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1. CH-1, 2, 3(1)
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2. CH-3(2), 4, 5
3. CH-6, 7, 8
4. CH- 9, 11
5. CH-10, 12
6. CH- 10,12

Chap -1 : The Challenge of Management

1. Definition of engr mngt
2. Briefly disc 3 x mngt approaches
3. App and scope of industrial mngt

Management - Definition

- Operationally –
- “A dynamic process, that helps to get the things done, through and with the efforts of people”
- Succinctly, “Management is the exercise of drawing the straight line from what you are and where you are; to what you want to be; where you want to go. The straight line connotes the economy in time and means – materials, and human; a journey starting from the starting point to the destination.”

Management - Definition

- Other Definitions
- “Urwick defines management as the art of directing human activities”.
- “Management is considered as the art and science of making decisions”
- “It is the process of relating resources to goal accomplishment.”

Definition

“Management is optimization of constraining resources to achieve some intended goals.

- “Resources” is a broad term and it encompasses everything that we require as inputs (including knowledge and information)
- Resources are not available in abundance, thus exist resource constraints.

Management Approaches

Analyzing the history, management approaches can be classified from three different perspectives:

- Classical Approach
- Neo-classical Approach
- Modern Approach

Classical Approach

- Conventionally considered as traditionally accepted views and time-bound
- Emphasizes the concept of organizational efficiency to increase organizational success.
- Classical thoughts on management developed in three different directions – bureaucracy, scientific management and administrative theory.

Neo-Classical Approach

- Emphasizes human relations, importance of man behind the machine, the importance of individual as well as group relationships, social aspects, etc.
- Pioneered by Elton Mayo and his associates.
- Got extended to behavioral sciences approach.

Modern Approach

- Combines concepts of classical approach with social and natural science.
- It emerged from systems analysis.

Application and Scope of Industrial Management

- Initially the scope & application of industrial management was restricted to manufacturing industry. Later on it spread to non-manufacturing activities such as construction & transportation, farm and airline operations and maintenance, public utilities govt. & military operations.
- In an industry besides the production, other departments utilizing industrial management concepts are Marketing, Finance, Purchasing, Industrialrelations etc.

Major Applications of Industrial Management

1. Pre–Production Planning

- Plant Location
- Capacity Planning
- Selection of Machinery and Equipment
- Plant Layout
- Material Handling

2. Production Planning and Control

- Planning
- Routing
- Scheduling
- Dispatching
- Controlling

3. Inventory Management & Store Keeping

4. Total Quality Management

To improve the process and Service in

- Finance
- Marketing
- Human Resource

Scope of Industrial Management

Expertise Help

- Help in all decision making and problem solving
- Help in design of production system
- Help in design, selection and implementation of new technology

Advise and Consultancy

- Interpretation of data and information
- Review of data and information
- Productivity measurement and improvement

System Analysis

- Identification of faults in the production system
- Job analysis of the system

Scope of Industrial Management

Training and Motivation

- Motivation practice of employee
- Work and motion study
- Training of workers in motion study
- Application of new technology
- Negotiation

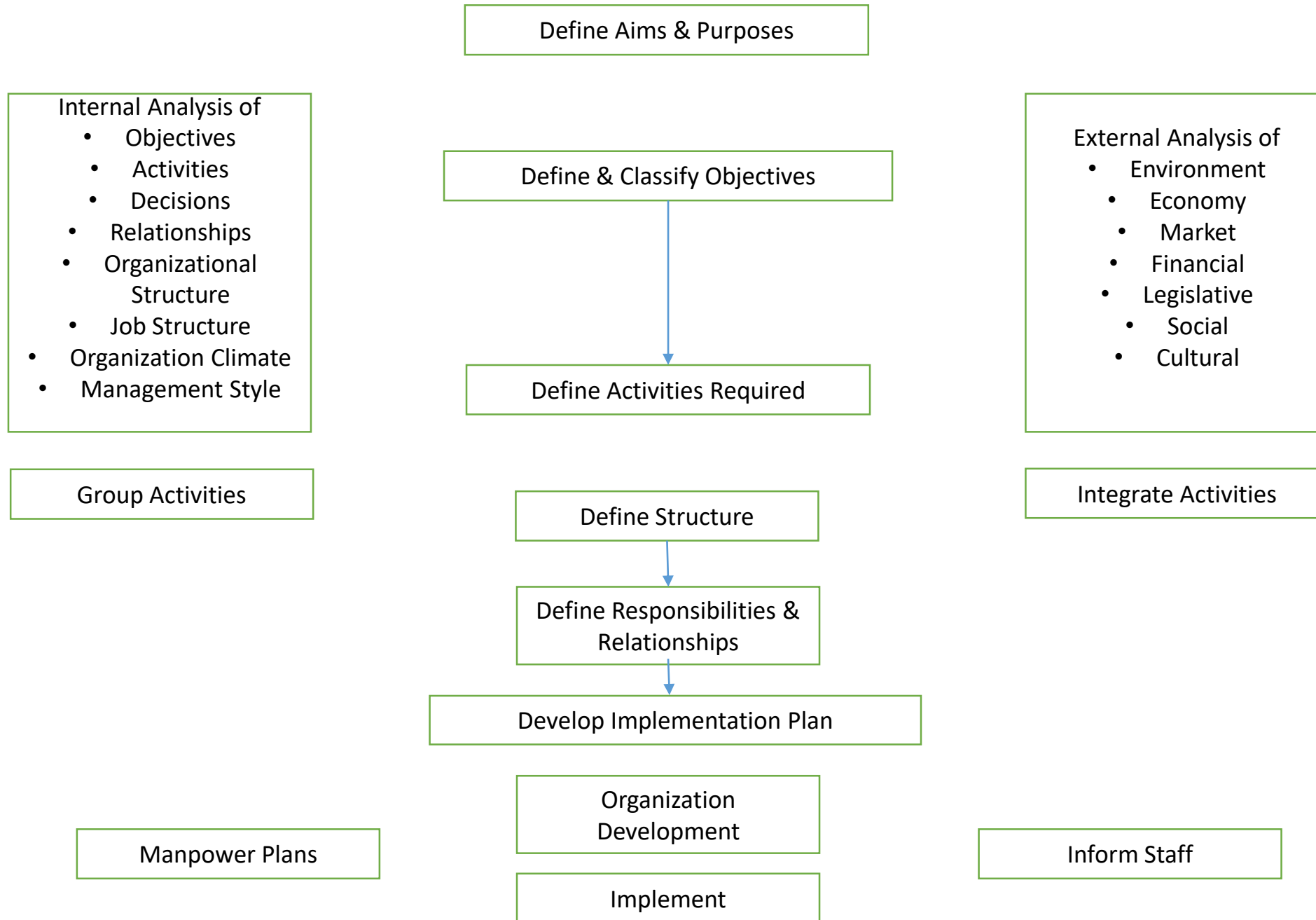
Decision Making

- Application of operation research in management
- Development and use of decision tools
- Use of MIS and Computers.

Chap -2 : Organization Planning, Design and Development

1. Stages followed in an Organization Planning (Organization Planning Programme) Diag
incl SWOT (Strength, Weakness, Opportunities and Threats) analysis
2. Symptoms of an Inadequate Organizational Structure
3. Organizational Design
4. Organizational Development (OD)—imp
5. Organizational Development – Objectives—imp
6. Kurt Lewin's Model---imp
7. Characteristics of a Successful OD Program---imp

Stages followed in an Organization Planning (Organization Planning Programme)



Organizational Analysis

Organizational Analysis Examines:

1. **Objectives:** To find out what they are and how clearly they are defined and understood at all levels.
2. **Activities:** To establish what work is done and what work needs to be done by the organization to achieve its objectives.
3. **Decisions:** To study where and by whom the key decisions are made and how work is delegated and decentralized.
4. **Relationships:** To define what interactions and communications take place between people in the organization so that an assessment can be made of the extent to which the grouping of activities, lines of communication and information systems facilitate effective management and coordination.
5. **Organization Structure:** To find out
 - How activities are grouped together
 - The spans of control of senior and middle managers and
 - The number of levels in the management hierarchy

Organizational Analysis – cont'd

Organizational Analysis Examines:

6. **Job Structure:** To determine the content of individual jobs in terms of duties, responsibilities and authorities. The aim is to establish the degree to which tasks are logically and clearly allocated and to indicate whether job holders are clear about what they are expected to achieve.

7. **Organization Climate:** To get a feel of the working atmosphere with regards to teamwork and cooperation, commitment, communication, creativity, conflict resolution, participation and confidence and trust between people.

8. **Management Style:** To find out what sort of approach to management is being practiced, especially at the top.

9. **Management:** To establish

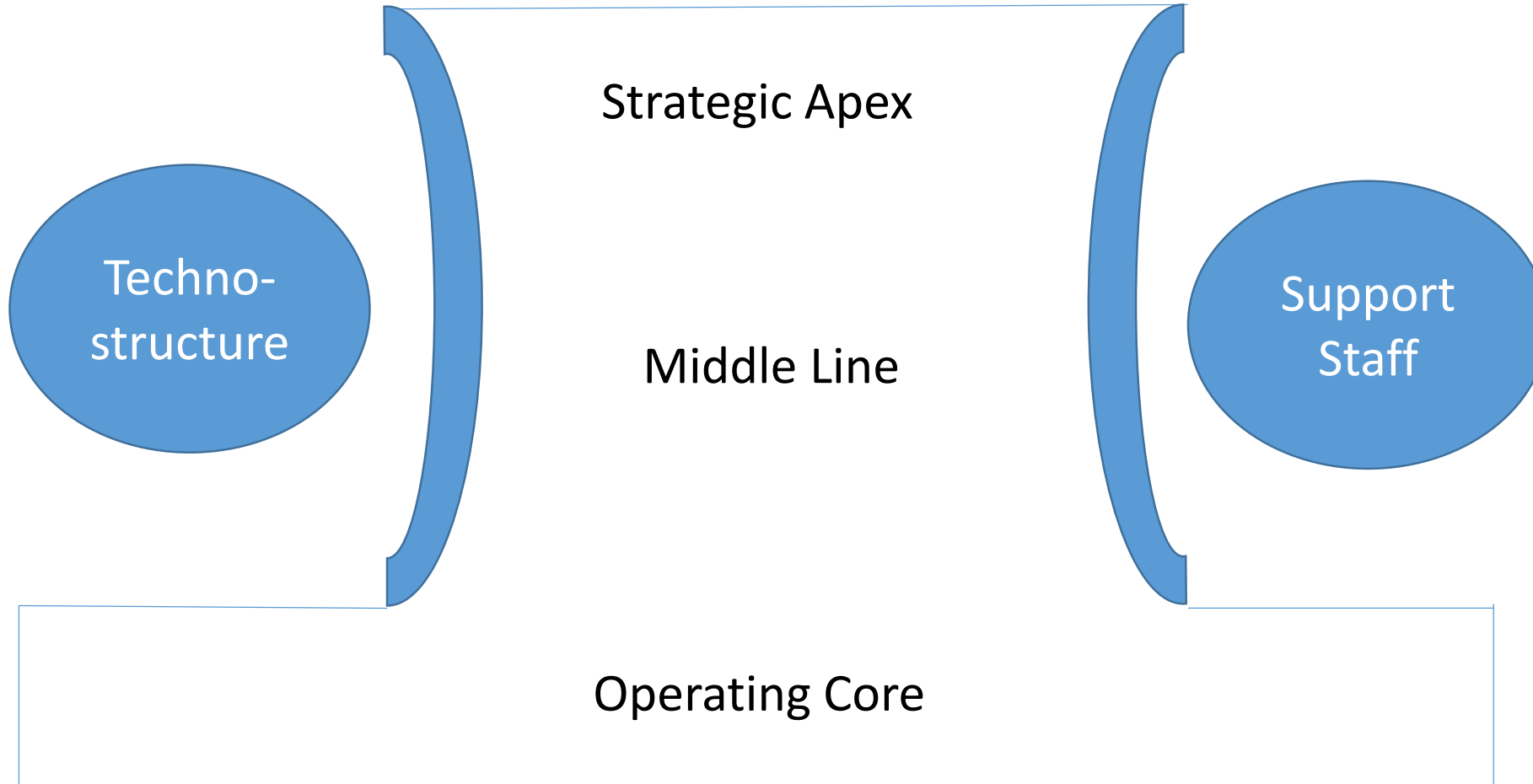
- the extent to which the existing organization has been built around the personalities, strengths and weaknesses of the key people in it and
- The availability of the quality of people required to facilitate necessary changes in the organization structure.

Organizational Structure

Symptoms of an Inadequate Organizational Structure

1. Lack of opportunities for development
2. Insufficient time for development
3. Intensive antagonistic environment
4. Lack of definition in portfolio business planning
5. Lack of coordination with sister division
6. Excessive duplication of functions in different units of the firm
7. Excessive dispersion of functions in one unit of the firm
8. Poor profit performance and low return expectations

Organizational Design



Organizational Design

Mintzberg conceptually describes an organization as typically having Five basic parts: Fig. 2.3

1. **Operating Core:** This part consists of those who performs the basic work relating to production or services.
2. **Strategic Apex:** Comprises people having overall responsibility of the organization, namely chief executive and other top-level managers.
3. **Middle Line:** It is the linking pin between the strategic apex and the operating core. The chain runs from the senior managers down to the first-line managers.
4. **Technostructure:** Is made up of analysts whose job is to control, stabilize and standardize patterns of activity in the organization.
5. **Support Staff:** Support staff are engaged in large organizations to encompass more and more boundary activities. Can be found at various levels of hierarchy.

Organizational Development (OD)

Definition: Is concerned with planning and implementation of programs designed to improve effectiveness with which an organization functions and responds to change.

