

INTRODUCTION TO INDUSTRIAL MANAGEMENT

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NOTE:

MAKAUT course structure and syllabus of 5th semester has been changed from 2020. **INTRODUCTION TO INDUSTRIAL MANAGEMENT** has been introduced as a new subject in present curriculum. Taking special care of this matter we are providing chapterwise model questions and answers, so that students can get an idea about university questions patterns.

INTRODUCTION**Multiple Choice Type Questions**

1. Who is the father of Scientific Management?
 a) Frank Gilberth
 b) F. W. Taylor
 c) Mark Parker Follet
 d) Max Weber
 Answer: (b) [MODEL QUESTION]
2. Which function of the management is the basic of all other functions?
 a) controlling b) staffing c) planning d) directing
 Answer: (c) [MODEL QUESTION]
3. The Wage Boards appointed by the Government and usually consist of number of persons
 a) 5 b) 7 c) 10 d) 12
 Answer: (c) [MODEL QUESTION]
4. Decision making helps in
 a) improving efficiency
 b) increasing profits
 c) achieving organizational goal
 d) implementing a policy
 Answer: (c) [MODEL QUESTION]
5. Planning is
 a) looking ahead
 b) looking back
 c) guiding people
 d) delegation of authority
 Answer: (a) [MODEL QUESTION]
6. Who is the father of Human Relation approach?
 a) Elton Mayo
 b) Henri Fayol
 c) F.W. Taylor
 d) Mary Parker Follett
 Answer: (a) [MODEL QUESTION]
7. Management is a art of
 a) profit making
 b) getting thing done by others
 c) misleading customer
 d) satisfying the competitors
 Answer: (c) [MODEL QUESTION]
8. Management is
 a) an art
 b) a science
 c) both (a) & (b)
 d) none of these
 Answer: (c) [MODEL QUESTION]

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9. Basic objective of financial management is
 a) profit maximization
 b) wealth maximization
 c) both of these
 d) none of these.
 Answer: (b) [MODEL QUESTION]
10. When authority flows from the top executive to the lower level of employees it is known as
 a) Functional Organisation
 b) Staff Organisation
 c) Formal Organisation
 d) Line organization
 Answer: (c) [MODEL QUESTION]
11. Job satisfaction refers to
 a) attitude of an employee towards his work
 b) work culture
 c) relationship between superiors and subordinates
 d) appraisal of the performance of employees
 Answer: (a) [MODEL QUESTION]
12. A _____ is a quantity that influences the output or behavior of a mathematical object but is viewed as being held constant.
 a) Parameter b) Function c) Input d) Coefficient
 Answer: (a) [MODEL QUESTION]
13. Models that describe aspects of a domain or system can be characterized as
 a) emphasizing static
 b) dynamic information
 c) both of them
 d) either (a) & (b)
 Answer: (d) [MODEL QUESTION]
14. _____ is the collective set of attitudes, emotions, and satisfaction exhibited by employees
 a) morale b) Behavior c) Content d) Proactive
 Answer: (a) [MODEL QUESTION]
15. Something that makes people feel more confident and cheerful
 a) moral booster b) satisfaction c) productivity d) motivation
 Answer: (a) [MODEL QUESTION]
16. In which year did factories act come into force?
 a) 23rd September, 1948
 b) 1st April, 1949
 c) 4th April, 1949
 d) 12th September, 1948
 Answer: (b) [MODEL QUESTION]

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Short Answer Type Questions**[MODEL QUESTION]****1. What is System? Explain its classification.****Answer:**

A System may be defined as a collection of interacting elements that operate to achieve a predetermined objective. In simple terms, a system may be visualized as a processing unit which receives certain inputs and is urged to act upon them in some desirable fashion to produce outputs with a purpose to optimize some function of input and output. Inputs may be in the form of energy, matter, information, etc. Processing unit may be activated and controlled by men or machines. The output may be in the form of products, services or information and the objective may be to maximize output. A system is dynamic in nature. A system may have animate or inanimate interacting elements. A thunder storm is an inanimate system whereas a hospital (building) together with its staff and operating conditions is an animate system. In this system, the input is medicines, medical instruments, patients, etc.; the processing unit includes doctors, other staff and machinery; the output is the relief to the patients and the objective is to treat satisfactorily as many patients as possible in a given time.

A few examples of other systems are as under:

- (a) A human body is a system with various sub-systems like nervous, blood circulation, breathing, eating and drinking, etc.
- (b) An industry is a system with various subsystems like purchase, production, sales, etc.

Classification of Systems:

A system may be

(i) Mechanistic:

A mechanistic system is one which though is fully mechanised yet the choice of system composition remains in the hands of human beings. The examples of the mechanistic systems are, dial telephone, guided missiles, space rockets, etc.

(ii) Quasi-Mechanistic:

In a quasi-mechanistic system human beings carry out some of the mechanical functions. A fighter plane is a quasi-mechanistic system.

2. Highlight the basic elements of Management.**[MODEL QUESTION]****Answer:**

Following are the basic elements of management:

1. Selection of personnel
2. Placement of personnel
3. Training of personnel
4. Job analysis includes the followings:
 - i) Time study
 - ii) Motion study
 - iii) Fatigue study
5. Incentive system
6. Appointment of function foreman

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7. Good relation between worker and manager
All the above are human aspect element. Non human aspect elements are as follows:

1. Separation of planning from doing
2. Standardization
3. Economy

3. What do you mean by Management? Write down the main functions of management?**Answer:**

1st Part:
Management is a functional concept and can be defined as "It is an effort for getting things done in order to achieve the predetermined goals of the concern through co-ordination of human and other elements. But, as its scope is so wide it is not easy task to define management. It is correct perspective. The difficulty is mainly due to the fact that the word management is highly concerned with the people. The behaviors and attitude of the people are highly unpredictable and defy all calculations. Besides, management is a growing science and its generalization is thus in the process of development. For this it is very difficult to confirm its subject matter within a tight compartment of a short definition. Thus various Authors, Writers and Economists define management in different ways but main idea of these definitions is more or less similar though differ in their wordings. Economists define management as a factor of production, Sociologists consider management as a group of persons and as per specialists management is a system of authority.

2nd Part:

Management is a functional concept and can be defined as "It is an effort for getting things done in order to achieve the predetermined goals of the concern through co-ordination of human and other elements. The major role and functions of management are as follows:

- a) **Planning:** The first function of management is planning. The planning works out in broad outlines the things that need to be done and the methods of doing them in an orderly manner.
- b) **Organizing:** Once the plan is formulated then there is the need for organizing. This is nothing but a structure created to give successful form of all the combined efforts.
- c) **Staffing:** In organizing, the manager seeks to establish position and decide the duties and responsibilities that belong to each one. But in case of staffing, the manager finds the right man for each job, brings and trains the whole staff for this purpose and maintains congenial atmosphere for work.
- d) **Commanding:** Planning and organizing are not sufficient to move the staff into action. For this command is necessary. Command is the starting signal or order to enable the staff member to move into operational activities.
- e) **Directing:** Direction is associated with command. Directions include guidance and supervision of work of the subordinate. Direction is a continuous process and involves making decision giving necessary instruction for work performance.

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- f) **Motivating:** Motivation is psychological acts that help the workers to do more work. It is psychological aspect since it is linked to mental state. Motivation is the actuating force, which inspires a worker to put his best in the accomplishment of the task.
- g) **Controlling:** The work of planning, organization, command, direction and motivation if carried into effect smoothly and properly, leaves nothing to be desired for the accomplishment of the objectives.
- h) **Coordinating:** In a large organization, the number of workers and volume of work is large. The jobs of different workers need to be harmonized. This task is performed with the help of Coordination.
4. What do you mean by Organization Structure? What are the types of Organization Structure? Describe its advantages and disadvantages. [MODEL QUESTION]

Answer:
Organization Structure is a set of planned relationships between groups of related functions and between physical factors and personnel required for the achievement of organisational goals. Since these activities may be divided and assigned in different ways, there are many forms of organization structure.

Some of the types and classification of organisation structure are:

1. Entrepreneurial Structure (Simple Structure)
2. Functional Structure
3. Divisional Structure
4. Strategic Business Unit (SBU) Structure
5. Matrix Structure
6. Team-Based Organisation
7. Virtual Organisation
8. Boundary Less Organisation
9. Product Based Structure
10. Geographical or Territory Based Structure
11. Customer Based Structure
12. Project Organisation Structure
13. Virtual or Network Organisation
14. Mechanistic and Organic Structure.

Advantages:

The main advantages of Organization structure are the following:

- i) The owner manager gets invested with a complete knowledge of his organization and its business.
- ii) Decision-making is very quick.
- iii) Helps to maintain an intimate relationship with everybody in the organization.

Disadvantages:

- i. Taking everything on one's head has its own risks and disadvantages.
- ii. It does not encourage development of future managers.

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- iii. The simple structure becomes inadequate as the business grows.
5. What is the meaning of Division of Labour? Explain its advantages and [MODEL QUESTION] disadvantages.

Answer:
Division of Labour means division of work into different part or processes which are performed by one or group of workers according to their ability and aptitude.

Division of labour is of four kinds:

- (i) When there is complete division of jobs among different members of a community, it is called **simple division of labour**.
- (ii) When the work is divided into a number of processes in such a way that each worker does one process only, it is called **complex division of labour**.
- (iii) When due to one reason or the other a particular area specialises in a type of labour, it is called **territorial division of labour**.
- (iv) When different countries produce things of their specialisation, is called international division of labour.

Advantages:

1. Each worker specialises in a particular type of work, therefore, efficiency increases.
2. Since each worker performs the same work again and again, therefore, there is improvement in skill.
3. It results in greater production.
4. It becomes possible to do work quickly and efficiently without putting much strain on workers and industry.

Disadvantages:

1. Since a worker is required to do the same work again and again, hence he becomes dull.
2. It divides the responsibility for which there are more chances of shifting.
3. It hinders the mobility of labour.
4. If operations in one department are stopped, then whole of the industry suffers.

6. State how authority and responsibility are interrelated. [MODEL QUESTION]

Answer:

Delegation of Authority

The process by which authority passes from one managerial level to another is known as delegation. As organizations grow in size and complexity, no one person can perform all the tasks or exercise all the authority that is needed to accomplish goals.

Delegation of authority is not the same as division of work. As Henry Fayol says, "Division of work permits reduction in the number of objects to which attention and effort must be directed and has been recognised as the best means of making use of individuals and of groups of people".

Delegation of authority denotes the superior vesting decision-making power in his subordinate. No one can delegate an authority which he himself does not have.

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Delegation is one of the most important skills a manager must possess. The overworked managers are often those who do not know how to delegate. For they lack the skill to get results through others. An individual can perform limited work in a day, all by himself. But through delegation—through dividing his load and sharing his responsibilities with others—he can accomplish much more. No manager and no organisation can run smoothly and effectively without delegation.

Elements of Delegation
The number of delegation marks the effectiveness of the manager and influences the relationship between the superior and the subordinate.
Delegation is the process where a manager divides the work assigned to him so as to get help from others in accomplishing the same. It involves the following four steps that are indivisible:

- the determination of results expected
- the assignment of tasks
- the delegation of authority for accomplishing these tasks
- the exaction of responsibility for their accomplishment

Looked at differently, these four steps have three elements: responsibility, authority and accountability. Delegation is the entrustment of responsibility and authority to another and the creation of accountability for performance. Let us briefly consider these three elements.

Responsibility

Responsibility refers to the activities which must be performed to carry out the task assigned. Responsibility can be delegated.

Authority

Authority refers to the powers and rights entrusted to enable performance of the task assigned or delegated. Certain authority is imperative to shoulder a given responsibility. In organisations people derive authority mainly from two sources: position and personal. Position authority is related to powers of decision-making, reward and punishment. Personal authority refers to the expert knowledge and certain qualities which are part of the personality of an individual manager. Position authority can be delegated, but not personal authority. Authority could be formal or informal. Here we refer to formal authority that is clear, structured and communicated to all.

Accountability

Accountability is the obligation to carry out responsibility and exercise authority as per established standards or norms. It is an obligation to account for, and report upon, the discharge of responsibility or use of authority. Accountability can not be delegated. The person who delegates continues to be responsible to his superior for what he had delegated as well.

Since accountability cannot be delegated, the accountability of superiors for the acts of their subordinates is absolute. By the same token, we see that the delegate is accountable to the delegator to the extent he is delegated responsibility and authority. For example, if

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the line managers are not given the responsibility to train the operators, they cannot be held accountable for the operators' proficiency. While accountability always moves upward, responsibility and authority move downward in a hierarchy. A person can be accountable only to one superior for delegated responsibility and authority. Accountability is easy to establish if the standards and measures of performance are predetermined.

[MODEL QUESTION]

7. State the concept of 'Delegation of Authority'.

Answer:
The process by which authority passes from one managerial level to another is known as delegation. As organisations grow in size and complexity, no one person can perform all the tasks or exercise all the authority that is needed to accomplish goals.

Delegation of authority is not the same as division of work. As Henry Fayol says, 'Division of work permits reduction in the number of objects to which attention and effort must be directed and has been recognised as the best means of making use of individuals and of groups of people'.

Delegation of authority denotes the superior vesting decision-making power in his subordinate. No one can delegate an authority which he himself does not have.

Delegation is one of the most important skills a manager must possess. The overworked managers are often those who do not know how to delegate. For they lack the skill to get results through others. An individual can perform limited work in a day, all by himself. But through delegation—through dividing his load and sharing his responsibilities with others—he can accomplish much more. No manager and no organisation can run smoothly and effectively without delegation.

8. What is Organizational culture? What are the qualities needed for a great organizational culture?

[MODEL QUESTION]

Answer:

Organizational culture is the collection of values, expectations, and practices that guide and inform the actions of all team members. A great culture involves a positive traits that lead to improved performance, while a functional company culture brings out qualities that can hinder even the most successful organizations.

Qualities of a great organizational culture:

Every organization's culture is different, and it's important to retain what makes your company unique. However, the cultures of high-performing organizations consistently reflect certain qualities that you should seek to cultivate:

- **Alignment** comes when the company's objectives and its employees' motivations are all pulling in the same direction. Exceptional organizations work to build continuous alignment to their vision, purpose, and goals.
- **Appreciation** can take many forms: a public kudos, a note of thanks, or a promotion. A culture of appreciation is one in which all team members frequently provide recognition and thanks for the contributions of others.

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- Trust is vital to an organization. With a culture of trust, team members can express themselves and rely on others to have their back when they try something new.
- Performance is key, as great companies create a culture that means business.
- Resilience is a key quality in highly dynamic environments where change is continuous. A resilient culture will teach leaders to watch for and respond to change with ease.
- Teamwork encompasses collaboration, communication, and respect between team members. When everyone on the team supports each other, employee will get more done and feel happier while doing it.

9. State the factors affecting industrial relations.

Answer: Factors Affecting Industrial Relations

1. **Enlightened Management:** Enlightened management who recognize rights of workers and utilizes every opportunity to appreciate the sincere efforts of the employees.
2. **Strong and Responsible Trade Unions:** Strong and responsible trade unions who promote welfare of workers without harming interests of management. A responsible union is one, which exhorts workers to produce more, persuades management to give higher wages.
3. **Economic Satisfaction of Workers:** Only satisfied workers will think through their hearts instead through their mind.
4. **Social and Psychological Needs Satisfaction:** As man is a social animal, satisfaction of social and psychological needs encourage them for participation in management, suggestion schemes, grievance committee, etc. help to build good industrial relationships.
5. **On-The-Job Conditions:** Good lighting, safety conditions, provision of drinking water, management efforts to reduce noise/vibrations, shorter hours of work, flexible timings etc. gives the feeling to employees that management thinks for them which helps to improve industrial relations.
6. **Off-The-Job Conditions:** Off the job conditions in the form of conditions at home have influenced the industrial relations.
7. **Literacy of Workers:** Educated workers have greater sense of responsibility and are not misled by outside trade union leaders.

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10. Explain the Relationship between Morale and Productivity. [MODEL QUESTION]

Answer:

Morale	High Morale Low Productivity	High Morale High Productivity
Low	Low Morale Low Productivity	Low Morale High Productivity

Fig.: Morale and productivity

High Morale-High Productivity: High morale reflects a predisposition to be more productive if proper leadership is provided. This situation is likely to occur when employees are motivated to achieve high performance standards through financial and non financial rewards. Complete identity between individual and organisation goals can lead to this situation.

High Morale-Low Productivity: The situation arises when employees spend their time and energy in satisfying their personal objectives unrelated to the company's goals. Faulty machinery, lack of training, ineffective supervision and restrictive norms of informal groups can also lead to low productivity on the part of employees with high morale.

Low Morale-High Productivity: Low morale cannot result in high productivity for a long period. However, this situation can occur for a temporary period due to fear of loss of job, exceptionally good supervision and machine paced work in which only a part of workers' capabilities are used.

Low Morale-Low Productivity: This is a normal relationship. In the long run low morale is likely to result in low productivity. Low employee morale can hinder a business from achieving organization-wide goals. Thus, there is a complex relationship between morale and productivity. This is because morale is only one of the factors influencing productivity.

11. Discuss the contrast between system variables and system parameters. [MODEL QUESTION]

Answer:

System parameters is any characteristic that can help in defining or classifying a particular system (meaning an event, project, object, situation, etc.). That is, a parameter is an element of a system that is useful or critical, when identifying the system or when evaluating its performance, status, condition, etc.

Parameter has more specific meanings within various disciplines, including mathematics, computer programming, engineering, statistics, logic, linguistics, electronic musical composition.

In addition to its technical uses, there are also extended uses, especially in non-scientific contexts, where it is used to mean defining characteristics or boundaries, as in the phrases 'test parameters' or 'game play parameters'.

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System variables represent measurable value that can change, depending on conditions or on information in a system. **Variables** are used to store the changing data in one place where it's easy to be change in the context of a system. Variables represents the measurable traits that can change over the course of a scientific experiment. In all there are six basic variable types: dependent, independent, intervening, moderator, controlled and extraneous variables. In a system, we purposefully change one variable, which is the independent variable. But a variable that changes in direct response to the independent variable is the dependent variable. Say there's an experiment to test whether changing the position of an ice cube affects its ability to melt. The change in an ice cube's position represents the independent variable. The result of whether the ice cube melts or not is the dependent variable.

Long Answer Type Questions

1. Write down the basic roles and functions of management. [MODEL QUESTION]

Answer:

The basic roles and Function of Management are as follows:

a) **Planning:** The first function of management is planning. The planning works out in broad outlines the things that need to be done and the methods of doing them in an orderly manner. Planning for an objective is like the sketch of a building. Just as a building cannot be erected without a good sketch and other preparatory arrangement, so also a business cannot function properly without a plan. Planning, of course, includes some amount of forecasting and decision-making.

Forecasting is the process of assessing future. Decision making will diagnose the problem develop and evaluate alternatives and select the best course of action. Hence, every undertaking, be it a business, new business, Government or any other body should consider planning and forecasting as essential preliminaries to effect action. But to be successful, they must have the attributes of utility, flexibility, continuity and precision.

b) **Organising:** Once the plan is formulated then there is the need for organizing. This is nothing but a structure created to give successful form of all the combined efforts. In order to actualize the planning, the task of organizing is essential for co-coordinating or integrating the activities of the individuals of the concern. The work of organisation can be done in the following way -

1. In order to achieve the objectives according to plan, specification and fixation of required activities.
2. Combining those activities in a property.
3. Delegation of authority and responsibility at different level of the organization.

c) **Staffing:** In organizing, the manager seeks to establish position and decide the duties and responsibilities that belong to each one. But in case of staffing, the manager finds the right man for each job brings and trains the whole staff for this purpose and maintains congenial atmosphere for work. But while staffing, it should be remembered that staffing

cannot be done once for all, because the member of staff may change due to leaving, retiring, dying, etc.

d) **Commanding:** Planning and organizing are not sufficient to move the staff into action. For this command is necessary. Command is the starting signal or order to enable the staff member to move into operational activities. Command may be compared with a guard of a train. The train moves as soon as the guard shows the green signal. Similarly the staff member will start their activities as soon as they receive the command from the respective manager. But command or order should not be arbitrary. It should be the outcome of the requirements of the situation.

e) **Directing:** Direction is associated with command direction includes guidance and supervision of work of the subordinate. Direction is a continuous process and involves making decision, and giving necessary instruction for work performance. For effectiveness, the direction must be praised and clear possible and acceptable, received and thoroughly understood, respected and obeyed. Management should not issue such type of direction or orders which cannot or will not be obeyed.

f) **Motivating:** Motivation is a psychological act that helps the workers to do more work. It psychological aspect since it is linked to mental state. Motivation is the actuating force, which inspires a worker to put his best in accomplishment of the task. Management is the art of getting work done form workers to achieve the objectives of the organisation. Collective efforts are necessary to realize productivity of operation, which is key to growth and prosperity. And the collective efforts of the workers in turn depend upon "capability to work".

Capability to work is fully dependent on workers physical attributes, mental outlook and technical skill. On the other hand desire to work is dependent on how much workers are motivated. Thus, healthy and motivated work force is necessary to achieve goals of the business.

g) **Controlling:** The work of planning, organisation, command, direction and motivation if carried into effect smoothly and properly, leaves nothing to be desired for the accomplishment of the objectives. But mistake, misunderstanding, friction, loss and lack of efforts are not of uncommon occurrence in business affairs. Moreover, the plan may be found defective, organisation unsound, command and direction lacking in force and sincerity, motivation ineffective and co-ordination loose. In order to checks and remedy for all these loopholes, there is need for control.

Control consists in verifying whether everything occurs in conformity with the plan adopted, the instruction issued and the principles established. It has for its object to point out weakness and errors in order to rectify them and prevent occurrence. Control is like examining student. Student requires periodical examinations by which we can assess their performance. These examinations are necessary in spite of their regular attendance and adequate attention to their studies, to check actual performance against agreed standard.

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Similarly, control is necessary to see that everything is done according to the rules laid down and instructions given and that actual performance corresponds with the planned course of action. The check will not only ensure adequate progress and satisfactory performance, but will also contribute greatly to possible future needs.

b) Coordinating: In a large organisation, the number of workers and volume of work is large. The jobs of different workers need to be harmonized. This task is performed with the help of co-ordination.

2. Mention the basic steps in the formation of an organization. [MODEL QUESTION]

Answer:
In order to form a company, the promoters are needed. According to Companies Act, 1956 at least two persons required for private limited company and seven persons required for public limited company. For formation of a company, the following step should be considered.

Preliminary Planning: In the first stage, the promoter with the expert knowledge discovers an idea of a new project and prepares a draft planning about the proposed business.

Preliminary Investigation: The promoter is to require preparing a draft account as regards estimated income and expenditure of the proposed business. If the proposal is profitable, the promoter will proceed for the next step i.e., searches for capital, labour, raw materials, etc. If required, promoter can take advice from different experts. He will then prepare a draft plan on the basis of information received from enquiry in respect of different matters. This draft plan on the basis of information received from enquiry in respect of different matters. This draft plan shall mention the amount of Authorised Capital, Working Capital and Capital Budgeting Decision.

Assembling Promoters: After preparation of planning the promoters assemble to make discussion and contact. A board of promoters is constituted with adequate number of entrepreneurs who desirous of making capital investment and participating actively in promotion. This entrepreneur would sign on the documents needed for incorporation.

Procurement of Industrial License: As per provisions of the Industrial Development and Regulation Act, 1951, Industrial license must be obtained from the Govt. Department.

Preparation of Different Documents: In accordance with the provisions of the companies Act, 1956, every company has to submit different documents along with the requisite fees for registration.

The documents are as follow:

- i) Memorandum of association
- ii) Article of Association.
- iii) Consent from the Directors to act as a director.
- iv) Letter of consent from Directors as regards qualifying shares.
- v) Address of the registered office, etc.

Obtaining Certificate of Incorporation: After submitting the necessary documents along with prescribed fees to the Registrar of Companies, the Registrar will look over the

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documents thoroughly. If he satisfied, he would incorporate the name of the company and issue a certificate to it. This certificate is known as certificate of incorporation.

Preparation of Prospectus: After incorporation, a document is circulated for inviting the public to subscribe for capital and loan. It is known as prospectus. It is not obligatory to circulate the prospectus. If the prospectus is not circulated then a statement in lieu of prospectus to be submitted to the Registrar containing in writing the different matter with conditions relating to the issue of shares to the public.

Allotment of Shares
Concerned with the allotment of shares on the basis of prospectus issued, people apply for share. Allotment of shares is made to them who have submitted the application.

Certificate of Commencement of Business: Within a month after the allotment of shares, the secretary or director so authorised would apply on behalf of the company, to the registrar to the effect that minimum subscription has been collected and other necessary conditions have been complied. Then the Registrar will issue a certificate of commencement of business.

[MODEL QUESTION]

3. a) Define the concept of industrial relation.

[MODEL QUESTION]

b) State the factors affecting industrial relations.

c) What are the causes of industrial dispute? State the steps that have been taken by the Government to prevent industrial disputes.

Answer:

a) Industrial relations, also called "Labour-management relations" or "Employer-employee relations", represent the relationships that exist in an industrial organization between the employer and employees as between employees and employees. Poor industrial relations cause industrial disputes, which reduces productivity of the concern. The employee also suffer by way of loss of wages and salaries. Society also suffers due to higher prices and shortage of goods and services. A healthy industrial relations depends on Employer, Employee, Government, trade union and society.

b) Factors Affecting Industrial Relations

1. **Enlightened Management:** Enlightened management who recognize rights of workers and utilizes every opportunity to appreciate the sincere efforts of the employees.

2. **Strong and Responsible Trade Unions:** Strong and responsible trade unions who promote welfare of workers without harming interests of management. A responsible union is one, which exhorts workers to produce more, persuades management to give higher wages.

3. **Economic Satisfactions of Workers:** Only satisfied workers will think through their hearts instead through their mind.

4. **Social and Psychological Needs Satisfaction:** As man is a social animal, satisfaction of social and psychological needs encourage them for participation in management, suggestion schemes, grievance committee, etc. help to build good industrial relationships.

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5. **On-The-Job Conditions:** Good lighting, safety conditions, provision of drinking water, management efforts to reduce noise/vibrations, shorter hours of work, flexible timings etc. gives the feeling to employees that management thinks for them which helps to improve industrial relations.
6. **Off-The-Job Conditions:** Off the job conditions in the form of conditions at home have influenced the industrial relations.
7. **Literacy of Workers:** Educated workers have greater sense of responsibility and are not misled by outside trade union leaders.

c) Causes of Industrial Disputes

1) Economic Causes:

Industrial disputes relate to economic causes includes –

- a) Demand for higher wages.
- b) Demand for higher dearness allowance.
- c) Demand for share in the profits of the Company.
- d) Demand for better working conditions.
- e) Rationalization and automation in Industry
- f) Demand for facilities such as medical, education, housing etc.

2) Managerial Causes:

It includes the followings –

- a) Attitude of employers' towards labour in respect of (i) not to recognize the trade unions (ii) recognize the rival union (iii) not to follow the labour policy.
- b) Defection recruitment policy includes –
 - i) Hire and Fire Policy, (ii) Recruitment of Casuals, (iii) Wrong transfer and promotion policies (iv) not making worker permanent for long.
- c) Delays in labour agreement.
- d) Incorrect interpretation of terms of agreement.
- e) Inefficient leadership.
- f) Layoff and retrenchment.

3) Other Causes:

It includes -

- i) Irresponsible trade union.
- ii) Political affiliation.

Steps Taken by Government to Prevent Industrial Disputes

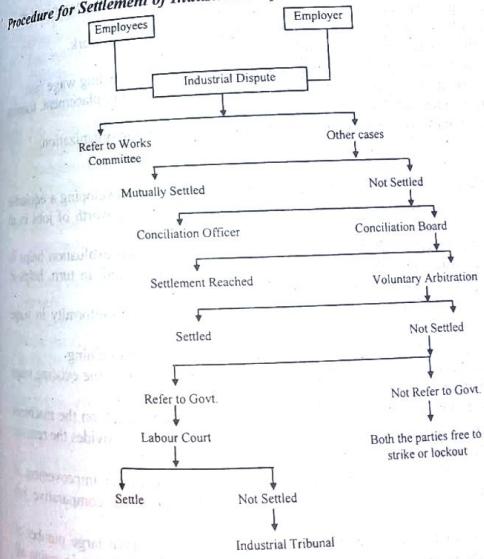
- The Government of India has taken following measures to prevent industrial disputes:
- a) Wages Boards have been set up by the Government of India for various industries such as jute, cotton, textile, sugar, cement iron & steel etc., whose main function is to fix wages in the respective industries.
 - b) The payment of Bonus Act 1965, which was introduced in the year 1965 provides for payment of minimum bonus at 8.33% of annual income for employees drawing monthly salary of Rs. 15000 or less.

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- c) The Industrial Employment (standing Order) Act, 1946 requires each employer to make their standing orders covering conditions of employment and get them certified from the certifying officer and make them known to all workers.
- d) Works committee, under the Industrial Dispute Act, 1947, every industrial unit employing 100 (one hundred) or more workers is required to set up a work committee consisting of representatives of employer and employees, to maintain a good relation between employer and employee.
- e) Joint Management Councils were suggested by the Government in its industrial resolution 1956 to initiate the process of labour participation in management but unfortunately the measure has not found much roots.
- f) National Arbitration Promotion Board set up in 1967, comprising representatives of employers' and employees' organizations, public undertakings and central and state government to promote voluntary arbitration to settle industrial disputes. Industrial disputes referred to voluntary arbitration if conciliation efforts fail.

Procedure for Settlement of Industrial Disputes



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POPULAR PUBLICATIONS

4. a) What is Job evaluation?
 b) State the importance of it.
 c) Discuss the advantages and limitations of Job evaluation.

Answer:
 a) Job evaluation is the rating of jobs in an organization. This is the process of establishing the value of jobs. It attempts to compare the relative intrinsic value of jobs within an organization.
 According to International Labour office "Job evaluation is an attempt to determine and compare the demands which the normal performance of a particular job makes on normal workers, without taking into account the individual abilities or performance of the workers concerned."

b) The importance of job evaluation are as follows –

- a) Provide a standard procedure for determining the relative worth of each job in a plant.
 - b) Determine equitable wage differentials between different jobs in the organization.
 - c) Eliminate wage inequalities.
 - d) Ensure that like wages are paid to all qualified employees for like work.
 - e) Form a basis for fixing incentives and different bonus plans.
 - f) Serve as a useful reference for settling individual grievances regarding wage rate.
 - g) Provide information for work organization, employees' selection, placement, training and numerous other similar problems.
 - h) Provide benchmark for career planning for the employees in the organization.
- c) **Advantages:**
1. Job evaluation being a logical process and technique help in developing a equitable and consistent wage and salary structure based on the relative worth of jobs in an organization.
 2. By eliminating wage differentials within the organization, job evaluation helps in minimizing conflict between labour unions and management and, in turn, helps in promoting harmonious relations between them.
 3. Job evaluation simplifies wage administration by establishing uniformity in wage rates.
 4. It provides a logical basis for wage negotiations and collective bargaining.
 5. In the case of new jobs, job evaluation facilitates spotting them into the existing wage and salary structure.
 6. In the modern times of mechanization, performance depends much on the machines than on the worker himself/herself. In such cases, job evaluation provides the realistic basis for determination of wages.
 7. The information generated by job evaluation may also be used for improvement of selection, transfer and promotion procedures on the basis of comparative job requirements.
 8. Job evaluation rates the job, not the workers. Organizations have large number of jobs with specializations. It is job evaluation here again which helps in rating all

[MODEL QUESTIONS]**INDUSTRIAL MANAGEMENT**

these jobs and determining the wages and salary and also removing ambiguity in them.

