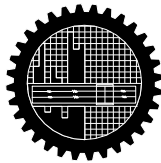


PROJECT MANAGEMENT



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PROJECT

Project

- A temporary endeavor undertaken to accomplish a specific goal
- One time activity with a well-defined set of desired end results

“A complex, non-routine, one-time effort limited by time, budget, resources and performance specifications designed to meet customer need.”

COMPLEX – need careful coordination and control in terms of

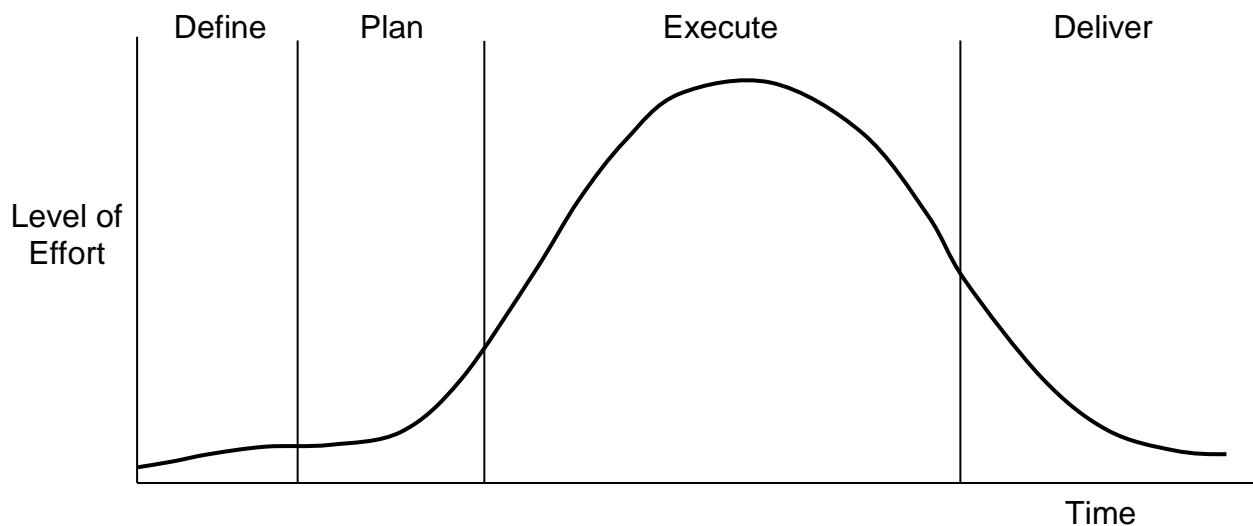
- Time
- Budget

Major characteristics of a Project:

- An established objective
- Defined life span
- Multifunctional
- Unique
- Interdependency
- Specific Time, cost and performance requirements
- CONFLICT

Project Life Cycle:

“Slow start, Quick Momentum, Slow Finish”



4 Stages:

Definition:

- Goal
- Specification
- Task

Planning:

- Schedule
- Responsibility
- Budget
- Risk

Execution:

- Status report
- Change
- Monitor and Control
- Quality

Delivery:

- Train customer
- Reassign staff
- Lesson learned

Classification of Projects (based on need):

Based on the need, projects can be classified under the following groups:

1. New project
2. Balancing project
3. Expansion project
4. Modernization project
5. Replacement project
6. Diversification project
7. Backward integration project
8. Forward integration project

New project: A new project is conceived and implemented to introduce a new product or a product that is already in the market but for there is more demand.

Balancing project: A project that is undertaken to improve upon the manufacturing capacity of one or more production units that will result in improvement in the overall production capacity of the plant as a whole is called a Balancing project. After implementation of the balancing project, under utilization of production capacity gets removed resulting in increase in production and profitability of the firm.

Expansion project: Aimed at increasing the plant capacity for the current product range. Expansion projects are undertaken only when there is definite long term upward trend in the demand for the product.

Modernization project: Technological innovation is a continuous process. With the passage of time, the existing technology becomes obsolete. Whenever either the plant and machinery becomes obsolete or whenever the production process becomes obsolete, there is a need for modernization of the project keeping in tune with the latest technological developments.

Replacement project: Replacement project involves replacing some of the old machinery with new one of the same capacity. Due to ageing and wear and tear of machinery, the maintenance cost starts mounting up and it will be no more advantageous to keep the worn out machinery in the production line.

Diversification project: Diversification project is undertaken when a manufacturer wants to offer more than one product. Diversification is generally of two types:

- *Related diversification:* making closely related diversifications to the product line.
- *Unrelated diversification:* proposed product range is different from the existing one.

Backward integration project: Backward integration project moves an organization into supplying some or all of the products used in producing its present products. Backward integration is done by adding manufacturing/processing facilities at the beginning stages of a product line.

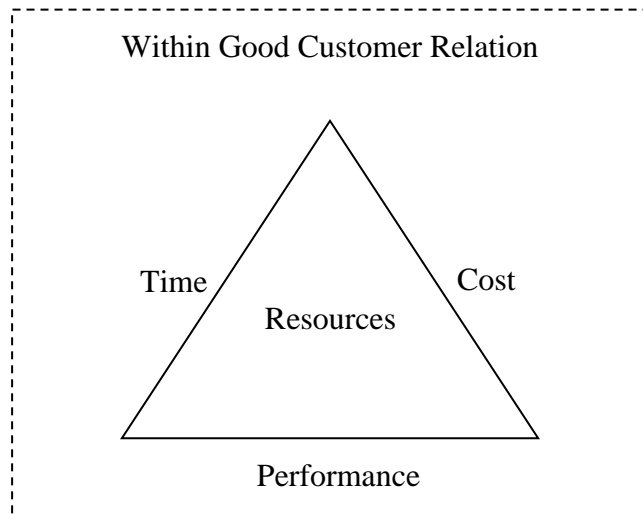
Forward integration project: Forward integration project moves the organization into further processing its present products or distributing its own products. Forward integration is done by adding additional manufacturing/processing facilities at the end of the production line.

Basic purpose of a project is to achieve specific goals. Need to organize the task as a project focusing:

- Responsibility
- Authority

Project management is no longer a special need management -- rapidly becoming a standard way of doing business.

To achieve the goal (performance) within limited time and cost.

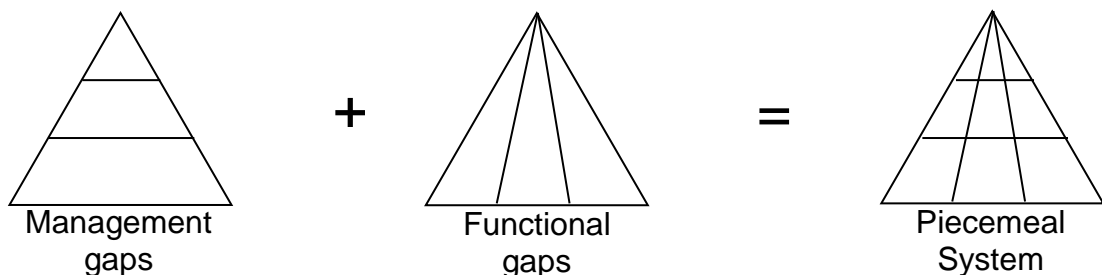


Project Management Approach

- Planning, organizing, directing and controlling of company resources for a relatively short-term objective that has been established to complete specific goals
- Utilizes the system approach to management by having functional personnel assigned to specific projects.

Piecemeal System

There exist class or prestige gaps between various levels of management – as well, functional gaps between working units.



If the management gaps are superimposed on functional gaps, small operational islands are created. Each of the operational island refuses to communicate each other.

Need to get these islands to communicate cross-functionally towards common goals or objectives.

Project management today is an integrated approach – “Getting it right at the first time”.

Piecemeal system:

- fails to tie to the overall strategies of the firm
- fails to balance the planning and control with appropriate adjustment

The main emphasis is on developing an Integrated Project Management approach – project effort is focused toward strategic plan.

PROJECT ORGANIZATION

How enterprises organize to manage projects

Three different types of Project Management structures:

1. Functional organization
2. Dedicated project organization
3. Matrix organization

A project management system provides a framework for launching and implementing project activities within parent organization.

A good system appropriately balances the needs of both parent and project

- define the interface between project and parent organization
 - authority
 - resource allocation
- eventually project outcome

Creating a system for organizing projects is a very difficult task

- projects are unique, one-time effort with discrete beginning and end
- multidisciplinary in nature – require coordinated efforts of a variety of specialists to be completed

Functional Organization

Simply manage within the existing functional hierarchy of the organization.

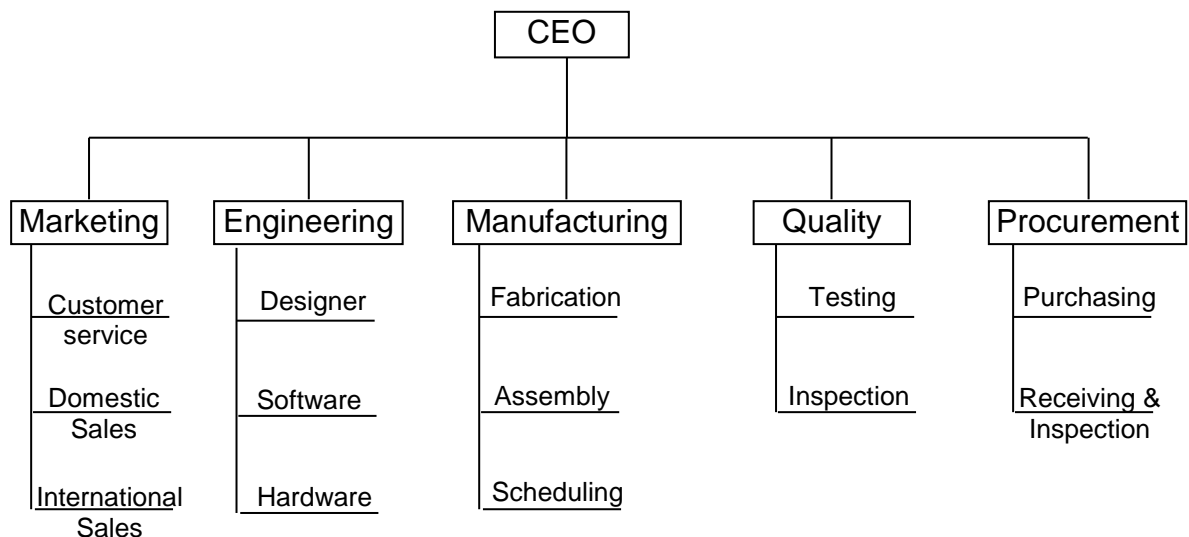
- different segment of the work are delegated to the respective functional units.
- each unit responsible for completing its segment of the project
- coordination is maintained through normal management channel
- one functional area can also manage the main portion of the project – top management of that department is given the responsibility

Advantages:

- no radical alteration in the design and operation of the parent organization
- maximum flexibility in the use of staff
- specialists in different units can temporarily be assigned
- in-depth expertise can be brought to bear on the most crucial aspects of the project
- normal career paths within a functional division are maintained

Disadvantages:

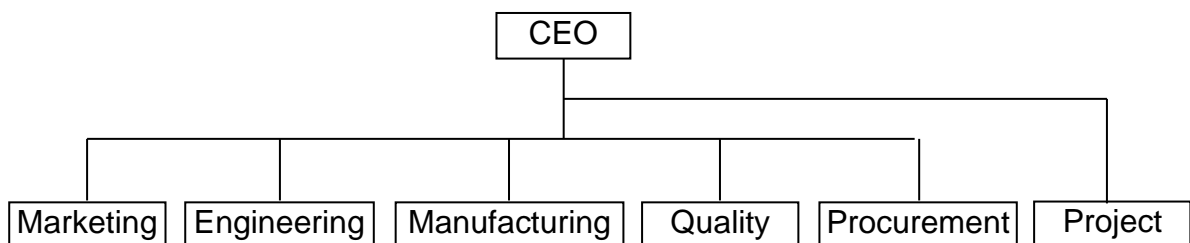
- own work of functional unit usually take precedence over the project work
- poor integration across functional units – people are only concerned about their portion
- lack of communication between top management inter-functional departments – slow response time
- project may be seen as an extra burden – lack of motivation



Dedicated Project Organization

Creation of independent project team.

- team operates as separate unit from rest of the parent organization
- a full time project manager is appointed – total responsibility of the project
- PM recruits full time employees from parent organization and outside
- totally separate from the parent organization



Advantages:

- does not interrupt usual functional operation
- project is the main focus – devote full attention into the project
- high motivation – share common goal and personal responsibility
- high level of cross-functional integration
- committed to optimize the project – not personal expertise

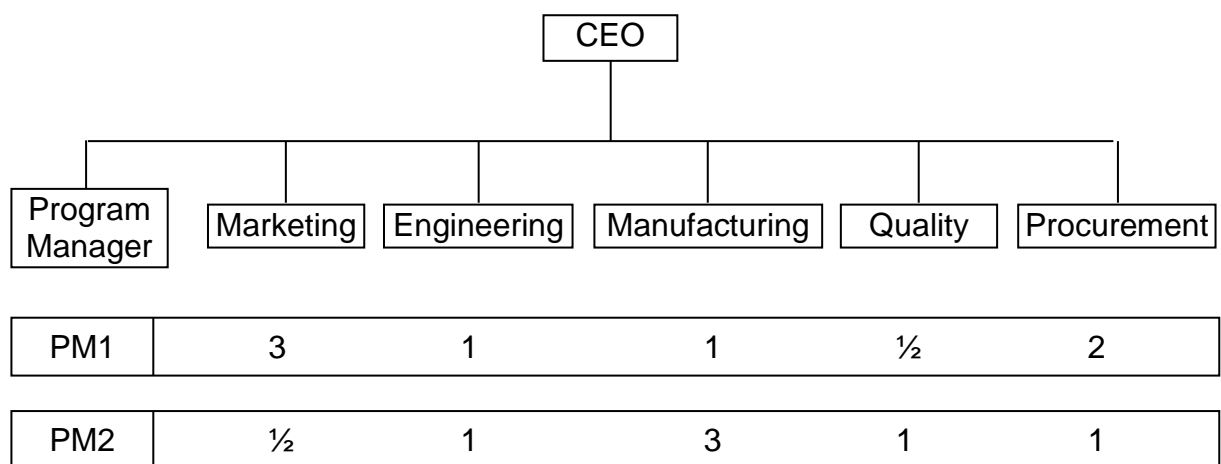
Disadvantages:

- expensive – new management and working force
- project members might not have that in-depth knowledge as functional departments
- we-they divisiveness – distorting the relationship between project team members
- after project completion, workers either need to go back to respective functional departments or just get lay-off.

