than contractual agreement

→ Diversification of proj risk
→ Pooling of knowledge / skill
→ Avoidance of capital investment
→ Shortening duration
→ Avoid litigation

Project chartering

Aggreement between groups / parties on large endeavors
Transforms adversial relationship into collaborative one.

- Detailed deliverables
- Attest to the fact that senior management, PM, FM are one the same page
- won't change anything w/o prior consultance

—

- deliveries on time
- completion of contract, on schedule
- keep cost below 2% growth

Scope change

Three causes → 1. Technological uncertainty; err in assessment
2. In light of new info leading better alt
3. It is a mandate by, e.g. govt. law

Multi-stepped approach for building partnered relat—

1. Firm commitments
2. Agreement on — joint review
how to resolve disagreements & problems
3. Acceptance of goal of continuous improvements
4. Continuous support
5. Joint review

Lec 19 negotiation methods

Requirements:

1. Allow conflict to be settled w/o irreparable damage to org
2. Foster honesty in words & action
3. Both parties seek to not only satisfy their own needs but also
   - other involved party
   - Parent org

(seek win-win soln)

Techniques for win-win solutions

1. Separate people from problem
2. Focus on interest, not positions
3. Invent alternative solutions before trying to reach aggn.
4. Emphasize on using obj criteria

The key to finding negotiator's interest is to ask 'why'

Test can't be done on May 15th
→ why → deliveries not arrived

Negotiation stages:

1. Preparation: collection & analysis of data, fact
2. Planning: find out intent, lvl of compromise, location
3. Introduction: cooperative env., common grounds, and diffs
4. Opening proposal: Initial offer w/ word of flexibility
5. Bargaining
6. Agreement
7. Finalizing

Lec 20

Linear Programming: A simple technique where we depict complex relationship through a linear function & find optimal output.
i.e, map real problems into mathematical models

Parameters used in LP:

(i) Decision making var
(ii) objective func
(iii) Constraints
(iv) Non-negativity restriction

Formulation of LP: Chocolate manufacturing company.

(i) Available choco: 12 units, milk: 5 units
(ii) variant A: 1 milk, 3 choco; B: 1 milk, 2 choco
(iii) Profit on A: $6, B: $5 per unit

variant	milk	choco	profit/unit
A	1	3	6
B	1	2	5
Total	5	12	

Func: (i) Profit: Z
(ii) $6X + 5Y = Z$ [#X of A, #Y of B]
(iii) $1X + 1Y \leq 5$; $3X + 2Y \leq 12$
(iv) $X \geq 0$, $Y \geq 0$

Lec 21

Graphical method:

P07/ Budget $10,000; 1200 man-day; 110 hect;

variant	cost/hec	man-day/hec	net profit/hec
wheat	100	10	50
Barley	200	30	120

(i) Profit: Z

(ii) $50x + 120y = Z$

(iii) $10x + 30y \leq 1200$; $100x + 200y \leq 10,000$; $x + y \leq 110$

$\Rightarrow x + 3y \leq 120$; $x + 2y \leq 100$

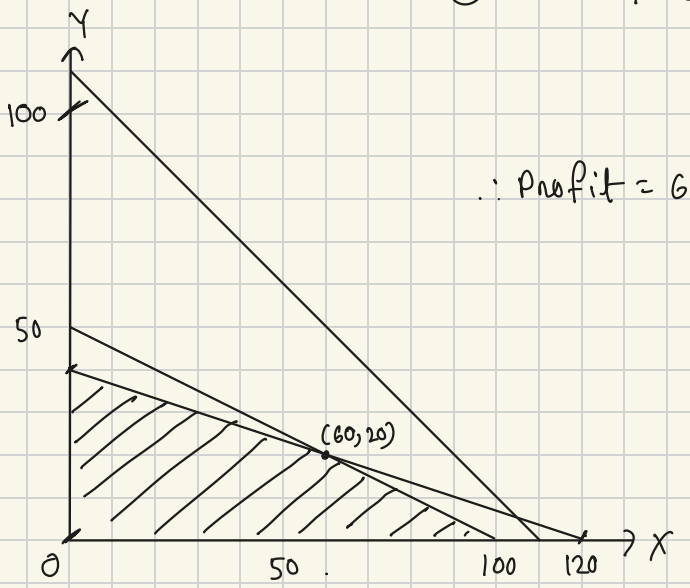
① ② ③

(iv) $x \geq 0$; $y \geq 0$

① when $x=0$, $y=40$; $y=0$, $x=120$

② $x=0$, $y=50$; $y=0$, $x=100$

③ $x=0$, $y=110$; $y=0$, $x=110$



$\therefore$ Profit $= 60 \times 50 + 20 \times 120 = \$5400$

North-west corner method:

From \ To	D	E	F	Supply
A	5 +20	8 +30	4	50 -20 -30
B	6	6 +40	3	40 -40
C	3	9 +25	6 +35	60 -25 -35
Demand	20 -20	95 -30 -40 -25	35 -35	150

Total cost: $5 \times 20 + 8 \times 30 + 6 \times 40 + 9 \times 25 + 6 \times 35 = 1015$

Least-cost method:

From \ To	D	E	F	Supply
A	5	8 +50	4	50
B	6	6 +5	3 +35	40 -35 -5
C	3 +20	9 +40	6	60 -40
Demand	20 -20	95 -5 -50 -40	35 -35	150

cost where max quantity can be assigned

Cost = $8 \times 50 + 6 \times 5 + 9 \times 40 + 3 \times 20 + 3 \times 35 = 956$

Other methods: Simplex method

Open solver method

Lec 23

Cash flow: Net amount of CCE (cash & cash equiv.) transferred in/out of proj. in specified duration

Free cash flow: Cash generated by a company by its normal op after substracting all expenses.

Working capital: Cash needed for day-to-day op.

Importance: - - -

Cash flow doesn't necessarily show all expenses:

→ accrues that are not paid right-away liabilities

Types of cash flow:

CFO ← i) Cash flow from op
CFI ← ii) " " " investing
CFF ← iii) " " " financing, debts, dividends, equity

Profitable companies may fail if,

a) donut generate enough cash to stay liquid
b) profits are tied to i) outstanding account receivable
(ii) overstocked inventory
(iii) excess capital expenditure

Lec 24

NPV: Net Present value

How much value a project will produce in a set period of time

Diff. between present value of cash inflow and present value of cash out flow over a period of time

TVM: Time value of money

$$NPV = \sum \frac{\text{cash flow}}{(1+i)^n} - \text{init investment}$$

Example 1:

init cost $1 m

generate $25k monthly for 5 y

$$NPV: \sum_{t=1}^{t=60} \frac{25{,}000}{(1+0.0064)^t} - 1{,}000{,}000$$

$$= 1{,}242{,}323 - 1{,}000{,}000$$

$$= 242{,}323$$

NPV is pos

Profitable

discount rate → 8%

when period = y

$$\therefore i = (1+0.08)^{1/12} - 1$$

$$\therefore 0.0064$$

Discount rate: Percentage used to adjust future cash into present value.

8% interest, $\times(1+0.08)^n$
-1 yr $\rightarrow \times(1+0.08)^{-1}$

E.g.; at 8% inflation rate
$100,000 of 2 years forward would be worth $\frac{100,000}{(1+0.08)^2} = \$85,733$ today

IRR → discount rate that would make NPV equal zero

Ex. 2 init $100,000
gen $30K yearly for 4
$i = 0.2$

$$\therefore NPV = \sum_{t=1}^{t=4} \frac{30,000}{(1.2)^t} - 100,000$$

$$= 95,096 - 100,000$$

$$= (-)$$

Ex. 3

Year	Cash in	Cash in (adj)	Cash out	Cash out (adj)
0	0	0	250,000	250,000
1	110,000	100,000	0	0
2	89,000	73,554	0	0
3	81,000	60,857	0	0
4	72,000	49,177	0	0
		283,588		250,000

NPV = (+)

Lec 24(2)