Limitations: In spite of many advantages, job evaluation suffers from the following drawbacks/limitations:

1. Job evaluation is susceptible because of human error and subjective judgment. While there is no standard list of factors to be considered for job evaluation, there are some factors that cannot be measured accurately.
2. There is a variation between wages fixed through job evaluation and market forces. Say Kerr and Fisher⁹, the jobs which tend to rate high as compared with the market are those of junior, nurse and typist, while craft rates are relatively low. Weaker groups are better served by an evaluation plan than by the market, the former places the emphasis not on force but on equity".
3. When job evaluation is applied for the first time in an organization, it creates doubts in the minds of workers whose jobs are evaluated and trade unions that it may do away with collective bargaining for fixing wage rates.
4. Job evaluation methods being lacking in scientific basis are often looked upon as suspicious about the efficacy of methods of job evaluation.
5. Job evaluation is a time-consuming process requiring specialized technical personnel to undertake it and, thus, is likely to be costly also.
6. Job evaluation is not found suitable for establishing the relative worth of the managerial jobs which are skill-oriented. But, these skills cannot be measured in quantitative terms.
7. Given the changes in job contents and work conditions, frequent evaluation of jobs is essential. This is not always so easy and simple.
8. Job evaluation leads to frequent and substantial changes in wage and salary structures. This, in turn, creates financial burden on organization.

[MODEL QUESTION]

5. Briefly explain the term 'Span of Management'.

Answer:

Span of Management

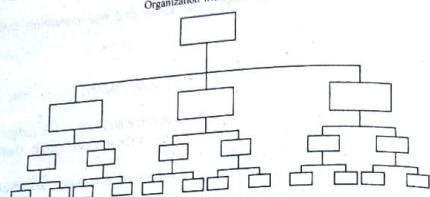
While the purpose of organizing is to make human cooperation effective, the reason for levels of organization is the limitations of the span of management. In other words, organization levels exist because there is a limit to the number of persons a manager can supervise effectively, even though this limit varies depending on situations. The relationships between the span of management and the organizational levels are shown in the following figure. A wide span of management is associated with few organizational levels, a narrow span, with many levels.

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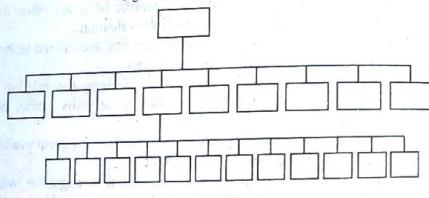
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Organization with narrow spans



Organization with wide spans



Advantage

- Close supervision
- Close control
- Fast communication between subordinates and superiors

Disadvantage

- Superiors tend to get too involved in subordinates' work
- Many levels of management
- High costs due to many levels
- Excessive distance between lowest level and top level

Advantage

- Superiors are forced to delegate
- Clear policies must be made
- Subordinates must be carefully selected

Disadvantage

- Tendency of overloaded superiors to become decision bottlenecks
- Danger of superior's loss of control
- Requires exceptional quality of managers

6. Explain the factors affecting employee morale.

[MODEL QUESTION]

Discuss how to overcome these in an organizational context.

Answer:

Employee morale is defined as the attitude, satisfaction and overall outlook of employees during their association with an organization or a business. An employee that is satisfied and motivated at workplace usually tend to have a higher morale than their counterparts. Employee engagement and employee satisfaction play an important role for employees to be happy in their workplace.

On the contrary, employees who are not happy in their workplace, who constantly complain and crib about the various attributes in an organization, like employee policies, workplace culture, facilities at work etc. tend to have a low employee morale.

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This is quite evident in their behavior. Employee morale is a complex concept because it involves a lot of factors that affect their morale. Employee morale is a complex phenomenon and depends on various factors. Here is the different criterion that affects employee morale:

1. Organization Itself: While it may sound surprising, but the organization itself is one of the biggest and most important factors that affect employee morale. An organization influences an employee's attitude towards his/her work. The reputation of an organization can certainly build up for better or worse, their attitude towards it.

2. Type of work: The nature of work an employee is performing at his/her workplace also is greatly responsible to determine the morale. If the employee is expected to perform the same task day in and out, there is going to boredom associated with it sooner or later. It can make situations worse for an employee. Unorganized organization structure also affects employees, if the employee feels that he/she is just a cog machine in a factory line, instead of a real person, this too may adversely affect their morale.

3. Personal attributes: Mental and physical health play an important role in determining employee morale. If the employee is not physically or mentally fit, this can be a potential obstacle to their progress and learning at their workplace. There are also other important factors that concern their progress and in turn their morale: age, education qualification, years of experience, occupational levels, reward perception, and similar factors.

4. Supervision and feedback: The level of supervision received by an employee is a tremendous factor that affects the morale. If the employees feel they have no direction or don't understand the organizational goals and commitments, then it is the job of the superiors and the leadership in the organization to get them on the same page. But there should not be too much interference too if the employees are given the freedom to work their morale will be high.

5. Work-Life balance: Most organizations fail to recognize the importance of a healthy work-life balance. It is important that the employees have some activities to relax while they are at work. It's not just about the foosball culture or an inventory stuffed with food. It is important that proper guidance and counseling is given to the employees whenever needed.

Here are the 4 simple ways of boosting employee morale in your workplace as mentioned by HR leaders across the globe:

1. Streamline work based on skills: It is important for the Human Resources to recruit and assign people based on their skillset. You cannot hire a lawyer and expect him/her to carry out tasks that you would expect an engineer to do. Allowing people to work based on their competency is a win-win situation for both employees and employers. Talent management is complex, yet necessary. If you cannot manage your employees and assign them tasks that they are hired to carry out then it's time to rethink your strategies because clearly, they will not yield the expected results. Therefore, make sure you invest in a competent human resources team, so the talent that is acquired performs well and stays happy.

2. Train them well for professional development: Most organizations fail to understand the importance of training their staff. Be it employee onboarding or any other formal

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training process, employees should be well-equipped to perform their tasks at work and achieve their goals. There should be a budget assigned at the start of the financial year that facilitates the training and development program. These training will help employees sharpen their skills, which will not only benefit them but also the organization. A well organized and self-sufficient workforce is every organization's dream, so pay for these courses that ignite imagination and spark curiosity, build confidence and leads to a high morale workforce.

3. Recognize and reward employees: Employee recognition and reward keeps your workforce motivated. When, as a leader, you create an environment where good work is appreciated, employees feel empowered and take a personal interest in the tasks they are assigned to them.

The purpose of employee recognition should be to reinforce what an organization wants an employee to do more. When an employee performs well to make sure to applaud his/her hard work and achievements. This will bring confidence to them to align their personal goals with that of the organization's goals.

4. Be open to feedback: Many organizations today, promote the open door policy, where an employee is free to express what they feel to their superiors or their reporting authority because they are open to feedback. If your employees know their voice is being heard and they are considered as an integral part of the organization, this will reflect in their confidence.

If the employees feel they cannot share information with you, there are greater chances that the information will never be conveyed to you rather will just make rounds within the team and you will be alienated from whatever is happening in your own team. Instead be receptive to feedback, transparency is the need of the hour for most organizations and so it should be.

Finally, employee morale is not just the employee's responsibility or attitude. It is a collective responsibility of the employees and the organization to provide a conducive working environment and a workplace culture that exudes positivity and goodwill. Work culture is because of the employees and they should know the importance of values and morale. To achieve the best, it is important to first be the best. Employee morale is vital to organization culture- a positive collective attitude will create a positive working environment for everyone. If your organization has a poor morale or a culture of suffering then there is a possibility that in your organization employees have a low or negative morale that can adversely affect the productivity of the organization. It can most certainly lead to greater employee attrition, just to begin with.

7. Discuss behavior of systems in industrial context.

Answer:

Systems have a number of behavioural traits. Knowledge of these greatly inform the business design process, enabling us to understand and predict the behaviour of the system over time; particularly how to affect change and the likely effects of any interventions – both desirable and undesirable.

- Emergent Properties
- Simple and Complex Systems

[MODEL QUESTION]

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- Stability and Leverage
- Side Effects
- Feedback Loops
- Cause and Effect
- Open and Closed Systems
- Limiting Complexity
- System Paradoxes

Emergent Properties

Systems are more than the sum of their parts. Systems function as a whole, so they have properties above and beyond the properties of their parts, called 'Emergent Properties'. If you take the system apart, you will not find its essential properties. These only arise when the system is operating.

Simple and Complex Systems

A system maintains itself through the interaction of its parts. It is the relationship between these parts that is important, rather than the number or size of the parts. These relationships, and therefore the systems, can be simple or dynamically complex. Dynamic complexity is where the elements can relate to each other in many different ways.

Stability and Leverage

Complex systems are bound together by many links, so they tend to be very stable. A potential downside is their resistance to change. In the case of our planet, this is no bad thing, and let's hope the resistance is greater than current projections would indicate. But for organisations, this lack of flexibility can be a major problem. New business practices are often resisted. People are comfortable with the old ways of doing things. This is not the people being difficult, it is the system that they are in and are part of, resisting the change.

When systems do change they tend to do so in a dramatic and rapid manner. There is a threshold beyond which a system will suddenly change or break down – referred to as a 'Tipping Point' – a major area of concern in relation to climatic change. Systems can also suddenly change if you find the right combination of actions. This is known as the 'Principle of Leverage'.

Complex systems are not always continuous in their behaviour. System behaviour is described as continuous when it behaves predictably through its range of states. Discontinuous system behaviour is when something unexpected happens under the right set of circumstances. This is a very useful feature. If you know where and how to intervene, small interventions can deliver large benefits.

To apply the concept of Leverage, ask the simple question "What stops the change? Look at the connections that hold the part of the system you want to change in place. Cut or weaken these and making the change becomes much easier."

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Some parts of the system are more critical than others – they exercise a higher degree of control. As a general rule, the higher degree of control a part of a system has, the more pervasive and wide-ranging the effects of any change in that part will be.

Side Effects

When you change one part of a system, this change will ripple through the system, creating side-effects. These may be desirable or undesirable. Fortunately, if you truly understand your system, you can begin to predict them and design your change to maximise the desirable side-effects, whilst minimising the undesirable.

Feedback Loops

As all parts of a system are connected directly or indirectly, a change in one will affect all the other parts; and there will be a subsequent response in the original source of the change. This is referred to as feedback. Fortunately, all systems, however complex, consist of just two types of feedback:

Reinforcing feedback – when changes in the whole system feedback to amplify the original change.

Balancing feedback – when changes in the whole system feedback to oppose the original change and dampen its effect.

A reinforcing feedback loop drives a system in the direction it is going. It may lead to growth or decline, depending on the starting conditions. It may be favourable or unfavourable. It can create vicious circles as well as virtuous ones. Reinforcing feedback, if unchecked, can lead to exponential change, instability and destruction. The increase in greenhouse gases in our atmosphere is believed to be one such example of this, with potential destructive consequences for humankind.

A balancing feedback loop restricts, limits or opposes the initial change. It keeps a system stable, counter-balancing the effects of reinforcing feedback. It achieves this by acting to reduce the difference between where a system is and where it 'should' be. Whilst there is a difference between the present state of the system and its desired state, balancing feedback will move the system in the direction of the desired state. The closer the system is to the desired state, the smaller the difference represented by the feedback, and so the less the system moves.

A system needs a way of measuring, otherwise it could not tell the difference between where it is and where it should be. It needs to measure accurately. If it does not then it can trigger feedback loops where none are needed. Secondly, the measuring system needs to measure at the right level of precision for the system to work.

Most of the time, feedback gives chains of cause and effect. Each action influences what follows. Cause and effect goes in circles; and what was the cause from one point of view becomes the effect from the other.

Feed-forward describes a slightly different effect. It comes from our ability to anticipate the future. An anticipated effect in the future triggers the cause in the present, which would otherwise not have happened. Feed-forward creates self-fulfilling, or self-defeating prophecies.

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There is frequently a time delay between cause and effect. We will often not see the result of a change immediately. The more dynamically complex the system, the longer the feedback takes to travel around the network of connections. The time the feedback takes to go through the system is referred to as its 'memory'.

Cause and Effect

When considering what causes a particular effect, we tend to generate a list of factors and weight these in terms of importance. This is sometimes referred to as 'laundry list thinking'.

This approach assumes a linear relationship between cause and effect, with each factor having a fixed relative importance. If only life was that simple. Unfortunately, causes are more often dynamic, rather than static. The relative importance of any one factor may change over time, depending on the feedback loops that exist. It is better to think in terms of influencing factors, rather than causes. This is an important point to remember next time you find yourself using an Ishikawa or fishbone diagram, as part of a quality improvement initiative.

Systems Thinking highlights three fallacies surrounding how we traditionally view questions of cause and effect:

Cause and Effect are separate, and the cause precedes the effect. Feedback tells us that the effect of a cause can be the cause of an effect. Does the shortage cause the hoarding, or the hoarding cause the shortage? Which one comes first depends on where you start;

Effect follows cause closely in time and space. This is a common expectation. But in systems there is always a delay and the effect may appear in a completely different part of the system. This means that when we are examining cause and effect chains, we need to extend our time horizon and focus. If you see a repeated pattern, look for the cause in the pattern, not the different circumstances or explanations for each event. Repetition is a clue that the cause lies within the underlying structure of the system;

The effect is proportional to the cause. This may be true for physical objects, but it is not necessarily the case for systems. Some actions may lead to big responses, or no response at all. Systems have thresholds. Only if the threshold is reached do you get a response.

Open and Closed Systems

Conventional physics deals with closed systems, those that can be considered isolated from their environment. In a closed system, the final state is completely determined by the initial conditions – a thermostat is an example of a closed system.

Social and living systems are open systems – they maintain themselves from moment to moment, by taking in and giving out to the surrounding environment. They change constantly, just to stay the same.

Open systems are extremely sensitive to their starting conditions. This is what makes them so unpredictable. A very small difference in starting conditions can lead to a very different result, under exactly the same stimulus. This is the starting point for chaos theory.

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theory and the study of highly complex systems. Fortunately, business organisations are complex, but not that complex!

Limiting Complexity

There are two kinds of complexity: inherent and apparent. Inherent complexity is the real thing. The system is so complex, the feedback loops form such a tangle, that their study is a task best left to chaos theorists and their super computers. Fortunately, business organisations do not fall into this category.

Apparent complexity looks complicated, but there is order to be found within. Aspects of an organisation, or problem, can seem very complex and unfathomable, but as a systems thinker we need to be looking for patterns in this apparent complexity.

There are two ideas that help to limit complexity in a system. The wider you cast the net, the more complexity there will be. So rule one – establish useful boundaries.

The other idea is that complex systems have a strong tendency to revert to a stable state. Order seems to arise spontaneously in complex systems. These ordered states, or ‘attractors’, happen because of the way feedback is organised within the system.

Business organisations settle into stable states. Organisational change therefore involves first destabilising the system in its present state and then creating another attractor state. This is in effect what happened at Toyota in the 1950s; and started their journey towards becoming the leading car manufacturer that they are today, through the creation of the Toyota Production System (TPS).

System Paradoxes

Systems create some strange, seemingly illogical paradoxes. A good illustration of this is traffic congestion. The logical answer to traffic congestion is to add more roads. Unfortunately, very often it is not the road space that is the problem, but the number of junctions, or congestion points. More roads create more junctions. This is known as the ‘Brass paradox’. It has implications in many areas, including the flow of information in organisations – more is not necessarily better.

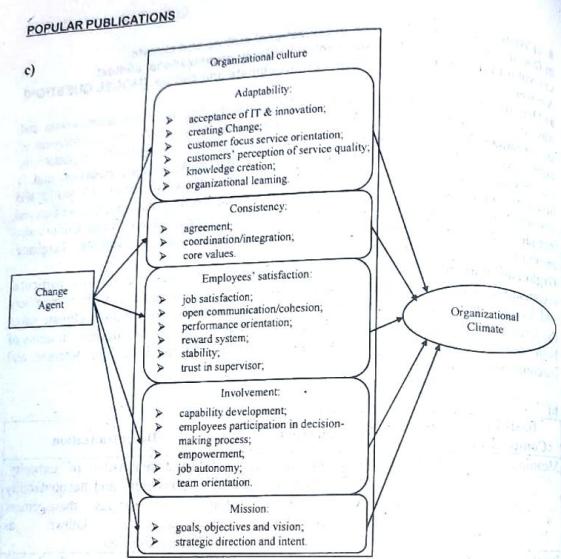
Adding new roads to a congested network can also create a second problem, exemplified by the M25 London orbital motorway. It was built to attract traffic away from London, providing a route around London, rather than through it. It worked well – too well. As well as attracting traffic from London, it created more traffic, creating more wear and tear, resulting in frequent roadworks, leading to a reinforcing feedback loop of more congestion.

The M25 is an example of a basic system pattern known as the ‘tragedy of the commons’. When there is an attractive common resource more and more people tend to use it. The more people who use it, the less attractive it becomes, until it loses its value to everyone. In the case of the M25, a balancing loop has set in. Certain sections of the road have become so congested that people avoid them and use other routes or forms of transport. A balance has been reached. Worth noting that the response has been to add more lanes. This is a good example of trying to solve a problem with the same thinking that created it.

- b) a) Write distinguish between organizational culture and climate.
 b) Discuss decentralization and centralization in organizational context
 c) Explain factors affecting organizational climate and culture. [MODEL QUESTION]

Answer:
 a) **Organizational culture** is defined as the underlying beliefs, assumptions, values and ways of interacting that contribute to the unique social and psychological environment of an organization. Organizational culture includes an organization's expectations, experiences, philosophy, as well as the values that guide member behavior, and is expressed in member self-image, inner workings, interactions with the outside world, and future expectations. Culture is based on shared attitudes, beliefs, customs, and written and unwritten rules that have been developed over time and are considered valid. Culture also includes the organization's vision, values, norms, systems, symbols, language, assumptions, beliefs, and habits.
 b) **Organisational climate** can be defined as a set of attributes specific to a particular organisation that may be induced from the way that organisation deals with its members and its environment. For the individual members within the organisation, climate takes the form of a set of attitudes and experiences which describe the organisation in terms of both static characteristics (such as degree of autonomy) and behaviour outcome and outcome-outcome contingencies.

b) Basis for Comparison	Centralization	Decentralization
Meaning	The retention of powers and authority with respect to planning and decisions, with the top management, is known as Centralization.	The dissemination of authority, responsibility and accountability to the various management levels, is known as Decentralization.
Involves	Systematic and consistent reservation of authority.	Systematic dispersal of authority.
Communication Flow	Vertical	Open and Free
Decision Making Advantage	Slow Proper coordination and Leadership	Comparatively faster Sharing of burden and responsibility
Power of decision making	Lies with the top management.	Multiple persons have the power of decision making.
Implemented when	Inadequate control over the organization	Considerable control over the organization
Best suited for	Small sized organization	Large sized organization



Adaptability Trait Adaptability is the ability of the company to scan the external environment and respond to the ever-changing needs of its customers and other stakeholders. Organisations hold a system of norms and beliefs that support the organisation's capacity to receive, interpret and translate signals from its environment into internal behaviour changes that increase its chances for survival and growth (Denison, 1990). Ironically, organizations that are well integrated are often the most difficult ones to change (Kanter, 1983). Adaptable organizations are driven by their customers, take risks and learn from their mistakes, and have capability and experience at creating change.

Consistency Trait Consistency is the organization's core values and the internal systems that support problem solving, efficiency, and effectiveness at every level and across organizational boundaries. Organizations also tend to be effective because they have "strong" cultures that are highly consistent, well coordinated, and well integrated.

Employee satisfaction, also known as job satisfaction, is the extent to which an individual is happy with their job and the role it plays in their life. "Employee satisfaction" describes employee perceptions of whether their desires are being met in the

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workplace. In many cases, perceptions of overall happiness are the main drivers of whether an employee feels satisfied. If an employee feels happy on an hourly basis throughout the day, they are likely to feel content with their job overall. Employees who are only happy for part of the day may feel happy as well if they have had negative experiences with other employers.

Involvement Trait Involvement is the degree to which individuals at all levels of the organization are engaged in pursuit of the mission and work in a collaborative manner to fulfil organizational objectives. This trait consists of building human capability, ownership and responsibility. Organisations empower their people, build their organizations around teams, and develop human capability at all levels.

Mission Trait Mission is the degree to which the organization and its members know where they are going, how they intend to get there, and how each individual can contribute to the organization's success. Successful organizations have a clear sense of purpose and direction that defines organizational goals and strategic objectives. They express the vision of how the organizations will look in the future.

9. How can we describe the concept of job satisfaction? Why is satisfaction of employees so important to an organization? Mention few factors which can affect the satisfaction of employees regarding their job. [MODEL QUESTION]

Answer:

Job satisfaction is the feeling and perception of a worker regarding his/her work and how he or she feels well in an organization. It indicates the extent of employees' positive or negative feelings towards their jobs and organizational behavior tried to improve it. Effective job satisfaction is a person's emotional feeling about the job as a whole. Cognitive job satisfaction is how satisfied employees feel concerning some aspect of their job, such as pay, hours, or benefits.

Job satisfaction has been linked to many variables, including productivity, absenteeism, turnover, etc. It is significant because a person's attitude and beliefs may affect his or her behavior.

Importance of job satisfaction are:

- Lower Turnover.
- Higher Productivity.
- Increased Customer Satisfaction.
- Employee Absenteeism.
- Helps to Earn Higher Revenues.
- Satisfied Employees Tend to Handle Pressure.
- Higher Job Satisfaction gives;
 - Higher productivity.
 - Less employee turnover.
 - Reduce absenteeism.
 - Reduces the level of unionization.
 - Reduces the number of accidents.
 - It helps to create a better working environment.

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CPM AND PERT**Multiple Choice Type Questions**

1. The proportion of profit to be retained for growth and to be distributed among shareholders is decided through
 a) Financing Decision
 b) Dividend Decision
 c) Investment Decision
 d) None of these

[MODEL QUESTION]

- Answer: (c)
2. Planning is
 a) Looking ahead
 b) Looking back
 c) Guiding people
 d) Delegation of authority.

[MODEL QUESTION]

[MODEL QUESTION]

3. "slack" refers to the difference between
 a) optimistic and pessimistic time
 b) early start time and early finished time
 c) late start time and early start time
 d) early start time and late finish time

[MODEL QUESTION]

- Answer: (c)
4. Which of the following is referred to as crash time?
 a) normal time allowed for a project activity
 b) time beyond which cost reduction is not possible
 c) time beyond which cost reduction is possible
 d) no float time

[MODEL QUESTION]

- Answer: (b)
5. The most befitting probability density function chosen for pert activity is the
 a) normal distribution
 b) binomial distribution
 c) poisson distribution
 d) beta distribution

[MODEL QUESTION]

[MODEL QUESTION]

- Answer: (d)
6. PERT method of project scheduling is suitable for
 a) construction of a chemical plant
 b) installation of a computerized system in an organization
 c) a spacecraft development project based on research
 d) turnkey project on BOT basis

[MODEL QUESTION]

[MODEL QUESTION]

- Answer: (c)
7. The Critical path has
 a) zero float
 b) longest activity duration
 c) both of these
 d) none of these

[MODEL QUESTION]

[MODEL QUESTION]

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8. A critical path network diagram does not
 a) calculate earned-value
 b) identify the particularly important activity
 c) calculate the duration of the whole project
 d) help determine the amount of float

Answer: (a)

9. Difference between PERT and CPM
 a) CPM takes less time than PERT
 b) PERT is probabilistic but CPM is not
 c) Crashing can be done in CPM but not in PERT
 d) all of these

Answer: (b)

10. For a critical activity, what is the relationship between total float, free float and independent float?
 a) Total float > Free float > independent float
 b) Total float ≥ Free float ≥ Independent float
 c) Total float = free float = independent float
 d) total float < free float < independent float

Answer: (b)

11. Project cost reduction can be achieved through
 a) value engineering
 b) line of balance
 c) feasibility study
 d) all of these

Answer: (a)

12. Dummy activity in a project network diagram represents
 a) logical relationship
 b) necessary time delay
 c) allocation of resources
 d) crashing of an activity

Answer: (a)

Short Answer Type Questions

1. Write down the terms CPM and PERT.

[MODEL QUESTION]

Answer:

CPM [Critical Path Method]:

In 1957, DuPont developed a project management method designed to address the challenge of shutting down chemical plants for maintenance and then restarting the plants once the maintenance had been completed. Given the complexity of the process, they developed the **Critical Path Method (CPM)** for managing such projects.

CPM provides the following benefits:

- Provides a graphical view of the project.
- Predicts the time required to complete the project.
- Shows which activities are critical to maintaining the schedule and which are not.

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CPM models the activities and events of a project as a network. Activities are depicted as nodes on the network and events that signify the beginning or ending of activities are depicted as arcs or lines between the nodes.

Steps in CPM Project Planning

1. Specify the individual activities.
2. Determine the sequence of those activities.
3. Draw a network diagram.
4. Estimate the completion time for each activity.
5. Identify the critical path (longest path through the network).
6. Update the CPM diagram as the project progresses.

PERT

The Program Evaluation and Review Technique (PERT) is a network model that allows for randomness in activity completion times. PERT was developed in the late 1950's for the U.S. Navy's Polaris project having thousands of contractors. It has the potential to reduce both the time and cost required to complete a project.

In a project, an activity is a task that must be performed and an event is a milestone marking the completion of one or more activities. Before an activity can begin, all of its predecessor activities must be completed. Project network models represent activities and milestones by arcs and nodes. PERT originally was an activity on arc network, in which the activities are represented on the lines and milestones on the nodes. Over time, some people began to use PERT as an activity on node network. For this discussion, we will use the original form of activity on arc.

2. Briefly describe the determination of project duration using CPM and PERT.
 [MODEL QUESTION]

Answer:

PERT [Program Evaluation & Review Technique]: It is generally used for those projects where time required to complete various activities are not known as *a priori*. It is probabilistic model & is primarily concerned for evaluation of time. It is event oriented.

CPM [Critical Path Analysis]: It is a commonly used for those projects which are repetitive in nature & where one has prior experience of handling similar projects. It is a deterministic model & places emphasis on time & cost for activities of a project.

Determination of time to complete each activity:

The CPM system of networks omits the probabilistic consideration and is based on a Single Time Estimate of the average time required to execute the activity. In PERT analysis, there is always a great deal of uncertainty associated with the activity durations of any project.

Therefore, the estimated time is better described by a probability distribution than by a single estimate. Three time estimates (*from beta probability distribution*) are made as follows:

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- 1) **The Optimistic Time Estimate (t_o):** Shortest possible time in which an activity can be completed in ideal conditions. No provisions are made for delays or setbacks while estimating this time.
 - 2) **The Most Likely Time (t_m):** It assumes that things go in normal way with few setbacks.
 - 3) **The Pessimistic Time (t_p):** The max. possible time if everything goes wrong & abnormal situations prevailed. However, major catastrophes such as earthquakes, labour troubles, etc. are not taken into account. The expected time (mean time) for each activity can be approximated using the weighted average i.e.

$$\text{Expected Time } (t_e) = (t_o + 4t_m + t_p)/6$$
- Forward Pass Computation:** It is the process of tracing the network from START to END. It gives the earliest start & finish times for each activity.
- Backward Pass Computation:** It is the process of tracing the network starting from LAST node & moving backward.

[MODEL QUESTION]

3. What are the utility of PERT Chart?

Answer:

1. PERT stands for Program Evaluation and Review Technique
2. A PERT chart is a project management tool used to schedule, organize, and coordinate tasks within a project
3. PERTs become very complex very quickly, so the key to usage is to plan and manage small chunks of work

In conclusion it is presented as:

WBS Charts aids the team to visualize the plan

- Reduces inconsistencies in the project plan
- Reduces duplicated tasks
- Intuitive
- PERT Charts reinforce sequencing (bi-directional)
- Locates orphan tasks
- Promotes fixing obvious missing predecessors and successors
- Identifies wrong owners & process groups
- Opportunities to shorten timelines

[MODEL QUESTION]

4. Distinguish between PERT and CPM.

Answer:

Project Evaluation and Review Technique (PERT):

PERT is appropriate technique which is used for the projects where the time required or needed to complete different activities are not known. PERT is majorly applied for scheduling, organization and integration of different tasks within a project. It provides the blueprint of project and is efficient technique for project evaluation.

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Critical Path Method (CPM):

CPM is a technique which is used for the projects where the time needed for completion of project is already known. It is majorly used for determining the approximate time within which a project can be completed. Critical path is the largest path in project management which always provide minimum time taken for completion of project

Difference between PERT and CPM:

PERT	CPM
1. PERT is that technique of project management which is used to manage uncertain (i.e., time is not known) activities of any project.	CPM is that technique of project management which is used to manage only certain (i.e., time is known) activities of any project.
2. It is event oriented technique which means that network is constructed on the basis of event.	It is activity oriented technique which means that network is constructed on the basis of activities.
3. It is a probability model.	It is a deterministic model.
4. It majorly focuses on time as meeting time target or estimation of percent completion is more important.	It majorly focuses on Time-cost trade off as minimizing cost is more important.
5. It is appropriate for high precision time estimation.	It is appropriate for reasonable time estimation.
6. It has non-repetitive nature of job.	It has repetitive nature of job.
7. There is no chance of crashing as there is no certainty of time.	There may be crashing because of certain time boundation.
8. It doesn't use any dummy activities.	It uses dummy activities for representing sequence of activities.
9. It is suitable for projects which required research and development.	It is suitable for construction projects.

5. In a network of project what does crashing and updating mean?

[MODEL QUESTION]

Answer:

Crashing an activity (Crashing the network): Reducing the time required to complete an activity (in hopes that this will reduce the completion time of the entire project) by assigning additional resources to that activity but reducing the duration time of the activities on the critical path may change the critical path. The main reason for which project crashing is chosen is precisely to speed up its conclusion. If the end date of the project needs to be anticipated, the crashing allows you to get the most compression of the planning with the least impact and the lowest cost

Network Updating: may be defined as any adjustment to the arrow diagram which becomes necessary owing to departure from the project schedule and laid down earlier. It is the process of incorporating in the network the changes which have occurred due to

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replanning and rescheduling. Updating can be undertaken at regular intervals depending upon the progress of the project. The frequency of updating is more in case of small projects as compared to large projects, because little problems here and there can easily delay a small project. Large projects also need updating but generally near their completion stage.

Long Answer Type Questions

i. a) State the uses of cost volume profit analysis.

[MODEL QUESTION]

Answer:

Cost volume profit analysis is a technique for studying the relationship between COST, Volume and Profit. Profit of an undertaking depend upon a large number of factors. But the most important of these factors are the COST of manufacturer, volume of sales and selling prices of the product. The CVP relationship is an important tools used for profit planning of a business.

Cost volume profit analysis can be used to answer the following quaries –

- 1) How much sales should be made to avoid losses?
- 2) How much should be the sales to earn desired profit?
- 3) What will be the effect of change in prices, costs and volume on profits?
- 4) Which product or product mix is most profitable?
- 5) Which product should manufacture or buy?

b) From the following information calculate

[MODEL QUESTION]

i) Profit-Volume Ratio

ii) Break-even point sales

iii) Sales required to earn a profit of Rs. 1,00,000.

Year	Sales	Profit
2009	4,00,000	60,000
2011	6,00,000	1,40,000

Answer:

$$i) P/V \text{ Ratio} = \frac{\text{Contribution Margin}}{\text{Contribution Margin} - \text{Fixed Cost}} \times 100 = \frac{80,000}{2,00,000} \times 100 = 40\%$$

ii) B.E.P. Sales

Fixed Cost

$$P/V \text{ Ratio} = \frac{P+F}{S}$$

$$\text{or, } F = S \times P/V \text{ Ratio} - P \\ = 4,00,000 \times \frac{40}{100} - 60,000 \\ = 1,60,000 - 60,000 = 1,00,000$$

$$\text{B.E.P. Sales} = \frac{F}{P/V \text{ Ratio}} = \frac{1,00,000}{40} = \frac{1,00,000 \times 100}{40} = 2,50,000$$

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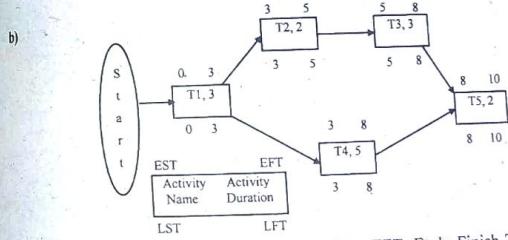
$$iii) \text{Sales to earn a Profit of Rs. 1,00,000/-} \\ \text{Required Sales} = \frac{F+P}{P/V \text{ Ratio}} = \frac{1,00,000 + 1,00,000}{40} = \frac{2,00,000 \times 100}{40} = 5,00,000$$

2. a) Explain when and why you will use PERT charts and when and why you will use Gantt charts while you are a project manager.
- b) Consider a software project with 5 activities T1 to T5. Duration of 5 activities in weeks are 3, 2, 3, 5, 2 respectively. T2 and T4 can start when T1 is complete. T3 can start when T2 is complete. T5 can start when both T3 and T4 are complete. Draw activity network for the project. When is the latest start date of the activity T3? What is the float of the activity T4? Which activities are on the critical path? Draw the Gantt chart also.