Matrix Organization

Hybrid organizational form in which a horizontal project management structure is “overlaid” on the normal functional hierarchy.

- couple some of the benefits of functional organization with dedicated project organization
- two chains of command – along functional line and along project line
- project participants reports simultaneously to both functional and project managers
- may be temporary or permanent structure



Advantages:

- resources can be shared across multiple projects as well as within functional divisions
- project is the main emphasis – to complete in time within cost
- project has reasonable access to entire reservoir of technology in all functional divisions
- flexible enough to respond to any sudden demand from either functional or project side

Disadvantages:

- legitimate conflict between PM and FM about objective
- conflict between project managers – sharing of scarce resources
- two different bosses – whom to listen

Three kinds of matrix organization structures:

Weak/Functional – balance of authority strongly favor the functional managers

Balanced matrix -- traditional matrix arrangement

Heavy/Project -- balance of authority strongly on the side of project manager

Functional:

- formally designated project manager is responsible for coordinating project activities
- PM basically acts as a staff assistant who draws the schedules, status of work and facilitates project completion
- has indirect authority to expedite and monitor the project

Balanced:

- PM establishes the overall plan for completing the project, set schedule and monitor the project
- FM assigns personnel and execute their segment of the project
- PM – what to do and FM – how to do

Project:

- PM controls most aspects of the project
- controls when and what specialists do
- has final say on major project decision
- FM is consulted on need basis

CHOOSING AN ORGANIZATIONAL STRUCTURE

Need to consider:

- the nature of the potential project
- characteristics of various organizational options
- pros and cons of each
- cultural preferences of the parent organization

Certain structures may contribute to success for certain project – whereas detrimental to another one.

Functional:

- major focus on in-depth application of technology
- project requiring large capital investment

Dedicated:

- large number of similar projects
- one time, highly specific unique tasks requiring careful control

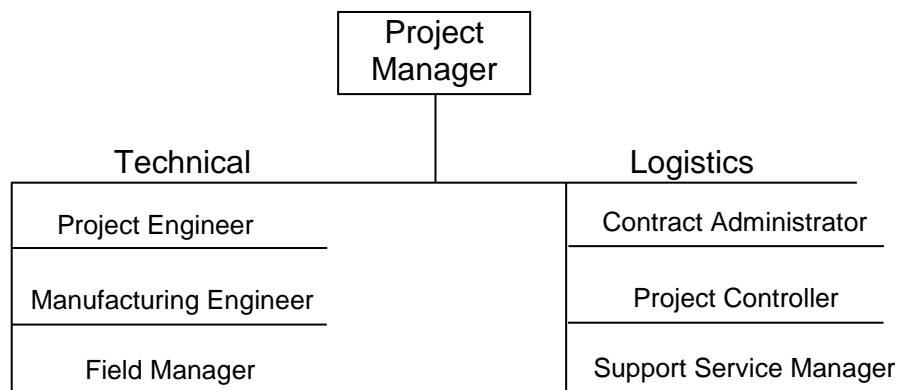
Matrix:

- requiring integration of inputs from several functional areas
- involves reasonably sophisticated technology
- need to share technical experts among several projects

Criteria for Choosing Structure

- Define project with a statement of the objectives that identifies major desired outcome
- Determine the key tasks associated with each objective and locate functional units
- Arrange the key tasks and decompose into work packages
- Determine the required organizational units to carryout the project
- List special characteristics on assumptions: level of technology, size of project, potential problems of assigned individuals and between functional units

PROJECT TEAM



Project Manager:

- overall in-charge of the project
- planning, controlling and completing

Project Engineer:

- product design and functional analysis
- drawings and specifications
- documentation

Manufacturing Engineer:

- efficient production of product or process
- tooling and jig/fixture
- scheduling

Field Manager:

- installations, testing and support
- after sales service

Contract Administrator:

- official paperwork, billing and cost
- complaints and legal aspects

Project Controller:

- daily accounts of budgets
- labor charges
- project supplies

Support Service Manager:

- subcontractor dealings
- data processing
- general management support

PROJECT MANAGER

Project manager is responsible for planning, implementing and controlling the project. PM is usually chosen as soon as the project is selected for funding.

If chosen prior to project selection, start-up tasks can be simplified.

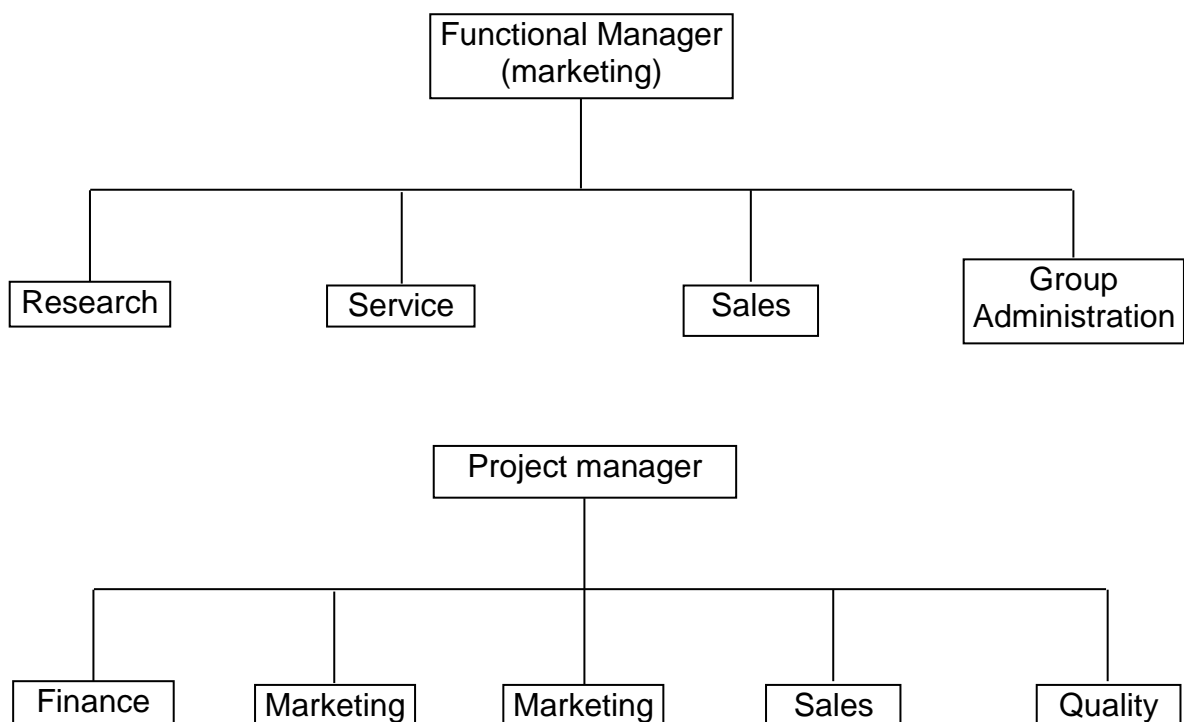
Functional vs. Project Manager

Functional manager:

- department heads are specialists in the areas they manage
- analyze and attack whenever any technically difficult task is required
- administratively responsible for deciding who, how and when task will be completed using specified resources

Project manager:

- must oversee many functional areas
- requires ability to put many pieces of task together to form a coherent whole
- must be skilled at synthesis
- uses systems approach



Special Demands on Project Manager

1. Acquiring adequate resources: need to understand clearly what the project is – how much time and money should be needed to achieve the goals
 - required resources are sometimes not available even after allocation
 - less time and money are sometimes allocated
 - sometimes functional managers do not want to provide resources on time

2. Acquiring and motivating personnel: borrow from other departments – need to negotiate with the managers and persons.
 - FM may not provide people on time
 - FM may be jealous of the project success compared to the department
 - need to motivate people

3. Dealing with obstacle: project is unique – so need to face a lot of new crises without warning.
 - better planning reduces crisis
 - need to learn from experience
 - for last minute schedule and technical change – need to do the best possible

4. Making goals trade-off: among time, budget and performance. Also, between several projects – high and low priority about resource allocation.
 - at the beginning, performance most important
 - during execution, cost precedes over performance and schedule
 - final stage, schedule is the most important

5. Breadth of Communication: Constant selling, reselling, explaining project to outsiders, top management, functional managers, clients etc. As well. liaison with outside world.
 - need to know inside and outside of the project
 - build solid information network
 - flexible to trade-off

6. Negotiation: PM need to be highly skilled in negotiation.

- top management
- outside partners
- customers
- functional managers
- own team members

Selecting a Project Manager

Need to have 4 major categories of skills:

1. Credibility:

▪ Technical:

- provide sufficient technical knowledge to direct the project
- no need in-depth knowledge – just reasonable understanding of the base technologies so that can explain to senior management.
- also need to understand customer need and explain to team members

▪ Administrative:

- responsibilities need to be performed
- maintain schedule and budget
- make sure that all resources are available on time

2. Sensitivity:

- political sensitivity – support from top management
- balance of power between projects and financial units
- need to sense interpersonal conflicts early – not to avoid
- solve the conflicts politically

3. Leadership and Management Style: Interpersonal influence, exercised in situations and directed through the communication process, towards the attainment of specified goals.

- enthusiasm, optimism, energy, courage and personal maturity
- need to know people about their strength and weakness
- strong sense of ethics
- build team spirit

Project Appraisal

Project appraisal in simple terms means pre-investment analysis of a project with a view to determining the overall feasibility and measures its investment worth.

Appraisal provides a comprehensive review / assessment of all aspects of project that lays the foundation for implementation for implementation and evaluation when it is completed.

Project Appraisal has a number of dimensions, and a project may be evaluated from a number of points of view or the costs and benefits of may be identified and measured in more ways than one, depending on the nature of the project or overall context.

Basic Components of Appraisal or Feasibility Study include:

- Market Study
- Technical / technological Study
- Managerial Study
- Financial Study
- Economic Study
- Environmental Study

Basic Elements of Market Study

- Existing Demand situation
- Existing Supply situation
- Demand supply gap and projection
- Commodity flow
- Price analysis
- Nature and degree of competition
- Marketing strategies

Basic Elements of Technical / technological Study

- Scale of the project
- Project location
- Project Design and Engineering
- Project layout
- Physical resource requirement
- Choice of technical process
- Sourcing and procurement of inputs
- Project timing and scheduling
- Alternative uses of the project
- Provisions and expansions

Basic Elements of Managerial / organizational Study

- Organizational Structure and Arrangement
- Operation and Maintenance system

- Manpower requirements and qualifications
- Capability and build ups
- Interagency coordination
- Legal requirements / impediments
- Organizational culture

Basic Elements of Financial Study

- Magnitude of capital and operating costs
- Sourcing, timing and costs of fund
- Financial Plans and budgets
- Financial statements
- Financial viability
- Sensitivity Analysis

Basic Elements of Economic Study

- Objectives and constraints facing the Economy
- Key sector al analysis
- Economic Costs and Benefits
- Economic Assessments
- Other multiplier and indirect effects, both positive and negative

Basic Elements of Environmental and Social Study

- Socio cultural and demographic characteristics
- Social organizations, structure and social capital (linkage , Partnership association)
- Social Acceptability
- Physical and technical effects
- Ecological effects
- Aesthetic effects (creative, cultural)
- Social and environmental strategies

A project may be acceptable when:

- Market - - - - - **profitable**
- Technology - - - - - **available and user-friendly**
- Management - - - - - **manageable**
- Financially - - - - - **viable**
- Economically - - - - - **sound**
- Environmentally - - - - - **sustainable**

MARKET ANALYSIS:

Before the project is formulated, the size and composition of the present effective market demand, by segment, should be determined in order to estimate the possible degree of market penetration by a particular product. Also, the income from sales should be projected taking into account technology, plant capacity, production program and marketing strategy. The latter has to be set up during the feasibility study giving due consideration to product pricing, promotional measures, distribution systems and costs.

Once the sales projects are available, a detailed production program should be made showing the various production activities and their timing. The final step at this stage of a feasibility study is to determine the plant capacity taking into account alternative levels of production, investment outlay and sales revenues.

Objective and Scope of Market Analysis

What Product? –

– Product characteristics:

- Physical / Chemical / Composition
- Design
- Color
- Sizes
- Quality
- Package / Sizes / Form / Color etc
- Brand
- Level
- Product servicing

– Product Classification:

- Consumer Product
- Industrial Product

– Product Uses:

- Single use Product
- Multi-end-use product

– Complementary vs. Substitute product

Who wants the Product and Why?

– Market Size and Structure

– Determinants of Demand:

- Consumer Goods
 - Demographic
 - Income
 - Price

- Product / Obsolescence and Fashion
- General Economic Conditions
- Behavioral Patterns
- Government Policies

- Industrial Goods
 - Number and Types of Industrial Users
 - = Total Market, Size of Industrial Users
 - = Regional Concentration
 - = Vertical vs. Horizontal Market
 - Buying Powers of Industrial Users
 - Buying Motives
 - Government Policies

- Composition of Demand
 - New vs. Replacement Demand

Where does he want the Product?

- Channels of Distribution, Ownership, Structure
- Types of Intermediaries, their Strength and Weakness
- Physical Distribution Networks
- Existing Distribution Practices

How does he learn about the product?

- Forms of Promotion, Existing Practices
- Market Susceptibility to particular form of Promotion

How much is he prepared to pay?

- Prices charged
- Price Elasticity

Who are the competitors?