-- based on scientific awareness of

1. Human behavior
2. Organizational Dynamics

-- directed towards

1. more participative management
2. Integration of individual goals with organizational goals

-- OD is intended to create an internal environment of openness, trust, mutual confidence and collaboration.

Organizational Development - Objectives

Objectives

-- There are 4 basic objectives of OD

1. Improve Organizational Performance as measured by profitability, market share, and innovativeness.
2. Better Adaptability to its environment
3. Willingness of Members to face organizational problems and find creative solutions
4. Improve Internal behavioral patterns

Characteristic Features

-- There are 3 main features

1. They are managed or at least strongly supported
2. The plans for OD are based upon systematic analysis and diagnosis
3. They make use of behavioral science to improve

Organization Development (OD) Models

There are 3 popular Models of OD – Change Process (Behavior)

1. Kurt Lewin's Model----
2. Larry Griener's Sequential Process Model
3. HJ Leavitt's System Model

Organization Development (OD) Models

Kurt Lewin's Model – It can be divided into 3 stages:

-- **Stage 1:** Unfreezing (Creating the need for change, motivating the people for change and minimizing resistance to change)

-- **Stage 2:** Changing (Transition from old behavior to experimentation with new behavior in terms of cognitive redefinition through identification and scanning.

-- **Stage 3:** Re-freezing (Stablising and integrating the change by reinforcing the new behaviors and integrating them into one's personality as well as in formal and interpersonal relationships.

Characteristics of a Successful OD Program

1. It is a planned program which involves the whole of an organization or a relatively autonomous unit within an organization.
2. It is designed to create organizational conditions which will directly help the institution to accomplish a specific strategy.
3. The senior management is personally committed to the goals of the program.
4. It is a long-term effort (takes 2-3 years)
5. The program is action-oriented (the program is designed from outside to generate action by those involved)
6. Particular emphasis is placed on changing perceptions, attitude and behavior, not solely on structural or procedural change
7. It relies on some form of experience-based learning through which participants can examine the present situation, define new goals, and explore new ways of achieving them.
8. The basis of all programs are the groups or teams from which the organization is constructed.

Chap -3 (part 1) : Management Planning and Control

1. Four functions of General Management....book...p-31,32...imp
2. Two Main Activities of General Management....book...p-31,32....imp
3. Engineering Management Definition and - Typical Engineering Organization (Fig. 3.4 of page 37) incl 2/3 activities.....book p -37 ...imp
4. Benefits of Corporate Planning – page 44

Engineering Management

- Definition
- Typical Engineering Organization (Fig. 3.4 of page 37)
- Chief of Systems
- Chief of Design
- Chief of Reliability
- Chief of Development

3.9 Engineering Management

Engineering management is the art and science of planning, organizing, allocating resources, directing and controlling activities which have a technological component. This definition identifies a management speciality and also identifies specific activities which are integral to the full practice of various engineering and scientific disciplines. The practitioners of engineering management, known as 'Engineering Managers', generally claim an identification with some field of engineering/science or a related area which is also rooted in mathematics and physical sciences. Engineering management differs from industrial engineering, to which it is most closely related, by its greater focus on 'people' problems rather than on system design, which, of course, also includes people along with material and equipment. On the management side, it differs from general management in its requirement that practitioners be competent in some technical field. Engineering managers may be found occupying top, middle and supervisory management positions. They may be found working wherever a blend of managerial and technical knowledge is required, whether or not the primary business of the organization is technological in content.

The first real move towards recognition of this speciality as a separate profession took place in the USA in 1979 when a group of interested people from government, industry, and universities organized the American Society for Engineering Management. This society was expected to be influential in advancing engineering management in both theory and practice and in maintaining a high professional standard among its members. In India, there is no such society at present, but existence of such a society would lead to increased recognition of engineering management as an important profession in the future.

A typical engineering organization is shown in Fig. 3.4. Here the span of control for the engineering manager is four line supervisors. This arrangement is manageable and controllable; a number greater than seven will increase the control problem significantly.

3.6.2 Functions of General Management

The four functions of general management are:

- (a) **Planning:** Deciding where the organization should be going and how it should get there. This requires the appraisal of external and internal changes and constraints, forecasting, setting objectives, developing strategies and policies and preparing action plans.
- (b) **Organizing:** Deciding who does what. This requires the definition and grouping of activities, defining responsibilities, and establishing means of communication, coordination and control.
- (c) **Directing:** Ensuring that people know what to do and when to do it, and exercising leadership to get individuals to work to the best of their ability as part of a team.
- (d) **Controlling:** Measuring and monitoring results, comparing results with plans and taking corrective action when required.

These functions and the continuous feedback that is received as a result of control mechanisms and planning, organizing and directing activities are shown in Fig. 3.1 schematically.

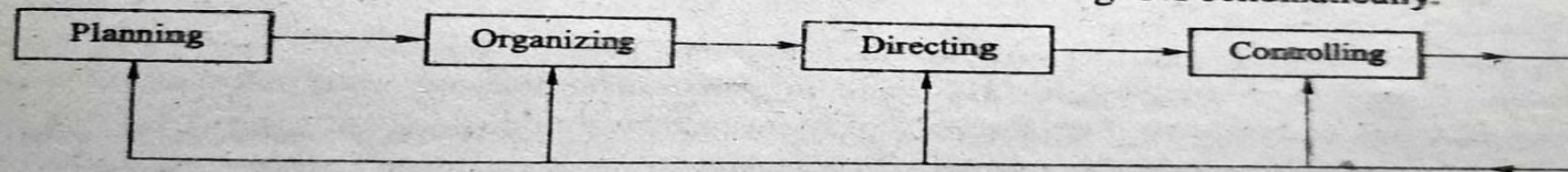


Fig. 3.1 Four functions of general management

3.6.3 General Management Activities

General management controls *two* main activities:

Line Activities

In a commercial enterprise, these comprise:

- **Business generation:** Innovation (new product development), marketing and selling.
- **Demand satisfaction:** Manufacturing the product to meet demand and distributing it to the customer. Feedback from the customer in the form of new orders and reactions to the product will affect the business generation activities.

Staff or Service Activities

These ensure fulfilment of line activities by means such as:

- Giving a sense of direction through planning and budgeting.
- Providing finance and the means of planning and controlling expenditure.
- Providing manpower in the quantities and qualities required.
- Providing management services and management support activities which include information technology, operations research, work study and other activities designed to improve the efficiency and effectiveness of the organization.

The relationships between these activities are shown in Fig. 3.2.

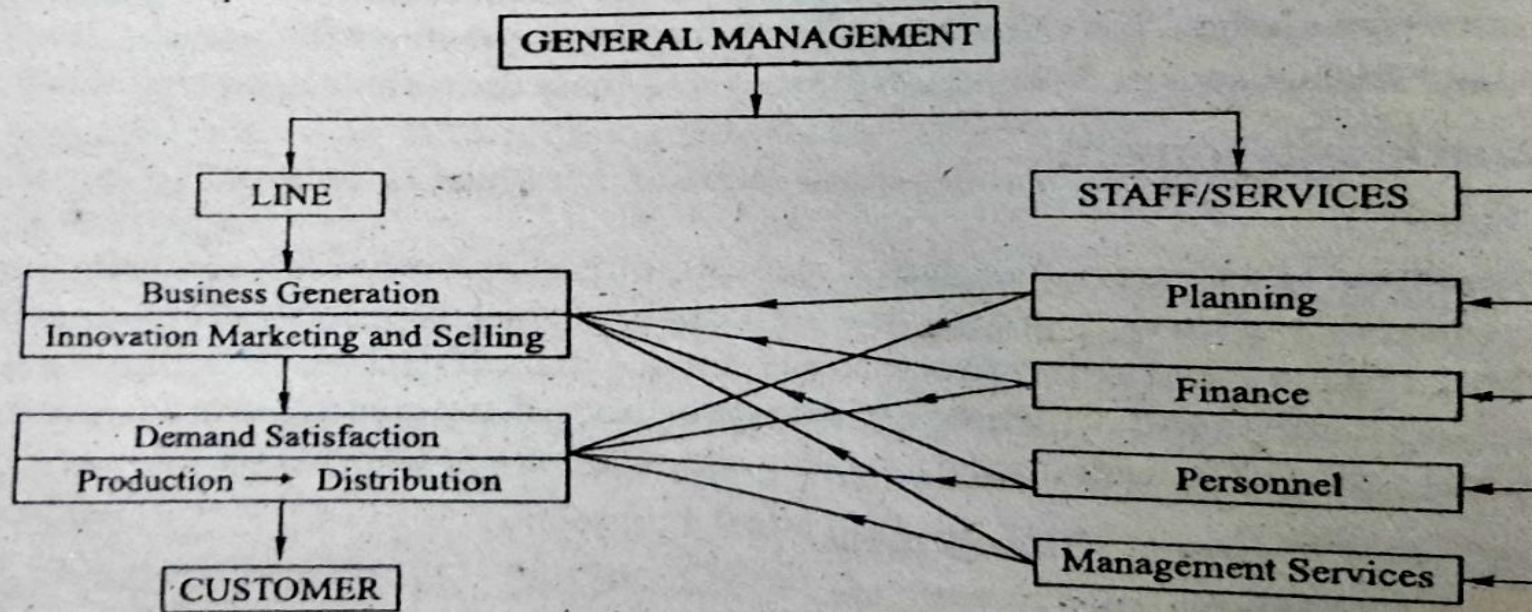
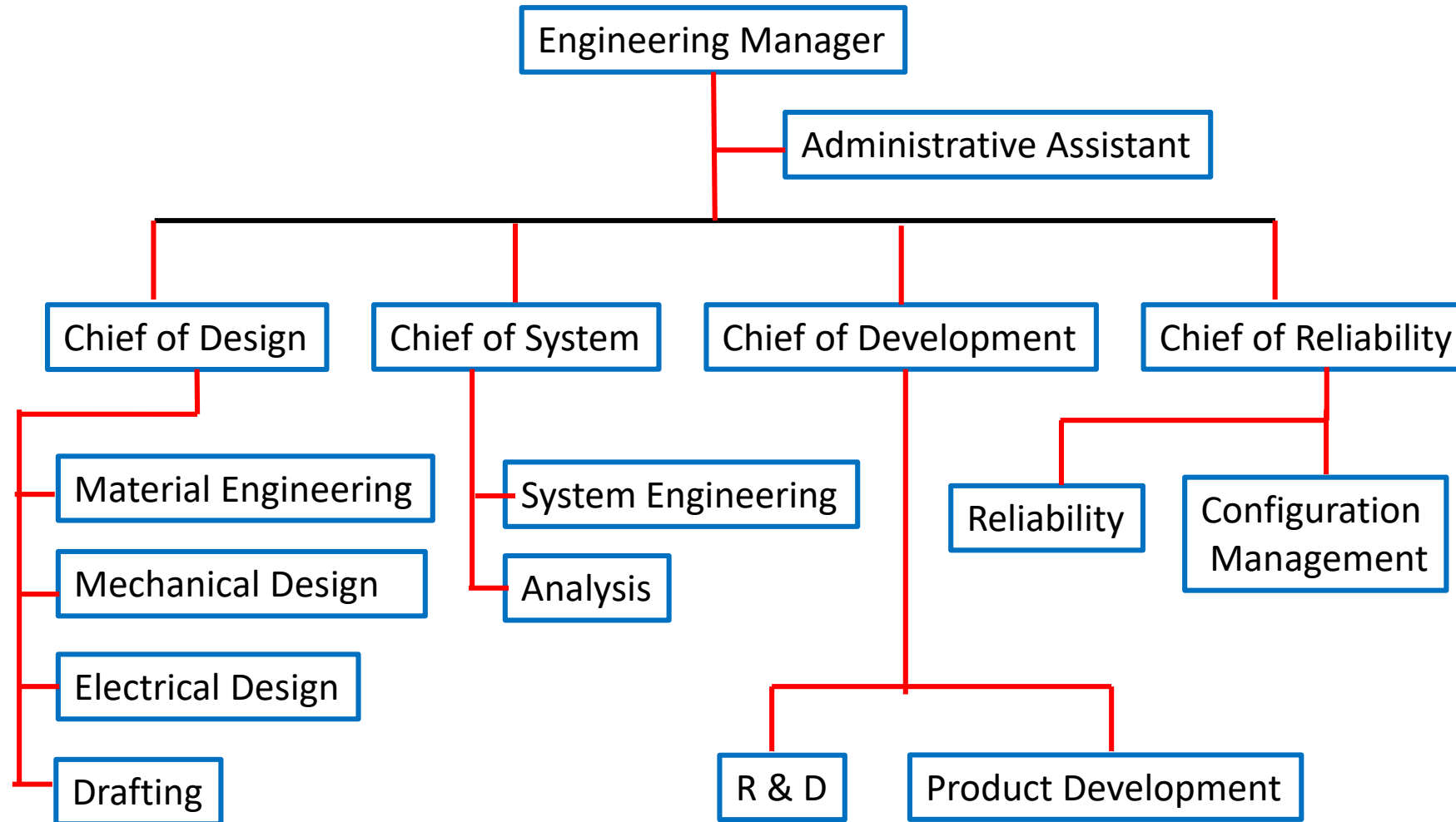


Fig. 3.2 Activities of general management

3.6.4 Techniques Used in General Management

The purpose of management techniques is to assist in the process of decision-making. Essentially, they are used to support, not supplement, the exercise of management.

Engineering Management - Typical Engineering Organization (Fig. 3.4 of page 37)



The scope and responsibilities of each of the four engineering areas reporting to the engineering manager are given below:

3.9.1 Chief of Systems

The responsibilities of the Chief of Systems are to:

- Convert customer requirements into a workable system, optimized for best performance.
- Provide system schematics.
- Create detailed requirements for component design.
- Analyse system performance.
- Analyse component performance.
- Interface with customers to assure them that system performance meets all customer requirements.