[MODEL QUESTION]

Answer:
a) One significant advantage of PERT charts is that all individual tasks and dependencies are shown

- 1) PERT stands for Project Evaluation and review Technique
- 2) PERT network produces probabilistic measures, where as Gantt only estimates.
- 3) A PERT chart displays the critical path for the overall project and the slack time
- 4) A Gantt chart offers a rapid overview
- 5) PERT and Gantt charts are not mutually exclusive techniques.



LFT: Latest Finish Time; LST: Latest Start Time; EFT: Early Finish Time; EST: Early Start Time

Latest Start date of T3: 5 days

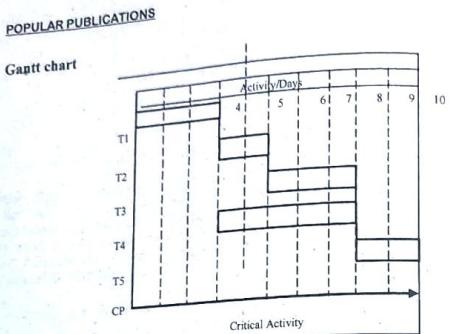
Float at T4 = LST-EST=3-3=0 days

The two critical paths of the project are:

1. Start-T1-T2-T3-T5 = 10 Days
2. Start-T1-T4-T5=10 Days

As both the paths takes 10 days, both are critical, so slack at any activity is zero and all activities are considered to be critical.

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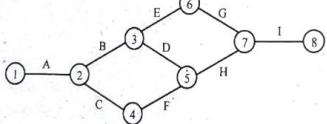
3. The following table shows the activities, sequences and the three time estimates

Activity		Time (Days)		
Immediate Predecessor		Optimistic (t ₀)	Most Likely (t _m)	Pessimistic (t _p)
A	...	14	16	16
B	A	15	17	25
C	A	14	18	22
D	B	15	20	25
E	B	10	18	26
F	C	8	9	16
G	E	4	8	12
H	D, F	11	15	19
I	G, H	16	17	18

- a) Draw the network diagram.
 b) Calculate the estimated time (t_e) and variance (σ^2) for all activities and find the critical path.
 c) How completion probability is estimated? [MODEL QUESTION]
 Answer:

[MODEL QUESTION]

Answer:



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a) Construction of Network Diagram
and Time Calculation

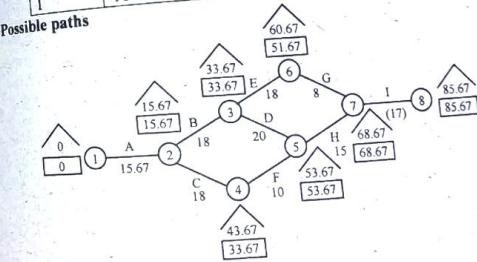
b) Estimated Time Calculation

$$t_e = \frac{(t_0 + 4t_m + t_p)}{6}$$

$$\left(t_p - t_0 \right)^2$$

t_0 = optimistic time
 t_m = most likely time
 t_p = pessimistic time

Activity	Time (Days)			Expected time (t_e)	Variance (σ^2)
	Optimistic (t_o)	Most likely (t_m)	Pessimistic (t_p)		
A	14	16	16	15.67	0.11
B	15	17	25	18	2.78
C	14	18	22	18	1.77
D	15	20	25	20	2.78
E	10	18	26	18	7.11
F	8	9	16	10	1.77
G	4	8	12	8	1.77
H	11	15	19	15	1.77
I	16	17	18	17	1.77



Forward Pass Calculation:

Earliest start time of Event (E_2) = Earliest finish time of E_1 + 1 (E_2) + Time required completion

= Earliest start

In the above case, $E_1 = 0 + 15.67 = 15.67$.

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If more than one activity merges in a cell, then,
For example,

$$E_3 = \max \left\{ \begin{array}{l} E_1 + t_{1-3} \\ E_4 + t_{4-3} \end{array} \right\}$$

$$= \max \left\{ \begin{array}{l} [33.67 + 20] \\ [33.67 + 10] \end{array} \right\} = \max \left\{ \begin{array}{l} 53.67 \\ 43.67 \end{array} \right\} = 53.67$$

Backward Pass Calculation:
Latest Finish time of Event 1 = (latest Finish time of Event 2)
- (time required to activity completion)

$$L_2 = L_1 - t_{1-2}$$

For example,

$$L_2 = L_1 - t_{1-2}$$

$$= (85.67 - 17) = 68.67$$

For more than one activity merge in a cell,

$$L_2 = \min \left\{ \begin{array}{l} L_6 - t_{3-6} \\ L_5 - t_{3-5} \end{array} \right\}$$

$$= \min \left\{ \begin{array}{l} [60.67 - 18] \\ [53.67 - 20] \end{array} \right\} = \min \{42.67 - 33.67\} = 33.67$$

Critical path: The sequence of critical activity in a network is called the critical path. If (i, j) is a critical activity then, total float for (i, j) ,

$$\text{i.e., } (TF)_j = (L_j - E_i) - t_{ij} = 0$$

In the above case, the critical path is indicated as

1—2—3—5—7—8

i.e., A—B—D—H—I

c) Variance of the Critical Path = $0.11 + 2.78 + 2.78 + 1.77 + 1.77 = 9.21$.

Optimum length of the Critical Path is 85.67 days.

Now, if the expected time of computes is given, then we can estimate the Standard Normal Distribute (SND)

$$= \frac{(Scheduled\ time - 85.67)}{\sqrt{\sigma^2}}$$

From that probability of completion is estimated from the normal distributor curve.

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4. Various activities of a small project and other relevant information have been shown in the table below

Activity	Most optimistic Time in days (t_o)	Most likely time in days (t_m)	Most pessimistic time in days (t_p)
1-2	4	8	12
2-3	1	4	7
2-4	8	12	16
3-5	3	5	7
4-5	0	0	0
4-6	3	6	9
5-7	3	6	9
5-8	4	6	8
7-9	4	8	12
8-9	2	5	8
9-10	4	10	16
6-10	4	6	8

Calculate:

- expected task times and variances
- earliest and latest times for each event
- draw the network and the critical path
- The probability of an event occurring at the proposed completion date if the original contract time of completion is 48 days.

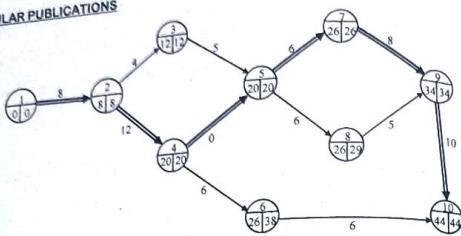
[MODEL QUESTION]

Answer:

Activity	t_o	t_m	t_p	Expected time $T_e = 1/6(t_p + 4t_m + t_o)$	Variance $\Omega^2 = (1/6(t_p - t_o)^2)$
1-2	4	8	12	8	1.78
2-3	1	4	7	4	1
2-4	8	12	16	12	1.78
3-5	3	5	7	5	0.44
4-5	0	0	0	0	0
4-6	3	6	9	6	1
5-7	3	6	9	6	0.44
5-8	4	6	8	6	1.78
7-9	4	8	12	8	1
8-9	2	5	8	5	4
9-10	4	10	16	10	0.44
6-10	4	6	8	6	

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It may be observed from the fig. that critical path 1-2-4-5-7-9-10

Expected length of the project is $T_e = 8 + 12 + 0 + 6 + 8 + 10 = 44$ days

Variance (Ω^2) = $1.78 + 1.78 + 0 + 1 + 1.78 + 4 = 10.34$

Therefore $\Omega = 3.216$

Probability that the project will be completed within 48 days is

$$P\{X \leq 48\} = P\{Z \leq (48 - 44)/3.216\}$$

$$= 0.5 + P\{0 \leq Z \leq 1.24\} = 0.5 + 0.3925 = 0.8925 \text{ Ans.}$$

5. A construction company is preparing a PERT network for laying the foundation of a new art museum. Given the following set of activities and their timelines (in days)

Activity	Predecessors	Optimistic time t_o	Pessimistic time t_p	Most likely time t_m
A	-	2	4	3
B	-	8	8	8
C	A	7	11	9
D	B	6	6	6
E	C	9	11	10
F	C	10	18	14
G	C,D	11	11	11
H	F,G	6	14	10
I	E	4	6	5
J	I	3	5	4
K	H	1	1	1

i) draw PERT network

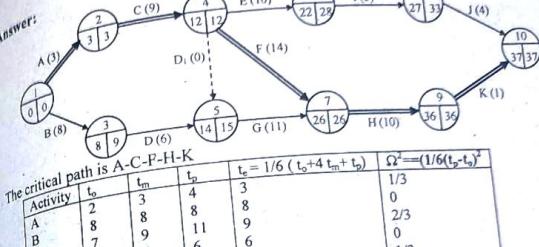
ii) compute activity slack and determine the critical path

iii) the contract specifies a Rs.5000 per day penalty for each day of the project extends beyond 37 days. What is the probability that the company will have to pay a maximum penalty of Rs.15000?

[MODEL QUESTION]

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Answer:



The critical path is A-C-P-H-K

Activity	t_o	t_m	t_p	$t_e = 1/6 (t_o + 4 t_m + t_p)$	$\Omega^2 = (1/6(t_p - t_o))^2$
A	2	3	4	3	1/3
B	8	8	8	8	0
C	7	9	11	9	0
D	6	6	6	6	1/3
E	9	10	11	10	4/3
F	10	14	18	14	0
G	11	11	11	11	4/3
H	6	10	14	10	1/3
I	4	5	6	5	1/3
J	3	4	5	4	0
K	1	1	1	1	0

The expected project length $T_e = 3 + 9 + 14 + 10 + 1 = 37$ days

$$s.d = \sqrt{(1/3)^2 + (2/3)^2 + (4/3)^2 + 0} = 2.024 \text{ days}$$

A penalty of Rs.15000 would mean that the project got delayed by 3 days beyond 37 days

Therefore, $P\{X \leq 40\} = P\{Z \leq (40 - 37)/2.024\} = P\{Z \leq 1.48\} = 0.93056 \text{ Ans.}$

Hence, there is a 93% probability that the company will have to pay a maximum penalty of Rs.15000.

6. A medium project has twelve distinct activities which are to be further analysed by using PERT. Following are some relevant information about the project

Activity	Predecessor	t_o	t_m	t_p
A	-	2	2	2
B	-	1	3	7
C	A	4	5	7
D	A	3	6	9
E	B	2	3	11
F	B	5	6	8
G	C,D	3	6	9
H	E	2	5	8
I	C,D	3	5	4
J	G,H	1	8	11
K	F	4	5	7
L	J,K	2	5	7

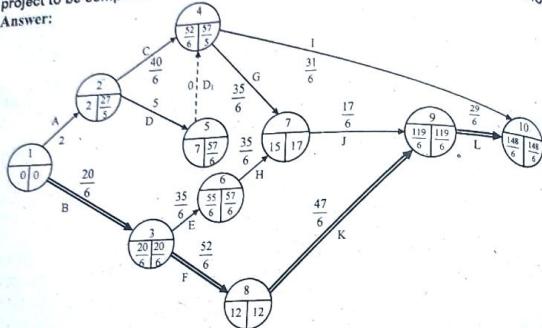
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i) Draw the PERT network ii) find the expected total float for each activity iii) determine average critical path iv) within how many days would you expect the project to be completed with 99% chance? [MODEL QUESTION]

Answer:



Activity	T _e	Ω^2	Earliest Start	Earliest Finish	Latest Start	Latest Finish	Total float
A (1-2)	2	0	0	2	15/6	27/6	15/6
B (1-3)	20/6	1	0	20/6	0	20/6	0
C (2-4)	40/6	16/36	2	52/6	27/6	67/6	15/6
D (2-5)	5	16/36	2	7	37/6	67/6	25/6
E (3-6)	35/6	49/6	20/6	55/6	32/6	67/6	2
F (3-8)	52/6	1	20/6	72/6	20/6	12	0
G (4-7)	35/6	25/36	52/6	87/6	67/6	17	15/6
H (6-7)	35/6	49/36	55/6	90/6	67/6	17	2
I (4-10)	31/6	25/36	52/6	83/6	117/6	148/6	65/6
J (7-9)	17/9	9/36	15	107/6	14	119/6	2
K (8-9)	47/6	49/36	12	119/6	12	119/6	0
L (9-10)	29/6	25/36	119/6	148/6	119/6	148/6	0

By observing the activities with zero float, we can say that critical path is 1-3-8-9-10 and critical activity are B,F,K AND L.

Expected time for completion of project = $20/6 + 52/6 + 47/6 + 29/6 = 148/6 = 24.66$
Variance = $1+1+49/36+25/36=146/36$

The expected time for completing the project with 99% of chance is

$$P\{Z<2.33\}=0.99$$

$$Z = [(Due date - Expected date of completion)/\Omega] = [(T-24.66) / \sqrt{(146/36)}]=2.33$$

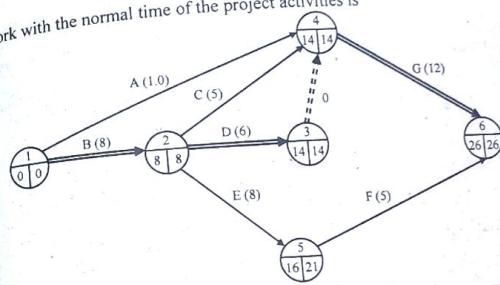
Hence $T = 24.66 + 2.01 \cdot 2.33 = 29.4$ days.

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7. The following table shows the details of a project

Activity	Predecessor	Normal time (wks)	Normal cost (Rs. 000)	Crash time (wks)	Crash cost (Rs. 000)
A	-	10	20	7	30
B	B	8	15	6	20
C	B	5	8	4	14
D	B	6	11	4	15
E	E	8	9	5	15
F	A,D,C	5	5	4	8
G	A,D,C	12	3	8	4

Indirect cost is Rs. 400 per day. Find the optimal duration and associated minimum cost.
Answer:
The network with the normal time of the project activities is



Critical path is 1-2-3-4-6 and normal project duration is 26wks
Hence, associated cost is Total cost = Total direct cost + Indirect cost for 26wks
 $= 71000+400*26*7 = \text{Rs. } 1,43,800$

Indirect cost - Rs. 400 per day or Rs. 2800 per week.
For finding the optimal duration, we will have to crash the project step by step using cost slope of each activity.

$$\text{Crashing cost per day} = [\text{crashing cost} - \text{normal cost}] / [\text{normal time} - \text{crashing time}]$$

For various activities crashing costs are:

Activity	A	B	C	D	E	F	G
cost/day (in Rs.000)	3.33	2.5	6	2	2	3	0.25

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Crashing schedule for the project is:						
Project duration (wks)	Crashing activity & weeks	Normal (a)	Direct cost (Rs.) (b)	Total (a+b)	Indirect cost (Rs.)	Total cost (Rs.)
26	4-6(4)	71,000	$4*250=1000$	71,000	$26*2800=72,800$	1,43,800
22	2-3(1)	71,000	$4*250=1000$	72,000	$22*2800=61,600$	1,33,600
21	1-2(2)	71,000	$1000+2000=3000$	74,000	$21*2800=58,800$	1,32,800
19	2-4(1)	71,000	$3000+5000=8000$	79,000	$19*2800=53,200$	1,32,200
18	2-3(1) 2-5(1)	71,000	$8000+10,000=18,000$	89,000	$18*2800=50,400$	1,39,400

Hence we can observe that the minimum cost associated with the optimal project duration of 19wks is Rs.1,32,200. Ans.

8. The normal and crash duration (days) and cost (Rs.) supervision with direct cost for various activities involved in a repair work is given below.

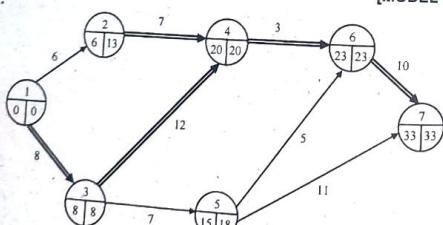
Activity	Normal time	Crash time	Normal cost	Crash cost	Expediting cost/day
1-2	6	2	4000	12000	2000
1-3	8	3	3000	6000	600
2-4	7	4	2800	4000	400
3-4	12	8	3000	11000	500
4-6	3	1	10000	13000	1500
5-6	5	2	4900	7000	700
3-5	7	3	1800	5000	800
5-7	11	5	6600	12000	900
6-7	10	6	4000	8400	1100
total			46100	78400	

The indirect cost of the project is Rs. 2000 per day.

- i) draw a network diagram for these activities indicating the earliest start and latest finishing time at each node?
- ii) what is the normal and ultimate crash duration of the project ?
- iii) considering the effect of direct and indirect cost, find the optimum project cost.

Answer:

[MODEL QUESTION]



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The critical path is 1—3—4—6—7. Normal duration is 33days
Normal cost of completing the project within 33days
= direct cost + indirect cost = Rs. (46100+33*2000) = Rs. 112100

Crashing stage	Options	Possible crash (days)	Cost (₹)	Decision	
				Project duration	Critical path (s)
First	(i) 1-3	5	600	30	1-3-4-6-7
	(ii) 3-4	4	500		1-3-5-6-7
	(iii) 4-6	2	1,500		1-2-4-6-7
	(iv) 6-7	4	1,100		1-3-5-6-7
Second	(i) 1-3	5	600	Crash 1-3 by 4 days	1-3-4-6-7
	(ii) 2-4, 1-3	1	1,000	Crash 2-4, 1-3 by 1 day	1-3-4-6-7
Third	(i) 6-7	4	1,100	Crash 6-7 by 4 days	1-2-4-6-7
	(ii) 2-4, 3-4, 3-5	2	1,700	Crash 2-4, 3-4, 3-5 by 1 day	1-3-4-6-7
	(iii) 3-5, 4-6	2	2,300		1-3-5-6-7
Fourth	(i) 4-6	2	3,100		1-2-4-6-7
	(ii) 5-6, 4-6	2	3,100		1-3-4-6-7
	(iii) 3-5, 4-6	2	2,300	Crash 3-5, 4-6 by 2 days	1-3-5-6-7
	(iv) 5-7	2	3,100		1-2-4-6-7
Fifth	(i) 5-6, 4-6	2	3,100		1-3-5-6-7
	(ii) 3-5, 4-6	2	2,300		1-2-4-6-7
	(iii) 5-7, 5-6	2	3,100		1-3-5-7
Sixth	(i) 5-6, 4-6	2	3,100		1-3-5-6-7
	(ii) 3-5, 4-6	2	2,300		1-2-4-6-7
	(iii) 5-7	2	3,100		1-3-5-7

Project Duration (days)	Direct cost			Indirect cost	Total cost
	Normal	Crashing	Total		
33	46100	0	46100	$33*2000=66000$	112100
30	46100	1500	47600	60000	107600
26	46100	3900	50000	52000	102000
25	46100	4900	51000	5000	101000
21	46100	9300	55400	42000	97400
20	46100	11000	57100	40000	97100
18	46100	15600	61700	36000	97700

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Since the crashing cost can be further reduced till 20th day beyond which the cost will rise, the ultimate duration of the project is 20 days and the optimal project cost is Rs. 97100.

4. Write short notes on the following:

- a) Gant Chart
- b) PERT and CPM

Answer:

a) **Gant Chart:**

A Gant chart, similar to a bar chart, lists tasks down the left side and elapsed time is marked off across the top. This graphical depiction of the schedule will track the planning and coordination of work that must be completed to produce the defined product. Major task groupings are entered as general areas of work (summary tasks), and then broken down into bodies of work that can be completed independently. Project detail can be added to the smallest increment of definable tasks. As work is completed, the project manager receives updates from each person or resource working, and the plan is updated frequently and then progress is measured against the plan. The Gant chart reflects the entire schedule of work which might include duration, resources, milestones, etc. A Gant chart can also provide performance and efficiency information that directly impacts reward systems of monetary compensation and promotion.

Gant chart information

The Gant chart is versatile and timeless for use in every kind of project from building a house to constructing the tallest building and overhauling a computer system. The time required to build detail into the original plan and keep the plan updated throughout the project will provide all the information necessary to keep the project on track.

b) **PERT and CPM:**

PERT (Project Evaluation and Review Technique)

- Another derivative of the GANTT chart
- Multiple time estimates were used for each activity that allowed for variation in activity times
- Activity times are assumed to be random, with assumed probability distribution ("probabilistic")
- Activities are represented by arrowed lines between the nodes or circles.

CPM (Critical Path Method)

- Tool to analyze project and determine duration, based on identification of "critical path" through an activity network.

MATERIALS MANAGEMENT**Multiple Choice Type Questions**

1. Which method of analysis is used for determining criticality of items?
 a) VED Analysis b) ABC analysis
 c) FSN analysis d) A combination of FSN and ABC analysis
 Answer: (a)
2. Under Selective Inventory Control, VED analysis defines VED as
 a) Value, Engineering and Design b) Vital, Essential and Desirable
 c) Volume, Economy and Demand d) None of these
 Answer: (b)
3. EOQ is a particular order size at which
 a) carrying costs become minimum b) ordering costs become minimum
 c) total inventory costs become minimum d) all of these costs are minimum
 Answer: (c)
4. FSN analysis is required to control
 a) Quality of the product b) Inventory
 c) Industrial disputes d) All of these
 Answer: (b)
5. If the order quantity is increased, the annual cost of carrying inventory
 a) increases b) remains the same
 c) decreases d) not affected
 Answer: (a)
6. The basis for 'ABC' Analysis is
 a) interests of Materials Manager
 b) interests of Top Management
 c) Pareto's 80-20 Rule
 d) none of these
 Answer: (c)
7. EOQ means
 a) Excess Order Quantity
 b) Economic Order Quantity
 c) Exempted Order Quantity
 d) none of these
 Answer: (b)
8. Mechanization of material handling increases
 a) output cost b) handling cost
 c) efficiency and economy in handling d) none of these
 Answer: (c)

[MODEL QUESTION]

9. The objectives of MRP are to
 a) determine requirements
 b) both (a) and (b)
 c) both (a) and (b)
 d) none of these
 Answer: (c)

10. The objective of materials management is to
 a) provide the required level of customer service
 b) maximize the use of the firm's resources
 c) both (a) and (b)
 d) none of these
 Answer: (b)

11. Materials Management can improve a company's profit by
 a) increasing sales b) reduction of direct materials cost
 c) reduction of direct labour cost d) none of these
 Answer: (b)

12. also called part lists or building lists is the document generated
 at the design stage.
 a) MRP (Material Requirement Planning) b) BOM (Bill of Materials)
 c) MPS (Master Production Schedule) d) None of these
 Answer: (b)

13. Materials Management does not depend on
 a) Supply Chain Management b) Enterprise Resource Management
 c) Human Resource Management d) None of these
 Answer: (d)

14. Which of the following is not a function of purchasing management?
 a) Selecting the source b) Placement of purchase order
 c) Physical controls of material d) None of these
 Answer: (d)

16. The purchase order form is designed by
 a) Materials Manager b) Purchase Manager
 c) Marketing Manager d) None of them
 Answer: (b)

17. The objective(s) of forward purchasing is / are
 a) To guard against interruption in supply
 b) To economize the use of storage space
 c) To guard against the future rise in price
 d) All of these
 Answer: (a)

Short Answer Type Questions

1. Derive an expression for computation of Economic Order Quantity stating the assumptions made.

[MODEL QUESTION]

Answer:
EOQ can be determined by the following formula-

$$EOQ = \sqrt{\frac{2CoO}{Cc}}$$

C_o = Consumption per annum (i.e. usage) in Units.

O = Ordering Cost for placing one order.

C_c = Carrying Cost (Including interest) of one Unit for one year (usually expressed as a percentage of the cost per unit.)

Assumptions:

- i) All cost are known and constant (i.e. Ordering Costs, Unit Costs etc.).
- ii) Rate of interest (component of Carrying Cost) is fixed.
- iii) Consumption or usage rate is constant throughout the year.

2. What do you understand by materials management? Explain different functions of materials Management.

[MODEL QUESTION]

Answer:

Materials management is a body of knowledge which helps the manager to improve the productivity of capital by reducing the material cost, prevents large amount from capital turnover ratio.

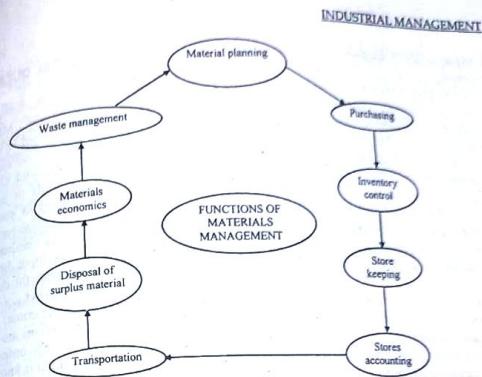
Mr. Dean S. Ammer defines "Materials Management" as the "total control and thus combines those managerial arts connected with control of goods at all stages in a firm's operations".

Materials management mainly concerns with all the planning, programming, controlling and decision making process related with materials procured for the organisation. It is mainly relevant with manufacturing industries but, as service industries explore it needs concept of materials management to use its resources (materials and machines) optimally and get increased profit. In the following line the functions of materials management are elucidated:

Function of material management includes following:

- i) Materials Planning.
- ii) Purchasing.
- iii) Inventory control.
- iv) Store-Keeping.
- v) Store-accounting.
- vi) Transportation both internal i.e. (material handling) and external i.e., (traffic, shipping etc.)
- vii) Disposal of scrap, surplus and obsolete materials.
- viii) Material economics.
- ix) Waste Management.

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3. From the following particulars, calculate Economic Order Quantity, number of order placed during the year and the gap between orders:

Monthly consumption 15,000 units, Carrying cost 20% on Cost of product, Cost of product is Rs. 100 per unit and Cost per order is Rs. 2000.

[MODEL QUESTION]

Answer:

Monthly Consumption = 15,000 units

Annual Consumption (D) = $(15,000 \times 12)$ = 180,000 units

Carrying Cost (I) = 0.20 cost of product

Cost of Product (C_p) = Rs. 100/-

Cost per Order (C_o) = Rs. 2000/-

Economic Order Quantity

$$(Q) = \sqrt{\frac{2 \times \text{Annual Demand} \times \text{Ordinary Cost/order}}{\text{Inventory holding Cost}}}$$

$$= \sqrt{\frac{2 \times D \times C_o}{C_p \times I}}$$

$$= \sqrt{\frac{2 \times 180,000 \times .2000}{100 \times 0.20}}$$

$$= 6000 \text{ Units}$$

Economic Order Quantity, (Q^*) = 6000 Units

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4. What is MRP? Explain its characteristics.

Answer:

Material requirements planning (MRP) is a production planning, scheduling, and inventory control system used to manage manufacturing processes. Material Requirement Planning (MRP) was introduced in 1970 as a computerized inventory control system. It helps in knowing the need of raw materials and helps to calculate the demand for a particular item. It takes into account the lead time required to order automatically with the help of software. It helps in tracking the records of the raw materials especially when the materials like raw materials or components parts are required. Basically MRP is an information system which generates automatic results in the area of systematic planning of materials requirement. It is known as computerized ordering and scheduling system for manufacturing. It uses three important input data: bill of materials data, inventory data, and master production schedule to calculate the demand for 3 particular items like raw materials or components parts. Joseph Orlicky, George Plossl and Oliver Wight introduced MRP and popularized this programme. They imparted training for this programme for many years. Many upgraded versions are made available till now. The benefits of MRP are remarkable as it generates work orders and purchase orders automatically. Now in these days MRP-II is available, which is known as Manufacturing Resource Planning.

The following are the Characteristics of MRP:

- i) MRP calculates the demand for components, subassemblies, raw-materials, spare parts.
- ii) MRP helps in systematic planning
- iii) MRP takes into account the lead time required for orders.
- iv) MRP helps in purchase orders planning and tracking
- v) MRP is helpful in preparing production schedules
- vi) MRP ensures materials are available for production and products are available for delivery to customers.
- vii) MRP maintains the lowest possible material and product levels in store.
- viii) MRP is helpful in planning manufacturing activities, delivery schedules and purchasing activities.

5. What is the importance of Inventory Control System?

[MODEL QUESTION]

Answer:

Inventory control system is essential for any organization implementing it. Here are few reasons for companies for effectively running their business:

- It is difficult for a large retail store to have a track of a proper inventory control as otherwise it might have items going out of stock. So re-order time can be calculated with auto alerts given by the ICS.
- To track large shipments automatically, Inventory control is important otherwise shortage of materials will be visible.
- Risks of errors are minimized through an automated inventory control system. A nicely developed ICS, in retail stores, helps to track theft of retail merchandise.

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Interestingly, today's inventory control systems are based on the modern barcode technology which is an automated ICS. A barcode scanner is used to read the barcode printed at the price tag of the product, and the information encoded by the barcode is read by the machine. This machine is designed effectively to encode the numeric as well as the alphanumeric symbols and thus keep the effective track of the current inventory status. Information is transmitted to a central computer through wireless technology, where a central database stores all information. Inventory control systems make it simple for the manager to locate and analyze complete inventory information in real-time with a simple database search.

6. How does MRP works? Explain the benefits and drawbacks of MRP.

[MODEL QUESTION]

Answer: MRP utilizes these three inputs in an appropriate fashion to work properly. Here are the few steps:

1. Create schedules identifying the specific parts and materials required to produce the end items.
2. The demand for end items is scheduled over a number of time periods and recorded on a master production schedule (MPS).
3. MRP takes the master schedule for end items and translates it into individual time-phased component requirements.
4. The product structure records or BOM is developed that contains information on every item or assembly required to produce end items.
5. Determine the *gross requirements* for a particular item from MPS and BOM.
6. Determine the *net requirements* and when orders will be released for fabrication or subassembly.
7. The gross component requirements will be reduced by the available inventory as indicated consulting the inventory status records that contains all such details. Finally the Inventory status file will be updated according to the components leftover for future needs.

Net Requirements = Total Requirements - Available Inventory

Net Requirements = (Gross Requirements + Allocations) - (On Hand) + Scheduled Receipts.

Benefits of MRP:

- Better inventory planning, scheduling orders and faster delivery of finished product.
- Keeping optimum and as far as possible reduced inventory levels without compromising customer service.
- Improves utilization of resources and facilities as well as personnel.
- Fairly responsive towards market changes and shifts or other issues.
- Increases customer service and satisfaction.
- Tracks material requirements with accuracy

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- Determines economical lot sizes for orders to be placed
- Accurate computation of quantities for safety stock
- Properly allocating production time among various products
- Adequate planning for future capacity needs.

Drawbacks of MRP:

- An MRP system must have an accurate and effective master production schedule, good lead time estimates, and current inventory records in order to function effectively and produce useful information. If any one of them fails at any point the overall production of the organization may suffer a lot.
- Information used as an input to the MRP system must be fairly accurate. If the information is inaccurate, it might lead to overstock, misplanning, understock, or lack of appropriate resources.
- MRP optimizes the inventory level but not the acquisition cost of the materials to be ordered. Inventory needs to be kept lower hence it is required to purchase materials more frequently, preferably in smaller quantities. This results in increasing the ordering costs.
- MRP systems can be costly and time-consuming to set up.
- It is difficult to implement an effective MRP system as strong resistance from employees may be expected, especially those who do not wish to shift from the comfort zone of the manual system.