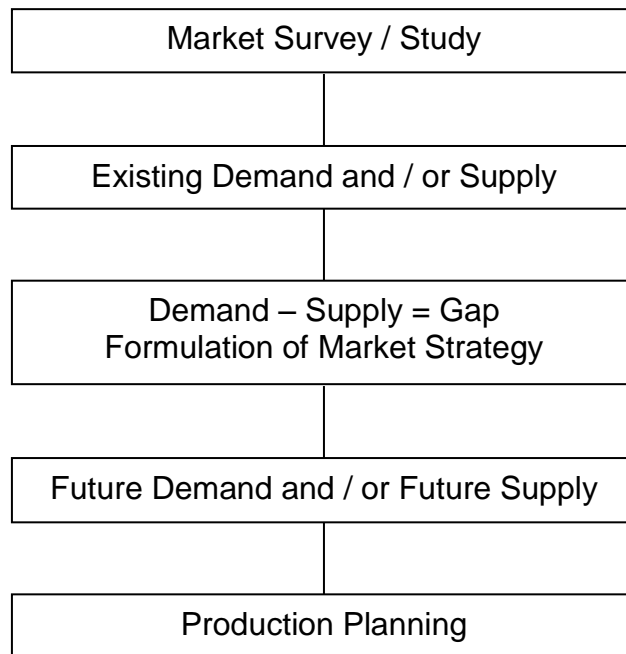
- Same product manufactured locally:
 - = Local Producer, Quality, Price, Distribution, Promotion
- Imports:
 - = Quality, Price, Distribution, Promotion, Import Restrictions and Govt. Policies
- Substitutes:
 - = Quality, Price, Distribution, Promotion, Tariff Structure

Are Complementary Goods Necessary?

- If “yes”
 - = Quality
 - = Availability
 - = Price
 - = Distribution

Government Policies:

- On Production
- On Consumption
- On Imports
- On Exports
- Fiscal
 - = Taxes
 - = Subsidies



TECHNICAL ANALYSIS

Introduction:

- Type of industry, priority in the Industrial Policy
- New or BMRE proposal, justification of BMRE, brief of the existing unit (date of setting up, production), whether financed by any FI earlier.

Capacity and Product Mix:

- Capacity–product and product–mix, number of units to be produced, shifts / day and number of days of operation, product specification; industry average of capacity utilization, capacity utilization considered and reasons thereof.
- An annexure showing the basis of estimating attainable capacity should be incorporated.

Technology and Technology Factor:

- Whether the technology considered is new or proven.
- Alternative / optional technologies and brief on each.
- Justification for selection of the technology
- Any plan for acquisition of patents.

Manufacturing Process:

- Description of the process, whether continuous, semi continuous or batch process
- Process flow diagram / chart
- Critical process areas (Fertilizer- Ammonia Reservoir)

Land and Location:

- Location of the land
- Present owner of the land
- Particulars of the land – Khatian no., mouza no., plot no., Upazilla
- Land area required, price of land and its reasonableness
- Availability of infrastructural facilities and other advantages
- Details of land development and cost thereof, whether piling is required
- Developed / less developed / least developed area, industrial zone and permission thereof to set up the project.
- Expansion provision

Building (Existing and Proposed):

- Preliminary drawing and design
- Total covered area of civil construction
- Specification of main factory building, workshop, raw material and finished goods storage, office / administrative buildings, guard house and other ancillary structures and rates of construction of these civil works.
- Source and availability of construction materials

- Total cost of civil construction
- Depreciated / revalued cost of existing assets
- An annex showing the details of the proposed building and civil works and another showing details of existing structures, if any.

Machinery and Equipment:

- Schedule of machinery showing model no., capacity, no. of units, name of manufacturer (s) and year of manufacture, depreciated costs.
- New or second hand, certified unexpired life in case of 2nd –hand machinery and suitability
- Balancing of capacity of individual machinery
- Availability of spare parts

Proposed Machinery (Local and Imported):

- Schedule of machinery showing the model number, capacity, number of units, price / unit, total cost
- Justification for the proposed schedule of machinery (old or new)
- Basis of selection
- Availability of spare parts, annual requirement and arrangement for their procurement
- Price validity and mode of delivery
- Economic life of the plant
- Scope of supply of plant and machinery
- Balancing of capacity of individual machine
- Economy of Scale

Installation of Machinery:

- Arrangement with supplies of machinery
- Arrangement with local contractors / erectors
- Sponsors own supervision
- Cost for supervision of erection and installation (please show F/C & L/C cost separately), civil foundation, electrical and mechanical works etc.

Operation of Machinery (Plant):

- Initial operation with technical assistance from supplier of machinery and cost, technical collaboration, technical services, etc
- Promoters own arrangement through hired technical and administrative personnel.
- Adequacy of arrangement
- Whether the proposed set of machinery with or without minor adjustment / addition is suitable for diversification of products

Auxiliaries / Utilities:

i) Water:

- Estimated annual requirement
- Arrangement for water treatment (if required) and cost thereof
- Cost of water connection, if any

ii) Power:

- Estimated requirement in KW (connected load)
- Estimated maximum power requirement for plant and machinery and for general use in KW
- Estimated annual consumption of power for plant and machinery in KW
- Availability of power supply from BPDB / REB and consent letter thereof
- Requirement of power generator and its capacity
- Estimated security deposit for power
- Needs for own sub – station equipment and its cost thereof
- Cost for power connection

iii) Process Steam:

- Estimated annual consumption
- Boiler capacity and cost thereof
- Steam specification

iv) Fuel and Lubricant:

- Specification and types
- Expected requirement per annum
- Source of supply
- Cost per unit

v) Gas:

- Estimated gas consumption per annum
- Cost for gas connection
- Security deposit for gas connection

Raw Material

- Total requirement of imported and local raw materials (item wise) and its sources, C & F price / local market price, import duty, tax, surcharge, insurance, transportation and other related costs
- Portion of raw materials to be imported under WES and foreign exchange allocation by GOB respectively
- Material balance of raw material
- Basis of raw material estimate to be enclosed as an Annex

Transportation:

- Arrangement for transportation of raw and finished goods (own or hired) and its expenses
- Requirement of general purpose / staff car and cost thereof

Furniture and Fixtures:

- Requirement of office equipment and furniture, and cost thereof

Quality control:

- Test to be carried out (goods in process, finished goods etc)
- Quality control and laboratory equipment to be required for carrying out the tests, its cost and adequacy of arrangements
- If tests are to be carried to be from other outside sources, indicate the charge per test Q.C. personnel requirement

Repair and Maintenance:

- Arrangement and cost

Stores and Spares:

- Amount of spares to be provided along with initial machinery supply
- Arrangements for stores and spares for subsequent years and cost thereof

Safety Provision:

- Arrangement for fighting fire hazards and cost thereof

Residue and Waste Disposal:

- Amount if any, of residue and waste to be discharged annually
- Arrangement for treatment and disposal of waste to be discharged annually
- Whether waste and effluent treatment arrangement is adequate for discharging the waste / effluent within the allowable standard set out by the Environmental Pollution Agency of GOB

Technical and Managerial Personnel and Labor:

- Number of technical and managerial personnel and labor required and availability of such persons
- Training requirement and cost thereof

Construction Schedule (for total project):

- Major physical works required
- Total of implementation time

Other Techno-Economic options:

- Considered and rejected with reasons thereof
- Whether any alternative is still unresolved

FINANCIAL EVALUATION

Money value changes over time period. There are several reasons:

- Individuals, in general, prefer current consumption to future consumptions
- Capital can be employed productively to generate positive returns
- In an inflationary period, value of money today is greater than that of a year later

Most financial problems involve cash flows occurring at different points of time. These cash flows need to be brought to the same point of time for purposes of comparison and aggregation. Hence it is important to understand the tools of compounding and discounting which underlie most of what is done in finance:

- From valuing securities to analyzing projects
- From determining lease rentals to choosing the right financing instruments
- From setting up the loan amortization schedules to valuing companies

Present Value of a Single Amount

$$FV_n = PV(1+r)^n$$

where, FV_n = Future value after year n

PV = Present value of that amount

r = discount rate (interest rate)

n = number of years

$$PV = \frac{FV_n}{(1+r)^n}$$

$\frac{1}{(1+r)^n}$ is called the discounting factor or present value interest factor.

INVESTMENT CRITERIA

The key steps involved in determining whether a project is worthwhile or not are:

- Estimate the costs and benefits of the project
- Assesses the riskiness of the project
- Calculate the cost of capital
- Compute the criterion of merit and judge whether the project is good or bad

The investment criteria can be broadly divided into two groups:

- Discounting
- Non-discounting

The basic discounting criteria are:

- Net Present Value (NPV)
- Benefit-cost Ratio (BCR)
- Internal Rate of Return (IRR)

The basic non-discounting criteria are:

- Payback period
- Accounting Rate of Return

NET PRESENT VALUE (NPV)

Net present value of a project is the sum of the present values of all the cash flows that are expected to occur over the life of the project.

$$\text{NPV of a project} = \sum_{t=1}^n \frac{C_t}{(1+r)^t} - \text{Initial investment}$$

where, C_t = cash flow at the end of year t

n = life of the project

r = discount rate

Example:

Year	Cash flow
0	Tk 1, 000,000
1	200,000
2	200,000
3	300,000
4	300,000
5	350,000

Discount rate = 10%

$$\begin{aligned} \text{NPV} &= \frac{200,000}{(1.10)} + \frac{200,000}{(1.10)^2} + \frac{300,000}{(1.10)^3} + \frac{300,000}{(1.10)^4} + \frac{350,000}{(1.10)^5} - 1,000,000 \\ &= 994,727 - 1,000,000 = - \text{Tk. } 5,273 \end{aligned}$$

If, NPV is positive, accept the project

NPV is negative, reject the project

BENEFIT COST RATIO (BCR)

Benefit cost ratio is the ratio of present value of benefits to initial investment.

$$\text{BCR} = \frac{\sum_{t=1}^n \frac{C_t}{(1+r)^t}}{I}$$

Example:

$$\text{BCR} = \frac{994,727}{1,000,000} = 0.995$$

If, BCR > 1.0, accept the project

BCR < 1.0, reject the project

INTERNAL RATE OF RETURN (IRR)

Internal rate of return of a project is the discount rate which makes its NPV equal to zero. In other way, it is the discount rate which equates the present value of cash flows with the initial investment.

$$\text{Investment} = \sum_{t=1}^n \frac{C_t}{(1+r)^t}$$

where, C_t = cash flow at the end of year t

n = life pf the project

r = Internal rate of return (IRR)

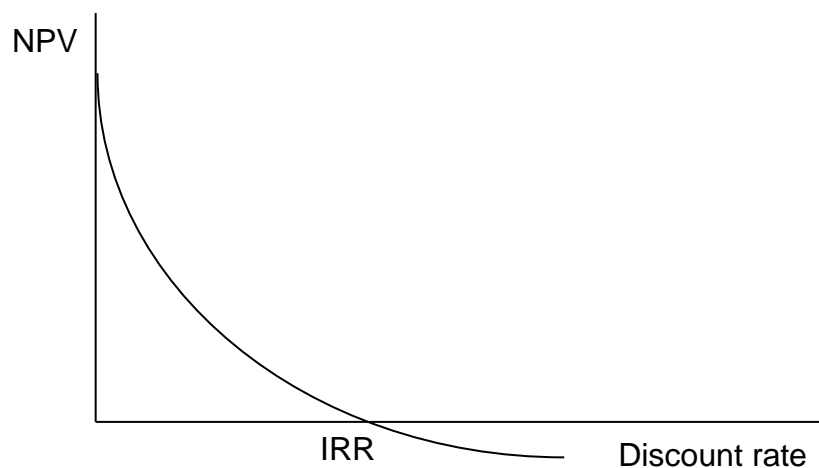
Example:

$$1,000,000 = \frac{200,000}{(1+r)} + \frac{200,000}{(1+r)^2} + \frac{300,000}{(1+r)^3} + \frac{300,000}{(1+r)^4} + \frac{350,000}{(1+r)^5}$$

Need to calculate the value of r by trial and error method, and with linear interpolation between the closest two numbers.

If, $\text{IRR} > \text{cost of capital or discount rate}$, accept the project

$\text{IRR} < \text{cost of capital or discount rate}$, reject the project



PAYBACK PERIOD

Payback period is the length of time required to recover the initial cash outlay on the project.

Limitations:

- Does not consider time value of money
- Ignores cash flow beyond the period

Example:

Year	Cash flow A		Cash flow B
0	Tk. 100,000		Tk. 100,000
1	50,000		20,000
2	30,000		20,000
3	20,000	→ Pay back period	20,000
4	10,000		40,000
5	10,000		50,000
6			60,000

Pay back period is 3 years for project A and 4 yrs for project B – but beyond the pay back period, net flow for project B is much more compared to project A.

Incorporating “time value of money” into account, a new procedure for calculating the pay back period has been considered, which is known as “discounted pay back period”. The cash flows at different time period is converted into “net present values”, and then the actual time period to recover the investment is calculated.

ACCOUNTING RATE OF RETURN

Also called average rate of return on investment, is a measure of the profitability which relates income to investment, both measured in accounting terms.

There are a number of measures of ARR:

1. Average income after tax / Initial investment
2. Average income after tax / Average investment
3. Average income after tax but before interest / Initial investment
4. Average income after tax but before interest / Average investment
5. Average income before tax and interest / Initial investment
6. Average income before tax and interest / Average investment
7. $(\text{Total income after tax but before depreciation} - \text{Initial investment})$

$(\text{Initial investment}/2) \times \text{years}$

PROJECT CONTRACTS

A contract is a legal agreement between two or more parties. A person, a firm or a company who undertakes contract is known as a contractor.

The essentials of a valid contract are as follows:

- There must be an offer and an acceptance of that offer
- The consent of the parties to the contract shall be free and genuine
- The parties to the contract shall be competent persons
- There must be a lawful consideration between the parties to the contract
- The meaning of the contract must be certain without any room for ambiguity or different interpretations
- The terms of the contract shall be capable of performance.
- A contract shall fulfill the necessary legal formalities.

CONDITIONS OF CONTRACT

The conditions of contract are the details of rights and obligations of the parties to the contract. The conditions generally cover:

1. Financial safeguards: A buyer protects its interests by including some clauses on the financial aspects of a contract. The points covered are:

(a) **Bid security**: is not a part of the conditions of contract, it is a precursor to a contract. A buyer may forfeit the bid security if a supplier refuses to accept the contract awarded on the basis of the offer made.

(b) **Performance security**: For a large value contract, a buyer may ask a supplier to furnish a performance security. Its amount ranges from 5 to 10% of the total contract price. The buyer will have a right to forfeit the performance security if a supplier fails to supply. Performance security may be either in the form of cash or bank guarantee.

(c) **Liquidated damage**: If a supplier fails to supply the goods according to the agreed terms of delivery, a buyer has a right to recover liquidated damage from the supplier. The maximum amount of LD can be only up to 10% of the value of delayed supplies.

(d) **Risk purchase**: A buyer has a right to purchase the goods from other sources if the goods are not delivered on time as per agreed terms of supply. If a buyer has to pay more on account of the resultant purchase, the buyer can recover the extra cost from the supplier.