3.9.2 Chief of Design

The responsibilities of the Chief of Design are to:

- Evolve component hardware concepts that meet system requirements.
- Create design layouts and manufacturing drawings.
- Maintain weight control.
- Conduct structural design analysis.
- Assure that proper interface control is maintained to meet customer installation requirements.
- Review test procedures to ensure that the test programme thoroughly exercises the equipment that has been designed.

3.9.3 Chief of Reliability

The functional responsibilities are to:

(a) Reliability

- Perform system and component reliability analysis.
- Perform safety and hazard analysis.
- Assist in failure analysis to assure that failures are understood and that corrective action is complete and precludes recurrence of the problem.

- Write failure reports.
- Review test procedures.

(b) *Configuration Management*

- Create specifications and draw tree diagrams.
- Ensure that engineering documentation defines hardware configurations.
- Write engineering changes.
- Interface with customers to assure them that field retrofits or modifications of hardware are all properly documented.

3.9.4 Chief of Development

Responsibilities are to:

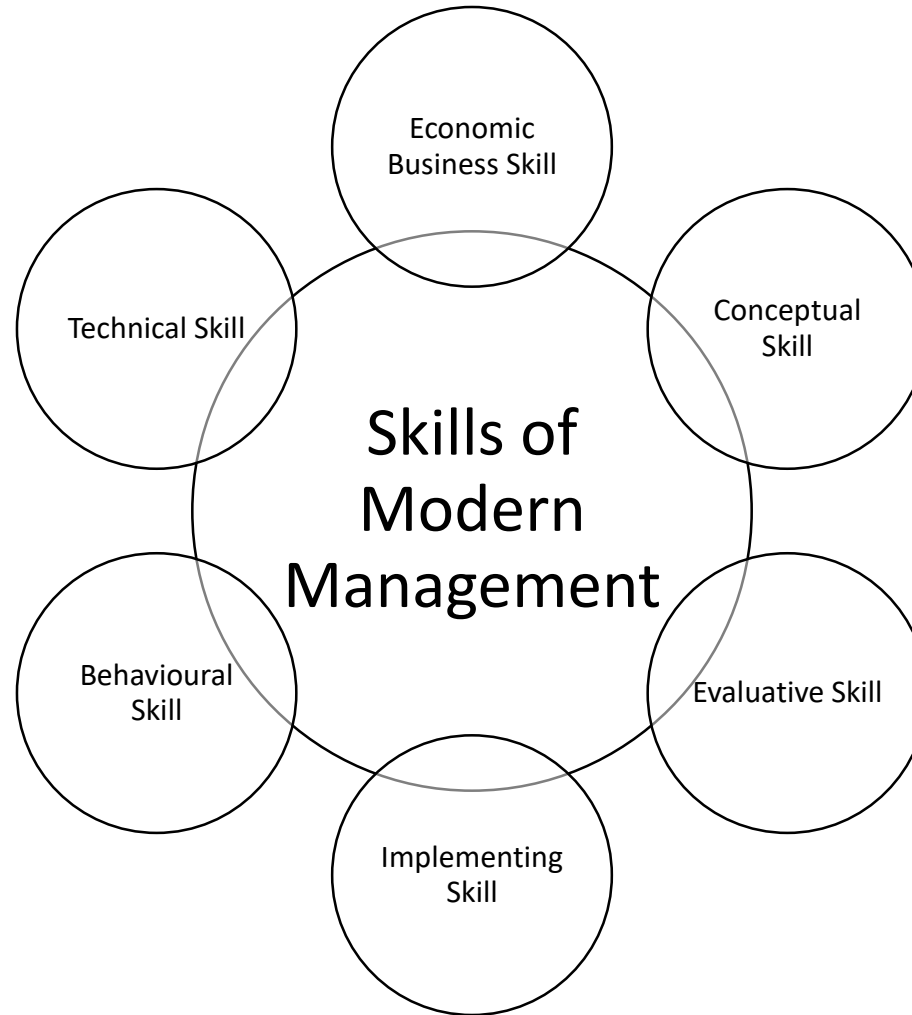
- Manage other engineering resources to provide a sound engineered product within engineering cost and schedule requirements.
- Maintain engineering liaison with manufacturing areas.
- Maintain day-to-day technical communications with customers and subcontractors.
- Direct resolution of problems occurring during manufacture, development, and in-service operation of the hardware.

Persons engaged in 'Engineering Management' may have educational background other than engineering, but they must be qualified by education and/or experience to make sound decisions involving technical work.

Chap -3 (part 2): Management Planning and Control

1. Six general categories of Skills incl short note of those skills (may one or two will be asked to write).....imp

Six general categories of Skills



Technical Skill

This skill requires the proficient use of the specialized information, methods, processes, procedures, and techniques involved in the technology of the product or services of the company or industry.

Examples include:

- Ability to sense and forecast trends in the growth and development of the organization's technology.
- Ability to communicate and understand technical terms of organizational specialists.
- Ability to exploit new knowledge to innovate services or products.

Behavioural Skill

This skill is primarily the utilization of knowledge to understand people as they conduct themselves. Such an understanding promotes working with others cooperatively and effectively as a natural and continuous activity. It requires an awareness of attitudes and beliefs held by the individuals and groups and how these govern their goal-reaching processes.

Examples include:

- Ability to sense people's needs and drives, and relate them to planned accomplishments
- Ability to coordinate various power groups
- Ability to empathize with various lifestyles.

Conceptual Skill

This skill is the ability to utilize the existing knowledge in order to acquire additional knowledge. It is purposeful risk-taking for creating new conditions. Exploring, questioning, and probing are some of the tools that cut across established areas of a business. Conceptual skill is interdisciplinary.

Examples include:

- Ability to generate alternatives from present and past experiences.
- Ability to see the whole from the given constituent parts.
- Ability to predict ends from certain beginnings even without an orientation.

Implementing Skill

This skill involves the ability to get work done on a day-to-day, programme-to-programme basis, or the ability to concentrate just enough resources of time, money, and effort to initiate an activity, conduct the activity and bring it to a successful end. Achievement and accomplishments are the principal dimensions for employing this skill.

Examples include:

- Ability to sense and make use of pace, sequence, and time.
- Ability to work a task to completion with intensified drive.
- Ability to foresee barriers and pursue circumventing steps.

Economic-business Skill

This skill is the utilization of knowledge to understand a business enterprise operating in a market for the sale of goods and services. It involves the manner in which an enterprise uses scarce and limited resources to meet demands. It involves the strategy of production, distribution, and consumption of goods and services with max output and min of input.

Examples include:

- Ability to move ahead, as a member of an organization, towards coordinated ends.
- Ability to undertake pursuit of a gain in the market-place in the face of risk and uncertainty.
- Ability to compete for positive results in the free enterprise system.

Evaluative Skill

This skill is the ability to appraise the value or the degree of worth of a process or accomplishment. This skill tends to be quantitative, since its basic idea is “how much”.

Examples include:

- Ability to analyze a complex mass of information into numeric and quantities.
- Ability to measure deviation, variation, and drift from prescribed directions.
- Ability to initiate feedback corrections to reduce variance within prescribed times.

Chap -4 (part 1) : Human Resource Planning and Management

1. The Process of HR Planning Diag and the process of HR Planning - 6 activities....imp
2. Database for Manpower Demand Forecasting both macro and micro level
3. Database for Supply Forecasting both macro and micro level
4. Manpower Productivity

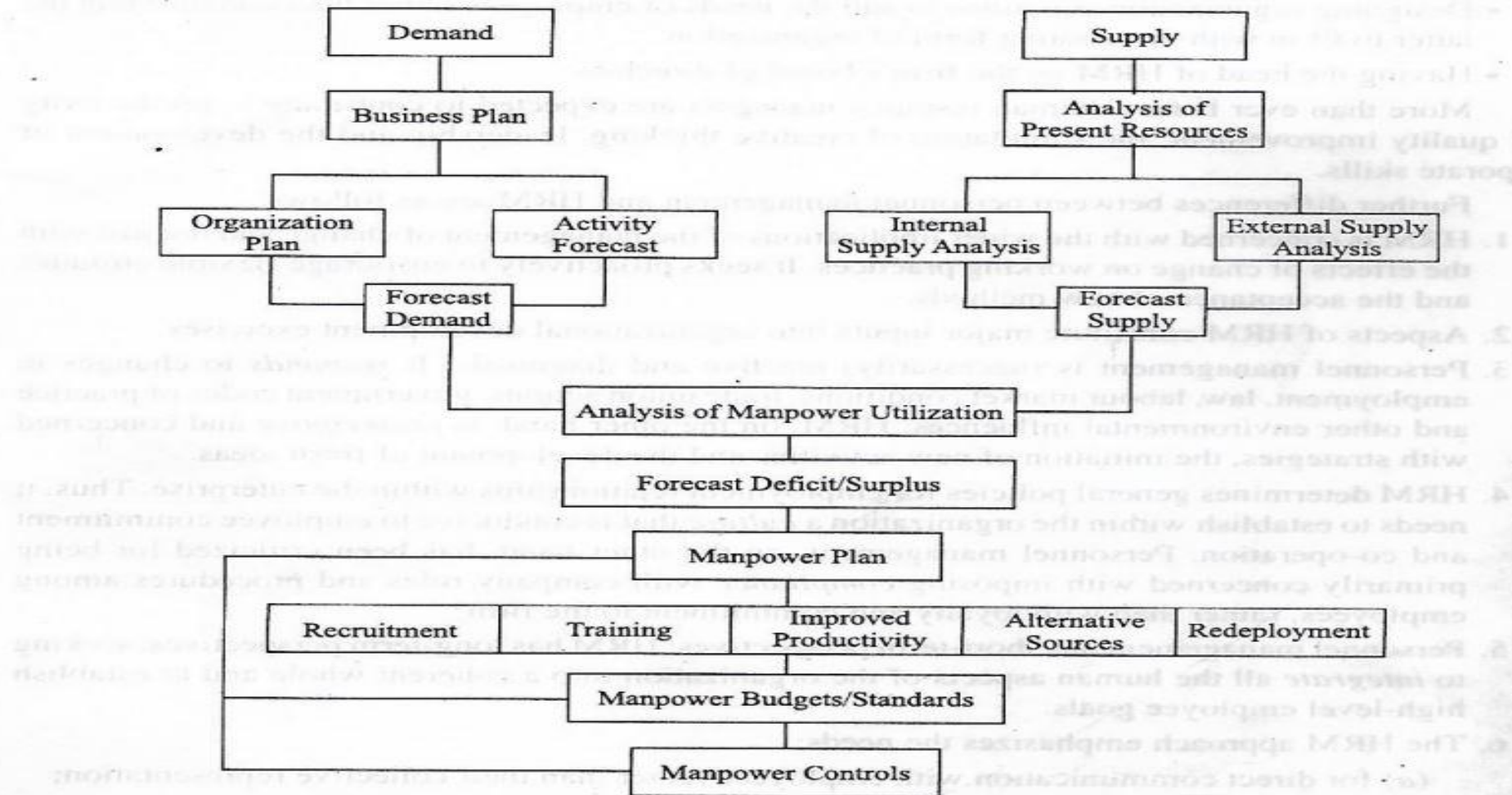


Fig. 4.1 The process of human resource planning

HRP should help management in making decisions concerning recruitment, the avoidance of redundancies, training and staff development, and the estimation of the costs of employing labour. Sometimes redundancies can be avoided through the preparation of '*skills inventories*' (i.e., detailed listings of all the competencies, work experiences and qualifications of current employees—even those characteristics not relevant to present occupations). The purpose of a skills inventory is to inform management of all the jobs that existing employees might be capable of undertaking.

The process of HR Planning - 6 Activities

1. Demand forecasting

- estimating the future needs of HR by reference to corporate and functional plans
- forecast of future activity levels

2. Supply forecasting

- estimating the supply of HR by reference to analysis of current resources and future availability, after allowing wastage

3. Determining HR requirements

- analyzing the demand and supply forecasts to identify future deficits or surpluses

The process of HR Planning - 6 Activities

4. Productivity and Cost Analysis

- analyzing HR productivity, capacity utilization and costs
- in order to identify the need for improvements in productivity or reductions in cost

5. Action Planning

- preparing plans to deal with forecast deficits or surpluses of HR
- to improve utilization and productivity or reduce HR costs

6. HR Budgeting and Control

- setting HR budgets and standards
- monitoring the implementation of HR plans against them

Database for Manpower Demand Forecasting

1. **Macro Level** – Comparable past data spanning several years
 - a. Population Statistics
 - b. Data on Economic Parameters, and
 - c. Information on Technologies

2. **Micro Level** – Well defined manpower system is needed for micro forecasting at the enterprise level. The system may have the following modules:
 - a. Personal Data Module
 - b. Recruitment Module
 - c. Job Experience Module
 - d. Performance Appraisal Module
 - e. Training and Development Module
 - f. Miscellaneous Module

Supply Forecasting

Manpower Supply is the totality of manpower employed and manpower unemployed (without job).

- Manpower is the skilled component of labor force irrespective of the level of skills attained.