TVM → Time value money

Money today is worth more than it would be in the future

Matters bcz → helps to make decision

equalize options that span long time

compare proj. w/ varying inflow throughout varying time

helps understand true value of investment

Lec 25

IRR → Internal Rate of Return

Discount rate for which NPV is zero

$$NPV = 0 = \sum \frac{\text{Cash flow}}{(1+IRR)^t} - \text{init invest}$$

Hurdle rate → min rate for proj. approval

Considerations for IRR

→ Guideline for whether to proceed

→ IRR > RRR → proceed

→ < → reject

Ex 1

Project 1:

$$NPV = 0 = \sum \frac{\text{Cash flow}}{(1+IRR)^t} - \text{init}$$

$$\Rightarrow 0 = -5000 + \frac{1700}{(1+IRR)^1} + \frac{1900}{(1+IRR)^2} + \frac{1600}{(1+IRR)^3} + \frac{1500}{(1+IRR)^4} + \frac{700}{(1+IRR)^5}$$

$$\Rightarrow IRR = 0.166 \rightarrow 16.6\%$$

Proj 2: - - -

Ex 2 Trial & error; $y = 4$

IRR	NPV
0.1	2679
0.15	1420
0.25	−554
0.22	−25
0.215	67
0.218	11
0.2186	0.42

Lec 26

Payback period: Amount of time it takes to recover any invst

P1

Y	Acc. invest	Inflow	Ac. inflow
0	500,000	0	0
2		100,000 + 150,000	250,000
3		150,000	400,000
4		50000	450,000
5		125,000	575,000

$\therefore$ Period 2 $4 + \frac{125-75}{125} = 4.4$ y

P2 Invest = $500,000

Year	inflow	discount	discounted inflow	acc. dis. inf
1	100,000	0.9091	90910	90910
2	150,000	0.8264	123966	214876
3	150,000	0.7513	112695	327571
4	50,000	0.6830	34150	361721
5	125,000	0.6209	77 613	439334
6	200,000	0.5645	112900	552234

$$5 + \frac{112900 - 52234}{112900} = 5.54$$

Lec 27

Cost - Benefit Ratio (CBR) (BCR) considers TVM

Rel^n btwn benefit & cost of inv.

BCR > 1 → + NPV, IRR above discount rate

= 1 → NPV of profit eq NPV of cost

< 1 → cost outweighs benefits

Ex for next (4) yrs

$$\text{Benefit} = \sum_{t=1}^{4} \frac{100,000}{(1.02)^t} = 3,80,773$$

cost = 50,000

$$\therefore BCR = \frac{380}{50} = 7.6$$

Fisher eq^n: nominal interest rate = real interest rate + inflation

$$(1+i) = (1+r)(1+\pi) \quad | \quad \approx \quad i = r + \pi$$

i: nominal interest rate
before adjustment
as advertised

r: real

π: interest

Lec 28

Proj. scheduling: Allocation of resources to planning
Formalized planned actions
Layout of actual works

Steps in developing schedule:

1. Plan schedule management
   Dev. docs & procedures governing the schedule
   Take into consideration: contingencies
   task dependence
   resources
   stakeholder
2. Define activities:
   Prepare WBS
   Map task to cost account
   Ensure, activities are reliably estimated
   each task is measurable, has deliverables
   only one is responsible
   of adequate len → 8/80 rule
3. Sequence activities:
   Develop logical sequence of task that'll be most efficient.
   Dev. rltnshp among task & their lead/lag

   FS, FF, SS, SF

4. Estimate activity resources:
   Identify type & quantity of resources req to complete the task
   Check w/ PM for resource availability on specific durations

5. Est. activity duration:
   Analogous: From prev project w/ conn. factor
   Parametric: Break-down task to known unit of duration
   3-point est: optimistic, pessimistic, most likely } avg by normal dist- beta dist

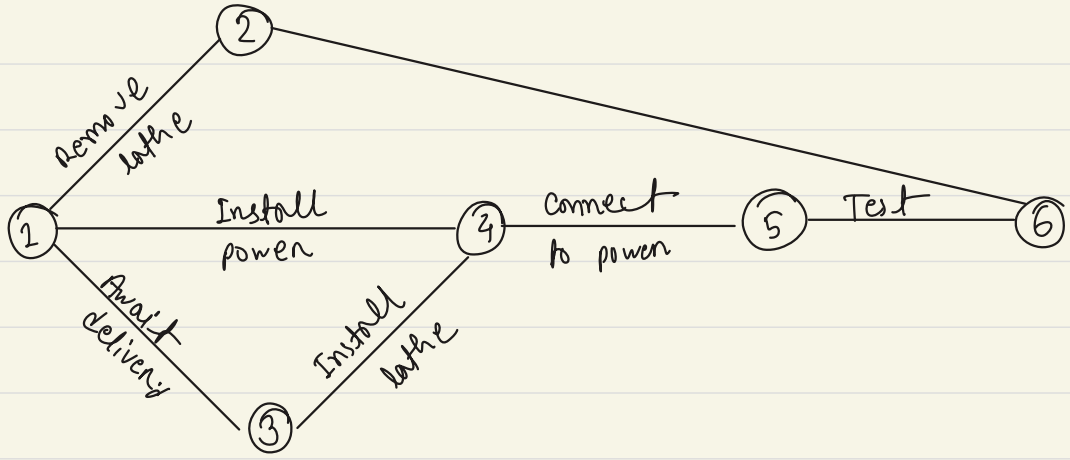
6. Dev schedule
   Decide start & finish date
   Use CPM for shortest duration sequence