7. Explain briefly what you understand by MRP1 and MRP2. Discuss briefly. [MODEL QUESTION]

Answer:

MRP-I (Materials Requirement Planning)

Materials requirement Planning is an ordering and scheduling system for manufacturing and fabrication industries, it uses bill of materials data, inventory data, and master production schedule to project what material is required, when, and in what quantity. MRP phases orders for dependent-demand items (such as raw materials, components, etc.) over a period to synchronize flow of materials and in-process inventories with production schedules. It also computes and tracks effect of hundreds of variables such as new orders, changes in various capacities, overloaded production centers, shortages, and delays by suppliers, and feeds financial data into the accounting system. In contrast to just in time inventory (a demand-pull production system), MRP is a plan-push system, and in contrast to advanced planning system (a forward scheduling system) it is a backward-scheduling system.

MRP-II – Manufacturing Resource Planning:

Manufacturing organizations can be broadly divided into sales, logistics, production, engineering and supporting functions. The development of Manufacturing Resource Planning (MRP II) links up all these functions together with a coverage much greater than what is being focused by traditional MRP I (Material Requirements Planning). MRP

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It can be defined as '*a method for the effective planning of all resources of a manufacturing company'*. It is made up of a variety of functions, each linked together; Business Planning, Production Planning, Master Scheduling, Material Requirement Planning and Capacity Requirement Planning. Output from these systems are integrated with financial reports such as the business plan, purchase commitment report, shipping budget, inventory projection in dollars, etc.

Functions of MRPII:

1. Top Management Planning,
2. Operation Planning and
3. Execution

8. State the objective of materials management.

[MODEL QUESTION]

Answer:
Needs and Objectives of Materials Management

Primary Needs/ Objective:

1) **Low price:** It means that the materials purchased by the company should be at the lowest possible cost but highest quality. So, that they can provide end product in lowest price.

2) **High inventory turnover:** It means that the average inventory locked up is low compared to sales. Inventory means idle and therefore, the lower it is, the better will be profitability.

3) **Low cost acquisition and possession:** This means the materials are acquired and kept in stores at a low cost.

4) **Continuity of supply:** Regular continuity of supply is the must to run uninterrupted production.

5) **Consistency of quality:** Quality should be up to the level and consistent.

6) **Low pay roll cost:** the materials department should be run at the lowest possible cost.

7) **Favorable supplier relation:** to ensure continuity of supply and consistency of quality, it is necessary to have a favorable supplier / buyer relation.

8) **Development of personnel:** development and training of personnel engaged in materials functions is necessary to make them seasoned with the present technology and trend.

9) **Maintenance of records:** Record maintenance is one of the major functions which materials department has to perform for efficiency.

Secondary Needs / objectives:

1) Favorable reciprocal relationship with supplier dealer and department.

2) **New materials and products:** materials manager acts as an information centre about latest modification of product, ingredients, supplier information, etc.

3) **Make or buy decision and analysis:** he / she should decide whether a product is to be made by company or, procured from some other company.

4) **Standardization:** the required materials which are bought from outside should be standardized so as to have fewer nos. of materials. This will help the total inventory.

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- 5) **Product improvement:** the materials department should help R&D dept. to improve the attributes, ingredients of product and quality as well to increase profit level.
- 6) **Interdepartmental harmony:** coordinating with all departments for smooth functioning.
- 7) **Forecast:** material department has to prepare the material budget and forecast the payment.
- 8) **Increase profitability:** Profitability can be increased by optimizing the resources, standardization, reduce scrap, obsolescence, damage of the materials, MRP, etc., these are the task of materials dept.

9. Name and discuss in short about five laws that have indirect impact on purchase activities. [MODEL QUESTION]

Answer:

5 Laws of Purchasing

5 R's of purchasing

- i) **Right quality:** Quality can be defined as the "power of accomplish or the capability of doing certain thing"
 - Quality means the useful value of a specific thing for a specific purpose to fulfill.
 - Quality can be specified in different meaning, i.e., dimension, power, tolerance, harness, etc.
 - Quality should be correctly specified.
 - Right quality means neither too high nor too low.
- ii) **Right quantity:** purchaser must buy the materials in right quantity to ensure that there is no stoppage of production or, no extra stock piling. Right quantity is yet another important parameter in buying. Quantity decisions are influenced by "replenishment method" and "buying methods".
- iii) **Right price:** it is purchasers' skill to determine the optimum price for a valued product. It does mean that the lowest price but the price which minimizes the overall cost. Right price is not that easy to determine. The technique of:
 - **Negotiation:** It is used when there are limited vendors, and /or time available to make purchase is short, and /or items belong to fixed price category.
 - **Tender system:** It is followed in public sector organization to identify the lowest potential bidder.
 - **Learning curve:** It is employed to determine the price of the item with high labor content.
- iv) **Right sources:** The right source must fulfill the following condition
 - Must be fully equipped to manufacture and supply the items ordered.
 - He must look after the interest and buyer interest.
 - He must also assist the buyer in market research.
 - Must be gentle in nature and improving himself to cope with the condition.
 - He must be man of integrity.
- v) **Right time:** Time is very essential components in case of any business. Right time and lead time are closely related. Right time implies that time at which the goods requested should be received while lead time refers the time that elapses between the

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communication of the need for the item by indentor to purchase till the item is actually received and is made available for consumption. Basic elements of lead time are:

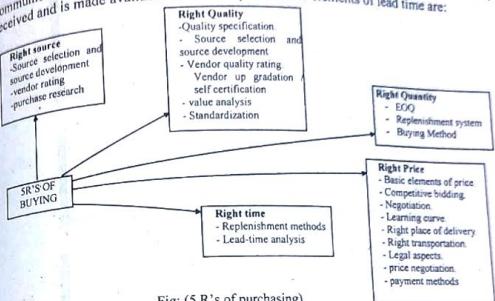


Fig: (5 R's of purchasing)

10. Explain entire purchasing procedure with the help of a block diagram. [MODEL QUESTION]

Answer:

Purchasing Procedure: Purchasing is not an instant function. It is a step by step process. In the following lines the process of purchasing is discussed.

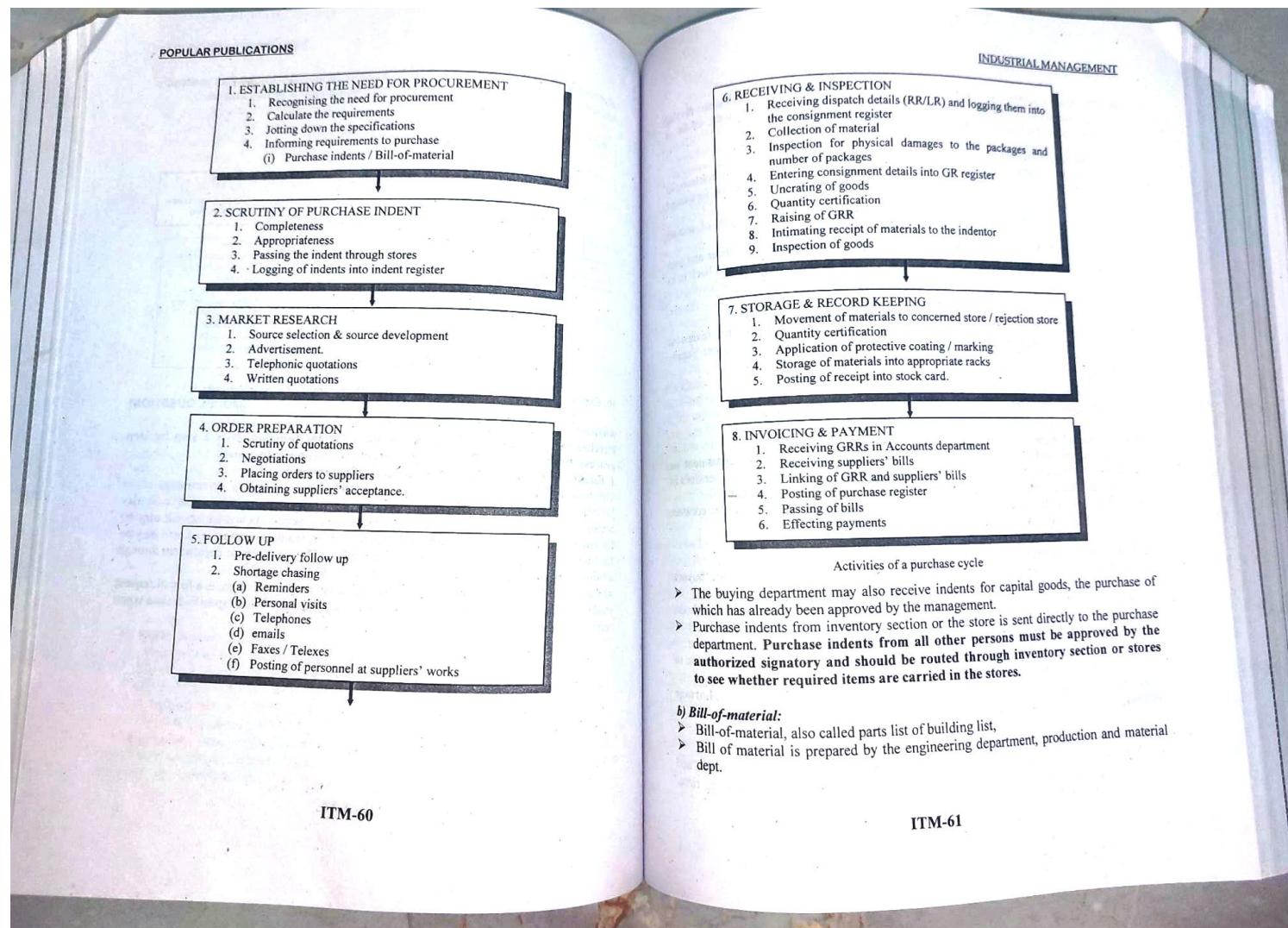
1. Establishing and communicating need for Procurement

The need for purchase originates in one of the firm's operating departments or its inventory control section. The demand may be for raw materials, such as steel; or it may be for semi-finished goods such as castings, forgings, semi-matched parts; or it may be for bought out parts; or for cutting tools such as drills, reamers, cutters, etc.; or it may be for supplies or for spares. The need is communicated to the purchase department through a formal document called "Purchase Indent" or a "Bill of Material".

2. Purchase Indent:

Purchase indent, also called purchase requisition, is a formal request made to the purchase department to purchase materials or services specified, time when required etc.

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- The final assembly is broken into major assemblies. Major assemblies are divided into parts. The individual parts comprising each assembly are arranged, as far as practical, in the manner in which each part is assembled.

2. Scrutinising Purchase Indents

- A purchase indent may describe the items either by its brand name, or by commercial standard, or by its performance standards. Sometimes the indents may be forwarded sample of the item.

➤ Purchase departments must scrutinize the accuracy and completeness of quality description.

Each purchase indent after scrutiny is recorded in the purchase indent register and then indented to the concerned buyer. The second copy is initiated, dated and returned back to its indentor.

3. Identification, Selection, development of Sources of Supply or Survey

- This stage involves differentiate and sorting of items into item groups, review of available information, and selecting potential source(s) of supply who can supply goods -
 - i) Of the right quality;
 - ii) At the right price; and
 - iii) Meet buyer's quantity requirements, and make reliable delivery promises.

4. Order Preparation

- A purchase order is a formal document prepared by the buying department on behalf of the company to authorize (request) the supply of the goods and services in the quantities, at the time and at the price specified there in the document.
- A purchase order is a legal document and serves as an evidence of the contract between the buyer and the seller.

5. Follow-up with Suppliers

The follow up function now-a-days has become the foremost function of the buyers. Basic rules of follow-up are:

- i) Follow-up should be based on market condition and buyer's experience with the vendor's delivery performance.
- ii) Buyer should keep a constant himself up-to-date with latest progress on each order.
- iii) Mode of follow-up should be based importance of the item, reliability or otherwise of the supplier, number of suppliers, location and so on.

Purchase follow-up is made in two stages: **pre-delivery follow-up and shortage chasing**

6. Receiving and Inspection

- After receiving the purchase order the supplier fills up the buyer's requirements and arranges delivery of the materials according to instructions regarding quantities, time, route, mode of transport, etc.

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7. Storage and record keeping

- After inspection the goods are segregated in to accepted and rejected categories.
- Only fully accepted quantity is forwarded to the stores. The quantity is physically verified and entered into the ledger or bin cards and only thereafter the issue is allowed.

8. Invoicing & Payment

Receipt of supplier's invoice:
When the supplier supplies goods, he immediately prepares invoices. Sometimes, both buyer and supplier have discussion and supplier agrees to raise invoices after the receipt of goods-receipt-reports.

11. Distinguish between Bin card and Stores Ledger.

[MODEL QUESTION]

Answer:

For proper control over material, it is necessary to record the physical movement of materials regularly. The main function of store - keeper is to maintain proper records regularly regarding receipts, issue and balance of various items of materials. Bin Card and store - ledger are the main tools to maintain proper record of stores.

Bin Card

Bin Card is a record maintained in respect of each item of materials to show the quantity in, the quantity out and quantity in stock after each transaction. The stock at any time as shown in Bin Card, may be verified with actual stock taking / verification. The bin cards provide a continuous record of stock of each item and assist the stores-keeper to control the store. For each material the maximum stock to be held are noted on the Card. Where the materials are of a kind requiring advance ordering, an ordering level is also indicated there in so that fresh supplies may be ordered before minimum level is reached. These cards also provide an independent check on the stores ledgers.

Stores Ledger

Store ledger is a document kept by the cost department for each item of material. The ledger is generally maintain under loose – leaf or Card type form. In the stores ledger every movement of material, either inward or outward, is recorded in quantity, rate and value and the balance of material, after each movement, is simultaneously struck out in quantity rate and value. It is therefore, a duplicate of Bin Card so far as the quantity is concerned and is also a step forward so far as the rate and value are concerned.

Distinction between Bin Card and Store Ledger

BIN CARD	STORES LEDGER
1. Bin Card is maintained by store Department. 2. It records the Quantity of inward and outward movements and extract the balance after each transaction.	1. Store Ledger is maintained by cost department. 2. It records both quantity and Value of the material in case of each inward and outward and extract the balance both quantity and Value after each transaction.

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BIN CARD
3. Entries are made in Bin Card when purchases or returns come in and when issues go out.
4. The officer-in-Charge of Bin Card is responsible for any Discrepancy in material.
5. Posting in Bin Card is made for each individual transaction.
6. Bin Card cannot supply inventory Valve for preparation of financial Profit / Loss Statement.

STORES LEDGER
3. Entries are made in respect of Purchases return and issue, but after recording in Bin Card.
4. The personnel-in-Charge of store ledger is not responsible for any such discrepancy as he has no connection with the materials.
5. Posting may be made on the basis of summary of several transactions in the same material for a particular period.
6. Store ledger can supply inventory Valve to help in preparing financial Profit / Loss A/c.

12. What are the benefits of scientific store-keeping?

[MODEL QUESTION]

Answer:**Benefits of Scientific Store Keeping:**

- i) Scientific stock control reduces losses due to accumulation of inventories.
- ii) Efficient stores issues reduce down time in production and increases profit.
- iii) Periodic review detects obsolete and non-moving items and helps the firm to get rid of unproductive inventory.
- iv) Follow up with purchase, helps to avoid stock outs and the production losses.
- v) Proper record keeping, provides exact picture of inventory in store to higher level of management.

13. What is storekeeping? Write down the main functions of storekeeping.

[MODEL QUESTION]

Answer:**Definition:**

The act of taking charge of stores or a store

Benefits of Scientific Store Keeping

- i) Scientific stock control reduces losses due to accumulation of inventories.
- ii) Efficient stores issues reduce down time in production and increases profit.
- iii) Periodic review detects obsolete and non-moving items and helps the firm to get rid of unproductive inventory.
- iv) Follow up with purchase, helps to avoid stock outs and the production losses.
- v) Proper record keeping, provides exact picture of inventory in store to higher level of management.

Functions of Store keeping:**1) Primary function:**

- a) To make available a balanced flow of raw materials, components, tools, equipment and other stores required for operation.
- b) To provide maintenance materials, spare parts and general stores as required.
- c) To receive and issue materials after physical inspection and proper identification.

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- d) Storage and preservation of materials.
- e) Safety and security of materials.
- f) To arrange for collection, acceptance of scrap & other discarded materials for disposal.

2) Secondary function:

- a) Quantity inspection and acceptance.
- b) Stores accounting.
- c) Stock control.
- d) Feedback information to material control section.
- e) Help in standardization and variety reduction.
- f) Service information such as:
 - i. Demand for materials and its specification quantity, etc.
 - ii. Notification when stocks are running low.
 - iii. Details of deliveries rejected on inspection.
 - iv. Certification of invoices for quantity and quality.
 - v. Particulars of anticipated change in consumption.
 - vi. Warning of items urgently required for breakdown.
 - vii. Listing of obsolete, surplus and scrap materials for disposal.

14. What is centralized and decentralized storing?

[MODEL QUESTION]

Answer:

A centralized store is that store which receives materials for and issues them to all departments, divisions and production floors of the company. Such a store is only one in the company which receives materials for and issues to all who need them. The materials required for all the departments and branches are stored and issued by only one store.

Advantages of Centralized Stores

The followings are the main advantages of centralized stores.

- 1. A better supervision of store is possible because the store is located under a single supervision.
- 2. A better layout of store and its control are possible.
- 3. Less space is occupied.
- 4. Investment in stock is minimized.
- 5. It is economical for storing materials.
- 6. Safety of materials is possible according to the nature of materials.
- 7. Trained and specialized persons can be appointed.
- 8. Wastage of materials can be minimized.

Disadvantages of Centralized Store

The followings are the main disadvantages of centralized stores.

- 1. Delay in sending materials to the departments and branches.
- 2. Increase in material handling cost.
- 3. Greater risk of loss by fire.

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4. Not suitable for a large company.

A decentralized store is that type of store which receives materials for and issues them to only one department and not to the whole company. The decentralized store may be in many numbers in the company, as each department has its own such store. Purchasing and handling of materials are undertaken by each and every department separately. If the volume of material activities is large, this type of store is suitable because each and every branch has their own store for facilitating smooth operations of their production activities.

Advantages of Decentralized Stores

1. Controlling and storing function can be accomplished easily.
2. Delay in material handling will be eliminated.
3. Minimizes the chances of loss by fire.
4. No need of internal transportation costs.
5. Specific needs of individual departments can be easily fulfilled.
6. Saving in material handling cost.

Disadvantages of Decentralized Stores

1. Higher cost of supervision
2. More space is required for individual departments.
3. Higher amount of investment is required.
4. More time for stock taking and taking.
5. Higher cost of staff and stationary.
6. Improved technique is less possible for controlling of materials.

15. What is the 'Q' system of inventory? In a 'Q' system of inventory what is called to be ROP? How is it calculated? [MODEL QUESTION]

Answer:

'Q' system of Inventory: 'Q' system of inventory is called as Fixed order Quantity system. This is also called perpetual inventory system. In this system, the order quantity is fixed and ordering time varies according to the fluctuation in demand. The characteristics of this system are:

- (i) Re-order quantity is fixed and normally it equals Economic order quantity (EOQ).
- (ii) Depending upon the demand, the time interval of ordering varies.
- (iii) Replenishment action is initiated when stock level falls to Re-order level (ROL).
- (iv) Safety stock is maintained to account for increase in demand during lead time.

Application of Q-System – TWO Bin System

Two bin system operates on R.O.L. system and it physically segregates the stock of entire items into two bins.

The second bin contains quantity equal to R.O.L. i.e., $(m + LC)$ and it means to satisfy demand during the replenishment period.

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The first bin contains the quantity (Order quantity) = $(Q - LC)$ to satisfy demand between the receipt of materials and placing the next order. LC is the lead time consumption.

The working of the system

To begin with, the stock from the first bin is consumed. The emptying of first bin indicates that the stock has reached R.O.L. and the replenishment action is initiated. The quantity in the second bin are thus consumed during the replenishment period. This system reduces the work involved in record keeping and entering (clerical) errors.

Advantages

1. Simple and cheaper to operate.
2. Stock control will be accurate as the replenishment action is initiated soon after the stock reaches R.O.L.
3. Suitable for low value items.
4. Appropriate for variety of inventory maintained within the organization.

Limitations

- (i) In this inventory system, there will be a load on the re-ordering system if many items reach R.O.L. at the same time.
- (ii) The stock levels records and usage rate data are to be maintained.

Re-order Point (ROP):

It is the point where purchase order will be placed for replenishment. O_1, O_2 indicates the re-order points.

It can be calculated in the following way.

This equals the sum of safety stock and lead time consumption.

$$R.O.P. = m + L \times C$$

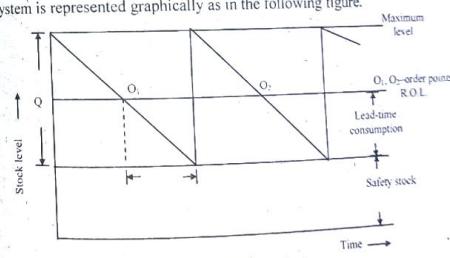
Where

m = is the minimum or safety stock.

L = Lead time (days/weeks/months)

C = consumption rate (per day/per week/per Month)

The system is represented graphically as in the following figure.



Fixed order quantity system.

16. Differentiate between P-system and Q-system of inventory management.

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[MODEL QUESTIONS]

Answer:**Fixed Order Quantity System**

This is also called perpetual inventory system or Q-system. In this system, the order quantity is fixed and ordering time varies according to the fluctuation in demand. The characteristics of this system are:

1. Re-order quantity is fixed and normally it equals Economic order quantity (EOQ).
2. Depending upon the demand, the time interval of ordering varies.
3. Replenishment action is initiated when stock level falls to Re-order level (ROL).
4. Safety stock is maintained to account for increase in demand during lead time.

Parameters to Operate the System**1. Re-order level (ROL)****2. Re-order quantity (Q)**

This normally equals Economic order quantity (EOQ)

3. Maximum stock level (M)**4. Average inventory**

The system is represented graphically as in Fig. c.

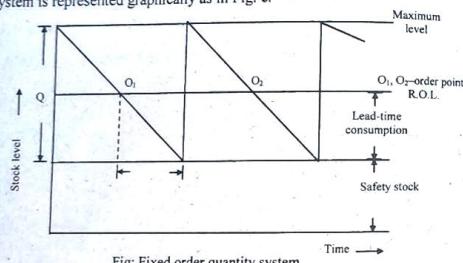


Fig: Fixed order quantity system.

Advantages

1. Simple and cheaper to operate.
2. Stock control will be accurate as the replenishment action is initiated soon after the stock reaches R.O.L.
3. Suitable for low value items.
4. Appropriate for variety of inventory maintained within the organization.

Limitations

- (i) In this inventory system, there will be a load on the re-ordering system if many items reach R.O.L. at the same time.
- (ii) The stock levels records and usage rate data are to be maintained.

Application of Q-System – TWO Bin System

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Two bin system operates on R.O.L. system and it physically segregates the stock of entire items into two bins. The second bin contains quantity equal to R.O.L. i.e., $(m + LC)$ and it means to satisfy demand during the replenishment period. The first bin contains the quantity (Order quantity) = $(Q - LC)$ to satisfy demand between the receipt of materials and placing the next order. LC is the lead time consumption.

Periodic Review System (P-system)

It is also called fixed period system or P-system. This system has a fixed ordering interval but the size of the order quantity may vary with changes in demand.

In this system, the inventory position is verified at prefixed interval, (weekly/monthly/quarterly), then depending upon the situation replenishment action is initiated.

The characteristics of the system are:

1. Order interval is fixed for individual item or group of items.
2. Stock is reviewed at periodic interval and the quantity (Q) which will bring the inventory to maximum level is orders.

The periodic review system is shown in Fig.

Parameters to Operate the System**1. Maximum level (M)****2. Re-order Quantity.**

(i) when lead time is less than review period.

$Q = \text{Maximum stock} - \text{stock actually held at the time of review.}$

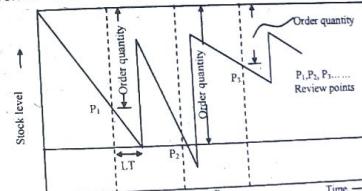


Fig: periodic review inventory system.

(ii) when lead time is more than review period

$$Q = \text{Max. Stock} - (\text{Stock on hand} + \text{Stock on order})$$

This system is suitable for high value items which require strict control on stock levels.

Comparison between Fixed Quantity (Q) and Fixed Period (P) System

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Q-system	P-System
The Quantity to be ordered each time is fixed and normally it is equal to EOQ.	The period of ordering the inventory is fixed and the order quantity depends on the stock on hand.
It is suitable for the low unit cost, high volume items. Normally preferred when supplier puts minimum quantity restriction.	Suitable for high unit cost and less in number items. Preferred when supplier delivers at fixed periods.

17. Discuss Two bin model of inventory management.

[MODEL QUESTION]

Answer:

Two-bin inventory control involves the storage of goods in two bins, one of which contains working stock and the other containing reserve stock. The amount of inventory kept in the reserve stock bin equals the amount the company expects to use during the ordering lead time associated with that item. To use this system, one should reorder goods as soon as the working stock bin is empty, so that replacement parts arrive before the reserve stock bin is empty. It is possible to fine-tune the inventory investment by altering the amount of goods kept in the reserve stock bin. The calculation for the amount of inventory to keep in the reserve stock bin is:

$$(\text{Daily usage rate} \times \text{Lead time}) + \text{Safety stock} = \text{Reserve bin quantity}$$

Two-bin inventory control is commonly used for low-value items that can be purchased and stored in bulk, and for which stocks are maintained in the production area, rather than the warehouse. More expensive inventory items are controlled with a perpetual inventory system, in order to maintain tighter control over the firm's working capital investment.

Example of Two-Bin Inventory Control

For example, a company experiences weekly usage of 500 units of a purple cell battery, so the daily usage rate is 100 units. The lead time for the battery is three days. The reserve storage bin should contain at least 300 batteries, to cover expected usage during the three-day lead time. In addition, the company assumes that usage levels can vary by as much as 25% from the average usage rate. Consequently, 75 additional batteries are kept in the reserve storage bin. This is calculated as $300 \text{ reserve units} \times 25\% \text{ safety stock allowance}$. Thus, the total reserve stock is 375 units.

Long Answer Type Questions

1. a) What do you mean by Economic Order Quantity (EOQ)? [MODEL QUESTION]

Answer:

EOQ represents the quantity of material (items) to be ordered at the re-order level. Normally this quantity equals the economic order quantity. There are two major costs associated with inventory. Procurement cost (ordering cost) and inventory carrying cost. Annual procurement cost varies with the number of order.

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This implies that the procurement cost will be high, if the item is procured frequently in small lots. The procurement cost is expressed as Rs./order. The annual inventory carrying cost (Products of average inventory x Carrying cost) is directly proportional to the quantity in stock. The inventory carrying cost decreases, if the quantity ordered per order is small. The two costs are diametrically opposite to each other. The right quantity to be ordered is one that strikes a balance between the two opposing costs. This quantity is referred to as "Economic order quantity" (EOQ). The cost relationships are shown in the following figure.

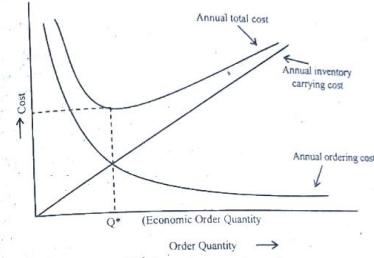


Fig: Inventory carrying cost

[MODEL QUESTION]

b) Mention with at least two examples, the costs that are sought to be optimized in the EOQ model.

Answer:

1. Ordering Cost

(i) Purchasing: The clerical and administrative cost associated with the purchasing, the cost of requisitioning material, placing the order, follow-up, receiving and evaluating quotations.

(ii) Inspection: The cost of checking material after they are received by the supplier for quantity and quality and maintaining records of the receipts.

(iii) Accounting: The cost of checking supply against each order, making payments and maintaining records of purchases.

(iv) Transportations costs: The cost of transportation of the materials between different channel intermediaries.

2. Inventory carrying cost (holding costs): These are the costs associated with holding a given level of inventory on hand and this cost varies in direct proportion to the amount of holding and period of holding the stock in stores. The holding costs include:

(i) Storage costs (rent, heating, lighting, etc.)
(ii) Handling costs: Costs associated with moving the items such as cost of labour, equipment for handling.

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- (iii) Depreciation, taxes and insurance
 - (iv) Costs on record keeping
 - (v) Product deterioration and obsolescence
 - (vi) Spoilage, breakage, pilferage and loss due to perishable nature
- c) A manufacturing company purchases 2000 units of a particular material per quarter costing Rs. 30/- per unit. The cost of placing an order to supplier is Rs. 120/-. The inventory carrying cost is 10% per annum on average inventory investment.
- However, the purchase manager of the company gets an offer of 2% discount on materials costs for bulk purchase of 8000 units or more at a time. Give your recommendation as to whether the purchase manager should accept the discount offer or not.

Answer:

Annual demand = $2000 \times 4 = 8000$ per year. [Quarterly Demand = 2000]

Ordering Cost / Order (C_p) = Rs. 120/-

Unit Cost (C) = Rs. 30/-

Inventory carrying cost (I) = 10% per annum on average inventory investment.

Holding Cost (C_h) = $C \times I = 30 \times 0.10$ per annum.

[MODEL QUESTION]

Case-I

Total cost calculation based on present purchase policy;

$TC(2000) = (\text{Unit cost} \times \text{annual consumption}) + (\text{Average Inventory}) \times (\text{Holding cost}) + (\text{No. of orders per annum}) \times (\text{ordering cost per order})$

$$= (30 \times 8000) + \left(\frac{2000}{2}\right) \times (30 \times 0.10) + \frac{8000}{2000} \times 120 \\ = 2,40,000 + 3000 + 480 = 2,43,480$$

Case-II

For bulk purchase 8000 units, 2% discount other on materials cost,

Unit cost (C) = $(\text{Rs. } 30/- \times 0.98) = \text{Rs. } 29.40/-$

Total cost calculation based on considering discount other,

$$TC(8000) = (29.4 \times 8000) + \frac{8000}{2} \times (29.4 \times 0.10) + \frac{8000}{8000} \times 120 \\ = 2,35,200 + 11,760 + 120 = \text{Rs. } 2,47,080/-$$

Conclusion:

If purchase manager accept the discount other, then he will incur loss $(2,47,080 - 2,43,480) = \text{Rs. } 3600/-$ over the present policy of placing an order or size 2000 units.

So, purchase manager should reject the proposal.

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2. a) What EOQ? Explain the concept of EOQ mathematically or graphically. [MODEL QUESTION]

Answer:

Economic Order Quantity: The economic order quantity (EOQ) refers to that order quantity within the range of possible order quantities, which minimizes total cost per annum. Total cost consists of two parts –

- (1) Ordering Cost
- (2) Carrying Cost

Ordering Cost:

Ordering Cost means total expenses incurred for placing order and includes the expenses incurred for following activities –

- (a) Preparation of Purchase Order,
- (b) Cost of receiving Goods,
- (c) Documentation
- (d) Processing Cost
- (e) Transport Cost
- (f) Intermittent Costs of Chasing Orders, rejection of faulty goods
- (g) Additional Costs of frequent or small quantity orders.

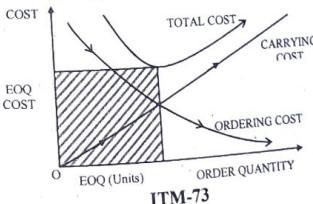
Carrying Cost:

Carrying Cost includes the followings.