Dimensions of Manpower Supply

- a. Stock and flow
- b. Quantity and quality
- c. Occupation and education
- d. Macro and Micro

Supply Forecasting

Database for Macro level

- Age at entry and at exit
- Annual enrollment and turnover
- Attrition rate
- Retirement age
- Migration
- Morality
- Labor force participation rate

Database for Manpower Supply Forecasting

2. Micro Level – Well defined manpower system is needed for micro forecasting at the enterprise level. The system may have the following modules:

- a. Personal Data Module
- b. Recruitment Module
- c. Job Experience Module
- d. Performance Appraisal Module
- e. Training and Development Module
- f. Miscellaneous Module

Manpower Productivity & Cost

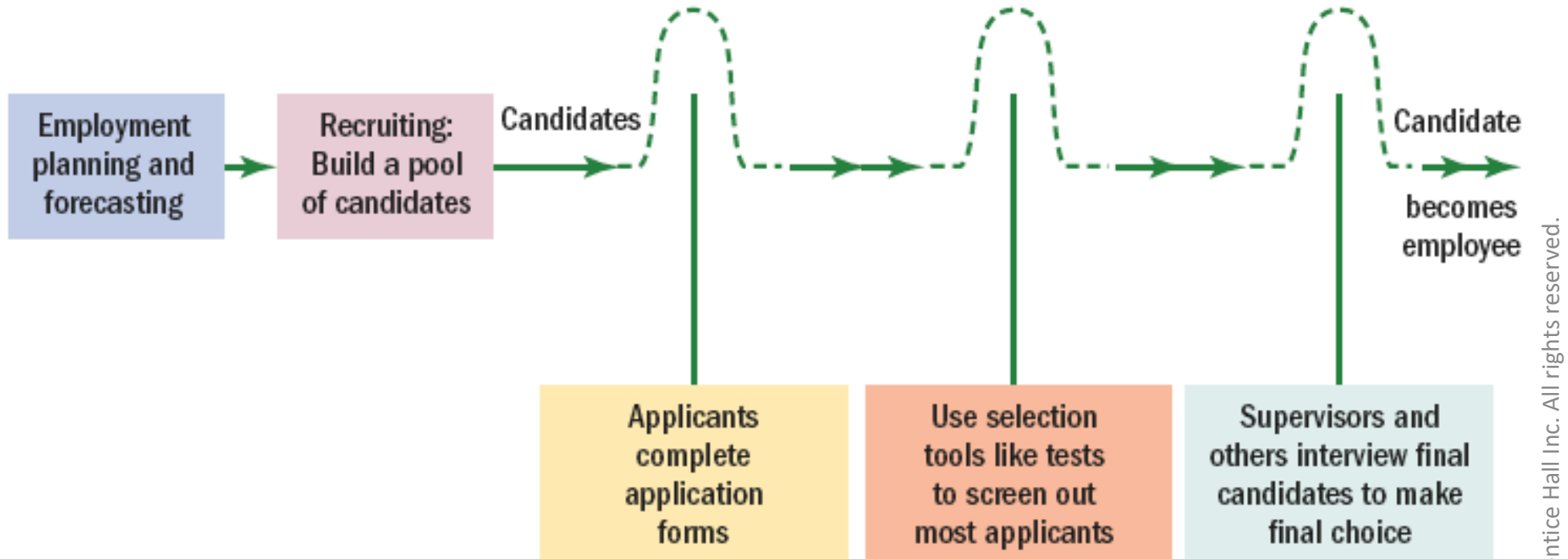
Productivity

- represents the output of goods and services which can be obtained from a given input of employees.
- Productivity should be monitored by using such measures as
 - i. Manpower costs per unit of output
 - ii. Manpower costs as a ratio of sales value
 - iii. Sales value per employee
 - iv. Tons of product handled per man-hour
 - v. labor cost as a percentage of added value (the difference between production cost and sales value)

Chap -4 (part 2) :Human Resource Planning and Management

1. Steps in Recruitment and Selection Process...imp
2. The “Big Five”imp
3. Types of Interviews.....imp
4. Factors Affecting Interviews.....only pts(sir er money nai just porey rakhtey bolsey)

Steps in Recruitment and Selection Process



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The recruitment and selection process is a series of hurdles aimed at selecting the best candidate for the job.

Figure 5-1

The “Big Five”

- Extraversion
 - The tendency to be sociable, assertive, active, and to experience positive effects, such as energy and zeal.
- Emotional stability/neuroticism
 - The tendency to exhibit poor emotional adjustment and experience negative effects, such as anxiety, insecurity, and hostility.
- Openness to experience
 - The disposition to be imaginative, nonconforming, unconventional, and autonomous.
- Agreeableness
 - The tendency to be trusting, compliant, caring, and gentle.
- Conscientiousness
 - Is comprised of two related facets: achievement and dependability.

Types of Interviews

- Selection interview
 - A selection procedure designed to predict future job performance on the basis of applicants' oral responses to oral inquiries.
- Appraisal interview
 - A discussion, following a performance appraisal, in which supervisor and employee discuss the employee's rating and possible remedial actions.
- Exit interview
 - An interview to elicit information about the job or related matters to the employer some insight into what's right or wrong about the firm.

Factors Affecting Interviews

- First impressions
 - The tendency for interviewers to jump to conclusions—make snap judgments—about candidates during the first few minutes of the interview.
 - Negative bias: unfavorable information about an applicant influences interviewers more than does positive information.

Factors Affecting Interviews (cont'd)

- Misunderstanding the job
 - Not knowing precisely what the job entails and what sort of candidate is best suited causes interviewers to make decisions based on incorrect stereotypes of what a good applicant is.
- Candidate-order error
 - An error of judgment on the part of the interviewer due to interviewing one or more very good or very bad candidates just before the interview in question.

Factors Affecting Interviews (cont'd)

- Nonverbal behavior and impression management
 - Interviewers' inferences of the interviewee's personality from the way he or she acts in the interview have a large impact on the interviewer's rating of the interviewee.
 - Clever interviewees attempt to manage the impression they present to persuade interviewers to view them more favorably.

Factors Affecting Interviews (cont'd)

- Effect of personal characteristics: attractiveness, gender, race
 - Interviewers tend to have a less favorable view of candidates who are:
 - Physically unattractive
 - Female
 - Of a different racial background
 - Disabled

Factors Affecting Interviews (cont'd)

- Interviewer behaviors affecting interview outcomes
 - Inadvertently telegraphing expected answers.
 - Talking so much that applicants have no time to answer questions.
 - Letting the applicant dominate the interview.
 - Acting more positively toward a favored (or similar to the interviewer) applicant.

Chap – 5 : Facility Location & Plant Layout

1. 3 Different Aspects of Facility Location
2. Factors Affecting Facility Location.....imp
3. Adv and disadv of Facilities Location in Urban Area
4. Adv and disadv of Facilities Location in Rural Area
5. Location Break-even Analysis Explanation and Math (Math er unit conversion ta bhujtey hobe sir ghuriay ditay paren).....imp

3 Different Aspects of Facility Location are:

- Selection of a Region
- Selection of a Locality
- Selection of a Site

Why these aspects are critical?

Selection of a Region

- Availability of raw materials
- Nearness to the source
- Proximity to the market
- Availability of transportation facilities
- Suitability of climate

Why these aspects are critical?

Selection of Locality

- Supply of labor
- Prevailing wage rates
- Existence of supplementary/complementary industries
- Banking, credit, and communication facilities
- Attitude of the local people
- Local taxes and laws
- Living conditions for workers
- Water supply and fire-fighting services

Why these aspects are critical?

Selection of a Site

- Price of the land
- Disposal of waste

Factors Affecting Facility Location – page 121

Fundamental factors that should be considered in deciding location of facilities:

- Demography - attitude of local population towards industrialization, expectations, adequate supply of labor of different skills and competitive price.
- Land – cost of land and its development, support, availability for expansion, and surroundings
- Incentives – Government provided incentives such as tax exemption, loans, subsidies, etc.
- Government Regulations – additional subsidies, laws related to environmental protection, construction, waste disposal and safety laws.

Factors Affecting Facility Location

– page 121 (cont'd)

Fundamental factors that should be considered in deciding location of facilities:

- Climate Conditions – subsoil water, humidity, local climate, etc.
- Information related to Location – adequate land availability for present and future requirements (construction and expansion).

Facilities Location in Urban Area

Advantages

- Well connected (by rail, road and air)
- Easy access pf experts and specialists
- Availability of right labor force
- Good facilities (hospitals, marketing, schools, banks, etc.)
- Safe to work

Disadvantage

- Limited availability of land
- Cost of land and construction are high
- High labor cost and local taxes
- High costs for consumer goods
- Labor union issues
- Not too many sites are available

Facilities Location in Rural Areas (Small Towns)

Advantages

- Easy availability of land and cheap
- Local laws are not so strict
- Low taxes, insurance, etc.
- Government incentives are available
- No labor union issues
- Healthy surroundings
- Less risk and labor turnover

Disadvantage

- Less availability of skilled labor
- Poor communication and inadequate transportation
- Inadequate power availability
- Poor facilities and lack of specialized services
- Non-availability of big market

Location Break-even Analysis

The economic comparison of location alternative is facilitated by the use of cost volume profit analysis **known as location break-even analysis.**

The analysis can be done numerically/graphically. Following steps are involved in the break-even analysis:

- a. Determine the fixed and variable costs associated with each location alternative.
- b. Draw the total cost lines for all locational alternatives on the same graph
- c. Determine the location having the lowest total cost for the expected level of output

Location Break-even Analysis

Assumptions

- a. Fixed costs are constant for the range of probable output
- b. The required level of output can be closely estimated
- c. Only one product is involved

Location Break-even Analysis

Example#1

Gazipur, Daudkandi and Sylhet are the three potential locations for producing telecommunication set expected to sell for Tk. 90. Find the most economical location for an expected volume of 1850 units/year.

Sites	Fixed cost/year	Variable cost/unit
Gazipur	20,000	50
Daudkandi	40,000	30
Sylhet	80,000	10

Let's Calculate – page 126

Steps:

1. Calculate the total cost

$$\text{Total Cost} = \text{Fixed Cost} + \text{Variable Cost}$$

$$\text{Total cost at Gazipur} = 20,000 + (50 \times 1850) = 1,12,500$$

$$\text{Total cost at Daudkandi} = 40,000 + (30 \times 1850) = 95,500$$

$$\text{Total cost at Sylhet} = 80,000 + (10 \times 1850) = 98,500$$

2. Draw the cost volume graph

3. Calculate expected Profit

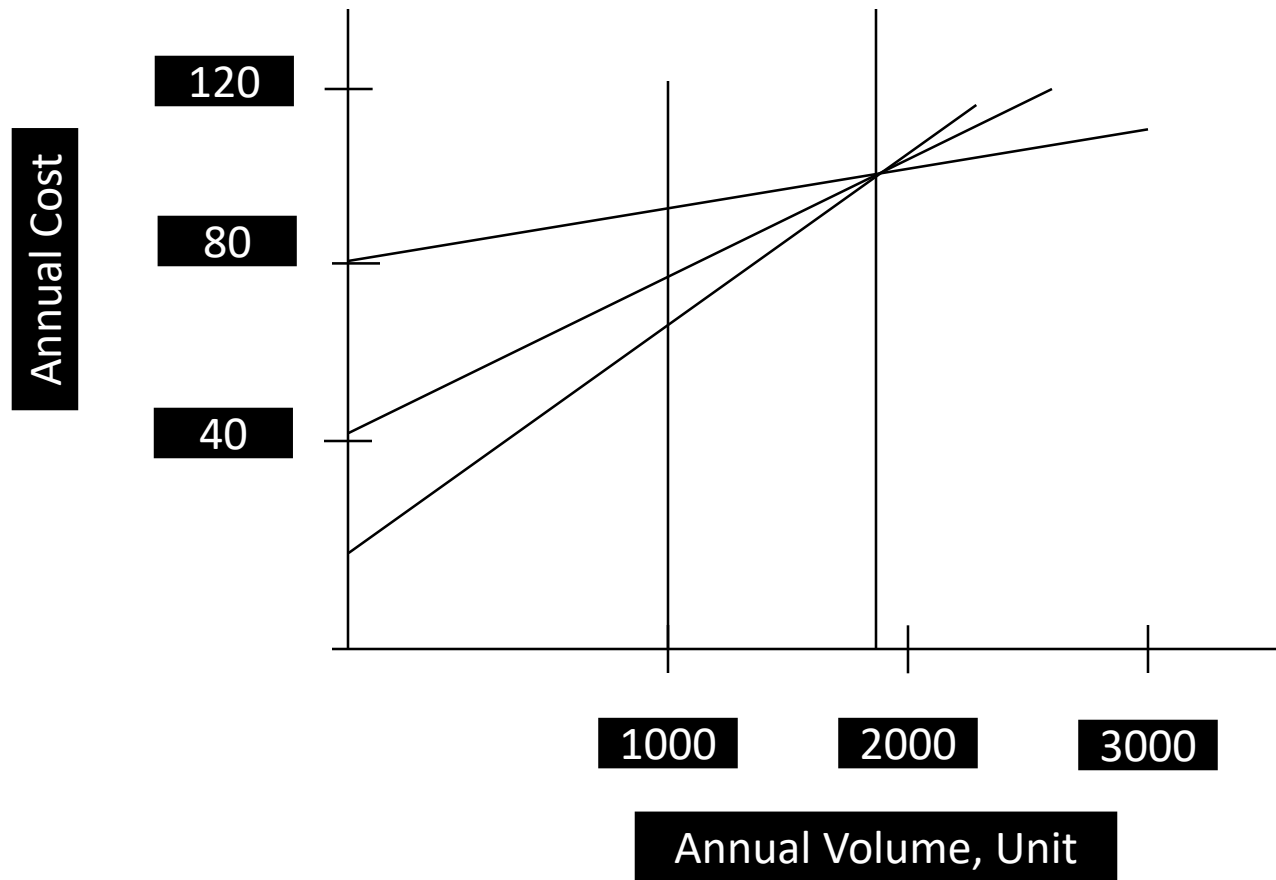
$$\text{Expected Profit} = \text{Total Revenue} - \text{Total Cost}$$

$$\text{Expected Profit at Gazipur} = (90 \times 1850) - 1,12,500 = 54,000/\text{yr}$$

$$\text{Expected Profit at Daudkandi} = (90 \times 1850) - 95,500 = 71,000/\text{yr}$$

$$\text{Expected Profit at Sylhet} = (90 \times 1850) - 98,500 = 68,000/\text{yr}$$