2. Quality of goods:

(a) **Standards**: the goods supplied should meet the standards laid down under the technical specifications for the goods.

(b) **Inspection and tests**: There are inspections and tests both before the dispatching of goods and on arrival at the premises of the buyer.

(c) **Warranty:** A buyer may insist on warranty and guarantee for the good quality of the goods supplied.

3. Price: Price is an important part of a contract. Both the buyer and the supplier have to be clear about it. The items generally covered are:

(a) *Duties and Taxes*

(b) *Freight*

(c) *Insurance*

4. Payment Terms: The payment terms usually cover:

(a) *Advance Payment*

(b) *Payment at the time of despatch of goods*

(c) *Final Payment*

5. Delivery of goods:

(a) *CIF (Cost, Insurance and Freight)*

(b) *FOB (Free on Board)*

(c) *FR (price includes cost of the goods and freight)*

6. Force Measure: absolves a supplier or a buyer from its obligation. e.g. wars, epidemics, floods, earthquakes etc.

7. Arbitration: The manners of resolving disputes between the two parties to a contract.

TYPES OF CONTRACT

Broadly 2 types:

(a) Turnkey contract

In a turnkey contract, the entire responsibility of project execution is entrusted to the contractor. This type of contract is entered into when the project involves high technology; the know-how is not available with the project promoter. Example of turn-key projects are-

BOT (Build, Operate, Transfer)/ BOD- (Build, operate, Deliver)

BOO (Build, Own, Operate)

(b) Non-turnkey contracts:

Non-turnkey contracts are preferred when the projects are small sized, the know-how for the projects is available with the promoters and when there is a strong, competent and capable project team available with the organization.

PROJECT FINANCING

Project financing is the long term financing of infrastructure and industrial projects based upon the projected cash flows of the project rather than the balance sheets of the project sponsors.

Difference between conventional financing and project financing:

	Conventional financing	Project financing
1.	Cash flow from different assets and businesses are co-mingled. A creditor makes an assessment of repayment of his loan by looking at all the cash flows and resources of the borrower.	Cash flows from the project related assets alone are considered for assessing the repaying capacity.
2.	End use of the borrowed funds is not strictly monitored by the lenders.	The creditors ensure proper utilization of funds and creation of assets as envisaged in the project proposal.
3.	The creditors are not interested in monitoring the performance of the enterprise; rather they are interested in getting repaid their money in one way or other.	Project financiers are keen to watch the performance of the enterprise and suggest remedial measures as and when required to ensure that the project repays the debt out of its cash generations.

Sources of Project Finance:

The sources of finance can be divided into two broad categories, viz., equity capital and debt capital (borrowed capital). The basic difference between equity and debt are as follows:

	Equity	Debt
1.	Equity shareholders have a residual claim on the income and the wealth of the firm	Creditors (suppliers of debt) have a fixed claim in the form of interest and principal payment.
2.	Dividend paid to equity shareholders is not a tax deductible payment	Interest paid to creditors is a tax deductible payment
3.	Equity ordinarily has an indefinite life	Debt has a fixed maturity.
4.	Equity investors enjoy the prerogative to control the affairs of the firm.	Debt investors play a passive role

MAIN SOURCES OF PROJECT FINANCE

- **Equity**
 - Ordinary shares
 - Preference shares
 - Internal Accruals
- **Debt**
 - Debentures/Bonds
 - Term loans
 - Syndicated loans
 - Bridge loans
 - Unsecured loans
- **Miscellaneous Sources**
 - Deferred credit
 - Lease finance

EQUITY

- **Ordinary Shares:** Ordinary shares (or common shares or equity shares) are the source of permanent capital. The holders of equity shares are the legal owner of the company. They enjoy the rewards and bear the risks of ownership.
- **Preference shares:** Preference shares bear a predetermined rate of dividend. They have priority of claim over equity shares in the matter of payment of dividend.
- **Internal Accruals:** The internal accruals of a firm consist of depreciation charges and retained earnings. Depreciation is the decline in the value of an asset over time due to wear and tear. It represents a periodic write-off of a capital cost incurred in the beginning and it is a non-cash charge. Hence, it is considered an internal source of finance.

Retained earnings are that portion of equity earnings (profit after tax less preference dividends) which are ploughed back in the firm. Because retained earnings are the sacrifice made by equity shareholders, they are referred to as internal equity.

DEBT

- **Debentures/Bonds:** Debentures are instruments for raising long term debt capital. Debenture holders are the creditors of the firm. The firm that has borrowed money by way of debenture has the obligation to repay interest and principal at specified times/dates. Debentures often provide more flexibility than term loans with respect to maturity, interest rate, security, repayment etc.

- **Term loans:** 'Term loans' denotes long term loans offered for project financing. Term loans, also referred to as term finance, represents a source of debt finance which is generally repayable in less than 10 years. They are employed to finance acquisition of fixed assets and working capital margin.
- **Syndicated Loans:** Syndication is an arrangement wherein several banks participate in a single loan. The borrower seeking a syndicated loan chooses a lead bank to manage the same. The lead bank is responsible for negotiating terms with the borrower.
- **Bridge Loans/Bridge Finance:** This is a temporary loan meant for speeding up the capital cost of a project. These are sanctioned by banks and financial institutions in order to help speedy implementation of the project. The necessity for bridge finance arises in situations where finance from a particular source is getting delayed, but the source is certain.
- **Unsecured loans:** The promoters can mobilize funds from their friends, relatives and well wishers in the form of loan to make good the shortfall. Such loans are always unsecured i.e. the lenders can not have any charge over the assets of the company. Unsecured loans can be mobilized only based on the rapport that the project promoters have with their friends and relatives.

MISCELLANEOUS SOURCES

- **Deferred Credit:** Many a time the suppliers of machinery provide deferred credit facility under which payment for the purchase of machinery is made over a period of time. The interest rate on deferred credit and the period of payment may rather vary. Usually, the supplier of machinery, when offers deferred credit facility, insists that a bank guarantee should be furnished by the buyer.
- **Lease finance:** A lease represents a contractual arrangement whereby the lessor (owner of an asset) gives the lessee (user of the asset) the right to use an asset in return for periodic lease rental payments.

ROLE OF FINANCIAL INSTITUTIONS IN PROJECT FINANCING:

Whatever may be the approach to lending, the lending decision is primarily governed by 3 (three) considerations:

1. The capacity of the project to repay the loan along with interest obligations, out of its own cash generations.
2. The value of security offered for the loan.
3. The integrity and willingness of the borrower to repay the loan in time i.e. the creditworthiness of the borrower.

PROJECT PLANNING

The most important responsibilities of a PM are:

- Planning – need formal detailed plan with time and budget constraint
- Integrating – integration of planning is required among functional units
- Executing – implementing the plans through integration

Planning can be described as a function of selecting the enterprise objectives and establishing the policies, procedures and programs necessary for achieving them.

“Establishing a pre-determined course of action within a forecasted environment”

The project plan will include a complete set of schedules together with the associated resources and personnel needed to perform all of the tasks required to complete the project.

The primary purpose of project planning is to establish a set of directions in sufficient detail to tell the project team exactly-

- what must be done
- when it must be done, and
- what resources to use in order to produce the deliverables of the project successfully.

Project Manager (PM) is the key to successful project planning.

Planning must be:

- systematic
- flexible to handle unique activities
- disciplined through review and control
- capable of accepting multifunctional inputs

Consequence of poor planning:

- Wild enthusiasm
- Chaos
- Search for guilty
- Punishment of innocents
- Promotion of non-participants

Basic reasons for planning:

- To eliminate / reduce uncertainty
- To improve efficiency of the operation
- To obtain better understanding of the objectives
- To provide a basis for monitoring and controlling work

Elements of Project Plan

The process of developing the project plan varies from organization to organization, but any project plan must contain the following elements:

Overview: short summary of the objectives and scope of the project.

Objectives: This contains a more detailed statement of goals or target to be achieved.

General Approach: This section describes both the managerial and the technical approaches to the work.

Contractual Aspects: includes a complete list and description of all reporting requirements.

Schedules: plan showing when individual or group activities will be started and completed

Budget: plan expenditures required to achieve objectives.

Resources: resource requirements are detailed by tasks.

Personnel: this section lists the expected personnel requirements of the project.

Risk management plan: covers any type of unwanted problems that could affect the project.

Evaluation: need to evaluate financially and technically against standards and by methods established at the project's inception.

IMPORTANT STAGES OF EFFECTIVE PLANNING

- Statement of work
- Milestone schedule
- Action plan

Statement of work

Narrative description of work to be accomplished.

- Objective of the project
- Brief description of the work
- Budget constraint
- Specification and schedule

Milestone schedule

Contains important information about project work.

- Project start date
- Project completion date
- Review meeting, prototype availability, procurement, testing

Action Plan

A portion of a project plan detailing the activities, their schedules and resources, including personnel.

To accomplish a specific project, number of major activities must be undertaken and completed.

- make a list of these activities in general order
- breakdown into tasks and sub-tasks

Steps:

- Objectives are taken from the process plan
- The set of required activities for the objectives are identified
- Each activity has an outcome associated with it – decomposed into tasks and sub-tasks

Linear Responsibility Chart:

Linear responsibility chart consists of the list of personnel and organizations responsible for each task and sub.

Task	Resources	Precedence Task	Time	Assigned

This is a specialized view of the action plan that focuses on who has what responsibility associated with each project task. Many different forms may be used for responsibility chart. Linear responsibility chart consists of the list of personnel and organizations responsible for each task and sub task.

Work Breakdown Structure (WBS)

Project manager (PM) needs to structure the work into small elements in such a way that the elements are:

- Manageable – authority and responsibility to be assigned
- Independent – minimum dependence on each other
- Integratable – total package to be seen
- Measurable – in terms of progress

WBS is the single most important element in planning process, which provides a common framework.

- The total program can be described as a summation of subdivided element
- Cost and budget can be easily established
- Time, cost and performance can be tracked
- Schedules and status reporting procedures can be established
- Responsibility assignment can be established

WBS acts as a vehicle to break the work into smaller elements – providing greater probability that every major and minor activity will be accounted for.

Most common type of WBS is the six-level indented structure

Level	Description
1	Total Program
2	Project
3	Task
4	Subtask
5	Work package
6	Level of effort

Levels 1 ~ 3 – centrally controlled by PM – integrated effort

Levels 4 ~ 6 – are for respective departments

Each element of work should be assigned to only one level of effort

There is no hard and fast rule as to the number of levels into which the project is to be broken down. The number of stages (levels) should be neither

too few nor too large. If the levels are too few integration of activities may become difficult. If the levels are too large, it will make the analysis complex and will lead to additional cost and time. The WBS and the constituent work packages become the basis for project planning, scheduling and controlling.

WBS acts as a vehicle to break the work into smaller elements – providing greater probability that every major and minor activity will be accounted for.

<u>Program:</u>	<u>New plant construction and start up</u>	<u>Responsibility</u>
<u>Project 1:</u>	<u>Analytical study</u>	
Task 1:	Marketing study	Marketing
Task 2:	Cost analysis	Finance/Accounting
<u>Project 2:</u>	<u>Construction</u>	
Task 1:	Plant design	Civil/Architecture
Task 2:	Plant construction	Civil
<u>Project 3:</u>	<u>Design and Layout</u>	
Task 1:	Product design	Design
Task 2:	Process layout	Industrial
<u>Project 4:</u>	<u>Installation</u>	
Task 1:	Fabrication	Manufacturing
Task 2:	Set up	Mechanical

Budgeting & Cost Estimation

Budget is a plan for allocating resources, especially, allocates the scarce resources to various endeavors of organization.

After planning phase, budgeting is the beginning of implementation. First priority is to obtain resources to do work.

If over-funding – produce waste/encourage slack management

If under-funding – inhibits accomplishments/creates frustration

Budget is also a control mechanism – baseline standard for comparison.

Budgeting procedures must associate resource use with the achievement of organizational goals. Over-spent or under-spent of budget may cause misinterpretation to management. Data must be collected and reported in a timely manner. Reporting process must be carefully designed and controlled.

Estimating Project Budgets

Need to forecast the resources the project will require, quantity of each, time needed, cost including effect of price inflation.

Cost estimation method is well-defined in many fields. Every business has its own rule of thumb for cost estimation. Different catalogues also help in cost estimation.

Budget uncertainty is significantly greater for projects than for traditional operations. Budgeter may use the similar projects as guidelines – but these are rough at best. As a project is unique, budget is based on forecasts of resources usage and the associated costs, thus estimating the cost for any project involves risk.

For multi-year project, budget is set at the beginning – but over the years, resources may be altered by the availability of alternate or new material, machinery or personnel – both technical and inflation risk. Longer the project life, less the PM can trust the budget.

Unless the PM understands the project details and company accounting system, he cannot prepare or control budget over the project. PM must be aware of both the resources requirements and the specific time-pattern of resource use.

Every expenditure must be identified with a specific project task. Each element of WBS has a unique account number to which charges are accrued as work is done – needed for PM to exercise budgetary control.

Mainly two types of budgeting

- Top-down
- Bottom-up

Top-Down Budgeting

Strategy is based on collecting the judgment and experiences of top and middle managers, and available past data concerning similar activities. Managers estimate overall project cost as well as cost of major subprojects. Cost estimates are then given to lower level managers who breakdown the estimates for the specific tasks. Gradually process continues to lower levels.

Budget is mainly prepared based on “considerable past experience”. Junior manager feel forced to accept what they perceive to be insufficient allocations to achieve the objectives to which they must commit.

Benefits:

- Aggregate budget can often be developed quite accurately
- Statistical distribution is also stable
- Small but costly items need not be individually identified nor need to be feared about overlooking of those items

Limitations:

- A few individual elements may be in significant error
- Strong biasness towards underestimating cost

Bottom-up Budgeting

Elemental tasks, schedules and individual budgets are constructed following WBS. People doing the work are consulted regarding times and budgets for task to ensure accuracy. First, estimates are made in terms of resources, e.g., labor hr, material. Later, those are converted to money equivalent. To improve estimates, learning curve and work sampling analysis can be included.

Senior and junior managers can resolve conflicts by discussion to ensure accuracy. Total direct costs are then aggregated – and also some indirect costs are included, e.g., G&A costs.