- (1) Storage Cost (Rent, Lighting, Heating, refrigeration, air conditioning etc.)
- (2) Stores staffing, equipment maintenance and running costs
- (3) Material handling Cost
- (4) Stock Audit, Stock taking or perpetual inventory cost
- (5) Obsolescence and Security Costs
- (6) Costs of money tied up in inventory
- (7) Pilferage and damage cost

Ordering cost is independent of the quantity of orders, while carrying cost increases with the increase in the quantity ordered. Thus, ordering cost decreases as the size of the purchase increases (because in that case the number of purchase decreases), but the carrying cost increases with the increase in the size of purchase. It is, therefore, necessary to find a balance between ordering costs and carrying costs in order to find the most favorable quantity.

Graphical Representation of EOQ:



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EOQ Determination:

$$EOQ = \sqrt{\frac{2AB}{CS}}$$

EOQ : Economic order quantity
 A : Annual Consumption
 B : Buying Cost per order
 C : Cost per Unit
 S : Carrying Cost

b) The rate of use of a particular raw material from stores is 20 units per year. The cost of placing and receiving an order is Rs. 40. The cost of each unit is Rs. 100. The cost of carrying inventory per cent per year is 0.16 and it depends upon the average stock. Determine the economic order quantity. [MODEL QUESTION]

Answer:

Annual demand (A) = 20 units
 Cost of procurement (C_p) = Rs. 40/-
 Cost of each unit (e) = Rs. 100/-

$$\text{Cost of carrying inventory } (J) = \frac{0.16}{100} = 0.0016$$

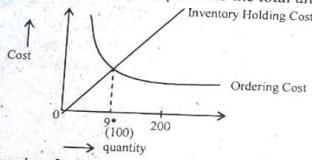
$$\text{Holding cost } (C_h) = 100 \times \frac{0.16}{100} = 0.16.$$

Economic order quantity

$$(9*) = \sqrt{\frac{2 \times \text{Annual demand } (A) \times \text{Ordering Cost } (C_p)}{\text{Inventory holding cost}}}$$

$$= \sqrt{\frac{2 \times 20 \times 40}{0.16}} = \sqrt{\frac{16 \times 100 \times 100}{16}} = 100$$

Economic order quantity = 100 units that optimizes the total annual inventory cost.



3. a) Derive an expression for computation of Economic Order Quantity stating the assumptions made. [MODEL QUESTION]

Answer:

EOQ can be determined by the following formula—

$$EOQ = \sqrt{\frac{2CoO}{Cc}}$$

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C_o = Consumption per annum (i.e. usage) in Units,

O = Ordering Cost for placing one order,

C_c = Carrying Cost (Including interest) of one Unit for one year (usually expressed as a percentage of the cost per unit.)

Assumptions:

- i) All costs are known and constant (i.e. Ordering Costs, Unit Costs etc.).
- ii) Rate of interest (component of Carrying Cost) is fixed.
- iii) Consumption or usage rate is constant throughout the year.

b) The price quoted for an item by the supplier is Rs. 20 per unit. A discount of 5% on the price is offered if the minimum order is for 100 units per order and a discount of 10% is offered for order size of minimum 200 units. If the ordering cost per order is Rs. 20 and the inventory carrying cost is 25% of the inventory cost, what ordering policy would you adopt if the annual average consumption of the item is 800 units? [MODEL QUESTION]

Answer:

Annual Requirement Units	Order Qty.	Average Qty. Order	No. of Orders	Unit Price after Discount	Purchase Price	Cost of Carrying	Total Ordering Cost	Total cost
(a)	(b)	(c) = b/2	d = a/b	(e)	(f) = a × e	g = c × 25 × e	h = d × 20/-	= f + g + h
800	100	50	8	19	15,200	238	160	15,598
800	200	100	4	18	14,400	450	80	14,930

Hence, second option should be adopted.

4. a) A company uses 2000 units per annum of special studs in the manufacture of its products. The studs are procured from a local manufacturer at a basic price of Rs. 10 each. The procurement cost per order is Rs. 20 and inventory-carrying cost is 20%. The supplier offers following discount on the basic price for order quantities of:

Order Quantity	Discount
400 - 799	2%
800 - 1599	4%
1600 & above	6%

What quantity should be ordered to optimize cost? [MODEL QUESTION]

Answer:

a) D = Annual Consumption = 2000 units

C_o = Procurement cost = Rs. 20/- order

I = Inventory carrying cost = 0.20.

Unit price [C_p] varies with order quantity. Basic price [C_p] = Rs. 20/-

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Order Quantity	Discount	Price
400 - 799	2%	$C_{P(1)} = 19.60/-$
800 - 1599	4%	$C_{P(2)} = 19.20/-$
1600 - above	6%	$C_{P(3)} = 18.80/-$

Calculate EOQ at each price level and determine the quantity to be purchased to get the price discount benefit.

Price	Range purchase Quantity(Q)	of EOQ	Quantity to be Purchased at the indicated price
$C_{P(1)} = 19.60/-$	$400 < Q < 799$	$\sqrt{\frac{2D C_0}{C_{P(1)} \times I}}$ $= \sqrt{\frac{2 \times 2000 \times 20}{19.6 \times 0.2}} = 143$	400
$C_{P(2)} = 19.20/-$	$800 < Q < 1599$	$\sqrt{\frac{2D C_0}{C_{P(2)} \times I}} = \sqrt{\frac{2 \times 2000 \times 20}{19.2 \times 0.2}} = 144$	800
$C_{P(3)} = 18.80/-$	$1600 \leq Q$	$\sqrt{\frac{2D C_0}{C_{P(3)} \times I}} = \sqrt{\frac{2 \times 2000 \times 20}{18.8 \times 0.2}} = 146$	1600

Annual Total Cost Calculation

Case-I [Consider $C_{P(1)} = 19.60/-$ $Q_1 = 400$]

$$\begin{aligned} ATC(I) &= D \times C_{P(1)} + \frac{Q_1}{2} \times C_{P(1)} \times I + \frac{D}{Q_1} \times C_0 \\ &= 2000 \times 19.6 + \frac{400}{2} \times 19.6 \times 0.2 + \frac{2000}{400} \times 20/- \\ &= 39,200/- + 784/- + 100/- = Rs. 40,084/- \end{aligned}$$

Case-II [Consider $C_{P(2)} = 19.20/-$ $Q_2 = 800$]

$$\begin{aligned} ATC(II) &= D \times C_{P(2)} + \frac{Q_2}{2} \times C_{P(2)} \times I + \frac{D}{Q_2} \times C_0 \\ &= 2000 \times 19.2 + \frac{800}{2} \times 19.2 \times 0.2 + \frac{2000}{800} \times 20/- \\ &= 38,400/- + 1536/- + 50/- = Rs. 39,986/- \end{aligned}$$

Case-III [Consider $C_{P(3)} = 18.80/-$ $Q_3 = 1600$]

$$ATC(III) = D \times C_{P(3)} + \frac{Q_3}{2} \times C_{P(3)} \times I + \frac{D}{Q_3} \times C_0$$

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$$\begin{aligned} &= 2000 \times 18.8 + \frac{1600}{2} \times 18.8 \times 0.2 + \frac{2000}{1600} \times 18.8 \\ &= Rs. 37600/- + Rs. 3008/- + Rs. 23.50/- \\ &= Rs. 40,682/- \end{aligned}$$

From the Annual Total Cost Calculation, We find that the cost incurred is the least when the quantity purchased is 800 nos. To optimize cost, one should opt for the 2nd strategic options (i.e., 4% discount) if the annual demand and other option remain same. Economic Purchase Quantity = 800 units.

b) What are the two costs associated with inventory management?

[MODEL QUESTION]

Answer:

Two costs associated with Inventory Management are as follows:
Ordering Cost: It is also known by the name procurement cost or replenishment cost or acquisition cost. Cost of ordering is the ordering cost of money expended to get an item into inventory. This takes into account all the costs incurred from calling the quotations to the point at which the items are taken to stock.
 Fixes costs do not depend on the number of orders whereas variable costs change with respect to the number of order placed. The salaries and wages of permanent employees involved in purchase function and control of inventory, purchasing, incoming inspection, accounting for purchase orders constitute the major part of the fixed costs. The cost of placing an order varies from one organization to another. They are generally classified under the following heads:

- (i) **Purchasing:** The clerical and administrative cost associated with the purchasing, the cost of requisitioning material, placing the order, follow-up, receiving and evaluation quotations.
- (ii) **Inspection:** The cost of checking material after they are received by the supplier for quantity and quality and maintaining records of the receipts.
- (iii) **Accounting:** The cost of checking supply against each order, making payments and maintaining records of purchases.

Carrying cost: These are costs associated with holding a given level of inventory on hand and this cost varies in direct proportion to the amount of holding and period of holding the stock in stores. The holding costs include:

- (i) Storage costs (rent, heating, lighting, etc.)
- (ii) Handling costs: Costs associated with moving the items such as cost of labour, equipment for handling.
- (iii) Depreciation, taxes and insurance.
- (iv) Costs on record keeping.
- (v) Product deterioration and obsolescence.
- (vi) Spoilage, breakage, pilferage and loss due to perishable nature.

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5. a) Classify the items into A, B and C categories:

Item Description	Annual consumption (Units)	Price per unit (Rs.)	[MODEL QUESTION]
1	3,000	200	
2	6,000	20	
3	200	500	
4	200	12.50	
5	350	9	
6	6,000	25	
7	4,000	10	
8	3,000	7	

Answer:

a) Table I: Determination of Usage value of items and ranking the items based on usage value.

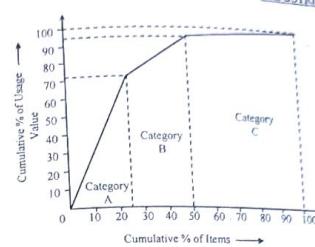
Items Description [1]	Annual Consumption (units) [2]	Price per unit (Rs.) [3]	Usage Value (4) = (3) × (2)	Ranking
1	3000	200	6,00,000	<I>
2	6000	20	1,20,000	<II>
3	200	500	1,00,000	<IV>
4	200	12.50	2500	<VII>
5	350	9	3150	<VII>
6	6,000	25	1,50,000	<II>
7	4,000	10	40,000	<V>
8	3,000	7	2,000	<VI>

Table II: Determination of Cumulative Usage value and category determinants.

Rank (1)	Item No (2)	% of Items (3)	Cumulative Usage Value (4) (Rs)	Cumulative % in Rs. (5)	Category
<I>	1	12.5	6,00,000	58.0	A
<II>	6	25.0	7,50,000	72.0	
<III>	2	37.5	8,70,000	84.0	B
<IV>	3	50.0	9,70,000	94.0	
<V>	7	62.5	10,10,000	97.0	
<VI>	8	75	10,31,000	99.0	
<VII>	5	87.5	10,34,150	99.75	C
<VIII>	4	100	10,36,650	100	

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b) Derive the basic formula for Economic Order Quantity for model without shortage. [MODEL QUESTION]

Answer: Inventory Model when shortages are permitted

Assumptions

- i) C_h is the holding cost per quantity unit per unit time
- ii) C_s is the shortage cost per quantity unit per unit time.
- iii) R quantity per unit time is the demand rate.
- iv) t_p is the scheduling time period which is constant
- v) q_p is the fixed lot size ($q_p = R t_p$)
- vi) Z is the order level to which the inventory is raised in the beginning of each scheduling period. Shortages, if any, have to be made up. Here Z is the variable.
- vii) Production rate is infinite
- viii) Lead time is zero.

Determine:

- (a) Optimum order level Z
- (b) Minimum average cost.

6. ABC Co. wants to buy a product. The price discount is as follows: [MODEL QUESTION]

Quantity	Unit Price (Rs.)
Less than 500	12
500 but less than 1600	11.80
1600 but less than 4000	11.60

Annual demand for the material is 8000 kg, ordering cost per order is Rs. 12/- and stock holding cost is 20% of the cost of material per annum. You are required to compute the best ordering quantity and total annual inventory capital.

Answer:

Annual Demand (D) = 8000 kg; Ordering cost per order (C_o) = Rs. 12/-

Inventory carrying cost (I) = 0.20, Unit price (C_p)

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EOQ at these three prices are given below:

Price (Rs.)	Range of price quantity (Q)	EOQ	Quantity to be purchased
Rs. 12	$0 < Q < 500$	$\sqrt{\frac{2 \times D \times C_o}{C_p \times I}}$ $= \sqrt{\frac{2 \times 8000 \times 12}{12 \times 0.20}}$ $= 282.85 \approx 283$	283
Rs. 11.80	$500 \leq Q < 1600$	$\sqrt{\frac{2 \times D \times C_o}{C_p \times I}}$ $= \sqrt{\frac{2 \times 8000 \times 12}{11.80 \times 0.20}}$ $= 285$	500
Rs. 11.60	$1600 \leq Q < 4000$	$\sqrt{\frac{2 \times D \times C_o}{C_p \times I}}$ $= \sqrt{\frac{2 \times 8000 \times 12}{11.60 \times 0.20}}$ $= 288$	1600

Case I Cost of unit (C_p) = Rs. 12/-, Order Quantity (Q) = 283

Total cost of Inventory = (Annual cost of material) + (Annual Order Cost)
+ (Annual Inventory carrying cost)

$$= (D \times C_p) + \left(\frac{D}{Q} \times C_o \right) + \frac{Q}{2} \times C_p \times I$$

$$= (8000 \times 12) + \left(\frac{8000}{283} \times 12 \right) + \left(\frac{283}{2} \times 12 \times 0.20 \right)$$

$$= 96,000 + 339.22 + 339.6 = \text{Rs. } 96,678.82/-$$

Case II Cost of unit (C_p) = Rs. 11.80/- Order Quantity (Q) = 500

Total cost of Inventory

$$= (8000 \times 11.80) + \left(\frac{8000}{500} \times 12 \right) + \left(\frac{500}{2} \times 11.80 \times 0.20 \right)$$

$$= \text{Rs. } 94,400/- + \text{Rs. } 192/- + \text{Rs. } 590/- = \text{Rs. } 95,182/-$$

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Case III Cost of unit (C_p) = Rs. 11.60/- Order Quantity (Q) = 1600

$$\text{Total cost of Inventory}$$

$$= (8000 \times 11.60) + \left(\frac{8000}{1600} \times 12 \right) + \left(\frac{1600}{2} \times 11.60 \times 0.20 \right)$$

$$= \text{Rs. } 91,200 + \text{Rs. } 60/- + \text{Rs. } 1856/-$$

$$= \text{Rs. } 93,116/-$$

Considering the above three cases, strategically we can say that the Case III situation is the best alternative, as this strategy can save (Rs. 96,678.82 - Rs. 93,116) = Rs. 3568.82 over Case I and it can save (Rs. 95,182 - Rs. 93,116) = Rs. 2,066/- over Case I.

Best ordering Quantity = 1600 kg per order; total annual inventory capital, Rs. 93,116/-

7. From the following information, calculate the minimum, maximum and re-order level:
[MODEL QUESTION]

Maximum consumption	200 units per day
Minimum consumption	150 units per day
Normal consumption	160 units per day
Re-order period	10 to 15 days
Normal re-order paid	12 days
Re-order quantity	1600 units

Answer:
Re-order Quantity = 1600 units.

Considering normal consumption as general case, then normal consumption would be 160 units per day and normal re-order paid 12 days.

Lead time (considering normal consumption) = 12 days.

Lead time consumption = [lead time × consumption rate (per day) considering normal consumption]

$$= [12 \times 160] = 1920$$

Minimum stock or safety stock = (Maximum lead time - normal lead time) × consumption rate

$$= (15 - 12) \times 160$$

$$= 3 \times 160$$

$$= 480$$

Reorder level (ROI) = Safety stock + lead time consumption

$$= 480 + 1920$$

$$= 2400$$

Maximum level has been reached, when the consumption level is minimum then, lead time consumption

$$= 15 \text{ days} \times 150 \text{ units per day}$$

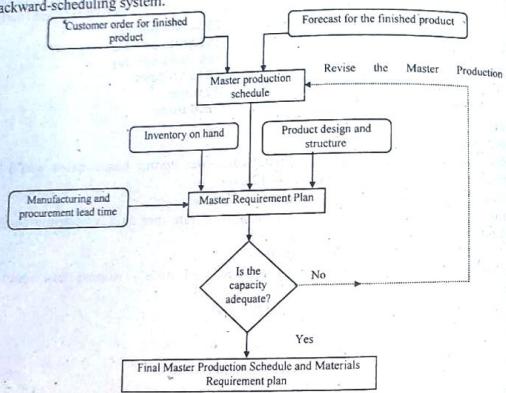
$$= 2250$$

$$\text{So, maximum level of inventory} = (480 + 2250) = 2730$$

8. What is materials requirement planning? What are the inputs of MRP? Discuss the steps involved in materials requirement planning.
[MODEL QUESTION]

Answer:
MRP-I (Materials Requirement Planning)

Materials requirement Planning is an ordering and scheduling system for manufacturing and fabrication industries. It uses bill of materials data, inventory data, and master production schedule to project what material is required, when, and in what quantity. MRP places orders for dependent-demand items (such as raw materials, components, etc.) over a period to synchronize flow of materials and in-process inventories with production schedules. It also computes and tracks effect of hundreds of variables such as new orders, changes in various capacities, overloaded production centers, shortages, and delays by suppliers, and feeds financial data into the accounting system. In contrast to just in time inventory (a demand-pull production system), MRP is a plan-push system, and in contrast to advanced planning systems (a forward scheduling system) it is a backward-scheduling system.



MRP is calculation of the requirement of the **dependent demand item** i.e., items whose demand is dependent upon the demand for their respective higher level items, and a reconciliation of this requirement with the production capacity available. The end product in a company would be the **independent demand** items if the demand for these is not easily computable based on the demand for other items else where.

Functions of MRP I:

- 1) **Order planning and control:** when to release orders and for what quantities.
- 2) **Priority planning and control:** how the expected date of availability compares to the need date for each item.

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3) **Provision of a basis for planning capacity:** requirement and development of broad business plan.

Inputs of MRP-I

- a) The final product is complex and is made up of several levels of assemblies and sub-assemblies which have many common part and sub-assemblies.
- b) The procurement lead time for components is relatively long.
- c) The manufacturing cycle is long for the finished product.
- d) The demand for the product is known.

Inputs to the Materials Requirement Planning System

❖ **Inventory records:** A major input to the MRP system is inventory. When a calculation is made to find out how many are need, the quantities available must be considered.

There are two kinds of information needed. The first is called **planning factors**.

The second kind of information necessary is on the status of each item.

❖ **Master production schedule:** It is the backbone of an MRP system. A master schedule gives the product wise quantities to be purchased / produced over the planning horizon.

❖ **Bills of Material Structure:** A bill of material structure refers to the overall design for the arrangement of bills of material files. Different departments in a company use bills of material for a variety of purposes. Although each user has individual preferences for the way the bill should be structured, the must be only one structure, and it should be designed to satisfy most needs.

Steps of MRP I

MRP is composed of a series of 12 steps.

Step 1: Determine the gross requirements of the finished products

The gross requirement is the aggregate quantity take from three sources:

- i) Period wise pending sales orders on hand.
- ii) Period wise forecasted sales.
- iii) Management decision to alter quantities derived under i) and ii) above to smoothen production.

Step 2: Determine the net requirement of finished product

The gross requirements obtained in step 1 are adjusted by the available inventory of the product to obtain net requirements.

That is –

Net requirements = Gross requirements – Inventory available.

Step 3: Develop a master production schedule

From the Net requirements, for each time period as determined in step 2, a master production schedule is prepared. Master production schedule is the key to MRP-I.

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A master production schedule expresses the overall plan of production. It spells out the different products to be manufactured over the given time span.

Step 4: Explored the Bill of Materials and determine gross requirements of parts
For each assembly, a structured Bill of Materials is available and it contains the information to identify each item of the assembly and the quantity required per assembly of which it is a part.

Step 5: Screen out B and C category of items

Step 6: Determine the Net requirements of items

The gross requirements of an item obtained in step 4 is adjusted for the "Stock on hand" and "Stock on order". At times, it may be found that the item is over stocked and does not require to be replenished and at other times, it needs to be ordered/ manufactured.

Step 7: Adjust requirement for scrap allowance

Depending upon criticality of the dimensions, there may be some rejection during manufacturing which needs to be accounted for so that correct numbers will be available for assembly. This is usually done by estimating the percentage of loss and adding it to the net requirement when the item is being ordered. In a computerized MRP system the percentage loss is kept in the file so that it may be automatically added when the item is being ordered.

Step 8: Schedule planned orders

Once the quantity of an item is determined, the next logical step is to schedule it. While scheduling, manufacturing cycle time is taken into account and to that extent the item is offset for delivery. The offset information on the items can be kept in a file record for ready reference.

Step 9: Explode the next level

As mentioned in step 4, the entire assembly is not exploded at one time but it is done level by level, after all previous steps have been completed. That is, each level of explosion is followed through step 5 to 7 and the steps from 5 to 7 are repeated again until the entire assembly has been exploded through all levels and quantities of items determined and time phased.

Step 10: Aggregate requirements and determine order quantities

Some of the items may be common to a number of assemblies and at various levels. It will be, therefore, wrong to place an order each time and item appears during explosion but wait until the demand is developed after entire assembly of each product has been exploded and then aggregate the demand so that just one order can be placed.

Step 11: Write and place planned orders

After the requirement of each product has been determined, their purchase orders / work orders can be printed in the form of a computer printout.

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Step 12: Maintain schedules

Writing the order is no assurance that the product will be delivered on time. Regular follow up is necessary. Expediting may require to be done in some cases until the product is ready to be delivered to the customer.

9. Explain the different method of purchasing. What are centralized and decentralized systems of purchasing? [MODEL QUESTION]

Answer:

Different types of Buying Methods

i) **Hand to Mouth Buying**

Hand to mouth buying also called "buying according to the requirements". It refers to the frequent purchases of an item in small quantities. Important characteristics of hand to mouth buying are undertaken:

- a) When demand arises.
- b) To cover immediate requirements.
- c) When the quantity purchased is small.
- d) When there is emergency or urgency.

Advantages:

- i) Inventory investment Low.
- ii) Carrying charges is Low.
- iii) Losses will be lesser when price declines.
- iv) Reduced deterioration and obsolescence of materials.

Disadvantages:

- i) Higher clerical costs.
- ii) In emergency case quality may be degraded.
- iii) Increase in prices may lead to loss.
- iv) In urgency buyer may have to buy the materials with high price.

Criteria:

This method applies to:

- a) Items whose prices are expected to fall in the near future;
- b) Items which are perishable;
- c) Items required for under development products in product development phase;
- d) Items which are used infrequently and would not be required to stock;
- e) Cover immediate requirements of a stock items caused either due to delay in delivery from regular supplies or due to increase in consumption;
- f) Replacement spares;
- g) Bulky Materials

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2) Speculative buying

Definition: Speculative buying refers to the buying large requirements of an item when its price is low with the intention to sell bulk of it at a higher price for speculative profits.

Characteristics:

- i) An item which is not required for production may be purchased.
- ii) Its single aim is to make speculative profits when price of the commodity increases.
- iii) The quantity purchased is high.

Advantage:

Speculative profit can be earned

Disadvantages:

- Investing large amount of capital.
- Storage problem.
- Risk of obsolescence.
- Inventory holding cost higher.

3) Hedging

One of the techniques used to minimize the risk associated with fluctuation of prices is Hedging.

Hedging is used to protect an organization, or business from an open exposure in the foreign exchange market. By using hedging, the trading party is protected from loss, - the risk of advance changes in the price of an asset.

Hedging is used by both traders to eliminate foreign exchange risk in international and by multinational corporations to avoid foreign exchange risks in the translation of their financial statement into dollars.

In order to protect their business traders have got two options (i) **hedging in Spot exchange rate** and (ii) **hedging in Forward exchange rate**.

(i) Hedging in Spot exchange rate

If the contract with the customer to buy or sell foreign currency is agreed upon and executed immediately it is known as **spot transaction** and the rate quoted is the spot rate.

Example: purchase of an export bill. Here the customer tenders the bill for which the bank quotes a rate. If the rate quoted by the bank is acceptable to the bank, the bill is purchased by the bank and the account of the customer is credited with the amount.

(ii) Hedging in Forward exchange rate.

A "future" transaction takes place where the purchase is made now at the quoted price, while the actual delivery will take place at a future date to be specified in the contract.

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4) Forward buying / Market purchasing:

Definition: In this case a buyer may enter in to a long term contract with a vendor, say for one in this one year vendors, and say for one year. In this one year time span the delivery only a single delivery.

Example: suppose buyer enter in to contract in March for one year and seller supply the material in September and it will be single delivery. But, the purchase contract inclusive of price, delivery date and other terms concluded in January

Reasons:

- i) It is a safeguard in regard to continuity of supplies.
- ii) It protects the price over a long period.
- iii) It is a safeguard in respect to standard of quality.
- iv) For seasonal product forward buying can be seen.

5) Scheduled Buying

Definition: Scheduled buying is the process of procuring an item in slower deliveries according to the delivery schedule furnished to the supplier by the buyer.

The salient characteristics of scheduled buying are:

- i) A purchase order covering annual requirements is placed to the supplier.
- ii) The supplier is given the estimate of the procurement needs covering a mutually agreed period of time.
- iii) When fresh delivery schedules are given to the supplier prior to completion of the previous schedule. Fresh schedule supersedes the previous schedule.
- iv) Monthly deliveries are usually specified except for perishable materials, bulky items and others required in large quantities

Advantages:

- i) This is a win-win situation where both buyer and seller enjoy the savings resulting from regularity of production and smaller inventories.
- ii) Buyer is assured of supply of goods while supplier is assured of business.
- iii) Supplier can effectively plan his factors of production while buyer can plan his requirements of finance.

Criteria:

Scheduled buying is best suited for –

- Items of regular use, Proprietary items and items produced according buyer's design.

6) Contract Buying

Definition (According to Spiegel): "Contract buying is the purchasing made under contract, usually formal, of needed materials, the delivery of which is frequently spread over a period of time."

Characteristics:

- a) Contracts are given to suppliers for large amount of future requirements or for a certain period.
- b) Quantity received per occasion is small.

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- c) The cycle time between two consecutive receipts may be any period considering the value of requirements, distance and the mode of transport;
- d) The buying department usually finds sufficient time to secure competitive bids and negotiate terms of contract.

Advantages:

- i) It saves time and money of the company from the inviting quotations, preparing comparative statements, placing of orders, etc.
- ii) It ensures regularity in supply.
- iii) The buyer needs to keep very little working stock and safety stock. So that capital blockage is minimum.
- iv) The buyer can plan their financial requirement as they have a prior idea about payment to vendor.

Types of contracts:

Contract buying is of three types:

- **Rate contract:** In this case rate is fixed but, quantity is not fixed.
- **Running contract:** Here the rate and the quantity both are fixed for the contract period.
- **Service contract:** In this case various services are obtained periodically.

Criteria:

Contract buying is suited to the procurement of materials and production items of regular use.

7) Blanket Orders

Definition: Blanket orders refer to the purchase of variety of items from single source, usually a middleman.

Characteristics:

- a) A blanket order specifies the categories of items covered by the order;
- b) The supplier is given requirements on phone who supplies at the prevailing prices with discount.
- c) The items covered by the order generally have low unit price;
- d) More than one middlemen may be selected ensure right time of delivery

Responsibility of the buying department:

- i) The middleman who is selected should be located nearer to buyer and should have large stock facilities (warehouse) and who are known for their honesty and reliability.
- ii) The buying department must watch the items in the groups and periodically check up whether the demand for any item has risen considerably.

Criteria:

The method is best suited to general hardware, electrical supplies, stationery.

8) Tender Buying

Generally government departments and public sector undertakings in India follow this method of buying.

Characteristics:

- i) The buying department establishes a bidder's list and invites them to submit bids (quotation)
- ii) Bids on receipt are evaluated by comparison and the right supplier is selected. Mainly lowest price is the criterion of this method. But, when supplier quoting the lowest price has questionable delivery time, quality, reliability or financial stability they may be evaluated under different criteria.

Advantage:
By tender buying is the purchaser can select qualified supplier on the basis of competitive price.

- i) It eliminates favoritism, patronage and personal preferences.

Disadvantages of the method:
Tender buying is costly and time-consuming.

Types of Tenders:

Tenders are of four types:
i) Single tender refers to the system of tendering wherein the details of the requirements are communicated only to one firm.

ii) Limited or closed tender refers to the system of tendering wherein enquiry is sent to a limited number of suppliers who are on the approved list of suppliers and bids are received in response.

iii) Open tender system is the system of tendering wherein the enquiry is advertised in the newspapers or periodicals. in response. It may be termed as 'open tender', 'advertised tender', or 'unlimited tender' is used.

iv) Global tender is the system of tendering wherein the enquiry is advertised in the newspapers and trade journals of not only of the home country but also in the foreign country.

9) Seasonal Buying

Definition: "Buying of the annual requirements of an item during its season". This method is used for items available in particular season only. Example: Food processing industry.

- a) The items involved are seasonal and therefore need to be purchased and stocked in sufficient quantities till the next season (e.g. oranges, sugarcane, apples, mangoes etc.).
- b) Usually purchases are made directly from producers / farmers of the goods.
- c) The items covered may be small in size but they are required in large quantity.

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- d) Market price is the lowest during the season. Therefore, the items can be purchased at the cheapest rates:

Criteria:

- Purely seasonal products
- Items which are having high price in off season.

10) Group Purchasing

Definition: 'buying of items in a single purchase order'.

Characteristics:

- a) Items required in small quantities are classified into few basic groups. These basic groups depend on the source of purchase.
- b) Inventory levels are fixed for each item within each classified group.
- c) One purchase order – one for each group – covering a number items within its group.
- d) Stocks-on-hand are reviewed periodically.
- e) Replenishment is also done

Advantages:

Group purchasing reduces clerical and delivery costs, because, one order is placed for a number of varied small items instead of an individual order for each item.

11) Sub-Contracting

Definition: Sub-contracting is the hiring of another firm to perform some of the manufacturing operations or assembling or producing certain parts and sub-assemblies to be incorporated into the buyer's end product.

Types of sub-contracting:

Sub-contracting is of two types:

- i) The company makes some units of the final product on their own shop and buys balance from outside.
- ii) The company buys some assembly form outside.
- iii) The company can do certain operations like electroplating, heat-treatment, rough blanking etc. done from others

Conditions:

Sub-contracting is desirable when –

- i) The product involves number of components requiring different types of machines.
- ii) Special expertise is required for certain operations and this is not available in the buyer's firm.
- iii) There is lack of capacity at the home plant
- iv) If the cost of buying is less than cost of production then company may buy materials from outside.

Responsibilities of the buying department:

- i) The buying department has to locate, select and develop qualified sub-contractors who can supply parts of right quality, in right quantity, at right cost in right time

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ii) Sub-contractor should be located within close proximity. Because,

- Transportation cost, and time is less.
- Follow up is easy and less costly.
- Buyer can have better control on supplier's quality
- iii) More than one sub-contractor should be selected for each component.
- iv) Maintain supply of goods from alternate source in the event of any production hold-up with one of the sub-contractors.
- v) Buyer should ensure the quality of the materials which are required to make final product.
- vi) Delivery scheduling is the most important aspect of sub-contracting.
- vii) Buyer can give financial, marketing and administrative support to the supplier to ensure time, price, delivery of goods (in the time of natural condition and in the time of emergency)

Central Purchase Organisation

A large firm in the public or private sector may have section-wise stores at different places. The requirements of these stores can be satisfied by either of the following two methods:

- i) Each store to make its own purchases.
- ii) A central stores to make purchases and supply material in turn to section wise stores.

The advantages of central stores purchases are:

- i) The central purchase organisation (CPO) can obtain quantity discounts, lower rate and better contract terms due to large purchases made possible due to consolidating the requirements of individual stores.
- ii) Malpractices by individual purchase officers by some kind of understanding with the local dealers which can result in purchase at higher prices are avoided.
- iii) The Central Purchase Organisation can exercise strict control on consumption thereby minimizing the risk of malpractices.
- iv) The central purchase organisation can contract directly with the manufacturers and obtain items as per specifications. Individual section stores may not be able to do this.

Examples:

Reserve Bank of India, State Bank of India, etc.