Cost Volume Graph



Chap – 6 : Maintenance Planning and Management

1. Objectives of Maintenance Management....imp
2. Failure Analysis – “Bath-tub” Curve....imp

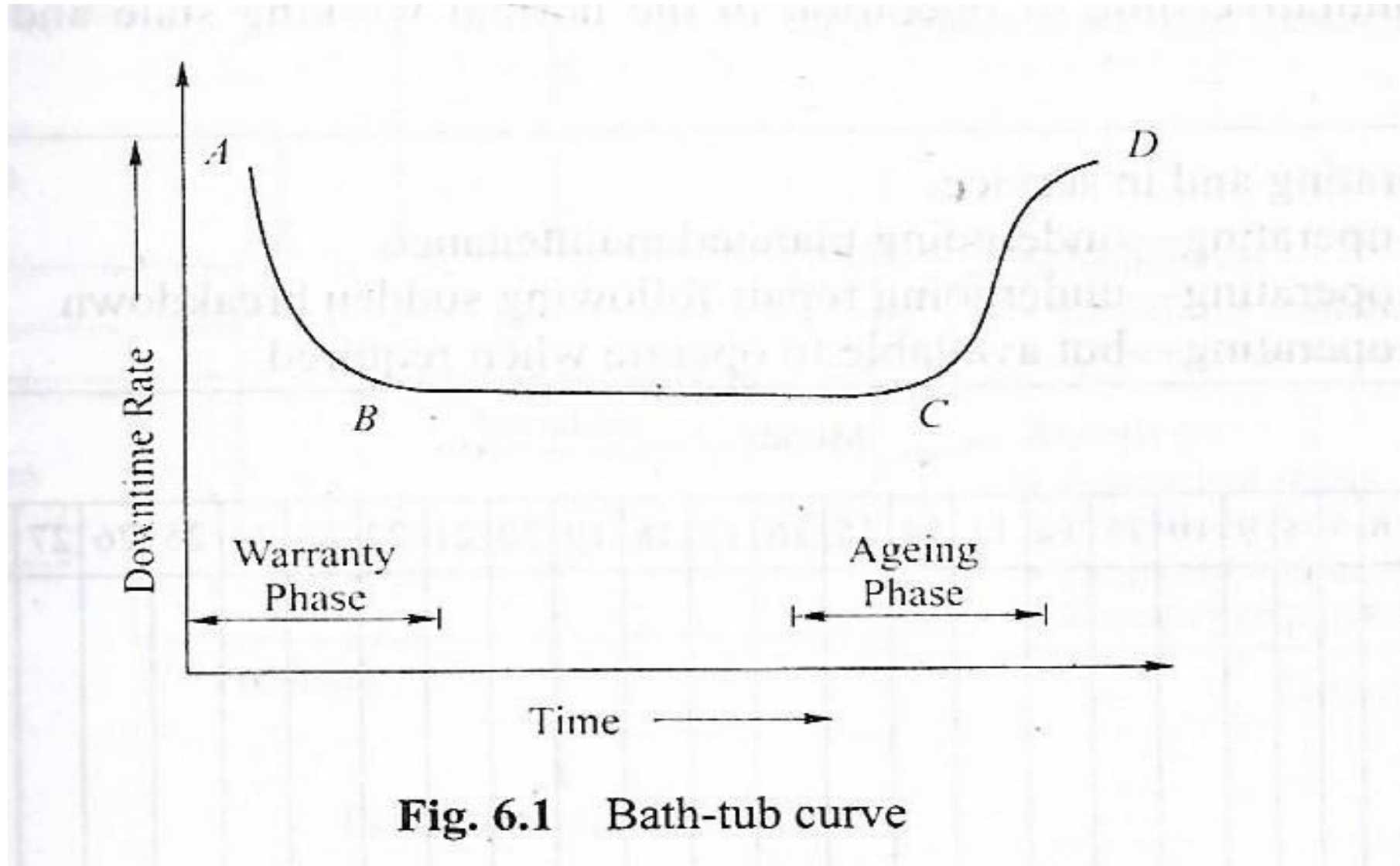
Objectives of Maintenance Management

- a. To maximize the availability and reliability of all assets
- b. To obtain the maximum possible return on investment
- c. To extend the life of assets by minimizing wear and tear and deterioration
- d. To ensure operational readiness of all equipment required for emergency (standby units, fire-fighting and rescue units, etc.)
- e. To ensure the safety of personnel using facilities

Failure Analysis – “Bath-tub” Curve

- It helps to
 - identify the nature and occurrence of failures
 - design and ensure reliable performance
 - Shows generalized relationship of failure depicted as a bath-tub curve that is typical for all operating mechanisms.
- Plays a vital role in taking decisions pertaining (RELATING) to maintenance planning and control.

Failure Analysis – Bath Tub Curve



Failure Analysis – Infant Morality

- **Infant Morality (A-B)** – New or recently serviced equipment is initially at a higher risk of failure (less reliable) due to minor breakdowns, vulnerable/damaged components.
 - Such behavior can be approximated to a “**Hyper Exponential**” **distribution**. This behavior indicates design and installation defects. Warranty Phase is provided to cover this types of failure.

Failure Analysis – Negative Exponential

- In this phase (B-C), failure risk is near constant that can be approximated to a “**Negative Exponential**” **distribution**.
 - Here morality rate is relatively stable
 - The equipment become progressively more reliable, i.e., the number of breakdowns in a given period of operation reduces to a minimum average failure rate.

Formula: $F = N/T = 1/MTBF$;

- where F = Failure rate; N = number of failure encounter in operating time T; T = operating time & MTBF = mean time between failures

Failure Analysis – Abnormal Exponential

- In this phase (C-D), components fail due to ageing and wear-out and the failure risk will increase with operating time. This phenomenon can be approximated to a “Abnormal Exponential” distribution.
- Weibull Distribution
 - - Three distributions as discussed above (1) Hyper, (2) Negative, and (3) Abnormal can be combined into one and known as Weibull Distribution as represented by Bath-tub Curve.
 - - The profitable decision in engineering is the one that costs the least over a defined period which may be called the “Life Cycle of the Equipment”.

Chap – 8 : Financial Management

1. Definiton of Financial Management
2. Objectives of Financial Management incl macro and micro level and firm level....imp
3. Accounting Classification
4. Any one may come out of these 3 ques

Introduction

- **Finance** – used to describe the money resources available to governments, firms, or individuals and the management of these resources.
- **Financial Management** – is the acquisition, management, and financing of resources by means of money with due regard for prices in external markets.
- **Resources are** – generally physical, such as cash, inventory, accounts receivable, equipment and machinery or manufacturing and distribution facilities including people.
- **Money comes from variety of sources** – borrowing, leasing, public issues, and the internal cash flow generated by firm's activities

Introduction – cont'd

- **Firm's Goal** – is to provide and manage these resources as efficiently as possible to balance the needs against risks and returns.
- **Financial Management** – is a set of administrative actions which relate to the arrangement of cash and credit to enable the organization to carry out its objectives satisfactorily.
- **Main features of Financial Management** is
 - the formulation of the firm's strategy towards determining the efficient use of funds currently at the disposal of the firm
 - selecting the most favorable sources of additional funds that the firm will need in the foreseeable future

Definition – Financial Management

- “Financial Management is an area of financial decision-making, harmonizing individual motives and enterprise goals” – Weston and Brigham
- “Financial Management is an application of general managerial principles to the area of financial decision-making” – Howard and Upton
- **Financial Management involves** – financial planning, forecasting and provision of finance as well as formulation of financial policies.

Definition - Accounting

- It is a system for collecting, summarizing, analyzing and reporting in monetary terms, financial information about an organization.
- Financial Information relates to production, sales, expenditure, investment, and losses and profits in the business.
- It provides information to both inside and outside parties such as shareholders, bankers, creditors, management, etc.
- **Accounting may be classified into three (03) categories.**
 - Financial Accounting
 - Cost Accounting
 - Management Accounting

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 - Management Accounting

Accounting Classification

Accounting may be classified into three (03) categories.

- **Financial Accounting** – is concerned with the recording, classification and reporting of various business transactions.
- **Cost Accounting** – ascertains cost of different items and presents information to the management for control of costs.
- **Management Accounting** – makes provision of financial costs and other monetary information for planning, coordination and control of business activities. (decisions with regards to determining the manufacturing or purchasing, prices, shutting down or continuing

Financial Management - Objectives

Macro-level

- At this level, financial management is to make an intensive and economical use of scarce capital resources.
- This is an indirect social responsibility of financial management which can be readily defined although not easily put in practice.

Micro-level

- Considered at the level of firm.
- Goals of finance can be reasonably associated with the overall goals of business..
- A successful business enterprise often uses a goal oriented financial structure.

Financial Management - Objectives

Primary Objectives of a Firm:

- **Profit Maximization** – Profit as a standard for measuring the success or efficiency of a business enterprise
- **Maximization of Return** – Provides a basic guideline according to which financial decisions can be evaluated, but returns are mainly based on the profits earned by a firm.
- **Maximization of Wealth** – Provides a basic guideline according to which financial decisions can be evaluated.

Chap – 9 : Managerial Economics

1. Aspects of Economics
2. Definition of Managerial Economics
3. Concerned with 4 Basic economic questions of Microeconomic Theory. Explain any 1-2 ques.....imp

Economics

Aspects of Economics

Human Behavior – It may relate to the behavior of the individual, firm or the government.

- Human behavior may pertain to the allocation of his income to various activities such as education, food, transport, housing and so on.
- Behavior of The firm may pertain to the allocation of resources (men, machine, materials, etc.) to various productive activities.
- Behavior of government may pertain to the allocation of resources to activities and sectors of economy such as agriculture, industry, defense, social service, law and order, etc.

Managerial Economics

- Managerial economics is the hybrid of two disciplines –
- Management and economics
- Management deals with a set of principles which help in decision-making under different situations, and improve the effectiveness of business organization.
- Economics provides a set of positions for optimal allocation of scarce resources to achieve the desired objectives.

Definition

- Spencer and Sigelman
- “ Managerial economics deals with integration of economic theory with business practice for the purpose of facilitating decision-making and forward planning by management”
- Joel Dean
- “The purpose of managerial economics is to show how economic analysis can be used in formulating business policies”.

Microeconomic Theory

Concerned
with 4 Basic
economic
questions

1. What goods shall be produced and in what quantities?
2. How shall they be produced?
3. How the goods and services produced shall be distributed?
4. How efficiently are the resources being used?

Microeconomic Theory

- The first question arises due to limited availability of resources
- The second question arises due to alternative methods of producing goods
- The third question is concerned with the distribution of national product amongst various individuals and groups engaged in the production process in different capacities in the society.
- The fourth question is concerned with the efficient use of resources in the production of maximum quantity of various goods and services

Microeconomics Theory - First Question

The first question arises due to limited availability of resources. The problem of allocating these resources optimally among the various uses is solved by the market system. The allocation of resources to the production of various goods and services in a free market economy depends upon the prices of various goods and factors of production. Thus, to explain how the allocation of resources is determined,

Microeconomics helps to analyze how the relative prices of goods and factors are determined. Since microeconomic theory is concerned with the analysis of price system, it is also called the theory of price.

Microeconomics Theory -Second Question

- The second question arises due to alternative methods of producing goods. Thus, there is a need to ascertain the best possible combination of resources to be used for producing any commodity. This type of problem is analyzed under the theory of production or under the theory of firm.

Microeconomics Theory -Third Question

- The third question is concerned with the distribution of national product amongst various individuals and groups engaged in the production process in different capacities in the society. This problem is analyzed under the theory of distribution or under the theory of factor pricing.

Microeconomics Theory - Fourth Questions

- The fourth question is concerned with the efficient use of resources in the production of maximum quantity of various goods and services. However, such goods and services must maximize the satisfaction of the consumers. This problem is analyzed and studied under welfare economics.

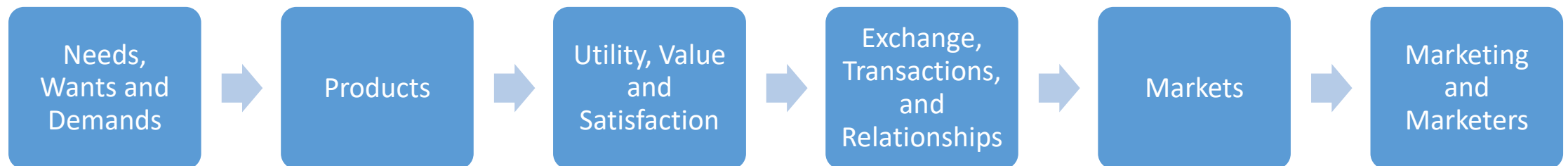
Chap – 11 : Marketing Management

1. Key Concepts of Marketing....imp
2. Basic elements or 4Ps in marketing....imp
3. Relationship between Marketing Planning and Marketing Mix
4. Relationship between Marketing Mix and Marketing Strategy
5. Fig. 11.2 Product Life Cycle....imp
6. Table. 11.3 Suggested Strategies relating to Marketing Mix Variables in PLC Stages....imp

Key Concepts of Marketing

The following key concepts of marketing emerge from the above-mentioned definitions

- Needs, wants, and demands
- Products
- Utility, value, and satisfaction
- Exchange, transactions, and relationships
- Markets
- Marketing and marketers



Key Concepts of Marketing

A human need is a state in which a person feels deprived of something. A need has to be converted into a want for product/service through adequate marketing strategy, such as promotion.

Demands are wants for specific products that are backed up by an ability and willingness to buy them. Wants become demands when backed up by purchasing power.