Lec 30 Elements of network

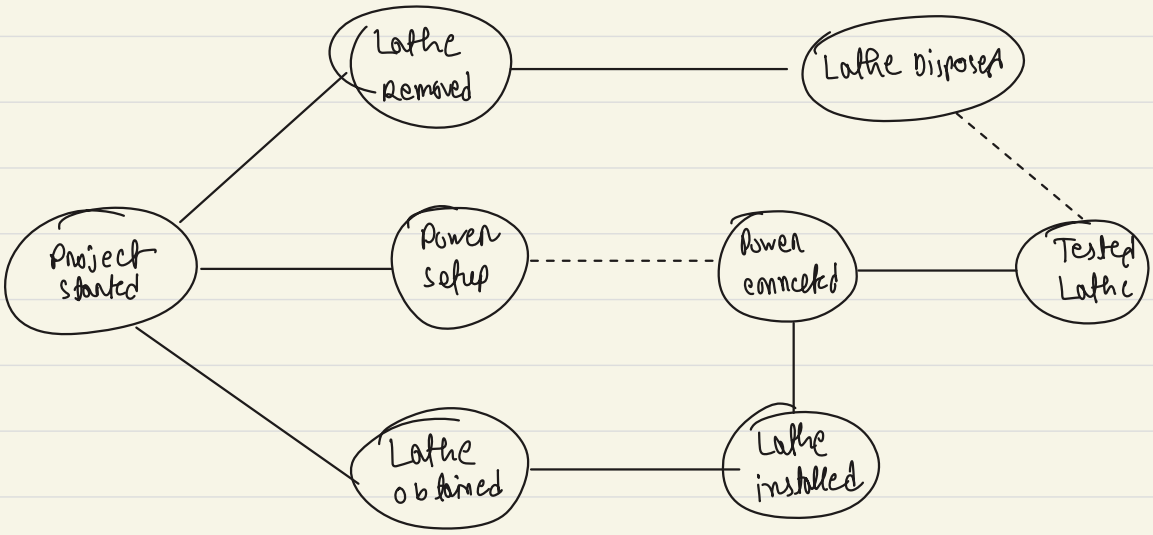
Type of network — PERT: Project eval & review technique
Evt oriented
CPM: Critical path method
Activity oriented

Example: Lathe replace

CPM:

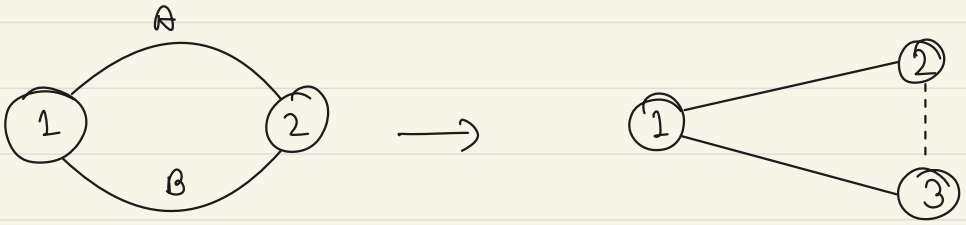


PERT:

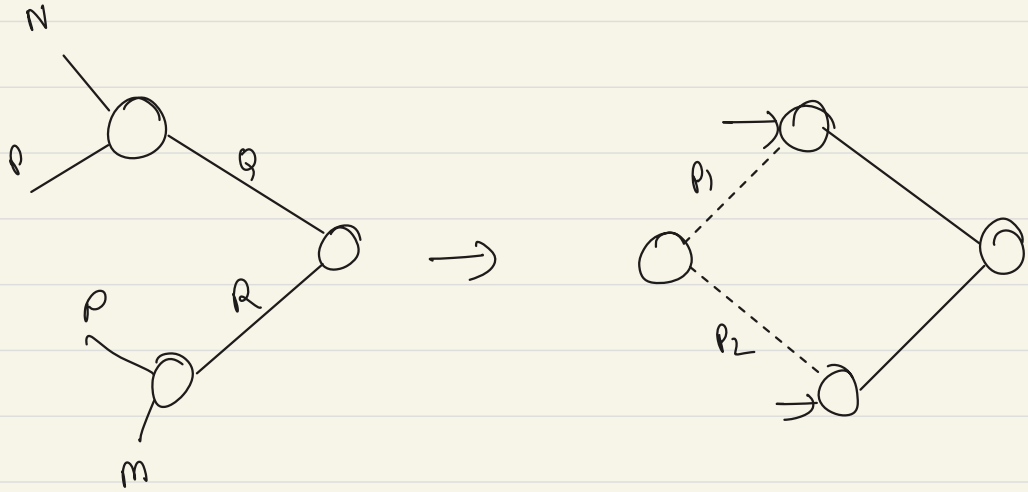


Dummy: Type of activity requiring no time or resources

Purpose: Grammatical, logical



Grammatical



Logical

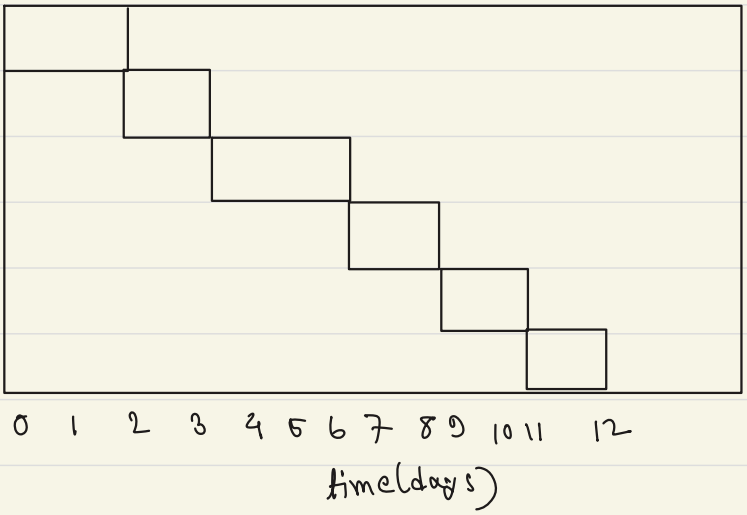
Lec 31

Gantt Chart : visual tool representing start / end of project activities

bar → activity
begin / end of bar → start / end of act
len of bar → duration

Example: Install Lathe machine

1. Call for quotation
2. Order lathe
3. Await delivery
4. Install lathe
5. Connect to power
6. Test



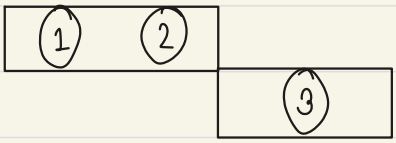
Stages of dev of

(i) Breakdown into activities
(ii) Defn activity sequence & duration
(iii) Present into bar chart

Shortcomings: Lack of degree of details → ①
Review of progress is diff. → ②
Activity interrelationship not shown → ③
Time uncertainties — ④

Remedies → ① subactivities on milestones
② hatched lines
③ subactivities showing interrelation
④ Not applicable for use of gantt chart

Milestone chart:



Milestone chart to PERT

Each milestone is joint w/ arrow

Lec 32

Milestone chart: Modification of original gantt chart to include subactivities

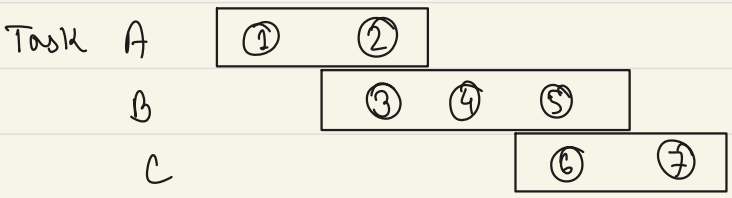
Shortcomings: Lack of cross-task interdependency
do not indicate if one milestone can start before end of another from diff task