Directorate General Suppliers & Disposal (DGS & D)

The DGS and D is the Central Purchasing Organisation for the various government departments. It enters into contract with various firms for the supply of certain materials to the government departments during the year at the agreed rate. A formal document raised for the purpose is called "rate contract".

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Centralized and Decentralized Purchasing

Centralized Purchasing:

When the purchasing function is entrusted to a single person, it is said to be centralized purchasing. It means all purchases are made by the Purchasing Officer. Generally large and medium size organisations accept centralized purchasing.

Merits of Centralized Purchasing:

- Centralized purchasing avoids duplication, so buying cost will be less.
- Departments other than purchasing are relieved from the burden of purchasing. As a result of which employees concentrate their mind in own work.
- Transportation cost and carrying cost become economical, because all purchases are made in bulk quantities.
- More trade discount can be availed due to bulk purchase.
- All the records with regard to purchase are kept in one place under the supervision of the purchase officer. It results economy in record management.

Demerits of Centralized Purchasing:

- Delay is caused in centralized purchasing as different departments of different places will send their requirements to the purchasing department. The purchasing department will purchase the necessary items and send to other departments.
- In this case centralized purchasing branches of different places can not take advantages of localized purchasing.
- There are chances of misunderstanding between purchase department and other departments because other departments may not get their requirement according to their own will.
- Centralized purchasing is not suitable in case of perishable commodities.
- It results more cost of transportation and botheration, as it is purchased in one place and send to the distance places

Decentralized purchasing:

Decentralized purchasing refers to purchasing materials by all departments and branches independently to fulfill their needs. Such a purchasing occurs when departments and branches purchase separately and individually. Under decentralized purchasing, there is no one purchasing manager who has the right to purchase materials for all departments and divisions. The defects of centralized purchasing can be overcome by decentralized purchasing system. Decentralized purchasing helps to purchase the materials immediately in case of an urgent situation.

Advantages of Decentralized Purchasing

- Materials can be purchased by each department locally as and when required.
- Materials are purchased in right quantity of right quality for each department easily.
- No heavy investment is required initially.
- Purchase orders can be placed quickly.
- The replacement of defective materials takes little time.

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Disadvantages of Decentralized Purchasing

- Organization losses the benefit of a bulk purchase.
- Specialized knowledge may be lacking in purchasing staff.
- There is a chance of over and under-purchasing of materials.
- Fewer chances of effective control of materials.
- Lack of proper co-operation and co-ordination among various departments.

10. Define codification and write down the advantages of codification.
[MODEL QUESTION]

Answer:

Codification: Codification in an industry is the systematic concise representation of equipment, raw materials, tools, spares, supplies, etc. in an abbreviated form complying alphabets, numerals, colors, symbols etc.

Objective of codification:

- a) To classify and codify the items on some logical basis to suit the objective of the organization.
- b) To assist the process of standardization and variety reduction.
- c) To facilitate proper functioning of the store house.
- d) To ensure that each item is kept under one unique code.
- e) To prepare a catalogue – nomenclature list to reduce ambiguity.
- f) To make available the catalogue to all concern dept.

Benefits of codification:

1. **Accurate and logical identification:**
 - Codification distinguishes one item from another item.
 - Helps in accurate identification which eliminates any confusion.
2. **Avoid long description:**
 - Codification reduces the chance of using long description of items which leads to incorrect and wrong typing of item name.
3. **Prevention of duplication:**
 - Items in absence of codification require to be described by brand names, trade names, or, technological names and as such they often requisitioned by different personnel under different names.
 - This can result in stocking of an item at different places under different names.
 - Codification system prevent duplication.
4. **Product simplification:**
 - A basic reason for codification is the simplification (i.e. reducing unnecessary variety) and standardization (i.e., regulating variety).

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Objectives

- a) For proper codification, grouping of identical items is essential.
- The most commonly used method is to take up an item group. Within its main classification list down variety in use, identify variations among the variety and prepare the vocabulary.
- b) Vocabulary (i.e., manual on codification) lists down all the items in stock according to the basic characteristics which provides a quick reference for the personnel from design and planning to know what variety already exists.

5. Smoothening the purchase activities:

Codification makes the purchase activity efficient due to the following:

- i) It helps to avoid long clerical activities.
- ii) Codes avoid the ambiguities.
- iii) Buying instructions to the suppliers become easy and quick if there is proper understanding of codification by the supplier.
- iv) Codification classifies the items in to groups which in a large sized firm enable section wise organization of purchase department based on group codes.
- v) Purchase records too can be maintained according to the group codes and different documents can also be filed accordingly.

6. Efficient storekeeping:

Codification facilitates locating and indexing of the materials in the main stores, sub stores, finished parts stores and warehouses.

7. Accurate and reliable recording and accounting:

Codification leads to effective store control, efficient recording and result-oriented accounting.

8. Others:

Codification –

- a) Helps to look for alternative at a time when the stock of a particular item is nil.
- b) Ensures proper quality description of the item which assists in efficient inspection.
- c) Simplifies costing and pricing since, due to codes cost can be calculated job wise for which different cost heading can be provided.
- d) Assist production since manufacturing runs can be planned on the concept of group technology.
- e) Assists management in their efforts to earn a good return on its investment. This being possible due to the various benefits of codification enumerated above.

Three Basic Stages of Scientific Codification

Three basic stages of scientific codification are: **Identification, Classification, and Codification.**

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a) **Identification:** it is the process of assigning correct nomenclature to the items. The nomenclature description must take into consideration the specification and technical name of the item. Identification system should be uniform for all items.

b) **Classification:** it is the arrangement of items in to groups according to the common features of the items. The grouping of stores items which may be done on the basis of "description", "supplier", "origin", "value" or "function" of the item.

i) **Description classification:** it refers to the grouping of items of similar description, irrespective of the end use, into one class.

ii) **Nature of materials:** items under this method are classified according to their nature such as raw materials, machinery, machinery and equipments, consumable items, chemicals, etc.

iii) **Source of purchase:** Under this the items are classified according to sources of procurement.

iv) **Source of origin:** This classification is rarely used except in cases of spares of machinery.

c) **Codification:** "it is the allocation of specific codes to the items within the broad frame work of the selected items".

Characteristics:

i) **Simplicity:** The system must be simple in its form. Personnel without any external assistance and without much of training can handle this.

ii) **Small:** The codes should use minimum possible number of characters/ digits/ symbols.

iii) **Flexibility:** The system should be flexible enough to comply with different situation.

iv) **Uniqueness:** The system should ensure one and only code for each item. That is each item should have a unique identification code.

v) **Proper choice of coding symbol:** The selection of the symbols especially in alpha - numerical system, should be such that there is no possibility of confusion. O, s, z, l, v should not be used because, they are similar to 0,5,2,1,u.

vi) **Self decoding:** The codes should be capable of being easily decoded.

vii) **Convenient for accounting:** the system should be convenient for accounting.

Basic System of Codification

Coding systems adopted by various organization may be classified under—

- 1) Alphabetical.
- 2) Numerical
- 3) Alpha-numerical
- 4) Color coding system

I. Alphabetical:

In this method letters or alphabets are used to describe an item. Sometimes combinations of alphabets are designed to give a mnemonic meaning.

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Methods:

- a) Each material group is assigned alphabet(s) as basics. Usually first one or two alphabets in the title of its material group is taken as the starting point of the code.
- b) Sub-alphabets, based on the characteristics of the items, are used for their identification.

Example:

Particulars	Sub-alphabet	vocabulary
I Acids (AC)	SU	AC-SU
i. Sulfuric acid	NI	AC-NI
ii. Nitric Acid	HC	AC-HC

Advantages:

- i) Simple to understand and easy to use
- ii) Do not require any formal training in code allotment or in its implementation.

Disadvantages:

- a) Codes are difficult to remember.
 - b) Chances of duplication.
 - c) Repetition of alphabets often leads to confusion.
 - d) Selection of proper alphabet is difficult.
2. **Alpha- numerical system:**
 Alpha-numerical system is the combination of alphabetical and numerical systems and is in improvement over the alphabetical method. The system operates as under:
- i) Each item is identified and is given a proper description.
 - ii) Identical items are classified into groups and each group is provided a suitable title.
 - iii) Codes are assigned next to the group, which are usually alphabets.
 - iv) Individual items within each group are assigned numbers based on block system or decimal system.

Item Group	Item main	Sub	Codes vocabulary
I	Acids:		
i. Sulfuric acid	(AC)	51	AC-51
ii. Nitric acid		52	AC-52
iii Hydrochloric acid		53	AC-53

3. Numerical system:

The numerical system is based on use of numbers. Three sub-systems within this category are:

- a) **Sequential code:**
 - The system is suitable for small organisation where the number of items is limited.

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- Each item is assigned a number and the new item is allotted the next higher number.
- After each allocation few numbers are reserved for future. These reserved numbers are allotted to new items in future when expansion takes place.

Example: manufacturer of water pumps coded following items as under.

Sr. No.	Item description	code
1.	Housing	1001
2.	Impeller	1002
3.	Cover	1003
4.	Inner gasket	1004

b) Block code:

- Under a block code system, items of similar nature are grouped together and a block of numbers is assigned to each group.

Example:

1001 to 2000	for raw materials
2001 to 3000	for electrical items
3001 to 4000	for mechanical item.

The block numbers may be further subdivided according to the need.

c) Decimal code:

- In this system a group of numbers separated from each other by a decimal point, identifying the general (or main) category of items, sub -category and individual items.
- The **first** category called general category divides the items in to main classification such as raw materials, electrical items, mechanical items, packaging and packing materials, etc.
- The **second** category called sub-category divides the main classification into sub-classification according to their nature, use or characteristics. Electrical items group may be sub-divided in to wires, fuses, plugs, shades, cutouts, etc.
- The **third** category called item category divides the sub-category into individual items within the sub-category.

Main class: tools (40)

Sub-classes: drills (01), tapes (04), etc.

Process of Codification

1. **Coding by end-use:** groups or sub groups may be evolved keeping in view the purpose for which the items are eventually employed.
2. **Coding by source of supply:** sometimes codification of an item done according to its source of supply.
3. **Coding by nature of items:** groups may be based on inherent characteristics.
4. **Coding customer wise:** groups may be based on end user.

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Codification systems:

There are two universal systems of classification and codification:-
1. Brisch system: Brisch system of classification was conceived by Mr. E.G. Brisch and was evolved by jointly with Mr. J. Gombinski. It is one of the most popular systems used in the industrial applications. The system is primarily design oriented and it divides all facets of an organization into number of main categories (ten or less) according to the nature of the business.

A 10 – digit typical class breakdown in an engineering company is given below.

- 0 – Organization and operations.
- 1 – preliminary materials.
- 2 – bought out commodities.
- 3 – components (single piece parts) to user's own design.
- 4 – sub assemblies and assemblies to user's own design.
- 5 – tools and portable equipment.
- 6 – plant and machinery.
- 7 – building, services, and utilities.
- 8 – Scrap and waste.
- 9 – Reserved.

The first digit of the code, depending upon class of the item, is picked up from the above series and all other digits are tailor-made to the client organization.

How to use this system:

The Brisch system basically consists of blocks separated by decimal point :

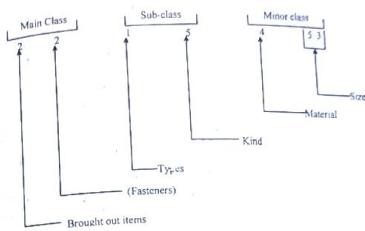
- The first block represents major classification. The materials to be coded are grouped together based on one of the classification systems (e.g. raw materials, packing materials, fasteners, stationary, tools, finished products, etc.). Usually, 2 digits (xx) are adequate for most of organization.
 - The second block represents the next level classification (next to primary classification). The items are divided and sub-divided based on their types and kinds. Usually, two digits are enough for secondary classification.
 - The third block represents the lowest level classification (usually dimensions, appearance, other distinguishing features)
- As mentioned above, the codes are assigned in three blocks separated by decimal point. Total number of digits can vary as per needs of the user but the common figure is seven.

2. The Kodak system:

This system was originated by the Eastman Kodak Company of New York, USA. The system is primarily based on numerical system of codification and it combines all the good points of other systems. The system employs ten – digit-numerical-code. The composition of code is in three groups of digits that are separated by hyphens. The hyphens serve to break the code into easy to handle group of digits.

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Salient characteristics:

- Materials are divided in to few broad classifications, called basic classifications.
- The number of basic classification is restricted to 100 and first two digits, between 00 to 99, are employed to indicate the basic classification of the item.
- The classification of materials is primarily based on purchase category. This system does not consider nature, use or characteristics for basic classification.
- The items are grouped according to purchase categorization.

Basic class (preliminary class): Materials based on purchase categorization:

First two digits (00-99)

Main class code

00-20
21-35
36-40
41-49
50-52
53-68
69-78
79-83
84-87
88-99

Raw materials
Machines and Mechanical Equipment.
Mechanical product and loose tools.
Electrical products and Electrical equip.
laboratory equip.
chemical, chemical equip. and misc. chemical product.
office equip. and other misc. items.
office equip. and other misc. items.
furniture and fixture.
Semi-finished and finished product.
Miscellaneous.

- Each preliminary class is further divided in to sub-classes (representative group). To illustrate the concept, we list below the subclasses of one of the basic classifications (say 40 covering cutting tools).

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Sub-division of basic classification

Main class	Sub-class (code)	Description (kind of cutting tool)
Cutting tools (40)	0	Drills, reamers, counter bores, broaches
	1	Cutters and hobs
	2	Single point tools
	3	Taps and dies

To form sub-groups, same factors and reasoning which apply to classes themselves are made applicable to sub-classes. For example,

- a) Drills, reamers, counter bores, etc. which are generally made by the same manufacturer and are used on the same machine are grouped together and are placed in one class.
- b) Tools required cutting threads – taps, dies, chasers, etc. are put together.
- c) Bar stocks are placed in one group while casting and forging are placed in different group.
- iii) Each sub-class is next amplified/ divided in to kinds of items. The kinds are arranged alphabetically within the sub-class.
- iv) Each kind of item is further split up into "types". Identification by alphabetization is continued further and each kind is divided in to "types". Next two digits – sixth and seventh digit of the two digits are assigned to the various types of particular kind.
- v) Each type of item is next arranged according to its size and next two digits – eighth and ninth digits – are utilized for the purpose.
- vi) The last digit – tenth digit – is assigned to minor variables such as :

 - a) Types of steel.
 - b) Surface finished desired
 - c) Special tolerance.
 - d) Source of origin.
 - e) Usage value classification.

- vii) Exception to the pattern discussed above is made in order to fit special kind of materials

3. Color Coding:

Color codes find their use in identification of raw materials, lubricants, pipelines, etc.

i) Color code for identification of pipelines

The Bureau of Indian Standards (BIS), vide there is : 2379 of 1963 has suggested the color identification as under:

Sr. No.	content	Ground color	First color band	Second color band
1	Cooling water/ chilled water	Sea green	French blue	-
2	Drinking water	Sea green	French blue	Signal red
3	treated soft water	Sea green	Light orange.	-

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ii) Color code for raw materials:
No standard system exists for color code for identification of raw materials. The practice varies from company to company.

iii) Color codes for lubricants:
Color codes find their application in the maintenance departments as well. Different colors may be specified for different types of lubricant. Color codes can also be applied to identify the lubricant to be applied to a particular point.

11. a) What do you understand by scientific storekeeping? State the main objectives of it.
b) Name the different types of store & explain briefly the function of each store.

[MODEL QUESTION]

Answer:
a) Scientific Store keeping is a service function which deals with the physical storage of goods under the custodianship of a person called storekeeper or stock controller. Goods stored may be either "stores" or "stocks". Materials which are not used in work or raw materials are usually referred to as "stores" and the place where they are kept is known as "store room".

- Objective of Scientific store keeping:**
- 1) The main objective is to provide uninterrupted supply of the raw materials, equipments, tools, components, to the user department.
 - 2) Receive the materials (raw materials, components, tools and equipments) and check the materials in respect to bills of materials.
 - 3) Receive, inspect, and issue the materials.
 - 4) Receive and issue finished goods.
 - 5) Accept, store, arrange scrap for disposal.
 - 6) To provide adequate and proper storage & preservation so that obsolescence and damage of materials will be minimized.
 - 7) To provide proper safety and security to materials & personnel.
 - 8) To meet the demand of the consuming departments by proper issues and account for the consumption.
 - 9) To minimize obsolescence, surplus, and scrap through proper codification, preservation and handling.
 - 10) To ensure good house keeping, so that material handling, material preservation, stocking, receipt and issue can be done adequately.
 - 11) To assist in verification and provide supportive information for effective purchase action.

b) Types of Stores

According to function (functionally) stores are of five types.

1. Receiving stores.
2. Main store.

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3. Finished product store (warehouse)
 4. Special store.
 5. Scrap yard.
- According geographical area stores are of four (4) types:
1. Central store
 2. Regional store.
 3. Divisional store.
 4. Sub store.

1. Receiving stores: it is concerned with receiving the materials on behalf of the organisation. In the following line the functions have been explained briefly

Functions:

- i) Verification of correctness of paperwork and appropriateness of supply before accepting the goods.
- ii) Verification of quantities.
- iii) Unloading of materials.
- iv) In warding of the consignment.
- v) Informing purchase/ indentor/PPC regarding receipt of goods.
- vi) Preparing necessary documents
- vii) Arranging inspection of materials.
- viii) Returning all rejected goods and all chargeable empties back to suppliers.
- ix) Forwarding accepted materials to appropriate stores for storage.

2. Main store It is the main part of he store, which will keep all the materials and ready for dispatch to the user departments.

Functions:

- i) Receiving all the materials.
- ii) Inspect quantitatively and check the quality of the materials.
- iii) Stock taking and proper description of the stock to be recorded by them.
- iv) Identification, codification to be done by them.
- v) Rail way receipt (RR)/ lorry receipt (LR), Bill of entry Cash memo, Delivery challan should be verified by them.
- vi) Verification correctness of paper work and appropriate ness of supply
- vii) Notifying inventor about receipt of materials
- viii) Preparation of goods received report
- ix) Return of defective materials back to suppliers
- x) Returning all changeable empties back to supplier
- xi) Issues the materials to the user department.
- xii) Stock accounting to be done.

3. Finished product store (warehouse): The place where end (finished) goods are kept is called 'warehouse'.

Functions:

- i. Storage of goods

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- ii. Protection of goods
- iii. Risk bearing
- iv. Financing
- v. Processing
- vi. Business Studies
- vii. Grading and branding
- viii. Transportation

4. Special store: it is the place where spare parts and emergency item will be stored.

Functions:

- i) It stores emergency items.
- ii) Facilitate production process or repairing work when necessary.

5. Scrap yard: It is the place where scrap materials are stored for further used or disposal or sell.

Functions:

- i) It holds scrap for further use or selling.
- ii) Since, it is adjacent to the production hub and main store but, not under one roof, it helps organisation to run it working without break.
- iii) It facilitates movement of scrap and wasteage.

12. Write short note on the following:

- a) VED analysis & FSN analysis.
- b) ABC system of inventory control
- c) Materials Handling
- d) Selective Inventory Control

[MODEL QUESTION]
[MODEL QUESTION]
[MODEL QUESTION]
[MODEL QUESTION]

Answer:

a) VED analysis & FSN analysis:

1st part: VED Analysis
VED analysis represents classification of items bases on their criticality. The analysis classifies the items into three groups called vital, essential and desirable.
"Vital" Category encompasses those items for want of which production would come to halt, "Essential" group includes items whose stock outs-cost is very high. And "Desirable" group comprises of items which do not cause any immediate loss of production or their stock-out cost is nominal.
VED (Vital – Essential – Desirable) analysis is carried out to identify critical items. An item which usage wise belongs to C – category may be critical from production point of view if its stock-out can cause heavy production loss.
An item may be vital for a number of reasons, namely

- ❖ If the non-availability of the item can cause serious production losses.
- ❖ Lead time for procurement is very large
- ❖ It is non-standard item and is procured to buyer's design.
- ❖ The sources of supply is only one and is located far off from the buyer's plant.

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Steps involved in making VED analysis are as under:

- Identify the factors to be considered for VED analysis. The commonly considered factors are: effect on production (i.e. stock out cost in the event of its non-availability), lead time, nature of the item and sources of supply.
- Assign points / weightages to the factors according to their importance to the company. Typical examples of the weightages to the above four factors may be 30, 30, 20 and 20 points.
- Divide each factor into three degrees and allocate points to each degree. Usually, the first degree is assigned points equal to the weightage of its factor; second degree is allocated points equal to twice the weightage of the factor and third degree is assigned points equal to thrice the weight age of the factor.
- Prepare categorization plan (Table A) which provides the basis of classification of items into vital essential and desirable categories.
- Evaluate items one by one against each factor and assign points to the item depending upon the extent of presence of the factor in the item.
- Place the items into V, E and D categories depending upon the points scored by them (Table B) and basis of classification set under step (iv).

Table A: Typical VED analysis categorization plan.

	Factor	First Degree	Second Degree	Third degree
1	Stock out cost In the event of non availability (30)	Above Rs. X (30)	Between Rs. X to Y (60)	Above Rs. y (90)
2	Lead time for Procurement (30)	1-4 Weeks (30)	4-8 weeks (60)	Over 8 weeks (90)
3	Nature of the item (20)	Produced to Commercial Standard, or off the shelf availability (20)	Produced to Suppliers' design (40)	Produced to buyer's design or proprietary items (60)
4	Sources of supply (20)	Local (20)	Outstation (40)	Imported, Quota items i.e. controlled supply (60)

Table B: Typical categorization plan

Points	Classification
100-160	Desirable
161-230	Essential
231-300	Vital

VED analysis is best suited for spares inventory. In fact, it is advantageous to use more than one method e.g. ABC and VED analysis together would be helpful for inventory control of spares.

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**2nd Part:
FSN Analysis**
FSN analysis is based on the *consumption figures of the items*. The items under this analysis are classified into three groups: F (fast moving), S (low moving) and N (non-moving).

To conduct the analysis, the last date of receipt or the last date of issue whichever is later is taken into account and the period, usually in terms of number of months that has elapsed since the last movement is recorded.

Such an analysis helps to identify:

- active items which require to be reviewed regularly.
- surplus items whose stocks are higher than their rate of consumption; and
- non moving items which are not being consumed. The last two categories are reviewed further to decide on disposal action to deplete their stocks and thereby release company's productive capital.

Further detailed analysis is made of the third category in regards to third year wise stocks and items can be sub-classified as non-moving for 2 years, non-moving for 3 years, non-moving for 5 years and so on.

b) ABC system of inventory control:

'ABC' Analysis is a basic tool, which helps the management to place their efforts where the results would be useful to the greatest possible extent. The first important step in inventory management is to have a selective approach to fix-up inventory levels, order quantities, and the extent to which the control can be exercised. The selective approach mainly depends on the annual consumption of various items.

For example, the items like nuts and bolts (though being equally important) cost less than the items like engines. But we cannot safely stock the items like engines because of their heavy cost, while the items like nut-bolts can be easily stocked. Thus, less control is required for stocking the items like nut-bolts etc. But, more emphasis should be given to control the stocking of big items like engines. The investment of such items is substantial, and record keeping is expensive.

ABC (Always Better Control) analysis is a very effective tool for such selective control. This technique involves the classification of inventory items into three categories A, B and C in descending order of annual consumption and annual monetary value of each item. Based on ABC analysis, an average pattern of percentages of items and percentages of their annual consumption value may be planned as below:

Category	Percentage of items (%)	Percentage of Annual Usage (%)
A	10	80
B	20	15
C	0	5

In practice it is experienced that bulks of items in an inventory have low usage value. Annual usage value = (annual requirement) × per unit cost.

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Thus for better and more economic control of items in inventory, the items should be classified according to their significance or priority for recording. So for effective inventory control a decision has to be made that – which items are little things and which need more careful control. The items of an inventory can be classified according to the following characteristics.

- (i) Items, which are functionally critical to the operations, no matter how little they cost.
- (ii) Items those are important because their usage value is very high.
- (iii) Items having average usage value.
- (iv) Items, which have, low usage value.

The 'ABC' analysis is based on **Pareto's Law** that – a few high usage value items constitute a major part of the capital invested in inventories, whereas bulk of items in inventory having low usage value constitute insignificant part of the capital. This concept is based upon selective control. If there are large numbers of items to be analyzed, then sampling technique may be used for ABC analysis.

In ABC analysis, the items are classified in three main categories based on their respective usage value:

(i) **Category 'A' items.** More costly and valuable items are classified as 'A'. Such items have large investment but not much a number, e.g., say 10% of items account for 75% of total capital invested in inventory. So, more careful and closer control is needed for such items.

The items of this category should be ordered frequently but in small number. A periodic review policy should be followed to minimize the shortage percentage of such items and top inventory staff should control these items. These items have high carrying cost and frequent orders of smaller size for these items can result in enormous savings.

(ii) **Category 'B' items.** The items having average consumption value are classified as 'B'. Nearly 15% of the items in an inventory account for 15% for the total investment. These items have less importance than 'A' class items, but are much costly to pay more attention on their use. These items cannot be overlooked and required lesser degree of control than those in category 'A'. Statistical sampling is generally useful to control them.

(iii) **Category 'C' items.** The items having low consumption value are put in category 'C'. Nearly 75% of inventory items account only for 10% of the total invested capital. Such items can be stocked at an operative place where people can help themselves with any requisition formality. These items can be charged to an over head account. In fact, loose control of 'C' items increase their investment cost and expenditure on shelf-wear, obsolescence and wasteful use, but this will not be so much offset for the saving in recording costs.

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c) Materials Handling:

Material handling is a technique of getting the right goods safely, to the right place, at a right time and a right cost. Material handling may be defined as art and science of movement handling and storage of materials during different stages of manufacturing. Material handling in a manufacturing concern takes place at various stages mentioned below:

- a) Cost of unloading in inward stores.
- b) Loading on to an internal transport.
- c) Movement from stores to manufacturing floor.
- d) Movement to and from one machine to another machine.
- e) Movement from floor to inspection department.
- f) Movement to and from assembly section
- g) Movement to and from finished good stores.
- h) Movement to and from dispatch department.
- i) Movement during packing.
- j) Loading of packed materials on to a external transport.

d) Selective Inventory Control:

Selective Inventory Control refers to the variation in method of control from item to item on some selective basis. There are many criteria used for this purpose. They are:

- Based on the cost of the product/item.
- Lead time
- Usage rate.

The selective Inventory Control is more effective and is directed to more significant groups of items. In this system, the items are categorized in a few groups depending upon the selected criteria such as value, usage and frequency of consumption. Such grouping helps the organization for scientific inventory control. The various types of classifications are shown in following Table.

Table: Types of Classifications

Classification	Criteria
1. A.B.C. Analysis	Annual usage value of items
2. H.M.L. Analysis (High, Low, Medium)	Unit price of the material (it does not depend upon consumption)
3. V.E.D. Analysis (Vital, Essential, Desirable)	Criticality of the item (material critically)
4. S.D.E. Analysis (Scarce, Difficult, Easy)	Procurement difficulties
5. F.S.N. Analysis (Fast, Slow, Non-moving)	Issues from stores
6. G.O.L.F. (Govt., Ordinary, Local, Foreign)	Source of material
7. (Seasonal, Off Seasonal)	Seasonality of items
8. X.Y.Z. Analysis	Age of Inventory

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13. What do you understand by inventory control? Discuss Two models of inventory controls that are widely used? [MODEL QUESTION]

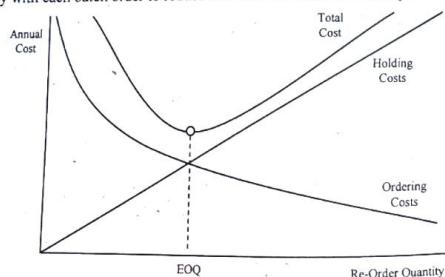
Answer:

Inventory control or stock control can be broadly defined as "the activity of checking a shop's stock." It is the process of ensuring that the right amount of supply is available within a business. However, a more focused definition takes into account the more science-based, methodical practice of not only verifying a business' inventory but also maximising the amount of profit from the least amount of inventory investment without affecting customer satisfaction. Other facets of inventory control include forecasting future demand, supply chain management, production control, financial flexibility, purchasing data, loss prevention and turnover, and customer satisfaction.

The ultimate goal of your inventory control should be to maximize your organization's use of inventory. When you maintain proper inventory levels, you can rest easily knowing that your capital is not unnecessarily tied up in your inventory. If you are in manufacturing, inventory control also protects production if there are problems with bottlenecks or the supply chain.

EOQ model (or Wilson Model)

The economic order quantity (EOQ) refers to the ideal order quantity a company should purchase in order to minimize its inventory costs, such as holding costs, shortage costs, and order costs. EOQ is necessarily used in inventory management, which is the oversight of the ordering, storing, and use of a company's inventory. Inventory management is tasked with calculating the number of units a company should add to its inventory with each batch order to reduce the total costs of its inventory.

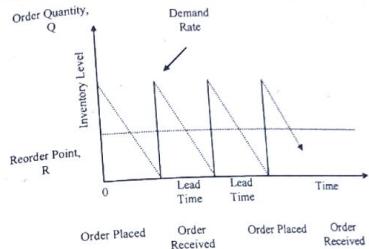


The EOQ model seeks to ensure that the right amount of inventory is ordered per batch so a company does not have to make orders too frequently and there is not an excess of inventory sitting on hand. It assumes that there is a trade-off between inventory holding costs and inventory setup costs, and total inventory costs are minimized when both setup costs and holding costs are minimized.

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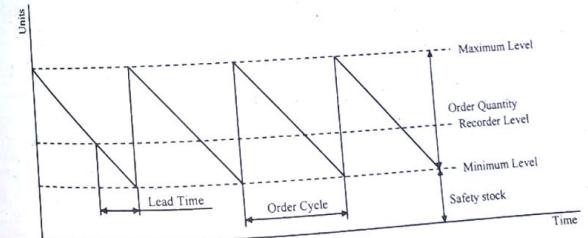
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Economic Order Quantity (EOQ) Model



Replenishment model

Replenishment is the movement of inventory from upstream — or reserve — product storage locations to downstream — or primary — storage, picking and shipment locations. The purpose of replenishment is to keep inventory flowing through the supply chain by maintaining efficient order and line item fill rates. Stock replenishment is a general practice to make sure that the right quantity of the products are available at the right time with the vendor or shopkeeper on the picking shelves. A solid inventory replenishment strategy is vital to businesses as it can help teams avoid costly supply chain issues such as out-of-stocks or overstocks. As we mentioned earlier, out-of-stocks not only result in lost sales but can also be a huge hit to customer loyalty and trust in a brand. They also can jeopardize your security on the shelf, as neighboring brands may begin to encroach on any empty space.



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Overstocking, on the other hand, can be equally problematic for your business. For starters, CPG companies know that having excess inventory can cause obstacles to new product rollouts, brand redesigns, or in the case of food and beverage brands, could push products beyond their "sell by" date and render them unfit for purchase. Additionally, overstocking can create confusion within the supply chain. If there is a lapse in communication about any backstock before an order for replenishment is placed, both brands and retailers could suffer losses in order to manage the excess product.

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PRODUCTION PLANNING AND CONTROL

Multiple Choice Type Questions

1. Productivity is the
 a) Output-input ratio
 b) Input-output ratio
 c) Both of these
 d) None of these

Answer: (a)

2. Productivity means
 a) increase in output keeping input unchanged
 b) increase in output increasing input
 c) decrease in output decreasing input
 d) none of these

Answer: (d)

3. What is the concept that holds that consumer will prefer products that are widely available and inexpensive called?
 a) Production concept
 b) Product concept
 c) Marketing concept
 d) Selling concept

Answer: (c)

4. The production which has definite beginning and definite end is known as
 a) Project Production
 b) Job Production
 c) Batch Production
 d) Mass Production

Answer: (a)

5. One of the major objectives of scheduling is to
 a) meet due dates
 b) measures the deviation from planning
 c) estimate correct requirement
 d) none of these

Answer: (d)

Short Answer Type Questions

1. What is the difference between production management and operation management? Explain.

Answer:

Production is the process by which goods and services are produced. The essential feature of a production function is to bring together people, machine and material to provide goods and services thereby satisfying the wants of the people. The concept of operation instead of production includes both manufacturing as well as service organizations. Operations in a manufacturing as well as in a service organization

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represent purposeful activities of the organization. Operations functions is the heart of and indeed the very reason for existence of an organization. An operation may be defined as "as the process of changing inputs into outputs thereby adding value to some entity".