Basic Elements

Marketing is performed within a certain environment which itself is always changing. It is appropriate to divide the marketing activities into four basic elements:

- Product – stands for goods or services offered by the organization.
- Price – refers to the money value that the customer has to pay
- Promotion – is the aspect of selling and advertising or communicating the benefits of product or services to the target customers.
- Place (or physical distribution) – refers to the aspect of the channels of distribution through which the product has to move it reaches the consumer.

These referred to as the 4Ps in marketing.

Relationship between Marketing Planning and Marketing Mix

11.2.3 Relationship between Marketing Planning Process and Marketing Mix

✓ The following components constitute a typical marketing plan:

- (a) **Current marketing situation:** The data relate to the market, product, competition, distribution and macro-environment.
- (b) **Identification of problems and opportunities:** Identification of SWOT analysis—strength, weaknesses, opportunities and threat—of a company's product.
- (c) **Defining aims:** Financial (long rate of return on investment; profits and cash flow during the current year) and marketing (sales revenue, sales volume, market share, average realized price, consumer awareness, distribution coverage, etc.) aims to achieve the financial objectives.
- (d) **Marketing strategy:** It consists of broad decisions on target markets, market positioning and mix and marketing expenditure levels. Marketing strategy also involves an awareness, the expected environment, and competitive conditions.

Marketing Management

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- (e) **Marketing programme development:** In developing each element of the marketing strategy, it is required to know (i) What will be done? (ii) When will it be done? (iii) Who will do it? (iv) How much will it cost?

Relationship between Marketing Mix and Marketing Strategy

11.2.4 Relationship between Marketing Mix and Marketing Strategy ✓ ✓

Marketing mix is the mixture of controllable marketing elements that the firm uses to achieve the target market. Marketing strategy is a set of sub-strategies concerned with competition, segmentation, pricing, promotion and distribution. Structural criteria cover the following: (a) Coherence, (b) Consistency, (c) Contribution, and (d) Relative significance.

The following factors determine the key element. These are: (a) product, (b) type of market (industrial/consumer), (c) stage in evolution (emerging, transition and decline), and competitive conditions. Therefore, the key factor in the marketing mix is crucial in drawing up a marketing strategy. In devising an optimum marketing mix, it is important to know how various marketing-mix variables interact in their impact on sales/profits.

Fig. 11.2 Product Life Cycle

Development of Market Strategies vs. Elements of Marketing Mix

The development of strategies in relation to some of the elements of marketing mix is discussed. These relate to marketing mix decisions with respect to new product development, stages in the life-cycle of a product, and the role of advertising and pricing in the marketing mix.

The product life-cycle (PLC) concept helps to understand how the components of the marketing mix change during different phases of the life-cycle curve. The product life-cycle curve (S-shaped) of introduction, growth, maturity and decline is shown in Fig. 11.2.

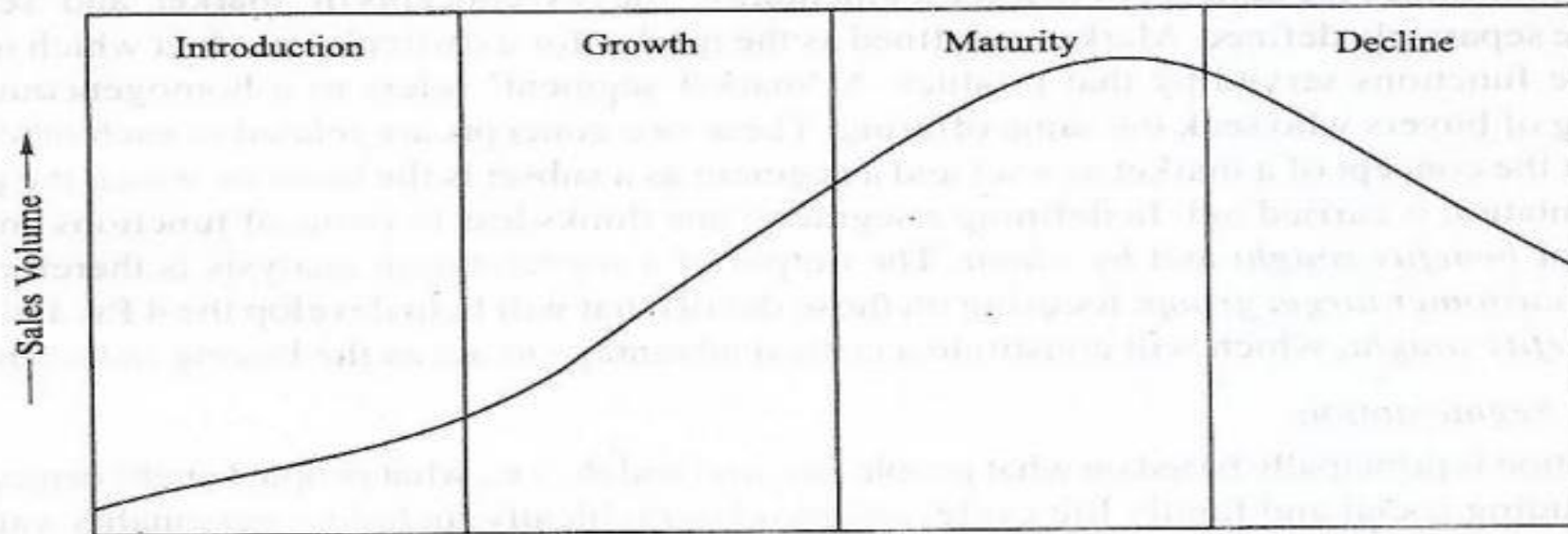


Fig. 11.2 Product life cycle

Different products will take different time periods to pass through the cycle of introduction, growth, maturity and decline. Many products such as light bulbs, machine tools, computer stationery seem to remain indefinitely at the maturity stage, while some products quickly come and go. Further, a product can be at different stages in different countries.

Table 11.3 shows some typical strategies relating to marketing mix variables in PLC stages.

Table. 11.3 Suggested Strategies relating to Marketing Mix Variables in PLC Stages

Table 11.3 Suggested Strategies Relating to Marketing Mix Variables in PLC Stages

<i>Stage in Life Cycle</i>	<i>Product</i>	<i>Pricing</i>	<i>Promotion</i>	<i>Distribution</i>
Introduction	Iron out product deficiencies	Highest	Create awareness of product's potential. Stimulate primary demand	Selective distribution
Growth	Focus on product quality. Introduce variations of product	High	Selective advertising of the brand. Heavy advertising to create image	Extended coverage
Maturity	Product adjustments for further brand differentiation	Moderate	Maintain and build image. Facilitate sales promotion.	Close-relationship with dealers
Decline	Simplify the product line. Seek new product uses. Introduce changes to revitalize the product.	Low	Primary demand may again be cultivated.	Selective cultivation

Chap – 10 : Total Quality Management (TQM)

1. Definition of Total Quality Management (TQM)
2. Dimensions of Quality
3. Juran's Quality Trilogy
4. ISO (International Organization for Standardization)
5. ISO 9000 vs. TQM.....most imp
6. Quality Circle
7. Quality Control
8. Quality Assurance (QA)



Anyone out of these 3 has come.

Introduction

Quality

Quality is defined by the consumers, rather than the designer or the inspector. A number of parameters associated with quality has been redefined as the concept of quality is gradually changing.

Total Quality Management (TQM)

It is essential to understand the term of “Total” and “Quality” in TQM.

Meaning of “Total” in TQM

Total in TQM means development of all aspects of an organization in satisfying the customer. This can be accomplished if a partnership environment at each stage of the business process is recognized within and outside the organization. **It involves:**

- ☐ Customer-Supplier relationship based on mutual trust and respect and,
- ☐ Win-win strategy for both
 - a) Organizations in-house requirements by the customers
 - b) Customer's needs are well understood by the supplier
 - c) Suppliers are partners in achieving zero-defect situation
 - d) Regular monitoring of supplier's processes and products by the customer.

Quality

Quality is defined by customer needs and expectations. Quality is what customer wants.

“ Quality is the totality of features and characteristics of a product/service that bear on its ability to satisfy a given need” – **American Society of Quality Control**

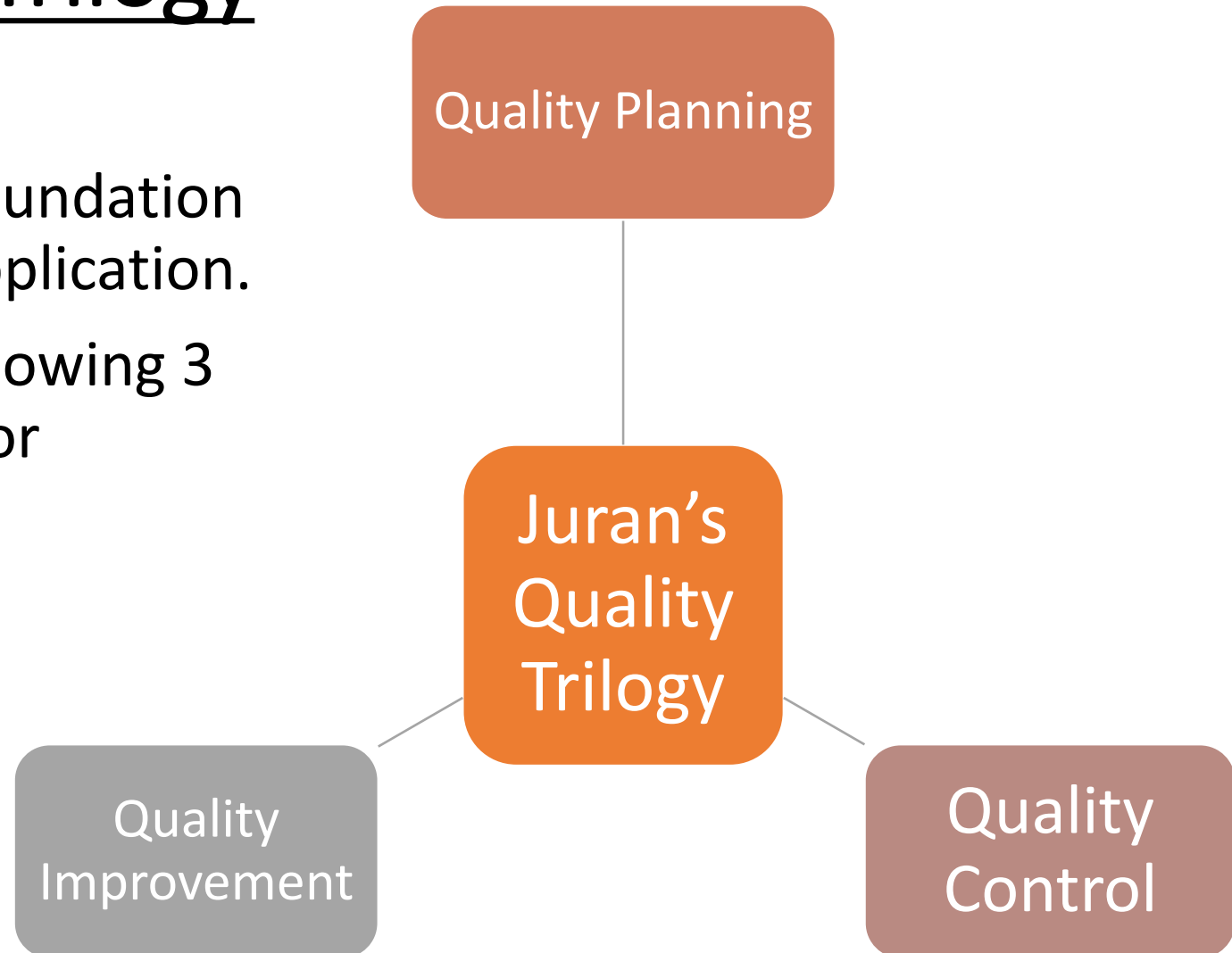
“Quality refers to an level of functionality possessed by a product/service based on the producers capability and customer’s need” – **Badiru and Ayeni (1993)**

Dimensions of Quality

1. Performance
2. Features
3. Durability
4. Reliability
5. Serviceability
6. Appearance
7. Safety
8. Time
9. Compatibility

Juran's Quality Trilogy

- Provided the basic foundation of TQM's practical application.
- He suggested the following 3 phases of activities for continuous quality improvement:



Juran's Trilogy – Quality Planning

“Quality is required to be planned for which special training is required” – Juran

Four (04) steps for planning of quality

- Identify the customers and their needs (both external and internal customers)
- Translate the customer's needs into technical specifications.
- Optimize the product design and process parameters capable of producing the required product
- Place the process into operation.

Juran's Trilogy – Quality Control

Quality Control is the process of detecting adverse changes in the process and taking corrective action when the process shows signs of drifting from its optimal setting.

- Statistical techniques and SPC should be used to control the quality. **The activities include:**
 - evaluate the actual performance of the product
 - compare the actual performance with the product goals
 - act on the performance

Juran's Trilogy – Quality Improvement

- Quality problems may be classified into two broad categories: (1) Sporadic and (2) Chronic.

Sporadic Problems

- problems are sudden change for the worse
- are best handled by statistical techniques.

Chronic Problems

- problem persists for a long time
- problems are solved by behavioral models which involve teamwork and employee participation
- It is estimated that 80% losses are due to chronic problems
- A quality breakthrough is needed to reduce the chronic waste

ISO (International Organization for Standardization)

Published the **first FIVE** standards on international Quality Assurance (QA), known as ISO 9000 Standards.

- These standards were described as **“the refinement of all the most practical and generally applicable principles of quality systems”** and **“the culmination of agreement between the world’s most advanced authorities of these standards as the basis of a new era of quality management.**

ISO (International Organization for Standardization)

The Actual Standards are:

1. **ISO 9000** – a road map for use of other standards in this series. It defines five key quality items in the ISO terminology.
2. **ISO 9001** – It specifies a model when two parties require the demonstration of a supplier's capability to design, produce, install and service a product.
3. **ISO 9002** – It specifies a model for quality assurance in production and installation.
4. **ISO 9003** – It is a model for quality assurance in the final inspection.
5. **ISO 9004** – It provides quality management guidelines for developing and implementing a quality system and in determining the extent to which every element is applicable.