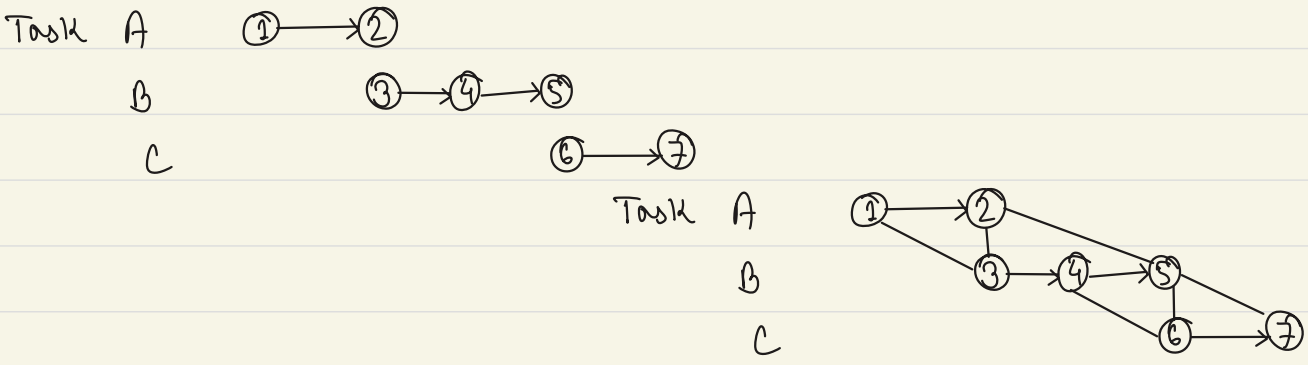
Ambiguity on dependcy:
Not clear whether one task is dependent on another task

Not applicable to time uncertains

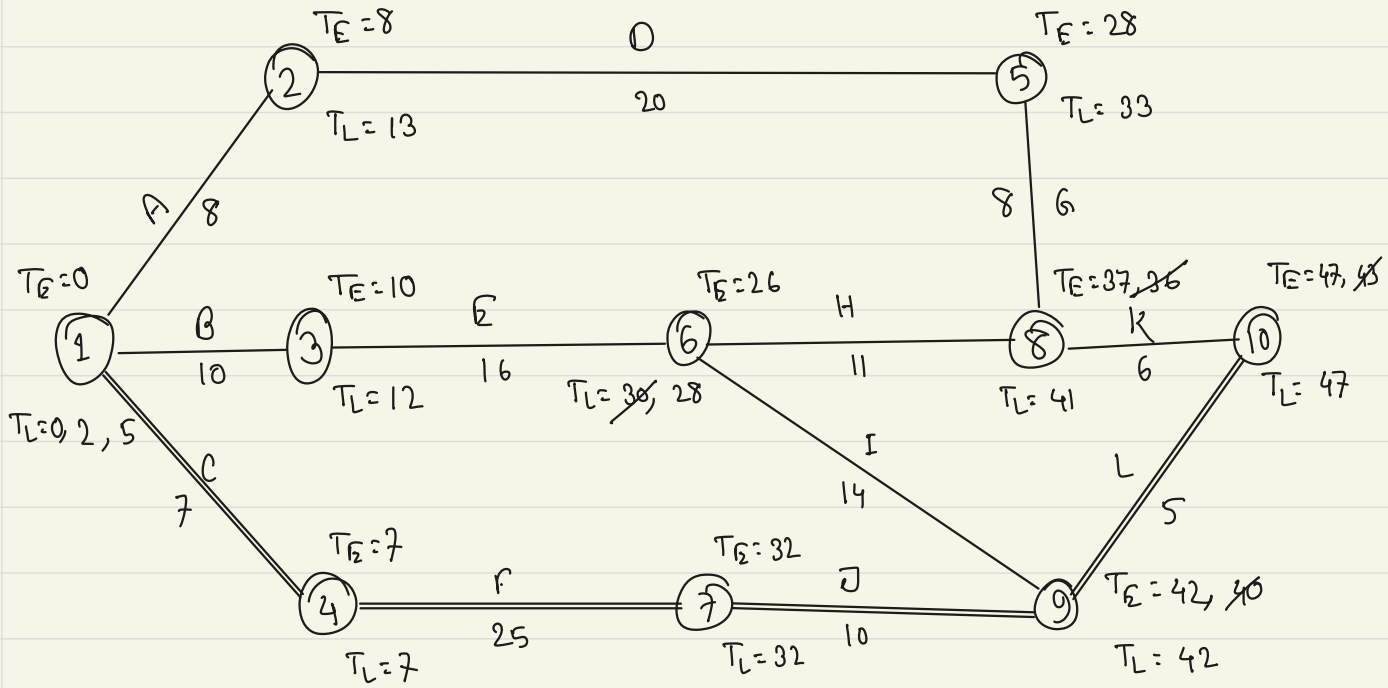
mitigate deficiencies by developing into network diagram