2. How is continuous production different from intermittent production system? [MODEL QUESTION]

Answer: In case of continuous production the input converted into output after several activities as per production schedules and same will be consider as finished goods. In case of intermittent production system the goods produced from inputs to be used as an input for the final product. Hence the goods produced in intermittent production is not a finished goods rather than a component for the finished goods.

3. State the objectives of Production Management.

Answer: Objectives of production management are as follows:

1. Product Selection and Design
2. Production process selection and planning
3. Facilities for plant locations
4. Facilities layout and material handling
5. Capacity planning
6. Production planning and control
7. Inventory control
8. Quality assurance and control
9. Work study and job design
10. Maintenance and replacement
11. Cost reduction and cost control

4. Explain the difference between production and productivity. What are the different methods of increasing productivity? [MODEL QUESTION]

Answer:

1st part: **Production:** Production concerns with the conversion of inputs into outputs, using physical resources, so as to provide the desired utility/utilities of form, place, position or state or combination thereof to the customer while meeting the organizational objectives.

Productivity: It means a measure of the quantity of output per unit of input. The input could be the man-hours spent on producing that output or it could be the number of machine-hours spent or the amount of material consumed.

Basically, productivity is known as the ratio between the output and the input.

$$\text{Productivity} = \frac{\text{Amount of output}}{\text{Amount of input}}$$

The time study, method study, incentive schemes and the like were seen as ways of managing or controlling the labour.

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2nd part: As productivity is the relation between output and input ratio, hence the productivity can be increase with the help of following factors:

- i) Increasing output while input remains constant. It indicates we can utilize our resources fully.
- ii) Decreasing input and output remains constants. It can be done with the help of proper planning, cost control and cost reductions. Regarding variable expenses cost reduction is not possible because variable expenses directly vary with the productions. Hence in case of variable and semi-variable expenses we can improve our productivity by controlling the variable cost. In case of fixed expenses, we can achieve more productivity by reducing the same with the help of cost control and cost reductions.
- iii) By increasing output as compared to increase of input.
- iv) Reducing more input as compared the reduction of output.

5. Define Scheduling. Explain critical ratio method of scheduling. [MODEL QUESTION]

Answer: **Scheduling** is the process of arranging, controlling and optimizing work and workloads in a production process or manufacturing process. In manufacturing, the purpose of **scheduling** is to minimize the production time and costs, by telling a production facility when to make, with which staff, and on which equipment.

Critical ratio method A dispatching rule that calculates a priority index number by dividing the time to due date remaining by the expected elapsed time to finish the job. Typically ratios of less than 1.0 are behind, ratios greater than 1.0 are ahead, and a ratio of 1.0 is on schedule. Critical Ratio scheduling has been implemented in job shops that manufacture component parts for stock replenishment as well as direct customer orders. Proponents of this technique argue that scheduling performance is improved by gathering and processing two different types of operating information on a routine basis for use in making priority scheduling decisions: queue waiting time information for individual machines and stock status information from the shop's inventory system. Simulation experiments are reported here which describe the effect on the performance of a shop and its associated inventor' system when using this type of information with an Order Point inventory control system. The results indicate that the additional information provided by the increased data collection and processing functions does not contribute a statistically significant improvement in the overall performance of the production system.

6. The following data were reported by the shop floor control system for order processing at the edge grinder. The current date is day 150. The number of remaining operations and the total work remaining include the operation at the edge grinder. All orders are available for processing, and none have been started yet. Assume the jobs were available for processing at the same time.

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Current order	Processing time (hrs.)	Due date (day)	Remaining operations	Shop time remaining (days)
A101	10	162	9	6
B272	7	158	1	1
C105	15	152	8	18
D707	4	170	5	8
E555	8	154		

- a. Specify the priorities for each job if the shop floor control system uses slack per remaining operations (S/RO) or critical ratio (CR).
 b. For each priority rule, calculate the average flow time per job at the edge grinder. [MODEL QUESTION]

Answer:

- A) We specify the priorities for each job using the two sequencing rules
 $S/RO = (\text{due date} - \text{today's date}) / \text{shop time remaining}$ / $\text{no. of operations remaining}$
 $E555 = 0.80 - 1$
 $B272 = 0.22 - 2$
 $D707 = 0.25 - 3$
 $A101 = 0.30 - 4$
 $C105 = 1.00 - 5$

$$CR = (\text{due date} - \text{today's date}) / \text{shop time remaining}$$

$$\begin{aligned} E555 &= 0.50 - 1 \\ D707 &= 1.11 - 2 \\ B272 &= 1.33 - 3 \\ A101 &= 1.33 - 4 \\ C105 &= 2.00 - 5 \end{aligned}$$

B) we are sequencing a set of jobs at a single, so each job's finish time equals the finish time of the job just prior to it in sequence plus its own processing time. Further, all jobs were available for processing at the same time, so each job's finish time equals its flow time. Consequently, the average flow times at this single machine are

$$S/RO: (8+15+19+29+44)/5=23.30HRS$$

$$CR: (8+12+19+29+44)/5=22.4HRS$$

In this example, the average flow time per job is lower for the CR rule, which is not always the case. For example, the critical ratios for B272 and A101 are tied at 1.33. If we arbitrarily assigned A101 before B272, the average flow time would increase to $(8 + 12 + 22 + 29 + 44)/5 = 23.0$ hours.

Long Answer Type Questions

1. a) What are the different types of production system? [MODEL QUESTION]
 b) How does production planning differ from production control?
 c) State the functions of production planning.

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Answer:

- a) Following are the types of production system
 1. Mass production or flow line production system: These systems have simplest flow characteristic constituting straight line flow. Facilities are arranged according to the sequence of operations where the output of one stage becomes input to the next stage.
 2. Batch production system: If a variety of products are made with relatively small volume of production it may not be possible to layout a separate line for each product. In such cases, batch production concept is adopted. When product is made in a certain quantity it is called as "Batch quantity". After a while it is discontinued and another product is scheduled in a certain batch quantity. The various products compete for the share of machine. The machines are for general purposes. Material flow in such systems is more complex than in mass production systems.
 3. Job production system: A job production does not have its own standard products but accept whatever customer order comes in. Thus it is essentially a group of facilities and processes that meets a wide variety of customer orders in varying batch sizes.
 4. Project production system: This type of production system generally adopted when there is a huge volume of one work, i.e., a ship production, a construction of a multistoried building or construction of a bridge etc. etc. Generally this system have definite beginning and definite end.
 b) Planning and control are the two important components of the management process. Planning involves the consideration of all input variables to achieve defined output goals. Control involves the corrective actions taken when the actual output varies from the desired one by bringing the actual output in line with the planned input.
 Production planning, in particular, would therefore consist mainly of the evaluation and determination of production-inputs such as labour (manpower), machinery and equipment, materials, and utilities to achieve the desired goals. The definition of the goals is also, of course, a part of the production planning process.

We may break down the planning process into various stages as follows

- Defining objectives and setting priority to attain these
- (a) Studying the environment external to the system being planned.
- (b) Studying the internal environment of the system being planned.
- iii) Determining realizable targets (quantified as far as possible).
- iv) Gearing the inputs to achieve these targets.

Production Control is the updating and revising procedure where, according to the requirements, the labour assignments, the machine assignments, the job priorities, the line speeds, the production routes, etc. may be revised. It is basically a correcting mechanism, which goes on throughout the implementation process of the already drawn up production plan and schedule.

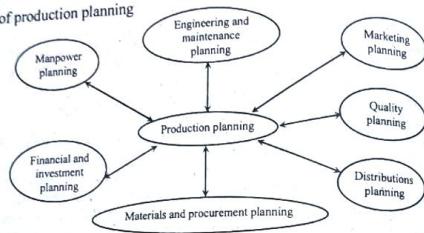
In order to continuously monitor the progress of implementation, many control techniques such as Gantt Charts, Line of Balance, PERT/CPM, etc. may be used. Essentially these are bar charts, with the latter two showing some sequence relationship. Extraordinary revision of schedules would need an extra person to look after the changes and monitor and communicate decisions and information faster on the production line. Such a person, who is not uncommon in industries, is called an "expediter".

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In order to control the production schedule as efficiently as possible, a procedure called Short Interval Scheduling is used in many western countries. This is nothing but scheduling production to a micro level, thereby exercising tight control over the minute deviations from the already drawn-up production schedule.

c) Function of production planning



2. Suppose you are the Project Manager of a Software Project that consists of following Activities in the table and you have to draw the activity network and find the critical tasks of the project.

Draw the Gantt chart of the Project. (Consider Resources allocation will start from 12th March, 2010). **(MODEL QUESTION)**

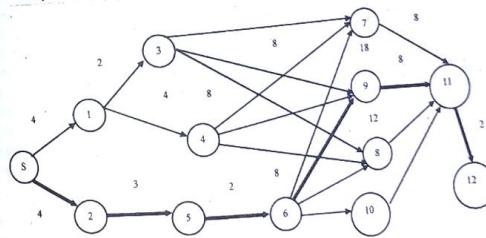
Activity No.	Activity Name	Duration (weeks)	Immediate Predecessor
1.	Obtain Requirements	4	—
2.	Analyze Operations	4	—
3.	Define Subsystems	2	1
4.	Develop Database	4	1
5.	Make Decision Analysis	3	2
6.	Identify Constraints	2	5
7.	Build Module 1	8	3, 4, 6
8.	Build Module 2	12	3, 4, 6
9.	Build Module 3	18	3, 4, 6
10.	Write Report	10	6
11.	Integration and Testing	8	7, 8, 9
12.	Implementation	2	10, 11

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Answer:

Task Name	Durat	Start	Finish	Predecessors
obtain requirement	4 wks	Fri 12-03-10	Thu 08-04-10	
Analyze operations	4 wks	Fri 12-03-10	Thu 08-04-10	
Define subsystems	2 wks	Fri 09-04-10	Thu 22-04-10	1
Develop Database	4 wks	Fri 09-04-10	Thu 06-05-10	1
Make decision Analysis	3 wks	Fri 09-04-10	Thu 29-04-10	2
Identify Constraints	2 wks	Fri 30-04-10	Thu 13-05-10	5
Build Module 1	8 wks	Fri 14-05-10	Thu 08-07-10	3,4,6
Build Module 2	12 wks	Fri 14-05-10	Thu 05-08-10	3,4,6
Build Module 3	18 wks	Fri 14-05-10	Thu 16-09-10	3,4,6
write Report	10 wks	Fri 14-05-10	Thu 22-07-10	6
Integration and Testing	8 wks	Fri 17-09-10	Thu 11-11-10	7,8,9
Implementation	2 wks	Fri 12-11-10	Thu 25-11-10	10,11



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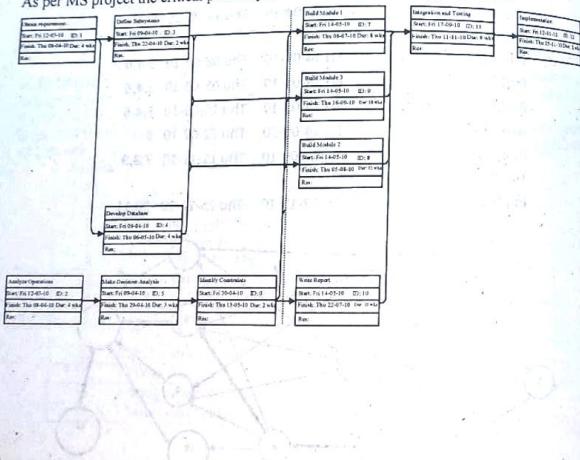
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List of paths:

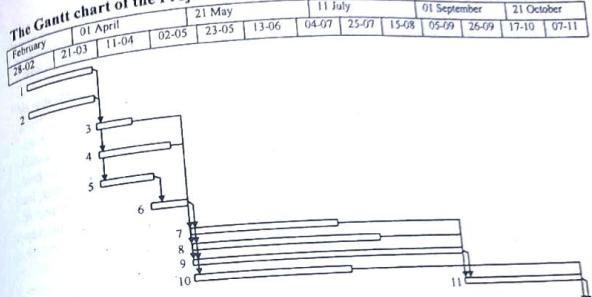
1. S-1-3-7-11-12 = 4+2+8+8+2 = 24 Wks
2. S-1-3-9-11-12 = 4+2+12+8+2 = 28 Wks
3. S-1-3-8-11-12 = 4+2+18+8+2 = 34 Wks
4. S-1-4-7-11-12 = 4+4+8+8+2 = 26 Wks
5. S-1-4-9-11-12 = 4+4+18+8+2 = 36 Wks
6. S-1-4-8-11-12 = 4+4+12+8+2 = 30 Wks
7. S-2-5-6-7-11-12 = 4+3+2+8+8+2 = 27 Wks
8. S-2-5-6-9-11-12 = 4+3+2+18+8+2 = 37 Wks
9. S-2-5-6-8-11-12 = 4+3+2+12+8+2 = 31 Wks

The path '8' is the longest path of the project i.e. the critical path of the project. Total duration along the critical path is 37 weeks. It starts at 12/03/10 and will finish at 25/11/10.

As per MS project the critical path may be derived as per the diagram below:



The Gantt chart of the Project is



[MODEL QUESTION]

3. Write short notes on the following:

- Batch production
- Mass production and flow production
- Production Management
- Product and Process layout
- Types of Production
- Gantt Chart

Answer:

a) **Batch production:**
When a variety of products are made with relatively small volume of productions it may not be possible to layout a separate line for each product. In such cases, batch production conception is adopted when a product is made in a certain quantity called as 'batch quantity' on a machine and after a while it is discontinued and another product is scheduled in a certain batch quantity. The various products compete for the share of a machine. The machines are for general purposes. **Material flow in such systems is more complex than in mass production systems.** Accordingly, the planning and control aspects are relatively more difficult. Some prominent problem areas are:

- Layout planning for the production system;
- Optical Aggregate production planning to absorb demand fluctuations economically;
- Machine-job allocation problem;
- Determination of economic batch quantity; and
- Scheduling and sequencing of operations

Production control assumes significance in such systems as the status of progress of various products must be chased up and effectively monitored.

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b) Mass production and flow production:

These systems have simplest flow characteristics constituting straight-line flow. Facilities are arranged according to sequence of operations where the output of one stage becomes input to the next stage. The whole system is cascaded. Major production management problems in mass production system are – balancing of production/assembly lines, machine maintenance and raw materials supply. In a production line consisting of the series of production centres, if workload is unbalanced, then the most bottle-necked production stage will govern the whole output rate. This will result in increased throughput time and poor capacity utilization thus contributing to low productivity. Hence a production or assembly line should be designed such that its workload is as evenly balanced as possible. Maintenance becomes important because if any production stage is under breakdown it will block the whole line unless quickly restored back into operational effectiveness. Raw material to first stage is important to avoid shortage and subsequent starvation of the whole line.

c) Production Management:

Production and operations management concerns with the conversion of inputs into outputs, using physical resources, so as to provide the desired utility/utilities-of form, place, possession or state or a combination thereof-to the customer while meeting the organizational objectives.

Objectives of production management are as follows:

- | | |
|------------------------------------|--|
| a) Product Selection and Design | b) Production process selection and planning |
| c) Facilities for plant locations | d) Facilities layout and material handling |
| e) Capacity planning | f) Production planning and control |
| g) Inventory control | h) Quality assurance and control |
| i) Work study and job design | j) Maintenance and replacement |
| k) Cost reduction and cost control | |

d) Product and Process layout:

1. **Investment in Plant:** Process layout requires higher investment as compare to product layout.
2. **Space Requirement:** Process layout requires additional space than product layout due to the following reasons:
 - a) Keep the jobs which queue up before each machine.
 - b) Accumulate jobs until they are moved to next working place.
3. **Manufacturing Time:** Manufacturing time in case of Process layout comparatively higher as compared to product layout because more time require on account of formation of queues at different machine due to different batch size and other operational activities.
4. **Material Handling:** Process layout involves more handling cost as compare to product layout due to the following reasons:
 - i) In case of process layout distance between two departments is so large which increase transport/handling cost due to which cost of production will increase.

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ii) Highly mechanized equipment cannot be used in Process layout which can be used in product layout.

5. **Flexibility:** Process layout involves very high flexibility which is not possible in product layout.

6. **Functions of Production Control:** Production control in product layout is comparatively simple and limited as compared to process layout.

g) Types of Production:

Following are the types of production system

1. **Mass production or flow line production system:** These systems have simplest flow characteristic constituting straight line flow. Facilities are arranged according to the sequence of operations where the output of one stage becomes input to the next stage.
2. **Batch production system:** If a variety of products are made with relatively small volume of production it may not be possible to layout a separate line for each product. In such cases, batch production concept is adopted. When product is made in a certain quantity it is called as "Batch quantity". After a while it is discontinued and another product is scheduled in a certain batch quantity. The various products compete for the share of machine. The machines are for general purposes. Material flow in such systems is more complex than in mass production systems.
3. **Job production system:** A job production does not have its own standard products but accept whatever customer order comes in. Thus it is essentially a group of facilities and processes that meets a wide variety of customer orders in varying batch sizes.
4. **Project production system:** This type of production system generally adopted when there is a huge volume of one work, i.e., a ship production, a construction of a multistoried building or construction of a bridge etc. etc. Generally this system have definite beginning and definite end.

f) Gantt Chart:

A Gantt chart, similar to a bar chart, lists tasks down the left side and elapsed time is marked off across the top. This graphical depiction of the schedule will track the planning and coordination of work that must be completed to produce the defined product. Major task groupings are entered as general areas of work (summary tasks), and then broken down into bodies of work that can be completed independently. Project detail can be added to the smallest increment of definable tasks. As work is completed, the project manager receives updates from each person or resource working, and the plan is updated frequently and their progress is measured against the plan. The Gantt chart reflects the entire schedule of work which might include duration, resources milestones, etc. A Gantt chart can also provide performance and efficiency information that directly impacts reward systems of monetary compensation and promotion.

Gantt chart information

The Gantt chart is versatile and timeless for use in every kind of project from building a house to constructing the tallest building and overhauling a computer system. The time

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required to build detail into the original plan and keep the plan updated throughout the project will provide all the information necessary to keep the project on track.

4. A machine shop has 5 jobs and 2 machines. Each job has to go through machine I first and then machine II. Details are:

JOB	Operations Time on Machine I (hrs.)	Operations time on Machine II (hrs.)
A	12	8
B	10	4
C	16	12
D	4	2
E		

Find the best sequence for minimum flow time using Johnson's rule. Also show the loading of the 5 jobs on the 2 machines with Gantt chart. [MODEL QUESTION]

Answer:

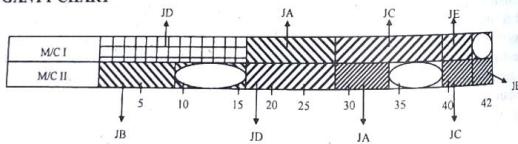
Processing of Job B is not required at M/C I, so the time duration is considered zero.

JOB	JA	JB	JC	JD	JE
M/C I	12	0	10	16	4
M/c II	6	8	4	12	2

Applying Johnson's algorithm,

JOB	M/C I		M/C II		Idle time	
	IN	OUT	IN	OUT	M/C I	M/C II
JB	—	—	0	8	—	—
JD	0	16	16	28	—	8
JA	16	28	28	64	—	—
JC	28	38	38	42	—	4
JE	38	42	42	44	—	—
				44 - 42 = 2 Hrs.	12 Hrs.	

GANTT CHART



5. Define Bottlenecking. How does it affect a production process and we can remove bottlenecks from a production process. [MODEL QUESTION]

Answer: A process bottleneck is a work stage that gets more work requests than it can process at its maximum throughput capacity. That causes an interruption to the flow of work and delays across the production process. In other words, even if this work stage operates at its maximum capacity, it still can't process all of the work items quick enough to push them to the next stages without causing a delay.

The workflow bottleneck can be a computer, a person, a department, or a whole work stage. Typical examples of bottlenecks in knowledge work are software testing and quality review processes.

Unfortunately, a bottleneck is often acknowledged only after it has caused a blockage in the workflow.

A bottleneck affects the level of production capacity that a firm can achieve each month. Theoretical capacity assumes that a company can produce at maximum capacity at all times. This concept assumes no machine breakdowns, bathroom breaks, or employee vacations.

Because theoretical capacity is not realistic, most businesses use practical capacity to manage production. This level of capacity assumes downtime for machine repairs and employee time off. Practical capacity provides a range for which different processes can operate efficiently without breaking down. Go above the optimum range and the risk increases for a bottleneck due to a breakdown of one or more processes.

If a company finds that its production capacity is inadequate to meet its production goals, it has several options at its disposal. Company management could decide to lower their production goals in order to bring them in line with their production capacity. Or, they could work to find solutions that simultaneously prevent bottlenecks and increase production. Companies often use capacity requirements planning (CRP) tools and methods to determine and meet production goals.

A bottleneck is a phenomenon where overcrowding occurs in a manufacturing process. For example, a line in an assembly or networking in a system gets overwhelmed with products on the production line and it can't be processed at the same time. Bottlenecks are a byproduct of business. You are not supposed to get frustrated by them because these issues can be rectified in the due course of time.

Or that note, bottlenecks happen when there are too much caseload and burden on a key processing plant, or a significant area that's held responsible for delegating things. A common real-life example of a bottleneck could be traffic jams. They occur when the traffic signals are not working, when there's an emergency situation or a traffic police warden is deployed at the area in case of traffic lights' malfunctioning. These kinds of irregularities cause the process to slow down and it further causes a deadlock or delay. Not to mention the fact that the cost to repair damages and time spent is something that many organizations cannot afford. This is why it is important to deal with bottlenecks before they happen. We can remove them by:

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1. Bottleneck Should Always Have a Significant Role:

Okay, a bottleneck has come up. Don't panic. What's the worse that could happen? Well, a lot of things can go downhill, but if you are willing to carefully mitigate the damage, you may as well come out happy on the other side. To minimize the bottleneck's effect, damages, you can start by monitoring everything. See what went wrong at the labors' side; what happened during the production phase?; is everything okay at the packaging side etc.? Monitoring always tends to solve a part of the bottleneck issues because it helps to identify the problem – or a number of problems for that matter.

2. Bottleneck Solutions Should Work Qualitatively not Quantitatively:

Instead of mass mitigation, try to focus on fixing one bottleneck issue at a time. By focusing on quality-oriented results, you are ensuring that these issues will not pop up anytime soon.

3. Inspect The Manufacturer Program:

You must inspect each process at a minute level, given that you are part of a plant that's responsible for manufacturing something. Fortunately, manufacturing plant bottleneck issues don't come up that often because the technology has advanced a lot these days.

However, there is always a chance of things going awry. Keep a backup plan on the side for worst-case scenario situations – especially when you are actively working in an environment where production is one of the main cogs of the business wheels.

4. Grow Operational Work Span:

Bottleneck mitigation is inversely proportioned to functional work activities. To minimize the possibility of a bottleneck occurring again, why don't you try and grow the operation work span? If you have enough monetary resources, perhaps it is a good idea to expand the ability to multitask and execute different activities simultaneously.

5. Reduce Break Times:

Don't take too much or useless breaks during an ongoing process as it adversely affects the whole operation. What if the crew is on an unscheduled break at the time of a bottleneck incident? Of course, there will be repercussions for that, but the unforeseen damage could have been avoided easily if everyone responsible was available at that time.

On a side note, also try your level best to minimize the changeover time which means switching from one process to another during simultaneous activities.

6. Bottleneck's Assets' Performance should be Improved:

Formulize a procedure with proper processing and systemized methodology so that there will be fewer chances of an error to occur. For things to get started, you need to gather resources to meet the requirements and then come up with essential documentation to highlight different steps for the aforementioned processes. You can, then, forward that

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documentation to the operation manager or people higher up the food chain to help implement a proper system where everything can work according to the grand plan.

7. Strategic Realignment & Division of Bottleneck's Work:

Breakdown complex parts of a bottleneck operation into simpler or relatively small portions so that any number of countermeasures to mitigate the problems can be performed easily. Keep your strategic realignment strategy short, clear and concise so that those people who are concerned with the implementation of that strategy, they can follow the direction without the possibility of further messing up things. Let's end it with a famous phrase: 'Every challenge is a new opportunity.' Obviously, during the course of your career, there will be pitfalls and obstacles that will set you back by a couple of miles. Adversity is part of the game. Therefore, don't let it tug you down. Bottlenecks are a naturally occurring consequence of any ongoing process. The only thing that matters is how you recover from such incidents. Of course, with the help of the aforementioned tips, you can minimize the possibility of any number of bottlenecks from happening again. If you liked this write-up or felt that we missed something, feel free to use the comments section below. We would love to hear your thoughts on this critical issue.

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VALUE ANALYSIS (VA) AND COST CONTROL**Multiple Choice Type Questions**

1. Value analysis is a technique of
 a) Calculating the inventory level
 b) Finding out the unnecessary cost associated with the production
 c) Appraising the investment proposals
 d) Routing and scheduling
 Answer: (b)
2. The cost reduction technique in comparison to the worth of a product is known as
 a) Reverse engineering
 b) Value engineering
 c) Material engineering
 d) Quality engineering
 Answer: (b)
3. Value analysis examines the
 a) Design of every component
 b) Method of manufacturing
 c) Material used
 d) All of these
 Answer: (d)
4. Value analysis is a _____ process
 a) Remedial b) Preventive c) Continuous d) None of these
 Answer: (c)

Short Answer Type Questions

1. Define the meaning of Value Analysis. What are the objectives of Value Analysis?
 Answer:

Value analysis is a problem-solving system implemented by the use of a specific set of techniques, a body of knowledge and a group of learned skills. It is an organized creative approach that has for its purpose the efficient identification of unnecessary cost, i.e., cost that provides neither quality nor use nor life nor appearance nor customer features. When applied to products, this approach assists in the orderly utilization of better approaches, alternative materials, newer processes, and abilities of specialized suppliers. It focuses engineering, manufacturing, and purchasing attention on one objective-equivalent performance for lower cost. Having this focus, it provides step-by-step procedures for accomplishing its objectives efficiently and with assurance. Value analysis approaches may assist all branches of an enterprise- engineering, manufacturing, procurement, marketing, and management- by securing better answers to their specific problems in supplying what the customer wants at lower production costs. Quite commonly, 15 to 25 per cent and very often much more of manufacturing costs can

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be made unnecessary without any reduction in customer values by the use of this problem-solving system in the significant decision areas.

The main objective of value analysis is

- To provide only the necessary functions to meet the required performance at the lowest overall cost of product or processes.
- To improve the products or processes in terms of designs.
- To provide better value to a product/service/process.
- To use the multi-disciplined teams of specialists to identify essential versus nonessential functions of the products or processes.
- The next important objective is to think creatively and to identify the ways to segregate the necessary functions from the unnecessary functions.
- To identify the costs associated with each type of functions.
- To improve the design, process, service, or product effectiveness by exploring the alternate ways of performing the functions at a lower overall cost.

2 Explain the process of Value Analysis?

Answer:
 The value analysis process is normally organized by a value analysis team. It is conducted in the sequential phases. The phases are Problem Identification Phase, Selection of the Members for the Functional Analysis Team, Information Phase, Function Analysis Phase, Creative Phase, Evaluation Phase, Development and Presentation Phase, and Implementation Phase.

- **Problem Identification Phase:** The first step of the value analysis process is the identification of the problem by the management and preparation for the value analysis. The problem can be complex design of the product and the production cost is high.
- **Selection of the Members for the Functional Analysis Team:** Usually six to eight members from different departments such as materials accounting, production, purchasing, engineering, design and marketing, etc. are selected for further analysis.
- **Information Phase:** This is a very important phase in which the issues are addressed. The targets for improvement and evaluation factors are discussed by the team members. For that purpose, the information from both inside the organisation like present detailed design, materials, manufacturing and marketing information and outside the organisation like the competitors' product designs, information about new technologies, etc. is collected.
- **Function Analysis Phase:** In this phase, first of all the major functions and supporting functions of the product are identified. Further, all parts of the products are dismantled or taken apart to pieces. All the pieces of the products are demonstrated separately.
- **Creative Phase:** The core philosophy of this phase is to emphasize on generation of as many ideas as possible to solve the problem identified in the first phase. During this exercise, no one is going evaluate the ideas as they come. The brainstorming group

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- for idea generation consists of six to seven experts of different backgrounds. The ideas given by members are listed for evaluation and development of promising ideas to generate a satisfactory solution of the problem.
- Evaluation Phase:** In this phase, the best ideas for the problem is refined and selected. The idea selected might be to use new materials to adopt a different method of manufacturing, to adopt completely new product, to add on new product functions, to modify the function(s) of the product, to combine the different functions, to eliminate certain functions. The best idea can be new design, compact design, new packaging, new technology etc. The core of the selection of the best solution for the problem is to lower down the cost.
 - Development and Presentation Phase:** At this stage, the 'best' alternative is developed finally for the presentation to management. Next is the commitment to follow a course of action for initiating the 'best' alternative.
 - Implementation Phase:** In this stage, the final approval of the proposal is obtained from the management and facilitates its implementation.

3." MUDA waste management techniques have identified a new (8th) waste that can affect the efficiency of processes in addition to the seven—overproduction, inventory, waiting, transport, defects, motion, processing --- which is "Waste of underutilized labour"----- Discuss.

[MODEL QUESTION]

Answer:

It is unfortunate to see and experience low morale — unmotivated employees who don't believe in the service or product. Feelings like that manifests itself at work and, at the end, the customer is the casualty.

Deming famously observed that 85% of all operational and business problems are the fault of management. Managers alone have the power to establish systems, and systems largely determine the quality of outputs and the customer experience. I agree with Deming, for the most part, but this post is not aiming to put blame on anybody, but is rather a lament on the 8th type of waste.

Part of Customer Obsession includes pleasing the employee — allowing him or her to shine and allowing him or her to use their skills and talents at work. If not, morale will decline and employees languish at work. Again, when this happens the customer becomes the ultimate casualty.

- Not applying a worker's talent or abilities effectively
- Not benefiting from the collective knowledge of a team
- Wasting skilled labor hours on tasks which could reasonably be automated

Causes:

- Poor company communication and consultation with staff
- Overly bureaucratic hierarchies which impose standards or techniques on teams which could give valuable input
- The failure to utilize simple technological solutions to reduce data entry and other low-skill labor-intensive tasks

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Elimination techniques:

- Involve internal process-facing staff who can work across different departments or organizational layers
- Utilize available automation technologies;

[MODEL QUESTION]

4. Discuss Kaizen 5S model in an industrial concept.

Answer:

"Kaizen" refers to a Japanese word which means "improvement" or "change for the better". Kaizen is defined as a continuous effort by each and every employee (from the CEO to field staff) to ensure improvement of all processes and systems of a particular organization. Work for a Japanese company and you would soon realize how much importance they give to the process of Kaizen. The process of Kaizen helps Japanese companies to outshine all other competitors by adhering to certain set policies and rules to eliminate defects and ensure long term superior quality and eventually customer satisfaction.

Kaizen works on the following basic principle.

"Change is for good".

Kaizen means "continuous improvement of processes and functions of an organization through change". In a layman's language, Kaizen brings continuous small improvements in the overall processes and eventually aims towards organization's success. Japanese feel that many small continuous changes in the systems and policies bring effective results than few major changes.

Kaizen process aims at continuous improvement of processes not only in manufacturing sector but all other departments as well. Implementing Kaizen tools is not the responsibility of a single individual but involves every member who is directly associated with the organization. Every individual, irrespective of his/her designation or level in the hierarchy needs to contribute by incorporating small improvements and changes in the system.