ISO 9000 vs. TQM

ISO 9000

- A set of standards and focuses on documents.
- Product conforms to specification
- Certification
- Audits and checks
- Key processes
- Quality system
- External trust
- Visibility of capability prior to delivery
- An assurance to external customers that a quality system is being pursued

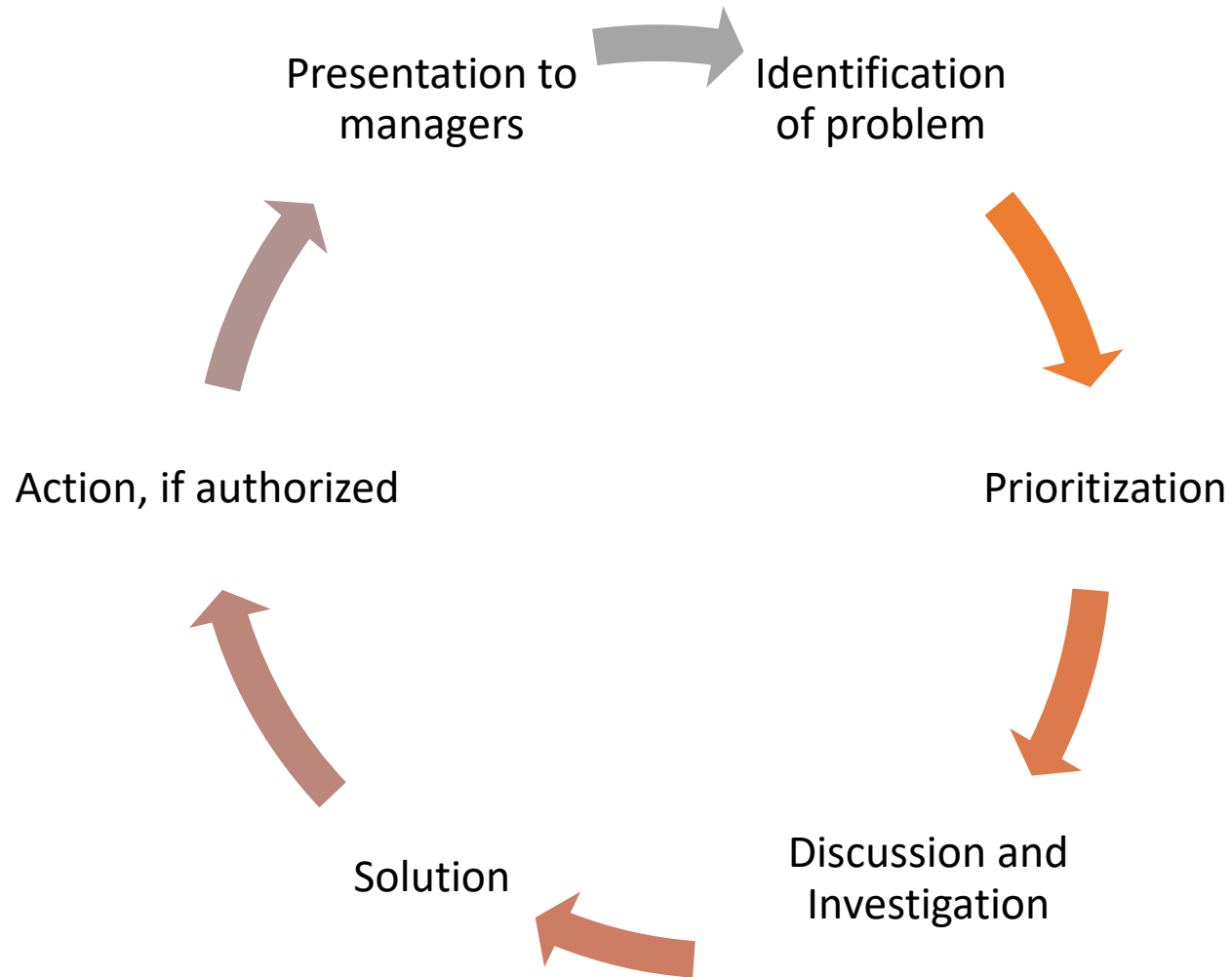
TQM

- TQM focuses on developing human elements.
- Customer delight and satisfaction
- Total organization – all resources
- Internal and external trust
- Leadership
- Internal customer
- Flexibility and change management
- Top management commitment
- Continuous improvement

Quality Circle

- It provides an effective channel of communication between the employees and the top management for discussion on problems related to quality.
- “A group who meet voluntarily and regularly to identify and solve their own work-related problems and implement their solutions with management approval”. (Industrial Society)
- Consists of 6-12 members
- Membership can be rotated or sub-group can be formed, if too many volunteers.
- Senior or experienced members of the circle becomes leader
- Unions are supportive and involved due to close workforce involvement and job satisfaction
- “Structured way of making management listen”

Quality Circle



Quality Control

- **Quality Control** can be defined as being concerned with checking for errors during and after the process of manufacture.
- **Modern control techniques** are based on idea of (1) error-free or (2) zero-defect approach or (3) doing it right first time.
- Reason – costs involved in correcting errors
- **At the strategic management level**, decisions are made about total quality management and systems of quality control.
- **The strategic approach includes:**
 - - Analysis of current position
 - - Choice of an appropriate starting point
 - - Implementation of policy, deciding what will be done, how, by whom and by when.

Quality Assurance (QA)

- **Quality Assurance** provides a framework for quality control and quality improvement.
- **QA supports teams of employees with**
 - systems, resources, and discretion appropriate to their unique contribution to the organization,
 - to keep them in tune with progress of quality management and improvement.
- **How Management can help teams?**
 - Understand quality characteristics
 - Be realistic about the standards to be attained
 - Undertake quality control through a measurement process, interpret the results and make propose changes

Chap – 12 (Part - 1) : INDUSTRIAL MANAGEMENT

1. Advantages of Using Formal Project Management
2. Definition of What Is a Project?....imp
3. Figure 1-1 The Triple Constraint of Project Management
4. What is Project Management?
5. Figure 1-2 Project Management Framework
6. 10 Project Management Knowledge Areas / The 10 knowledge areas of project management
7. Project Success? Table 1-2: What Helps Projects Succeed?*.....imp...good ques as sir said
8. Table 1-3 Ten Most Important Skills and Competencies for Project Managers
9. Ethics in Project Management

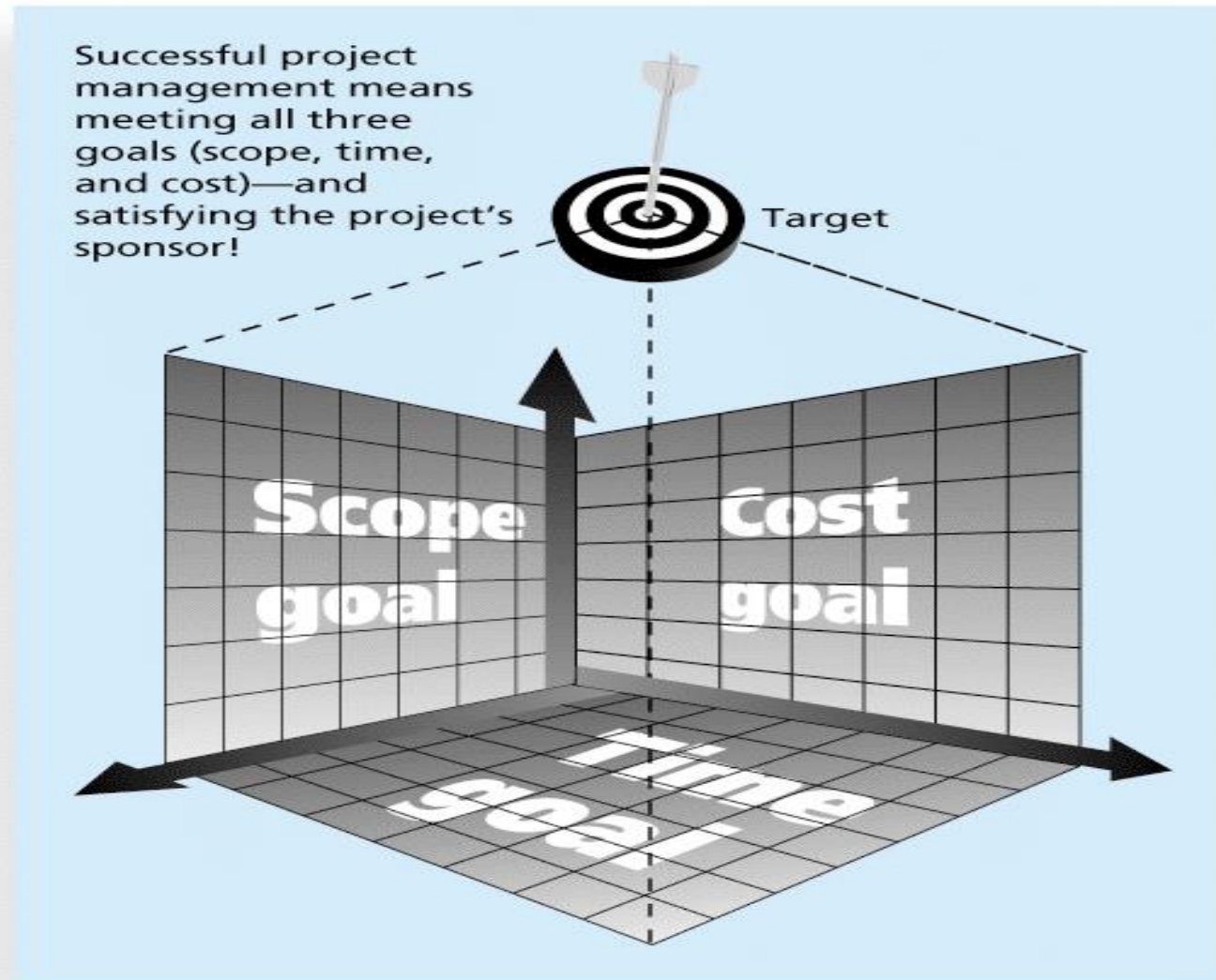
Advantages of Using Formal Project Management

- Better control of financial, physical, and human resources
- Improved customer relations
- Shorter development times
- Lower costs
- Higher quality and increased reliability
- Higher profit margins
- Improved productivity
- Better internal coordination
- Higher worker morale

What Is a Project?

- A **project** is “a temporary endeavor undertaken to create a unique product, service, or result” (PMBOK® Guide, Fifth Edition, 2012)
 - **Operations** is work done in the organization to sustain the business
- Projects end when their objectives have been reached or the project has been terminated
 - Projects can be large or small and take a short or long time to complete

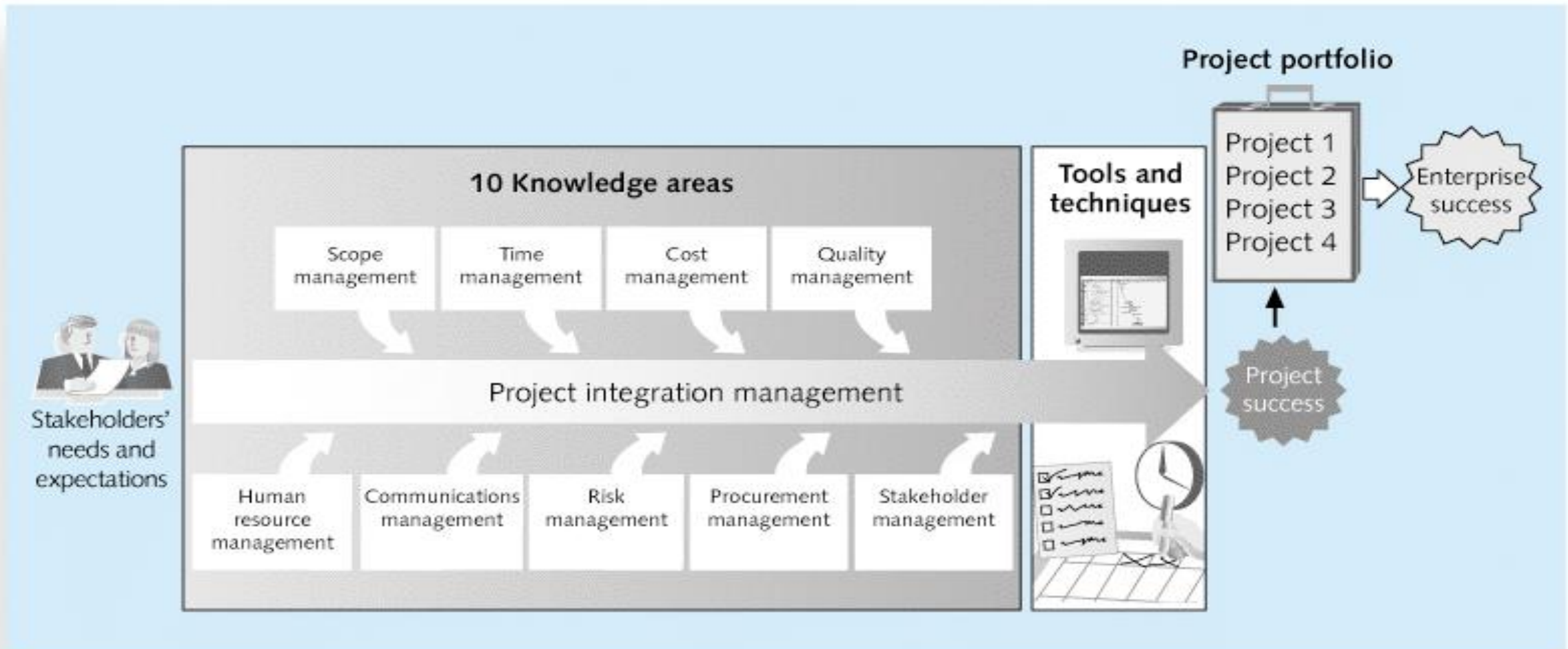
Figure 1-1 The Triple Constraint of Project Management



What is Project Management?