Benefits:

- More accurate as involved persons do the budget
- Junior managers get valuable experiences in budget preparation

Limitations:

- Critical that all elements are included
- Difficult to complete the list
- Individual overstate their needs as top managers might cut down the costs

Iterative Budgeting

Let's say budget is done both top-down and bottom-up approaches. These two budgets are never going to be same. Senior managements' allocation will definitely be conservative compared to the one prepared by involved person.

Further one move up the organizational position, away from immediate responsibility, easier, faster and cheaper the job looks. He doesn't know the details of each activity. By reducing the budget, senior management want to show the top management that the project is going to be a profitable venture. On the other hand, lower management or people actually involved in the work want to add too many allowances even though some have already been added.

For final approval, there will be only one budget to be submitted to top management. The steps are:

- First, the senior management need to change their position by increasing the budget they have prepared
- Seeing the senior management, the junior team involved in the real work will reduce their budget
- Even after these negotiations, budgets might still be different. When there will be no more room for negotiation, the following steps need to be taken depending on the type of project life cycle:
 - If low impact of budget at the final stage, accept the senior managements' one
 - If very high impact at the final stage, accept the juniors' one so that due to budget constraints, the project is not in a threat of failure.

Estimating Costs

Accuracy of the cost estimate improves as we move from the conceptual phase of the project to the point where individual items are defined. There are three main costs in estimation

1. Direct cost: clearly chargeable to work package. Can be influenced by the PM, project team and individuals implementing the package. These costs represent real cash outflows and must be paid as the project progresses. Direct cost include labor cost, material cost and equipment cost
2. Overhead cost: represents project costs that cannot be tied to a specific deliverable but serve the entire project. Include consultants, PM, travel, training etc.
3. General & Administrative (G&A) cost: represents organizational costs that are not directly linked to a specific project and are also called fixed costs. These costs are carried for the duration of the project. Usually allocated as a percentage of total direct costs.

Cost Estimating Methods

- Ratio methods are often used in the concept phase of a project to get an initial cost estimate for the project. Top-down budgeting usually follows this method. Three main types are:
 - i. cost estimate for a house by square feet
 - ii. cost of a new plant by capacity size
 - iii. software product estimated by line code

These methods are not very accurate as neither recognize differences among projects nor identify specific deliverables.

- If the project is similar to past projects, previous costs can be used as a starting point. Differences can be noted and cost estimates can be adjusted indicating the differences. Differences from the standardized projects are noted for time, cost and resources, and changes are made. This enables the firm to develop a budget within a very short span of time. Unfortunately applicable to only a small number of projects.
- Factors related to the uniqueness of the projects have strong influence on accuracy. Poorly written scope specifications for new technology result in errors in estimating times and costs. Environmental conditions also can produce errors.
- People factor can also introduce errors. A close match of people skills to the task will influence productivity and learning time. Relationship between the team members influence communications and hence project estimates.
- Factors external to the project can refine time and cost estimates. Equipment downtime, political disputes, vacations can influence project estimates.

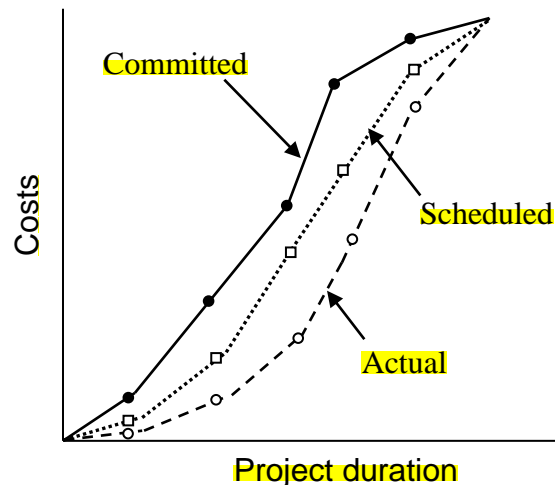
Most reliable method for estimating time and cost is to ask the responsible person for the work. They know the best about the cost either from experience or at least know where to get the information. If too much uncertainty, it is a prudent policy to acquire three cost estimates – best, average and high. This gives PM and owner an opportunity to assess the risks associated with project costs.

Time-Phased Budgets

Cost estimates are not a budget. A cost estimate becomes a budget when it is time-phased. A procedure is needed to determine when the money must be available. Each package estimate requires a time-phased budget. Work package duration is used to develop project network – that schedules when work package will start and finish. Time phased budgets are then assigned to scheduled time periods to determine the financial requirements for each period over the project life.

Perception of costs and budgets vary depending on their users. PM must be very aware of these differences when setting up the budget. Order might need to be placed well before and need to be paid in advance. Here, money

committed does not mirror the actual cash flow of the project schedule. This information is very useful in forecasting future cash outflows.



The scheduled budget represents the planned direct costs as they are expected to occur. Actual cost line represents actual direct costs as they occur as the project is implemented. The respective timings of these three costs are useful to forecast future cash needs, measure project schedule and track actual cost variances.

Estimating Guidelines for Time, Cost and Resources

Time, cost and resource estimates must be accurate if project planning, scheduling and controlling are to be effective. Effort should be made to see that initial estimates are as accurate as possible. Following are six guidelines to estimate work packages:

- **Responsibility:** Estimates should be made by the persons most familiar with the task. They want to materialize estimates when implementing the task.
- **Normal Condition:** Estimates should be based on normal working condition, efficient method and normal level of resources. Like, eight hr shift, one or two shift, standard computer etc.
- **Time Units:** All task time estimates need consistent time units. In practice, use of “workday” is the dominant choice for expressing task duration.
- **Independence:** Each task time estimate should be considered independently of other activities.
- **Contingencies:** Task estimates should not include allowances for contingencies. Top management keep an extra fund for contingencies that can be used to cover unforeseen events.
- **Estimate Errors:** Finally, project management culture should allow estimate mistakes and errors to occur. A strong element of trust in the project management culture results in more realistic estimates.

Learning Curve

If the project involves works in which the firm has little experience, cost estimation is little difficult, particularly for direct costs.

Suppose, total 25 units need to be produced for which each worker needs 50 hrs time. Each worker is paid a wage of Tk. 40/hr.

Total labor cost to produce 25 parts = 25 units X 50 hr/unit X Tk. 40/hr
= Tk. 50,000/-

In fact, this would underestimate actual cost as more time per unit output is needed early in the process. Study shows that human performance improves as task is repeated.

Learning rate is defined as the percentage rate at which required time for a unit product decrease each time the output doubles.

Time required to produce a unit of output follows a formula

$$T_n = T_1 n^r$$

where,

T_n = time required for nth unit of output

T_1 = time required for initial unit of output

n = number of unit need to be produced for a person to become expert

r = log decimal learning rate/log 2

In the previous example, let the learning rate is 80%. If after 20 unit, there is no further improvement, time needed for the first part can be calculated as

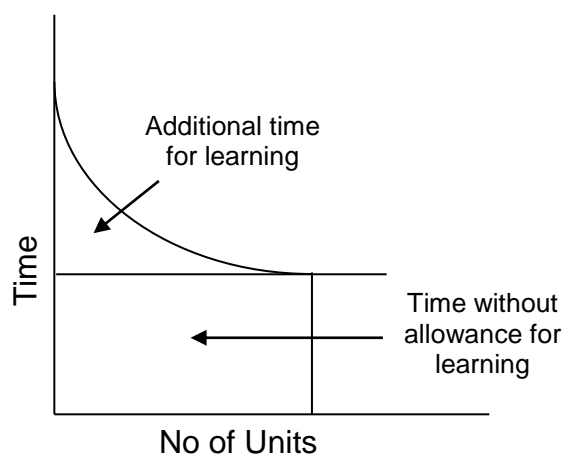
$$50 = T_1 (20)^{\log 0.8 / \log 2}$$

$$T_1 = 131.16 \text{ hr}$$

The second part will take the time $T_2 = 131.16 * 0.8 = 104.9 \text{ hr}$

Required time will gradually decrease until 20th part is completed. Rest of the parts will take approximately same time.

Therefore, neglecting the learning rate will significantly underestimate the total budget for a completely new task.



Making Better Estimates

There are two types of errors in budget estimation

- Random error – overestimate and underestimate are equally likely
- Biased error -- overestimate and underestimate are not equally likely

Two simple statistical measures are used for a person's performance as an estimator:

1. MAD/MAR – Mean absolute deviation/ration
2. TS – Tracking signal

$$MAD = \sum (|A(t) - F(t)|) / n$$

$$MAR = \sum ((A(t) / F(t)) - 1) / n$$

$$TS = RSFE / MAD$$

where, $A(t)$ = actual budget at period t

$F(t)$ = estimated (forecasted) budget at period t

$RSFE$ = running sum of the forecast errors

Template for improving estimating skill

1. Using Mean Absolute Deviation (MAD)

Period	Estimate	Actual	$A(t) - F(t)$	$ A(t) - F(t) $	MAD	TS
1	155	163	8	8		
2	242	240	-2	2	5.0	1.20
3	46	67	21	21	10.33	2.61
4	69	78	9	9	10.00	3.60

2. Using Mean Absolute Ratio (MAR)

Period	Estimate	Actual	$(A(t) / F(t)) - 1$	$ (A(t) / F(t)) - 1 $	MAR	TS
1	155	163	0.052	0.052		
2	242	240	-0.008	0.008	0.030	1.448
3	46	67	0.457	0.457	0.172	2.904
4	69	78	0.130	0.130	0.162	3.898

For any budget, estimated error should be unbiased so that tracking signal is close to zero. However, the value of the tracking signal should be within 3.0 for an acceptable budget.

CONFLICTS AND NEGOTIATION

CONFLICTS

Conflicts arise when people, working on the same project, have different ideas about how to achieve project objectives.

Conflicts can occur at any level – any stage of the work.

PM is often described as “Conflict Manager”—Team members run the project.

PM needs to have the capability to handle conflicts – needs understanding of why conflicts occur:

- What are the objectives?
- Can they be in conflict with other projects?
- Why do conflicts occur?
- How to resolve?
- Sense any indication / forecasting that conflicts arise

Objectives:

- Must be known to all project personnel and all managers in parent organization
- Must be specific
- Not overly complex
- Realistic and attainable
- Within resource bound
- Consistent with strategy

Conflict Environment

- Manpower
- Equipment and resources
- Technical opinion and trade-off
- Priorities
- Scheduling
- Responsibilities

Conflicts appear differently depending on structure:

Functional

- Should be avoided
- Conflict is bad
- Results by troublemaker

Dedicated

- Part of change – inevitable
- Conflict is good (sometimes)
- Relationship among components

Meaningful conflict is good in many ways – some new ideas can be generated to achieve the objectives.

Different types of conflicts

- Personality clash – inevitable
- Design/Manufacturing conflict
- Manufacturing/Quality conflict

Plans to resolve conflicts

- Concede low intensity conflict if a high intensity conflict is expected later
- Different projects – if resource conflict, can be resolved by setting priority based on customer opinion
- Resource allocation among different projects – internal meeting among different PMs

Priority:

- True as long as they are not shifted around
- Executives should set the priority and tell PMs

Negotiation

Process through which two or more parties seek an acceptable rate of exchange for items they own and control.

- Fulfillment of separate tasks
- Each unit activity should not have any conflict with other tasks
- Integration of all tasks
- Establish lateral relationship – decisions to be made horizontally

Pareto-optimal solution:

No party can be made better off without making another party worse-off by the same amount or more.

Need to optimize the outcome in terms of overall organizational goals.

Highest levels of negotiation skill is needed for:

- Partnering – use of subcontractors
- Chartering – use of inputs from functional units
- Change – management of changes once project is underway

PARTNERING

External suppliers – delivering parts of projects:

- Product
- Service
- Knowledge
- Skill

Parent organization: wants to get deliverables at lowest possible cost as soon as possible

Sub-contractors: wants to provide deliverables at highest possible profit at least effort

“Mutual suspicion and antagonism between both parties”

“Partnering is a method of transforming contractual relationships into a cohesive, cooperative project team with a single set of goals and established procedures for resolving disputes in a timely and effective manner.”

Change the atmosphere of mutual suspicion and antagonism into one of the cooperation and mutual helpfulness – although it is too difficult in reality.

First Step:

- Parent firm must make a commitment to partnering
- Select subcontractors who also make such commitment
- Engage in joint team building exercise

Second Step:

- Joint evaluation of progress
- Method for resolving any problem
- TQM for joint project
- Continuous support from both parties

Final Step:

- Commit a joint review of project execution when completed

These steps are an attempt to mitigate the risks associated with subcontracting which is firmly rooted in:

- Mutual trust between partners
- Non-adversarial negotiation

CHARTERING

Written agreement between PM, senior management and the functional managers who are committing resources and / or people to the project.

Details the expected project deliverables including project schedule and budget.

Senior management, Functional managers and PM should be on the same page:

- Agreeing what to be done, when and at what cost
- None of the parties will change the agreement unilaterally; or at least without prior consultation with other parties

Various members of the team sign a commitment to

- Meet design intent
- Complete contract without need of litigation
- Finish project on schedule
 - Timely resolution of issues
 - Manage joint schedule

SCOPE CHANGE

Scope changing in a project is almost certain – no matter how carefully a project is planned.

Scope of project is subjected to considerable uncertainty.

Basic reasons for scope change

1. From technical / technological uncertainty

Error in initial assessment how to achieve goal or even choice of proper goal

- Test of soil
- Test of material
- New innovation

2. Increase in user / team knowledge or sophistication

Client / user or project team learns more about the nature of the deliverables

- Computer software
- Air flow system in ICU

3. Mandate

Change in environment in which the project is being conducted

- New policy
- New Government law
- New criterion

e.g., Effluent Treatment Plant (ETP) – must be adopted for waste water treatment.

Remedy of the scope changes:

Technological Uncertainty:

- Careful analysis of technologies involved
- Implementing recent technologies
- Technical forecasting

Improved Knowledge:

- Improving upfront communication with the client
- Establish formal process to handle changes

Mandate:

- Unpredictable
- Need to be managed by flexibility in budget and schedule

Principles of Negotiations

- Separate people from problem – emotional people tend to attack one another rather than the problem
 - Should concentrate on goals
- Focus on interest, not position – ego problem
 - Negotiator needs to determine underlying concern of other party, not just own opinion
- Invent options for mutual gain – win-win negotiations
- Using objective criteria – to find standard to determine quality of outcome

SCHEDULING

- Conversion of project action plan into an operating timetable
- Serves as a basis for monitoring and controlling project activity

Scheduling is very important in project environment because

- Project lack continuity of day-to-day operations
- Project often present much more complex problems of co-ordination
- Sometimes customer requirements

Schedules are typically based on previously determined action plan and WBS – usually created for each major task level.