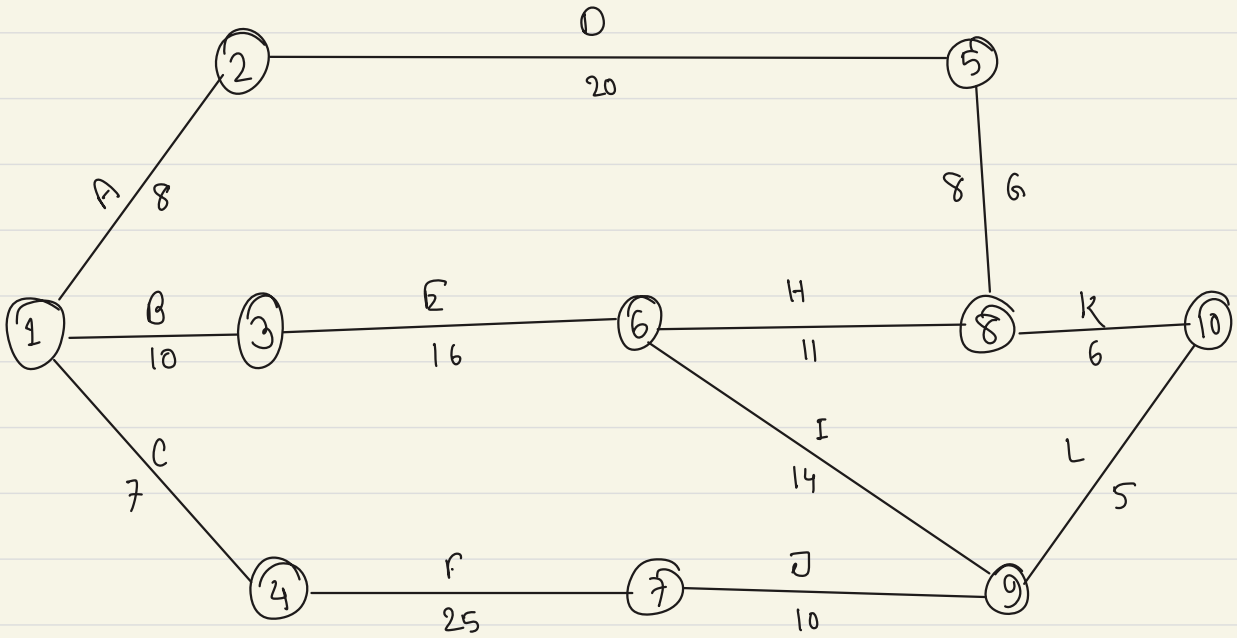
milestone evt; PERT evt oriented





Lec 33


$T_E = 8$
D
$T_E = 28$
20
$T_L = 13$
$T_L = 33$
A 8
8 G
$T_E = 0$
$T_E = 10$
$T_E = 26$
$T_E = 37, 36$
$T_E = 47, 43$
B
E
H
K
10
16
11
6
$T_L = 12$
$T_L = 30, 28$
$T_L = 41$
$T_L = 47$
$T_L = 0, 2, 5$
I
L
C
14
5
7
$T_E = 7$
$T_E = 32$
$T_E = 42, 40$
F
J
25
10
$T_L = 7$
$T_L = 32$
$T_L = 42$


D
20
A 8
8 G
B
E
H
K
10
16
11
6
I
L
C
14
5
7
F
J
25
10