- **Project management** is “the application of knowledge, skills, tools and techniques **to project activities to meet project requirements**” (PMBOK® Guide, Fourth Edition, 2012)
- Project managers strive to meet the **triple constraint** (project scope, time, cost and quality goals)
 - also facilitate the entire process to meet the needs and expectations of project stakeholders

Figure 1-2 Project Management Framework



10 Project Management Knowledge Areas

- **Knowledge areas** describe the **key competencies** that **Project Managers** must develop
- Project managers must have knowledge and skills in all 10 knowledge areas:
 - Project integration, scope, time, cost, quality, human resource, communications, risk, procurement, and stakeholder management

The 10 knowledge areas of project management

1. Project scope management involves **defining and managing all the work** required to complete the project successfully.
2. Project time management includes estimating **how long it will take to complete the work**, developing an acceptable **project schedule**, and ensuring **timely completion** of the project.
3. Project cost management consists of preparing and managing the **budget for the project**.
4. Project quality management ensures that the project will **satisfy the stated or implied needs** for which it was undertaken.
5. Project human resource management is concerned with making **effective use of the people** involved with the project.

The 10 knowledge areas of project management

6. Project communications management involves generating, collecting, disseminating, and storing project information.
7. Project risk management includes identifying, analyzing, and responding to risks related to the project.
8. Project procurement management involves acquiring or procuring goods and services for a project from outside the performing organization.
9. Project stakeholder management includes identifying and analyzing stakeholder needs while managing and controlling their engagement throughout the life of the project.
10. Project integration management is an overarching function that affects and is affected by all of the other knowledge areas.

Project Success

- There are several ways to define project success:
 - The project met scope, time, and cost goals
 - The project satisfied the customer/sponsor
 - The results of the project met its main objective, such as making or saving a certain amount of money, providing a good return on investment, or simply making the sponsors happy

Table 1-2: What Helps Projects Succeed?*

1. User involvement
2. Executive support
3. Clear business objectives
4. Emotional maturity
5. Optimizing scope
6. Agile process
7. Project management expertise
8. Skilled resources
9. Execution
10. Tools and infrastructure

*The Standish Group, “CHAOS Activity News” (August 2011).

Table 1-3 Ten Most Important Skills and Competencies for Project Managers

1. People skills
2. Leadership
3. Listening
4. Integrity, ethical behavior, consistent
5. Strong at building trust
6. Verbal communication
7. Strong at building teams
8. Conflict resolution, conflict management
9. Critical thinking, problem solving
10. Understands, balances priorities

Ethics in Project Management

- **Ethics**, loosely defined, is a set of principles that guide our decision making based on personal values of what is “right” and “wrong”
- Project managers often face ethical dilemmas
- In order to earn PMP certification, applicants must agree to PMI’s Code of Ethics and Professional Conduct
- Several questions on the PMP exam are related to professional responsibility, including ethics

Chap – 12 (Part - 2) : INDUSTRIAL MANAGEMENT

1. Project Time Management Processes....very very imp
2. Network Diagrams? Figure 6-2. How to make (methods) Network Diagram for Project X?
3. Critical Path Method (CPM)?.....imp
4. Math on Critical Path Method (CPM)....imp

Project Time Management Processes

1. **Planning schedule management:** determining the policies, procedures, and documentation that will be used for planning, executing, and controlling the project schedule
2. **Defining activities:** identifying the specific activities that the project team members and stakeholders must perform to produce the project deliverables
3. **Sequencing activities:** identifying and documenting the relationships between project activities
4. **Estimating activity resources:** estimating how many **resources** a project team should use to perform project activities
5. **Estimating activity durations:** estimating the number of work periods that are needed to complete individual activities
6. **Developing the schedule:** analyzing activity sequences, activity resource estimates, and activity duration estimates to create the project schedule
7. **Controlling the schedule:** controlling and managing changes to the project schedule

Figure 6-1. Project Time Management Summary

Planning

Process: **Plan schedule management**

Outputs: Schedule management plan

Process: **Define activities**

Outputs: Activity list, activity attributes, milestone list, project management plan updates

Process: **Sequence activities**

Outputs: Project schedule network diagrams, project documents updates

Process: **Estimate activity resources**

Outputs: Activity resource requirements, resource breakdown structure, project documents updates

Process: **Estimate activity durations**

Outputs: Activity duration estimates, project documents updates

Process: **Develop schedule**

Outputs: Schedule baseline, project schedule, schedule data, project calendars, project management plan updates, project documents updates

Monitoring and Controlling

Process: **Control schedule**

Outputs: Work performance information, schedule forecasts, change requests, project management plan updates, project documents updates, organizational process assets updates

Project Start

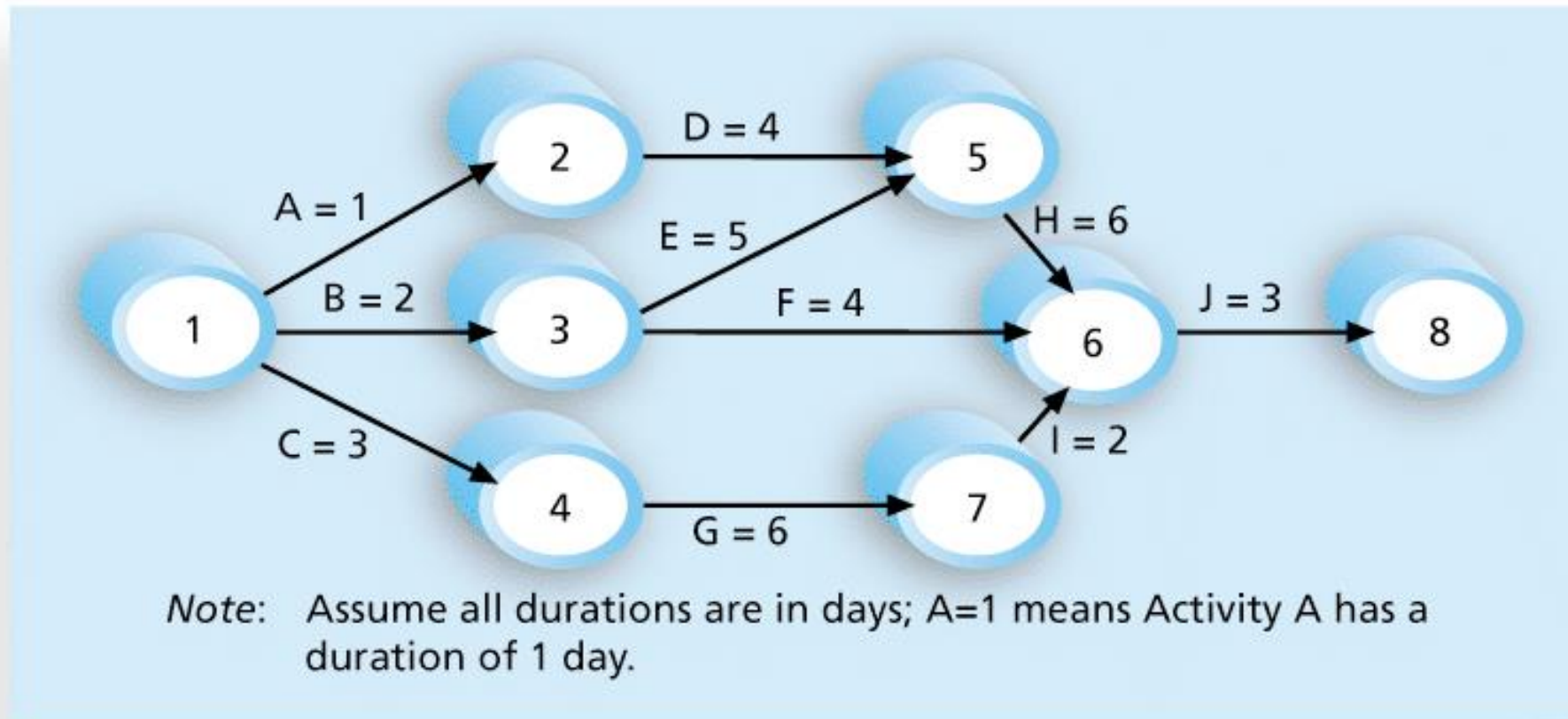
Project Finish

(**Eta na
dileyo
cholbey
as sir said
But he
also said
dilay valo
hoi r ki)

Network Diagrams

- Network diagrams are the preferred technique for showing activity sequencing
- A **network diagram** is a schematic display of the logical relationships among, or sequencing of, project activities
- Two main formats are the arrow and precedence diagramming methods

Figure 6-2. Network Diagram for Project X



Arrow Diagramming Method (ADM)

- Also called activity-on-arrow (AOA) network diagrams
- Activities are represented by arrows
- Nodes or circles are the starting and ending points of activities
- Can only show finish-to-start dependencies

Process for Creating AOA Diagrams

1. Find all of the activities that start at node 1. Draw their finish nodes and draw arrows between node 1 and those finish nodes. Put the activity letter or name and duration estimate on the associated arrow
2. Continuing drawing the network diagram, working from left to right. Look for bursts and merges. **Bursts** occur when a single node is followed by two or more activities. A **merge** occurs when two or more nodes precede a single node
3. Continue drawing the project network diagram until all activities are included on the diagram that have dependencies
4. As a rule of thumb, all arrowheads should face toward the right, and no arrows should cross on an AOA network diagram

Precedence Diagramming Method (PDM)

- Activities are represented by boxes
- Arrows show relationships between activities
- More popular than ADM (Arrow Diagramming Method) method and used by project management software
- Better at showing different types of dependencies

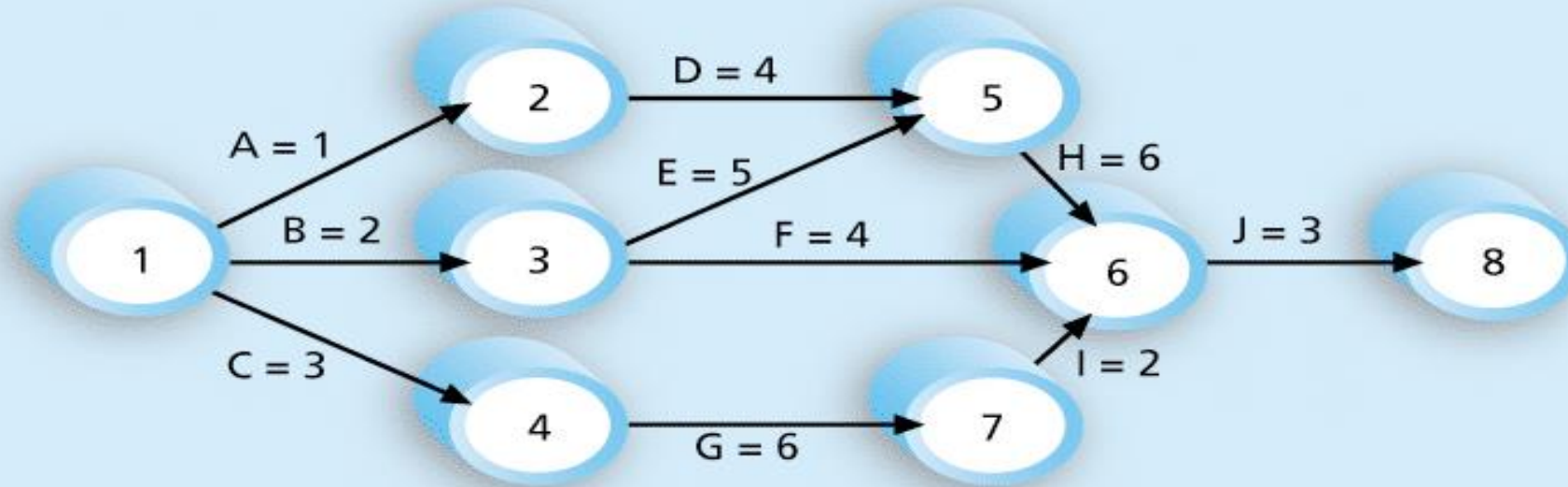
Critical Path Method (CPM)

- **CPM** is a network diagramming technique used to predict total project duration
- A **critical path** for a project is the series of activities that determines the *earliest time* by which the project can be completed
- The critical path is the *longest path* through the network diagram and has the least amount of slack or float
- **Slack** or **float** is the amount of time an activity may be delayed without delaying a succeeding activity or the project finish date

Calculating the Critical Path

- First develop a good network diagram
- Add the duration estimates for all activities on each path through the network diagram
- The longest path is the critical path
- If one or more of the activities on the critical path takes longer than planned, the whole project schedule will slip *unless* the project manager takes corrective action

Figure 6-8. Determining the Critical Path for Project X



Note: Assume all durations are in days.

Path 1: A-D-H-J Length = $1+4+6+3 = 14$ days

Path 2: B-E-H-J Length = $2+5+6+3 = 16$ days

Path 3: B-F-J Length = $2+4+3 = 9$ days

Path 4: C-G-I-J Length = $3+6+2+3 = 14$ days

Since the critical path is the longest path through the network diagram, Path 2, B-E-H-J, is the critical path for Project X.

More on the Critical Path

- The critical path is *not* the one with all the critical activities; it only accounts for time
 - Remember the example of ***growing grass*** being on the critical path for Disney's Animal Kingdom
- There can be more than one critical path if the lengths of two or more paths are the same
- The critical path can change as the project progresses