Basic approach is to form a network of activity and event relationships that graphically portrays the sequential relations between the tasks in a project.

- Can identify the preceding and following tasks
- Consistent framework for planning, executing, monitoring and controlling the project
- Illustrates the interdependence of all tasks, work packages and work elements
- Denotes time for specific resource requirements
- Determines an expected project completion date
- Identify slack activities that can be delayed without penalty
- Relieves interpersonal conflict by clearly showing time dependencies

NETWORK TECHNIQUES

PERT/CPM: Program evaluation and review techniques
Critical path method

PERT is more common to Research and Development (R & D)

CPM is mainly for Construction and Production

PERT is for probabilistic activity time

CPM is for deterministic activity time – controls both time and cost aspects of a project

CPM can be crashed or expedited at extra cost to speed up completion time

Critical path: path containing the activities that could not be delayed

Slack: activities that could be somewhat delayed without affecting project completion time

Activity: specific task or set of tasks

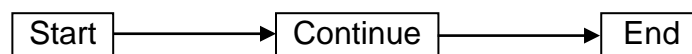
Event: end state occurring at particular time

Network: arrangement of all activities in a project arrayed in logical sequence

Path: series of connected activities between any two events of a network

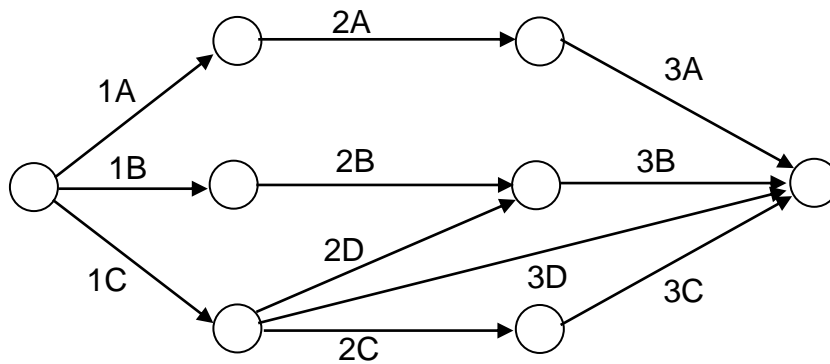
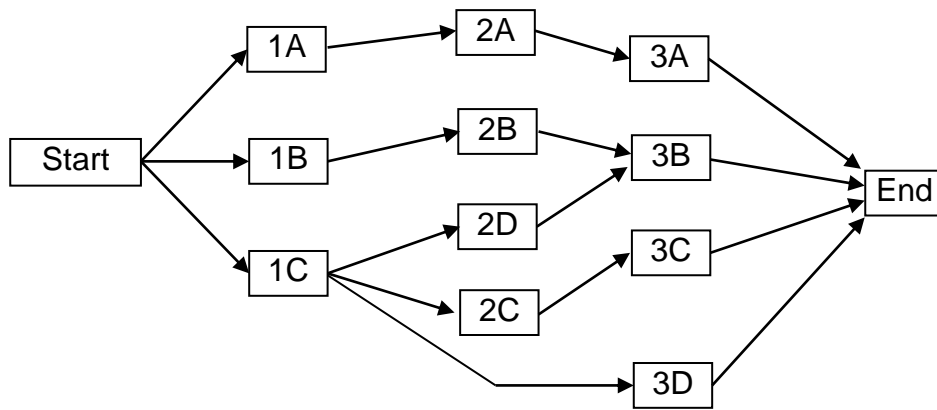
To build a network:

- Need to know all the activities comprise the project
- For each activity, need to know predecessor and/or successor
- Start and end time / date



Two types of network can be drawn:

1. Activity on Node (AON)
2. Activity of Arrow (AOA)

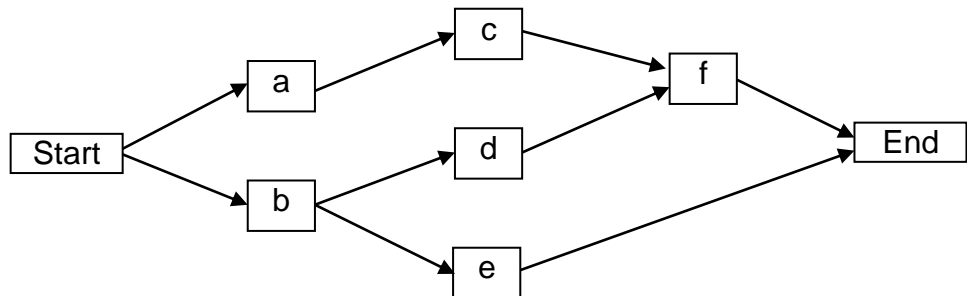


Task	Predecessor	Successor
1A	-----	2A
1B	-----	2B
1C	-----	2C, 2D, 3D
2A	1A	3A
2B	1B	3B
2C	1C	3C
2D	1C	3B
3A	2A	-----
3B	2B, 2D	-----
3C	2C	-----
3D	1C	-----

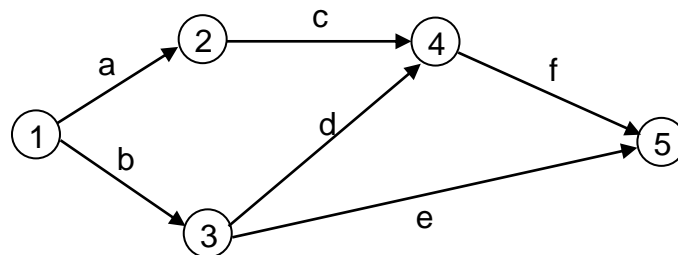
CONSTRUCTING A NETWORK

Task	Predecessor	Time	Cost	Person
a	----	5		
b	----	4		
c	a	6		
d	b	2		
e	b	5		
f	c,d	8		

Activity on Node

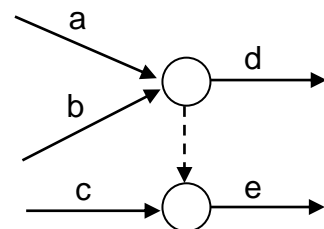


Activity on Arrow



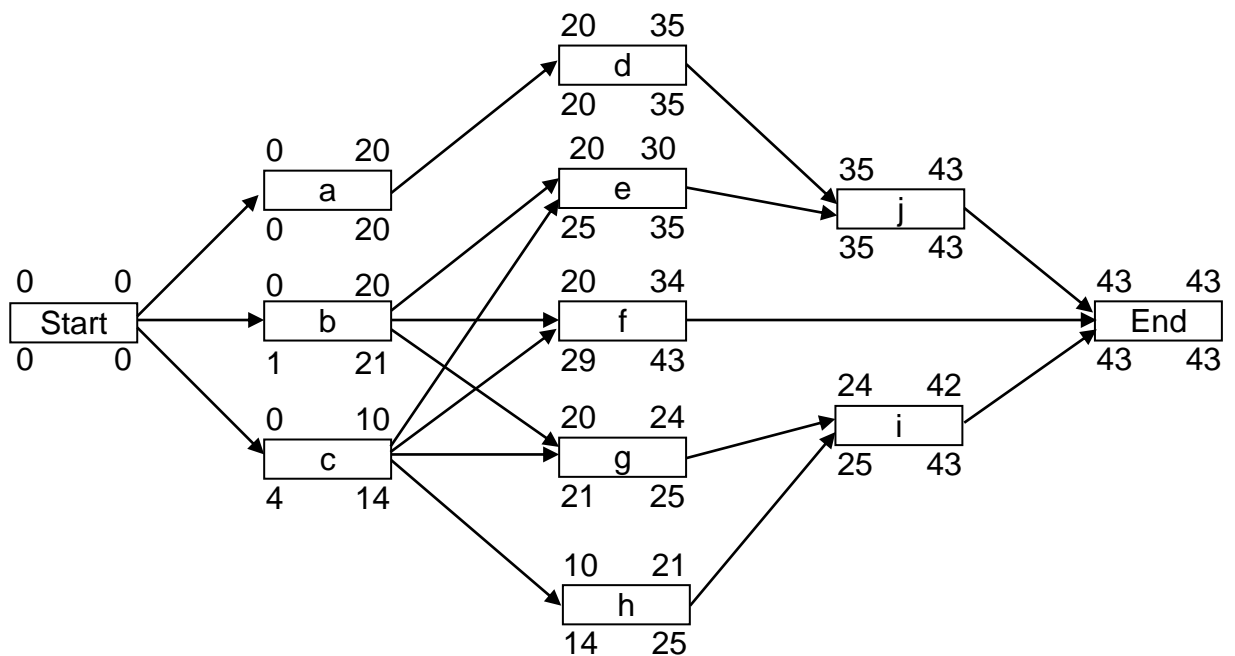
AOA sometimes need dummy;
 in comparison, AON is easier to draw
 e.g.,

- a, b precede d
- a, b and c precede e



SOLVING NETWORK

Task	Precedence	Time
a	----	20
b	----	20
c	----	10
d	a	15
e	b, c	10
f	b, c	14
g	b, c	4
h	c	11
i	g, h	18
j	d, e	8



The critical path in the network is: **a – d - j**

All other activities have slack time – can be delayed without delaying the project.

RESOURCE ALLOCATION

Allocation of physical resources

At any given time, the firm may have a fixed level of various resources available for its projects, which includes:

- Labor hours
- Machine hours
- Computing hours
- Location (specialized)
- Scarce resources

Need to adjust the project schedule to smooth the use of resources

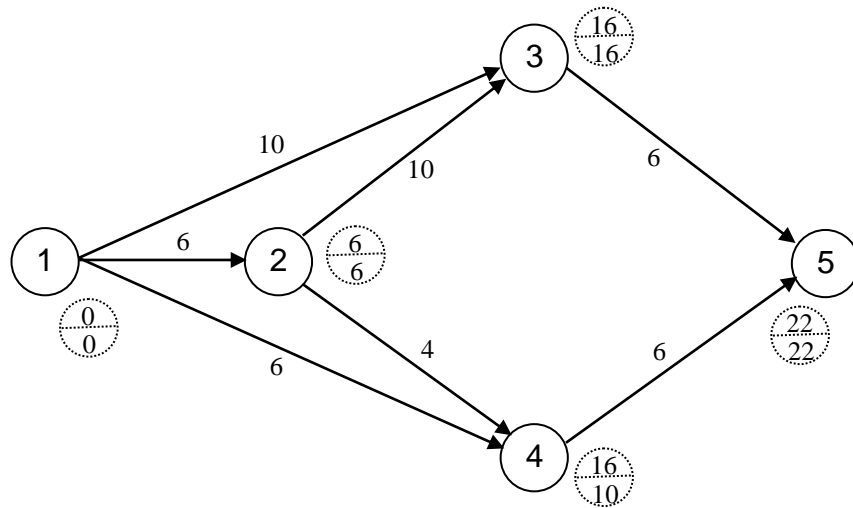
- to avoid project delay
- to avoid high cost allocation

RESOURCE LEVELING

The objective of resource leveling technique is to minimize the peak requirement and smooth out period to period variation without altering the normal project completion time.

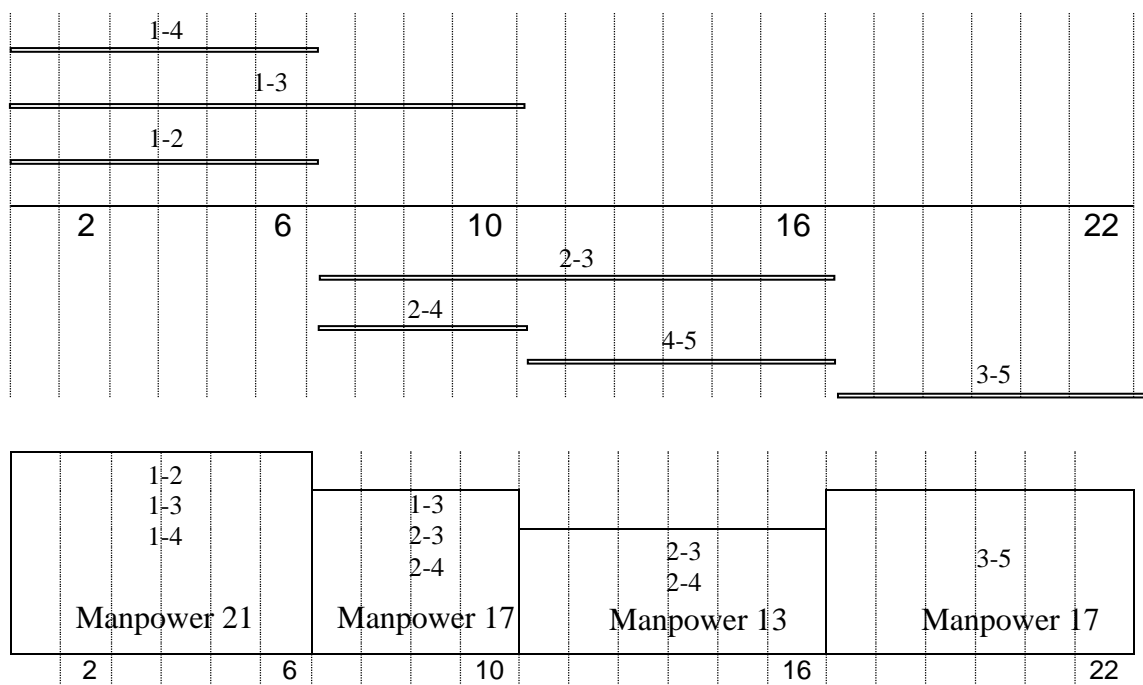
Activity	Duration (wk)	Manpower Requirement
1-2	6	8
1-3	10	4
1-4	6	9
2-3	10	7
2-4	4	6
3-5	6	17
4-5	6	6

PM needs to obtain a schedule which will minimize the peak manpower requirement and also smooth out period to period variation of manpower requirement.

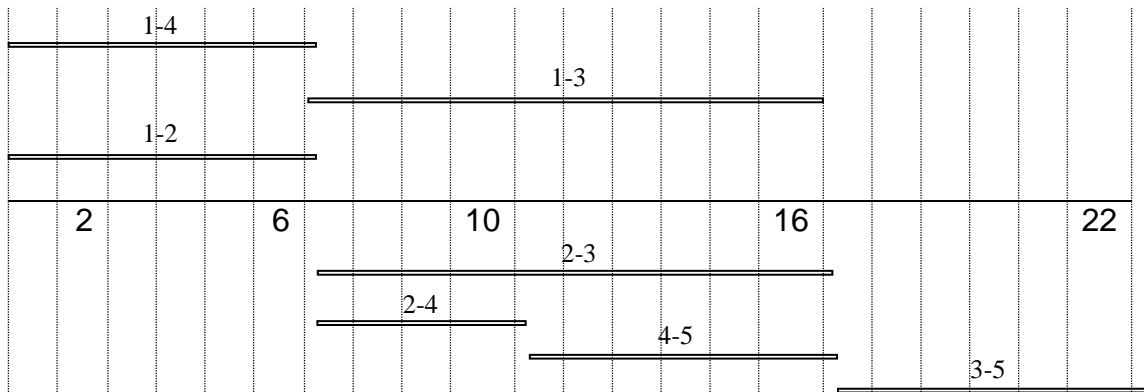


The critical path for this project is 1-2-3-5.

The project schedule along with the manpower requirement is shown below



The peak manpower is 21, and it occurs between 0-6 wks. The activities which are scheduled during this period are 1-2, 1-3 and 1-4. Activity 1-2 is a critical activity, hence it could not be disturbed. Out of the other two activities, 1-3 has a slack of 6 wks whereas 1-4 has a slack of 4 wks. So, move the activity 1-3 to its maximum extent.



1-2 1-4 Manpower 17	1-3 2-3 2-4 Manpower 17	2-3 2-4 Manpower 17	3-5 Manpower 17
2	6	10	16
			22

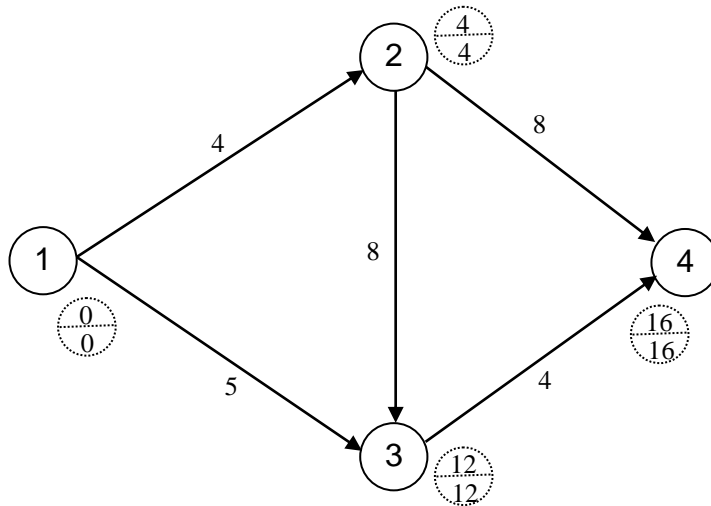
So now the manpower requirement is the same (17) throughout the project.

RESOURCE ALLOCATION

Objective of this technique is to adjust the non-critical activities such that the resource requirement in each period is within the constraint on the resource availability. In this process, the project completion time may be extended to satisfy the resource constraints.

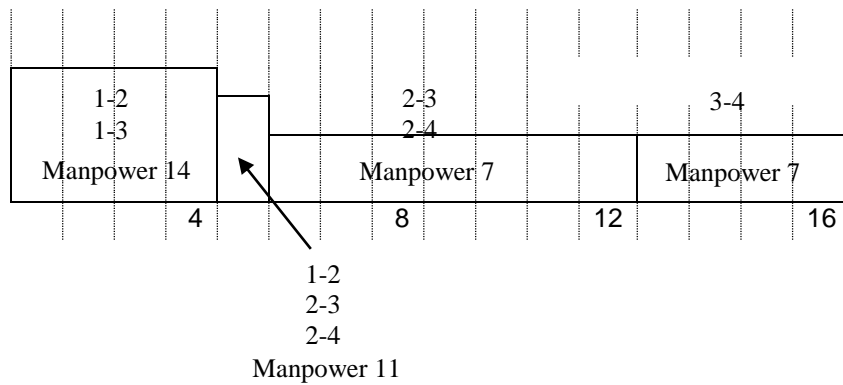
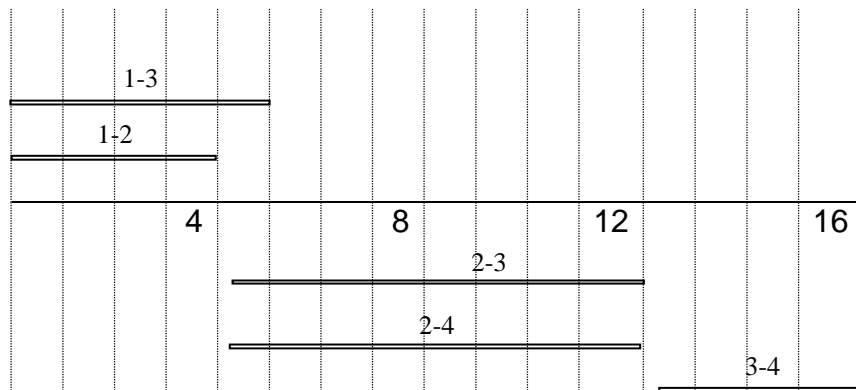
Activity	Duration (wk)	Manpower Requirement
1-2	4	10
1-3	5	4
2-3	8	5
2-4	8	2
3-4	4	7

PM needs to schedule the activities of the project with a maximum limit on the manpower requirement of 10.

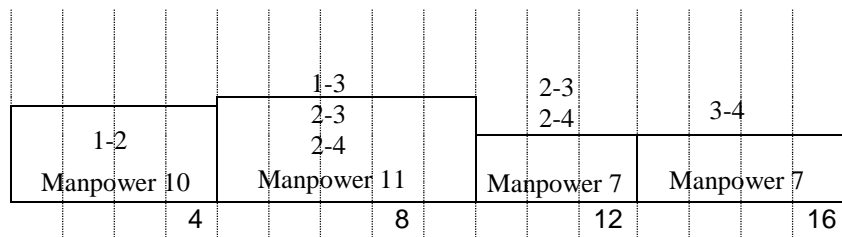
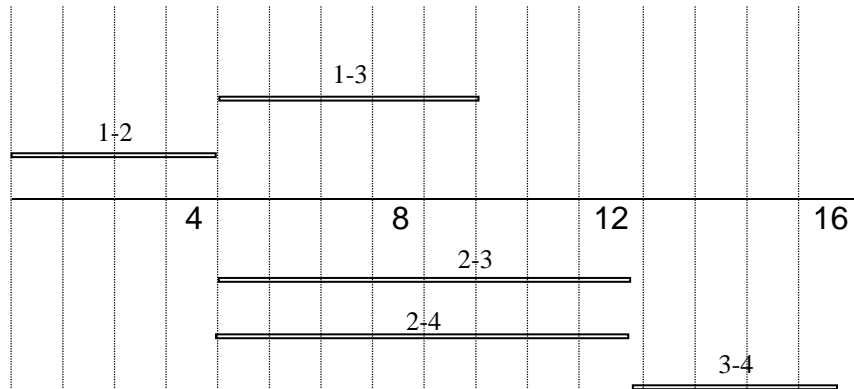


The critical path for this project is 1-2-3-4.

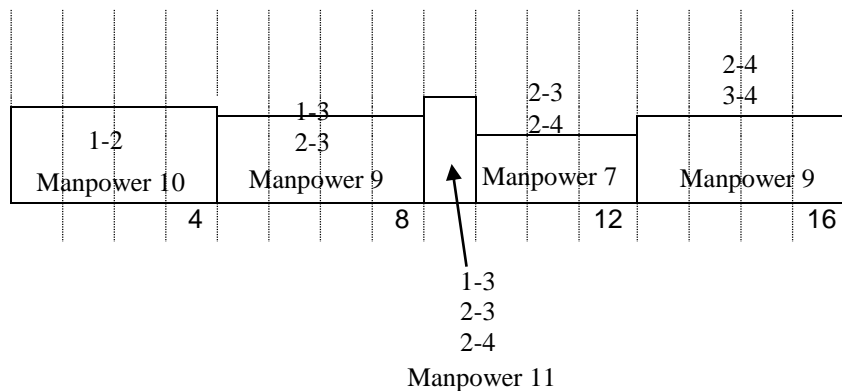
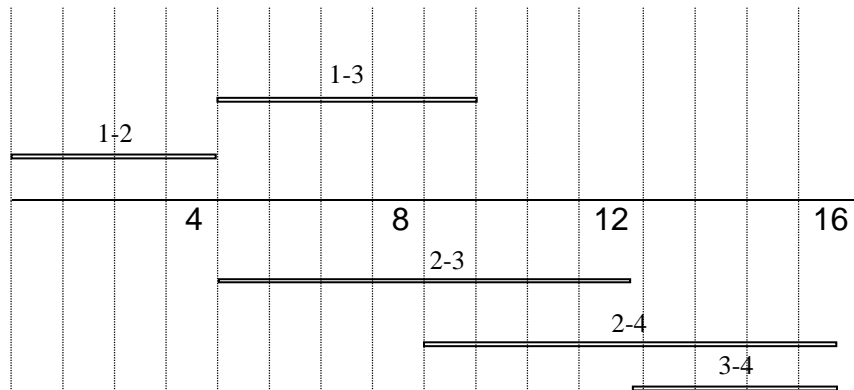
The project schedule along with the manpower requirement is shown below



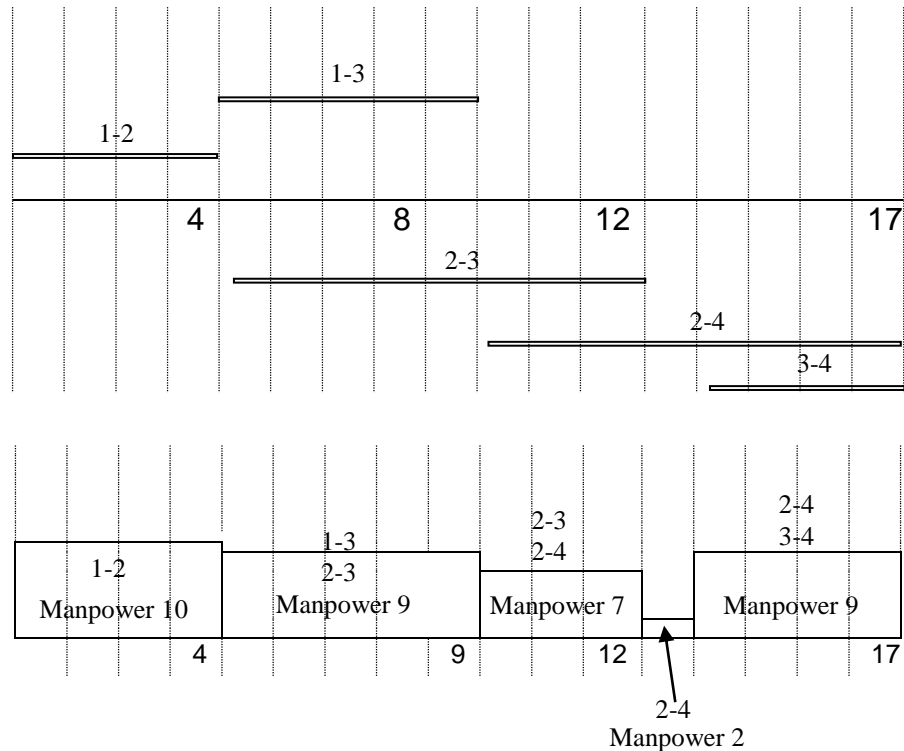
The peak manpower is 14, and it occurs between 0-4 wks. The activities which are scheduled during this period are 1-2 and 1-3. Activity 1-2 is a critical activity, hence it could not be disturbed. So, move the activity 1-3.



On wk 5-9, the manpower requirement is 11, still higher than the resource constraint. Move the other non-critical activity 2-4 to its maximum.



There is no other movement of the activities that can satisfy the constraint. The only way to manage the project is to extend it by one day. Move the non-critical activity 2-4 and consequently the critical activity 3-4 to one more wk on right. That will increase the project duration by one day.



CRITICAL PATH METHOD – **CRASHING A PROJECT**

Project manager (PM) is allowed to trade time for cost and vice versa.

In CPM, 2 activity time and 2 corresponding costs are specified:

- Normal
- Crash – expedite the activity by application of additional resources
 - overtime
 - special equipment
 - additional staff

Allocation of time and resources – standard practice and rule of thumb

Allocation problem requires more careful consideration if it is decided to speed up the accomplishment of tasks and the total project. Need to know the additional resources. Careful planning is critical when attempting to expedite a project.

Activity	Predecessor	Duration		Cost	
		Normal	Crash	Normal	Crash
a	----	3	2	40	80
b	a	2	1	20	80
c	a	2	2	20	20
d*	a	4	1	30	120
e**	b	3	1	10	80

* Partial crashing allowed

** Partial crashing not allowed

Calculate Cost-Time slope

$$\text{Slope} = \frac{\text{Crash cost} - \text{Normal cost}}{\text{Crash time} - \text{Normal time}}$$

Activity	Slope
a	-40
b	-60
c	---
d	-30
e	-70 (no partial)

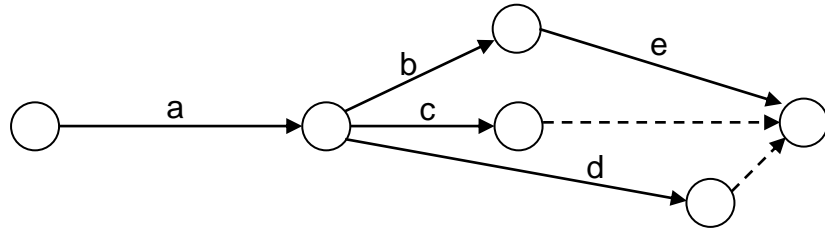
In CPM, first task is to develop a table or graph of the cost of a project as a function of various possible completion dates.

- Start with normal schedule for all project activities
- Then crash one activity at a time

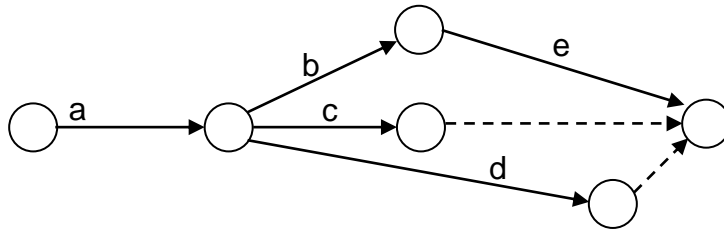
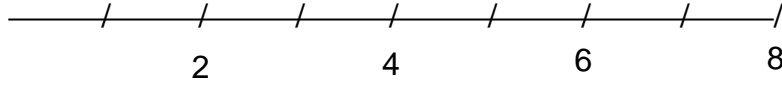
Goal is to decrease project duration at minimum additional cost.

Two simple principles in project crashing are:

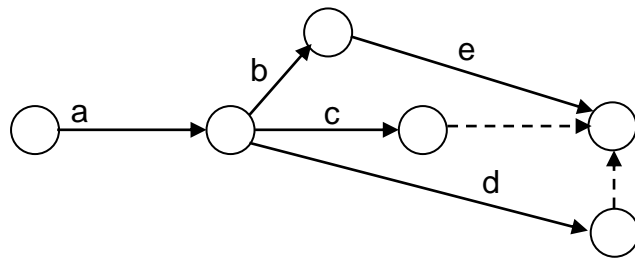
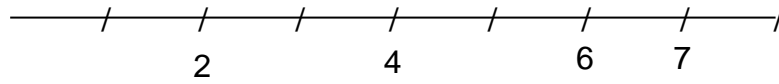
- Focus on the critical path
- Select least expensive way to do it



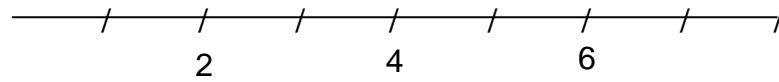
8 days
\$ 120

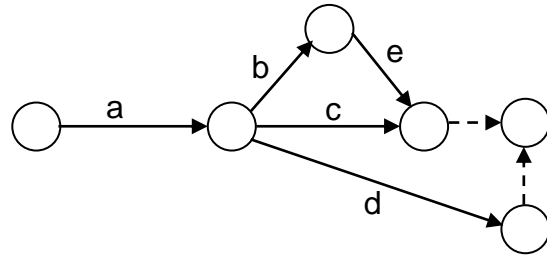


7 days
\$ 160

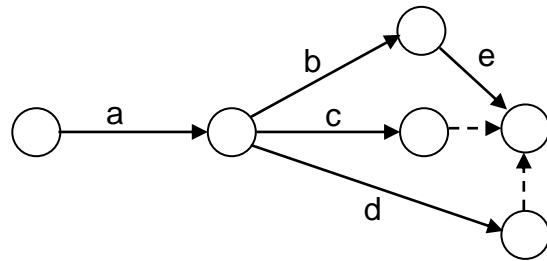
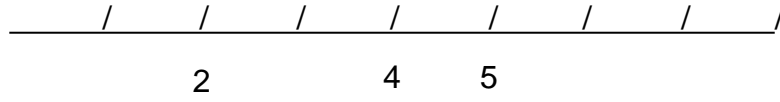


6 days
\$ 220

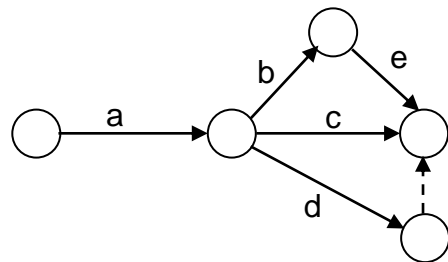




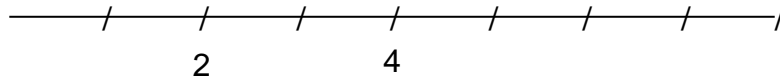
5 days
\$ 320



5 days
\$ 260



4 days
\$ 350



RESOURCE ALLOCATION PROBLEMS

Scheduling only focuses on time – not resource utilization and availability.

Only cost of resource utilization is not enough – should also refer to

- Individual types of labor
- Specific facilities
- Kinds of material
- Individual equipment

Fundamental measures of a PM's success are:

- skill to trade-off performance, time and cost
- skill in continuous process of cost-benefit analysis
- handle uncertainty in project

Two main constraints

- Time – project must be finished by a certain time
- Cost – project must be finished without exceeding specific level of resources

If no flexibility at all, the project is “over-determined”

PM must warn the senior management about time and budget uncertainty.

CONSTRAINED RESOURCE SCHEDULING

Heuristic Approach: employs rules of thumb that work reasonably well

Optimization Technique: seeks best solutions; far limited to handle complex situation

Heuristic Approach:

- Heuristic approach is the most widely used technique in resource allocation
- Only feasible method to attack large, non-linear, complex problems
- May not be optimal, but quite good – good enough for most purposes

Aided by simulation run – if fails to produce any better result, existing is the best.

The heuristic approach starts with PERT/CPM technique

- Analyze resource usage period by period, resource by resource
- Allocate scarce resources sequentially based on the following priority rules:
 - ASAP – as soon as possible -- default
 - ALAP – as late as possible – defer cash outflows
 - STF – shortest task first – maximize number of tasks in certain period
 - MRF – most resources first – more important task has higher demand
 - MSF – minimum slack first – to reduce risk
 - Arbitrary – according to some rules not associated with task length, slack or resource requirements:
 - Higher value
 - Favored customer

PROJECT MONITORING AND CONTROL

Planning – Monitoring – Control cycle

Key things to control in a project:

- Time (schedule)
- Cost (budget)
- Performance (specification)

Good planning requires greater investment of time and energy, however it significantly reduces the extent and cost of poor performance and time / cost overrun.

Control process should be closed looped system – with revised plans and schedules following corrective actions. The cycle is continuously in process until project is completed. This monitoring and control cycle should be internal part of organizational structure – just a normal way of life in the parent organization.

Designing Monitoring System

First step is to identify the key factors to be controlled.

- Performance
- Cost
- Time

Need to establish exact boundary – precisely which specific characteristics should be controlled. Some other factors to be controlled are:

- Number of labor hours
- Number or extent of processes or output changes
- Level of customer satisfaction

The best source of the factors to be monitored is Action Plan.

Monitoring is a direct connection between planning and control – problem in monitoring information results faulty control.

It is common to focus monitoring activities on data that can easily be gathered, rather than important.

More emphasis is on Objective, i.e., *Time* and *Cost*, rather than Subjective, i.e., *Performance*.

Monitoring should concentrate primarily on various facets of output, rather than intensity. PM concentrates on achieving result – not how hard the project team works.

Two important points in Data Collection

- Data collection standard and procedure
 - Standard can be altered over project life cycle
 - Due to altered capabilities or technological breakthrough
- Specify information to be collected
 - Accounting, operating, engineering tasks
 - Problem is to identify which data is needed
 - Dictated by project plan as well as by the goals of parent organization and need of the client to improve

Close monitoring project work is often justified with the argument that keeping close track can reduce the amount of crashing at the end.

Four Monitoring Policies

- At random time
- Equal interval
- More frequent at start
- More frequent at end

No one is superior to other -- different policies are suitable for different types of projects. Some project requires equal interval whereas some prefers more frequent at the end.

How to collect data:

Frequency Count: tally of occurrences of an event.

- Breakdowns
- Late report
- Quality defects

Raw Numbers:

- Hours
- Physical amount of resources
- Specifications

Subjective Numeric Ratings: subjective estimates made by knowledgeable individuals

- Quality
- Measurement

Indicators: cannot measure

- Response to change – how fast
- Good communications in project team

Verbal Measures:

- Quality of cooperation
- Morale of team members
- Quality of interaction with client

Fundamental purposes of control

- Regulation of results through the alteration of activities
- Stewardship conservation of original assets

Physical asset control: Control of the use of physical asset

1. **Machine control**

- Timing of maintenance and quality of maintenance
- Keep equipment in operating condition minimizing interference with ongoing work

2. **Material control**

- Received
- Inspected
- Stored prior to use

Human Resource control: Control of the use of personnel

- Controlling and maintaining the growth and development of people
- People can gain a wide range of experience in a reasonably short time

Performance can be measured by:

- Employee appraisal
- Personal performance indices
- Screening method during appointment, promotion

Financial Resource control: Accounting technique for the conservation of financial resources

Control focuses on both conservation and regulation.

- Current asset control
- Project budget control
- Capital investment control

Controls are exercised through a series of analyses and audits, which is mandatory for a project.

Control Processes

- at what point
- what to be controlled
- how to measure
- how much tolerance
- what kind of interventions
- how to correct

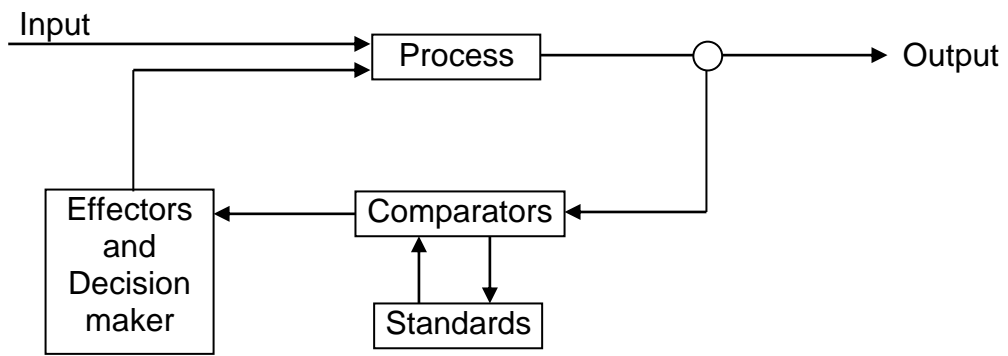
CONTROL MECHANISM

1. **Cybernetic Control:** most common type of control mechanism – steering control – key factor in automatic operation.

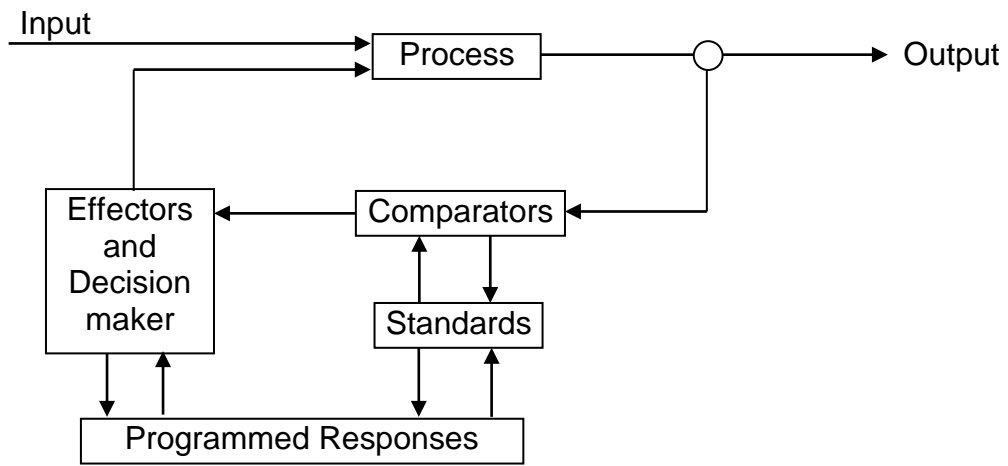
In order to control, the system output need to be monitored. The function is performed by the sensors that measure one or more aspects of the output. Measurements taken by the sensor are transmitted to the comparator, which compares them with a set of predetermined standards. The decision maker decides whether to corrections need to be made or not.

There are three types of cybernetic control system:

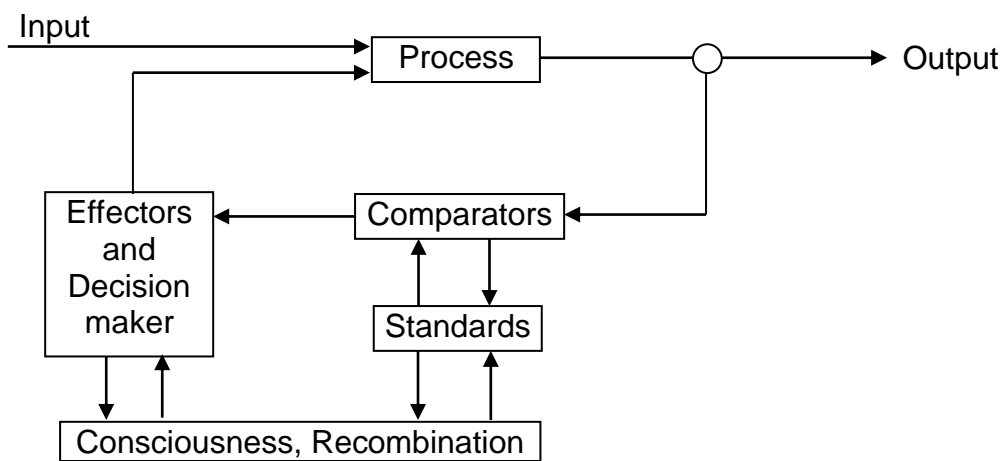
- a) **First-order control:** This is a goal-seeking device. The standard is set and there is no provision made for alternating it except by interventions by outside.
- b) **Second-order control:** This device can alter the system standards according to some predetermined set of rules or programs. An interactive computer program may alter its responses according to a complex set of pre-programmed rules. Many industrial projects involve second-order controllers, for example, Robot, FMS.



First-order control



Second-order control



Third-order control

c) Third-order control: This system can change its goals without specific pre-programming. It can reflect on system performance and decide to act in ways that are not contained in its instructions. This system has reflective consciousness, and thus must contain human.

2. Go / No-Go Control: test to see if some specific precondition has been met.

- most of the control in every aspect of a project
- mainly for product specification
- whether it falls precisely within a predetermined limit

- If non-conformance with the approved plan / design, both time and cost penalty
 - late delivery
 - cost overrun

3. Post Control: directed toward improving the chances for future projects to meet the goals.

- applied through a relatively formal document

Four distinct sections of the report:

1. Objectives: a description of objectives from project proposal
 - appendix to the report
2. Milestones, Checkpoints and Budget: starts with a full report of project performance against the planned schedule and budget.
 - combining and editing various project status reports made during project's life
3. Final report on result: both good and bad sides should be included
 - PM mainly focuses on troubles
4. Recommendations for improvement: set of recommendations to improve future projects.