"Five S" of Kaizen is a systematic approach which leads to foolproof systems, standard policies, rules and regulations to give rise to a healthy work culture at the organization. You would hardly find an individual representing a Japanese company unhappy or dissatisfied. Japanese employees never speak ill about their organization. Yes, the process of Kaizen plays an important role in employee satisfaction and customer satisfaction through small continuous changes and eliminating defects. Kaizen tools give rise to a well organized workplace which results in better productivity and yield better results. It also leads to employees who strongly feel attached towards the organization.

Let us understand the five S in Detail:

1. **SEIRI** - SEIRI stands for Sort Out. According to SEIRI, employees should sort out and organize things well. Label the items as "Necessary", "Critical", "Most Important", "Not needed now", "Useless and so on. Throw what all is useless.

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- Keep aside what all is not needed at the moment. Items which are critical and most important should be kept at a safe place.
2. **SEITON - SEITON** means to Organize. Research says that employees waste half of their precious time searching for items and important documents. Every item should have its own space and must be kept at its place only.
 3. **SEISO** - The word "SEISO" means shine the workplace. The workplace ought to be kept clean. De-clutter your workstation. Necessary documents should be kept in proper folders and files. Use cabinets and drawers to store your items.
 4. **SEIKETSU** - SEIKETSU refers to Standardization. Every organization needs to have certain standard rules and set policies to ensure superior quality.
 5. **SHITSUKE or Self Discipline** - Employees need to respect organization's policies and adhere to rules and regulations. Self discipline is essential. Do not attend office in casuals. Follow work procedures and do not forget to carry your identity cards to work. It gives you a sense of pride and respect for the organization.

Long Answer Type Questions

1. Define cost control in a production context. Discuss its importance and methods of cost control. [MODEL QUESTION]

Answer:

Cost control by management means a search for better and more economical ways of completing each operation. Cost control is simply the prevention of waste within the existing environment. This environment is made up of agreed operating methods for which standards have been developed. Business firms aim at producing the product at the minimum cost. It is necessary in order to achieve the goal of profit maximisation. The success of financial management is judged by the action of the business executives in controlling the cost. This has led to the emergence of cost accounting systems.

Cost control involves the following steps and covers various aspects of management. It has to be brought in the following manner:

(i) Planning:

Initially a plan or set of targets is established in the form of budgets, standards or estimates.

(ii) Communication:

The next step is to communicate the plan to those whose responsibility is to implement the plan.

(iii) Motivation:

After the plan is put into action, evaluation of the performance starts. Costs are ascertained and information about achievements is collected and reported. The fact that the costs are being reported for evaluating performance acts as a prompting force.

(iv) Appraisal:

Comparison has to be made with the predetermined targets and actual performance. Deficiencies are noted and discussion is started to overcome deficiencies.

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(v) Decision-making:

Finally, the reported variances are received. Corrective actions and remedial measures are taken or the set of targets is revised, depending upon the administration's understanding of the problem. The management and control of the resources used in most commercial organisations leaves a great deal to be desired. Waste is growing at such an enormous rate that it has spawned a new industry for recycling and extracting useful materials. Materials are wasted in a number of ways such as effluents, breakage, contamination, inefficient storage, poor workmanship, low quality, pilfering and obsolescence. All these contribute to significantly increased material costs and all can be controlled by efficient working methods and effective control.

Cost control has the following Importance

- (i) It helps the firm to improve its profitability and competitiveness.
- (ii) In the absence of cost control, profits may be drastically reduced despite a large and increasing sales volume.
- (iii) It is indispensable for achieving greater productivity.
- (iv) Cost control may also help a firm in reducing its costs and thus reduce its prices.
- (v) If the price of the product is stable and reasonable, it can maintain higher sales and thus employment of work force.

Tools of Cost Control:

Control has a regulatory effect. For better performance and better results certain means of control have been evolved. These are called control techniques.

Mainly two types of standards are established to control costs:**(i) External****(ii) Internal**

External standards are applied for comparing performance with other organisations. The external standards are used for comparing the cost performance with the other firm take the shape of a set of cost ratios.

Internal standards, on the other hand, are used for the evaluation of intra firm cost elements like materials, labour, etc.

The internal standards used for cost control are:

- (i) Budgetary control
- (ii) Standard costing

(i) Budgetary Control:

Budgetary control is derived from the concept and use of budgets. A budget is an anticipated financial statement of revenue and expenses for a specified period. Budgeting refers to the formulation of plan for given period in numerical terms. Thus budgetary control is a system which uses budgets as a means for planning and controlling entire aspects of organisational activities or parts thereof.

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:According to Floyd H. Rowland and William. H. Barr, "Budgetary control is a tool of management used to plan, carry out and control the operation of business. As a further explanation, it establishes predetermined objectives and provides the basis for measuring performance against these objectives." George R. Terry has defined budgetary control as "a process of comparing the actual results with the corresponding budget data in order to approve accomplishments or to remedy differences by either adjusting the budget estimates or correcting the cause of a difference". The above definitions point out that budgeting is an aid to planning and control.

(ii) Standard Costing:

Standard costing is one of the prominently used systems of cost control. It aims at establishing standards of performance and target costs which are to be achieved under a given set up working conditions. It is a pre-determined cost which determines what each product or service should cost under certain situation.

Standard costing is defined as the preparation and use of standard costs, their comparison with actual costs and the measurement and analysis of variances to their causes and points of incidence. Standard costs should be obtained under efficient operations.

It starts with an estimate of what a product should cost during a future period given reasonable efficiency. Standard costs are established by bringing together information collected from various sources within the company.

The degree of success is measured by a comparison of actual performance and standard performance. For example, if the standard material input for a unit of production is Rs. 500 and the actual cost is Rs 475 then the variance of Rs. (-) 25 is the measure of performance, which shows that the actual performance is an improvement over the standard.

This comparison of actual costs with standard cost will help in fixing responsibility for nonstandard performance and will focus attention on areas in which cost improvement should be sought by showing the source of loss and inefficiency.

2. a) What do you understand by value analysis? Describe the steps flow of a standard VA process.
 - b) A Bath Fitting product named CONC. FLUSH VALVE manufactured in LIDER. LIDER is making a wide range of products conforming to international standards. It is the first company in India to be ISO 9001:2000 certified for designing and manufacturing of taps. Value Engineering is applied to the Conc. Flush Valve. The steps used for this purpose are as follows:-
1. Functional Analysis Worksheet is prepared for the different parts of the product.
 2. Functional Evaluation is done of each part
 3. Creativity Worksheet
 4. Selection of alternative is done through Decision Matrix
 5. Finding and Recommendation
 6. Conclusion.
- Design the Value engineering steps.

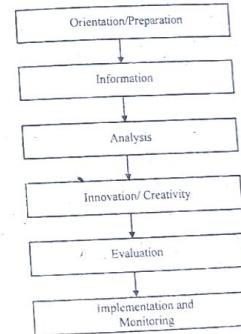
[MODEL QUESTION]

Answer:

a) **Value analysis** is an approach to improving the **value** of a product or process by understanding its constituent components and their associated costs. It then seeks to find improvements to the components by either reducing their cost or increasing the **value** of the functions. Value analysis is an effective tool for cost reduction. Cost reduction may be achieved by economizing expenditure and increasing productivity whereas value analysis probes into the economic attributes of value. In value analysis it is possible to improve performance, increase the value of a product and thus reduce costs by a continuous process of planned action.

Value analysis lays emphasis on searching out new ideas while cost reduction is usually confined to already known facts. Hence, value analysis is not a substitution for cost reduction methods but it is a completely different procedure for accomplishment of greater results leading to the elimination of unnecessary costs and value improvement of a product or service.

Value analysis is sometimes taken as value engineering. There is no doubt that value engineering is an important aspect of value analysis and is concerned with production technology, product designing, fabrication and quality control.



Orientation/ preparation: in this first phase, the team attempts to understand why the project exists and who or what it is to produce. They obtain project data, present the original design or product concepts, and understand the project scope.

Information: Here actual fact collection is done. Schedule, costs, budget, risk, and other non-monetary issues are studied until the team is comfortable with the concept of the project, what it is to produce, and who its end users are.

This step also includes things like site visits and meetings with the project team, if required. Project documents like plans, drawings, specifications, and reports are obtained and the value engineering team becomes familiar with them.

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Analysis: This step represents the meat and potatoes of the value analysis. The team attempts to determine the functions the project serves. Functions come in two forms:

1. **Primary functions** are those that represent the reason for the project's existence; for example, a building project might have adequate plumbing as a primary function.
2. **Secondary functions** are those that the project serves without being core to the project. For example, a building project might have as a secondary function maintaining the view of the neighboring building.

The functions are described in verb/noun pairs, such as "supply water to all suites," or "Maintain view of adjacent park." For a project like this, the team should come up with 10–15 functions. You might be surprised how many secondary functions exist for most projects. Subject matter experts would be a great resource, but in their absence an appropriate level of brainstorming and analysis are necessary.

The team should also identify value-mismatched functions to focus the improvements on. For example, maybe a large obstruction is preventing the view of the adjacent park from too many suites resulting in a potential mismatch of the cost vs. functional benefit. This is investigated in the next step.

Innovation and creativity: This phase represents the generation of improvement ideas. The team develops alternative ways that the project can perform the functions that have been identified. At this step, the functions are looked at individually and each one gets a list of alternative ways to perform the function. There is no judging between the importance of the various functions.

Evaluation: At this stage, a priority is given to each project improvement idea. The ideas are discussed and potential costs are determined. Once the risk-reward profile of each idea is itemized, the team has determined which ideas are worth implementing into the project or feature.

Implementation and monitoring: Once the value improvement options have been whittled down to the ones that make sense, the value engineering team develop the options to the point of passing them back to the original project team. They must be clearly written and explained so that the project owner and stakeholders can understand how it benefits the project and act on it. Any potential negative factors are identified. Potential costs and cost savings are itemized. This last phase represents the presentation of the alternatives to the stakeholders. Often value engineering represents a change in the normal practices that people are used to, an "out of the box thinking." Thus the best salesperson on the team is often the best one to do the presentation.

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Qty	Part Name/Descr.	Function	Part		Assembly	
			Verb	Noun	Basic	Sec.
1	Conc. Valve Body	Flush (1.25")	Holds	assembly	X	
			Facilitates	Transfer	X	
			Provide	Strength	X	
			Indicate	Working	X	
			Locate	Piston Rod	X	
			Turn	P Cock Cup	X	
			Facilitates	Tightening	X	
			Provide	Grip	X	
			Provide	Cover	X	
			Prevent	Movement	X	
			Improve	Appearance	X	
			Hold	Piston rod	X	
			Provide	Locking	X	
			Secure	Tightness	X	
			Control	direction	X	
			Provide	Flushing	X	X
			Provide	Sealing	X	
			Prevent	Transfer	X	
			Support	Piston Rod	X	
			Locate	Piston Body	X	
			Provide	Tension	X	
			Retrieve	Piston	X	
			Facilitate	Locking	X	
			Secure	Tightness	X	

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2. Functional Evaluation: Product: Conc. Flush Valve Basic Function: Provide Flushing				
Key Letter	Part	Function	Wt	% Cost
A	Conc. Flush Valve (1.25") Body	Holds Assembly	14	60.96
B	Push Button	Turn Stop Cock Cup	10	16.04
C	Sleeve	Provide cover	13	11.76
D	Stop Cock Cup	Provide Flashing	12	03.20
E	CFV Piston Base/Upper Nut	Provide sealing	4	06.84
F	CFV Spring	Provide Tension	2	01.10
G	Bockey Washer	Secure Tightness	0	0.10

3. Creativity Worksheet Function: Turn Stop Cock Cup (Push Button) I. Change the material to Aluminum II. Change the material to Aluminum alloy. III. Change the material to Plastic. IV. Change the material to Polypropylene. V. Make it through Forging. VI. Make the design simpler. VII. Make it in wood. VIII. Make threads on the inner side.

Sr No	Function	Creative Ideas and Development	Est. Cost (Rs.)
1	Turn Stop Cock Cup	Use Aluminum Alloy	40
		Use Plastic	20
		Use polypropylene	22

4. Decision Matrix Function: Turn Stop CockCup Objectives are: B1= Cost B2= Reliability B3= Performance Weightage of each objective are:

	B ₂	B ₃
B ₁	B ₁ =2 B ₂ =1	B ₃ =1
B ₂	B ₁ =1	B ₃ =1

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B ₁	2
B ₂	1
B ₃	1
Total (P ₁)	4

Using $w_i = B_i/P_1$ we get $w_1=0.5, w_2=0.25, w_3=0.25$
Alternatives are:- C1= Use Zamak (Aluminum Alloy) C2= Use Plastic C3= Use Polypropylene

Objectives	B ₁	B ₂	B ₃	Value
Weightage	0.5	0.25	0.25	84.75
C ₁	84 ₄₂	86 _{21.25}	86 _{21.25}	81
C ₂	90 ₄₅	73 _{18.25}	71 _{17.75}	81.5
C ₃	88 ₄₄	77 _{19.25}	73 _{18.25}	81.5

Alternative C1 has the maximum value of 84.75 Cost Improvement Recommendation Product: Conc. Flush Valve Quantity / year = 8000 Potential saving / year = Rs. 2,80,000/-

5. Finding And Recommendation: Push Button is a manufactured item. At present it is made from brass. The material is costly and hence the cost of the part made out from it is also costly. It is recommended that the Push Button should be made in the factory without changing the design of it through pressure die casting process. The proposed Push Button is to be made from Zamak (an aluminium alloy) which is cheaper than brass and with the use of PDC (pressure die casting) process, the excessive cost of machining is also eliminated.

Calculation of saving:

Item	Material cost (Rs.)	Machining cost (Rs)	Plating cost (Rs.)	Total Cost (Rs.)
Push Button (Brass)	62	8	5	75
Push	27	8	5	40
Part Eliminated	-	-	-	-
Difference/part	35	0	0	35

6. Conclusion: The total saving which can be incurred per annum by the implementation of above recommendation is Rs.2,80,000/-.

7. Conclusion & Future Scope: The Value Engineering process and procedures are generally well defined and well-understood at most levels, including senior management. VE is recognized as an effective way to improve the performance of a project and/or reduce unnecessary capital and operating costs. The quality (qualifications and experience) of the team leader and specialists is a key ingredient to the success of the VE program. It is more effective and influential on the performance, quality, and cost of a

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project when done relatively early in the project schedule. In the Case Study discussed above we have seen how the VE is used for the cost reduction without the change in the product design & its value. A proper decision matrix is prepared for choosing the appropriate alternative from the feasible choices available. In Future we can make the changes in the design so that the Value of the product can even be enhanced. Various other Industrial Engineering tools can be even made use in further improvement.

3. a) Explain the DARSIRI method of Value Analysis.
 b) A medical instrument manufacturing company, Aadarsh Instruments, located in Ambala, for analysis which runs export business of medical microscope. This firm is producing different types of microscopes which they export to various countries around the globe. All of the products manufactured here are conforming to the international standards. It is an ISO certified company. One of their model SL250 have a component named Focus Adjustment Knob for Slit Lamp in microscope. This microscope has found application in the field of eye inspection. Value Engineering is applied to the Focus Adjustment Knob. The steps used for this purpose are as follows:

1. Product selection plan
2. Gather information of product
3. Functional analysis
4. Creativity Worksheet
5. Evaluation sheet
6. Cost analysis
7. Result

Design their VA process.

Answer:

- a) In Sanskrit, DARSIRI method means "to consider" and also follows similar steps. DARSIRI stands for
- D- data collection
 - A-analysis
 - R-record ideas
 - S-speculate
 - I-investigate
 - R-recommend
 - I-implement
- **Data collection:** In this phase all relevant facts or data about a particular troublesome product or part are gathered, organized and analyzed while building cohesion among team members.
 - **Analysis:** The judicial analysis phase which means the ideas generated in the creative phase are now refine, select and evaluated the best ideas for development into specific value-improvement recommendations. In other word means that make it to become a practical, pragmatic and analytical mode. Each idea are selected and ranked according to their level of importance.

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Record ideas: It's the turn for development phase which determine the "best" alternatives for presentation to the decision-maker. The cost factor is added here and applied to reality. This is a consolidation of what the team thinks.

Speculate: By obtain a commitment to follow a course of action for initiating an alternative. In other words, the proposed changes are put in final form to be presented to the management decision makers. This proposal describes two or three ideas for performing the function of the original, basic and very expensive item with a workable alternative of better value.

Investigate: Take one new idea from the list of ideas that have been initially turned down by management, and with additional sophisticated fine-tuning analysis and description, and present it better in such a way that management can understand and implement.

Recommend: Here the alternative with best outcome is recommended for implementation to the functional areas.

Implement: Here the action plans are implemented into the functional areas for cost control and better value creation.

b) 1. **Plan For Product Selection** Product selected is Focus Adjustment Knob for Slit Lamp in microscope which is used to adjust the focus of lens for magnification purpose. The present specifications of this part and its material used are costlier than the average industry cost. Value of this product can be increased by maintaining its functions and reducing its cost or keeping the cost constant and increasing the functionality of the product.

2. **Obtain Product Information** Product specifications are:
 i. Material – Aluminum Bronze Alloy ii. Diameter of base plate –30 mm iii. Thickness of plate--3 mm iv. Cost of the scrap is – ₹ 293/Kg v. Pieces Produced annually – 8000 vi. Process used – C.N.C. indexing milling vii. Cycle time—2.5 min viii. Anodizing—2/min ix. Material cost—65 gm x. Total Present cost – ₹ 29.99/piece

3. Functional Analysis of Present Functions

Name	Basic Function Verb	Basic Function Noun	Secondary Function Verb	Secondary Function Noun
Focus Adjustment Knob	Index	Lens	Fix	Gear tooth

4. **Develop Alternate Design Or Methods** During brainstorming these ideas were listed:- i. Change design ii. Change material iii. Use plastic iv. Make it lighter v. Change the production process vi. Use nylon indexing unit

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5. Evaluation Phase For judging the ideas, the following designs were considered: A Function B. Cost C. Maintainability D. Quality E. Space Each of these design criteria was given a weight age factor. This was carried out as follows: each of the above criteria was compared with others, and depending on their relative importance, three categories was formed, viz. major, medium, and minor. A score of 3, 2 and 1 respectively was assigned to each of the levels.

The details are as given in the table

Weight age analysis	Points
Major difference	3
Medium difference	2
Minor differences	1

Paired comparison table

	B	C	D	E	SCORE
A	B2	A2	A1	A3	6
B	B2	B1	B3	8	
	C	D2	C2	2	
		D	D3	5	
			E	0	

From the above paired comparison we get the following result

SYMBOL	ATTRIBUTE	SCORE
A	Function	6
B	Cost	8
C	Maintainability	2
D	Quality	5
E	Space	0

The above ideas were discussed and the best feasible ideas were separated which were:
a. Change the material to steel b. Use Nylon unit c. Use existing material

Feasibility rankings

Ideas	A	B	C	D	E	Score	Rank
a	1/6	2/16	1/2	1/5	3/3	32	III
b	3/18	2/16	2/4	2/10	1/1	49	I
c	1/6	2/16	2/4	1/5	2/2	33	II

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6. Cost Analysis	Item	Material Cost (Rs.)	Machining Cost (Rs.)	Anodizing Cost (Rs.)	Total Cost/Pc. (Rs.)
	Focus adjustment knob	19.04	7.30	3.65	2.99
	Nylon index init	11.60	6.80	-	18.40
	Part eliminated difference/part	-	-	-	-
		9.44	12.72	6	11.59

7. Result The total savings after the implementation of value engineering are given below:
o Cost before analysis - ₹ 29.99/- o Total Cost of nylon knob - ₹ 18.40/- Saving per product - ₹ 11.59/- o Percentage saving per product - 38.64 % o Annual Demand of the product - 8000 o Total Annual Saving - ₹ 92,720/- o Value Improvement - 62.98 % Value engineering methodology is a powerful tool for resolving system failures and designing improvements in performance of any process, product, service or organization. Its application results in significant improvements to quality and reliability by focusing the team's attention on the functions that are contributing most to the problems, and the most likely causes of these problems. Then, the team develops ways to improve these root causes of the problems, and ways to fix the problems that have occurred along with means to prevent their reoccurrence. In the Case Study discussed above we have used the concept of Value Engineering to analysis the focus adjustment knob of microscope and with the critical evaluation of it we were able to increase the value of the product by substituting another material in place of the one that is currently in use. The various advantages have been observed in terms of cost reduction, increase in overall production, reduction in manpower, and reduction in scrap. In future we can alter the design of the product and integrate this technique with various other prevailing industrial engineering tools which will bring down the cost by substantial margin and thereby increasing the value of the product.

4. Discuss MUDA (waste) management. Mention its types, causes, elimination techniques. [MODEL QUESTION]

Answer:

Eliminating wasteful activities is one of the most important prerequisites for building a successful company. This concept is an integral part of Lean thinking, and it helps you increase profitability.

The idea of eliminating waste originates from the Toyota Production System. Taiichi Ohno, who is considered one of the founding fathers of lean manufacturing, dedicated his career to establishing a solid and efficient work process.

During his journey, Ohno described three major roadblocks that can influence a company's work processes negatively: Muda (wasteful activities), Muri (overburden), and Mura (unevenness).

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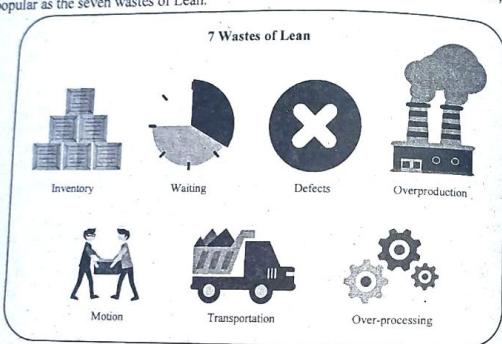
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Based on his observations and deep analysis, he categorized the 7 types of waste (7 Mudas), which later became a popular practice for cost reduction and optimizing resources. In reality, the activities that indeed create value for the customers are only a small portion of the whole work process. This is why businesses should focus on reducing wasteful activities as much as possible. By doing so, companies can identify significant opportunities to improve their overall performance.

Necessary waste – non-value-adding, but necessary to get things done in a quality manner. Such activities can be testing, planning, reporting, etc.

Pure waste – non-value-adding and unnecessary. Anything that doesn't bring value and can be removed from the process immediately. Any form of waiting (known as "waiting waste") can be described as pure waste.

The Lean theory describes 7 major areas where you can identify Muda activities, more popular as the seven wastes of Lean.



1. Transportation

This type of waste is when you move resources (materials), and the movement doesn't add value to the product. Excessive movement of materials can be costly to your business and cause damage to quality. Often, transportation may force you to pay additionally for time, space, and machinery.

Causes are:

- Faulty layout involving cross traffics and backtracking
- Work places spread over large space
- Over production
- Lack of proper material handling equipment
- Insufficient production capacity requiring sub-contract of bottleneck operations
- Excessive rejection/ rework requiring re-routing of parts

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• Multi-storeyed storage of material

• Bad housekeeping

Elimination techniques:

- Systematic plant layout
- Method study
- 5S techniques
- Store materials as close to the point of use as possible
- Avoid transporting over long distances
- Eliminate re-handling
- Minimize the need to move materials/parts from main stores to sub-stores
- Automat processes to reduce need for transportation
- Avoid manual handling of heavy materials
- Improve material flow
- Avoid over production
- Improve housekeeping

2. Inventory

Excessive inventory is often the result of a company holding "just in case" inventories. In such cases, companies overstock themselves in order to meet unexpected demand, protect from production delays, low quality, or other problems. However, these excessive inventories often don't meet customer's needs and don't add value. They only increase storage and depreciation costs.

Causes:

- Over stocking of materials
- Scheduling errors
- Errors of indenting
- Longer procurement lead time
- Poor control on quantity at receipt stage
- Accumulation of obsolete stock which are not disposed off
- Production/ procurement against faulty forecasts
- Over production

Elimination techniques:

- Dispose off obsolete materials to space up and avoid confusion
- Do not produce based on procrastinated demand
- Produce according to requirements
- Procure in small optimal lots
- Inventory levels should be maintained at optimal limits
- Constitute cross functional teams to measure stocking limits
- Reduce manufacturing and procurement lead times
- Introduce vendor management and SMED systems

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3. Motion

This kind of waste includes movements of employees (or machinery), which are complicated and unnecessary. They can cause injuries, extended production time, and more. In other words, do whatever is necessary to arrange a process where workers need to do as little as possible to finish their job.

Causes:

- Unnecessary movement of workmen
- Haphazard plant layout
- Distance of materials and machines
- Searching for materials tools

Elimination techniques:

- Improvement in layout
- Application of motion economy principles
- Effective supervision.
- Reduce unnecessary distance

4. Waiting

This is probably the easiest waste you can recognize. Whenever goods or tasks are not moving, the "waiting waste" occurs. It is easily identifiable because lost time is the most obvious thing you can detect. For example, goods waiting to be delivered, equipment waiting to be fixed, or a document waiting for executives' approval.

Causes:

- Interrupted flow of work from preceding operations
- Unoccupied time of the operator
- Lack of instruction in between jobs
- Delay in movements of raw materials
- Lack of sufficient work
- Faulty allocation of work

Elimination techniques:

- KAIZEN system
- Method study

5. Overproduction

Keeping in mind that waste is anything that the customer is unwilling to pay for, it is easy to realize why overproduction is Muda. Producing more means that you exceed customer's demand, which leads to additional costs. Actually, overproduction triggers the other 6 wastes to appear. The reason is that excess products or tasks require additional transportation, excessive motion, greater waiting time, and so on. Furthermore, if occasionally a defect appears during overproduction, it means your team will need to rework more units.

Causes:

- Production ahead of customer schedule
- Production to built up stocks

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Production to keep employees busy

- Production to utilize excess capacity
- Production to meet contingencies
- Production against advance planning
- Bulk production to reduce setup time
- Excess production due to imbalance in the production line
- Unnecessary production to show higher machine utilization.

Elimination techniques:

- Confirm deliver requirement from marketing
- Strong production planning and control
- Smaller lot size
- Set up time reduction (SMED)
- Improve supplier reliability
- Quality at source

6. Over-processing

This type of waste usually reflects on doing work that does not bring additional value, or it brings more value than required. Such things can be adding extra features to a given product that nobody will use, but they increase your business costs. For example, if a car manufacturer decides to put a TV screen in the back trunk of a vehicle, probably nobody will use it or find value in it. Even more, it will cost resources, and it will increase the end price of the product for something that customers are not willing to pay for.

Causes:

- Non value added operations
- Unnecessary closer tolerances and finishes
- Duplication of operations
- Uneconomical raw materials and products
- Poor allocation of work
- Wrong choice of effective methods
- Higher set up time and over production
- Lack of effort and failure to automate work
- Obsolete technology and design
- Frequent changes in job priority

Elimination techniques:

- Method study
- Value analysis
- Simplification
- kaizen

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7. Defects

Defects can cause rework, or even worse, they can lead to scrap. Usually, defective work should go back to production again, which costs valuable time. Moreover, in some cases, an extra reworking area is required, which comes with additional exploitation of labor and tools.

As you can see, the 7 types of waste are toxic to your business. However, you can see them more as an opportunity to improve work processes and, most importantly, optimize resources. For different businesses, the 7 forms of waste may have different aspects.

Causes:

- incorrect product design/ design errors
- defective materials r tools
- inadequate maintenance machines
- machine tools try outs
- inefficient processes
- poorly trained employees
- lack of process control

Elimination techniques:

- developing better processes
- design reviewing and improvements
- proper training of employees
- maintenance of machines and equipments.

RECENT TRENDS IN IM**Multiple Choice Type Questions**

[MODEL QUESTION]

1. The premise of Just In Time (JIT) approach is
- no interruption of flow in the supply chain
 - to have no buffer stock
 - not to procure material earlier than one hour
 - none of these

Answer: (b)

Short Answer Type Questions

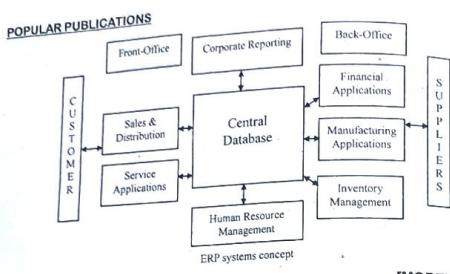
[MODEL QUESTION]

1. Define and explain ERP.

Answer:

ERP stands for Enterprise Resource Planning. It is a company-wide computer software system used to integrate the various processes, functions and data and processes of an organization into one single system. This helps the organization to make optimum utilization of management resources and to improve its process efficiency. There are many components of an ERP system, including hardware and software, and these ERP packages are integrated software packages that cater to the needs of almost the entire range of functions of an organization like manufacturing, marketing, quality management, human resources, finance, logistics and many more. Usually ERP systems use a single unified database to store data for various functions found throughout the organization. Enterprise resource planning (ERP) coordinate and manage all the resources, information, and functions of a business from this shared data store. The central feature of an ERP system is a shared database which supports multiple functions used by the different business units of an organization. In simple words, the employees in different departments of a company, say accounting and sales—can rely on one single database for information in accordance to their needs.

The architecture of the ERP system is service-oriented, with modular software and hardware units or "services" which communicate on a LAN. This modular design allows business houses to add/modify or reconfigure modules from different vendors and simultaneously preserving data integrity in one singly shared, centralized or distributed database. ERP is no longer constrained to large companies and many smaller companies are now slowly adapting to the concept for managing their resources properly.



2. What are the features of ERP?

Answer:

Some of the major features of ERP are as below:

- ERP systems can cover a wide range of organizational functions and processes and integrate them into one single unified database. For example, functions like Manufacturing, Human Resources, Financials, Supply Chain Management, Customer Relations Management, etc. were stand alone software applications once and usually had their own databases and networks. With ERP, they can all be fit under one umbrella.
- ERP bridges the information gap across the organization.
- ERP provides complete integration of Systems not only across the departments in a company but also across the companies under the same management.
- ERP allows automatic introduction of latest technologies like Electronic Fund Transfer (EFT), Electronic Data Interchange (EDI), Internet, Intranet, Video conferencing, E-Commerce, etc.
- ERP eliminates the most of the business problems like Material shortages, Productivity enhancements, Customer service, Cash Management, Inventory problems, Quality problems, prompt delivery etc.
- ERP not only addresses the current requirements of the company but also provides the opportunity of continually improving and refining business processes.
- ERP provides business intelligence tools like Decision Support Systems (DSS), Executive Information System (EIS), Reporting, Data Mining and Early Warning Systems (Robots) for enabling people to make better decisions and thus improve their business processes.

3. Give one Example how ERP works? What are the benefits of ERP.

[MODEL QUESTION]

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Answer:

1st Part:
A sales rep takes the order, routes it to ERP's ordering module, ERP checks the retailer's credit, price, etc. The order is approved.

Step 2: Simultaneously ERP's inventory module checks the stocks and notifies that half the order can be filled immediately from stock. The other half will be manufactured and delivered in 5 days directly from the factory in Taiwan.

Step 3: ERP's manufacturing module schedules the production in Taiwan and instructs the warehouse (in China) to ship the shoes to Brazil and print up an invoice (in Portuguese).

Step 4: ERP's human resources module calculates labor requirements. Due to a shortage, the personnel manager in Taiwan is instructed to get temporary workers.

Step 5: ERP's material planning module notifies the purchasing manager about a shortage of purple dye. A purchase order is automatically issued.

Step 6: The customer logs on via the extranet to the company's sneakers division. He can see that 500 shoes were shipped from the regional warehouse. This is done with ERP tracing capabilities.

Step 7: Based on data from ERP's forecasting and financial modules, the CEO can determine both demand and profitability per product. The financial module also converts all foreign moneys to \$U.S., whenever needed.

2nd Part:

The benefits of ERP systems are as follows:

- ERP systems help to increase integration/communication between departments starting from order tracking from acceptance through fulfillment and tracking the revenue cycle from invoice through cash receipt.
- For a manufacturing organization, ERP successfully helps in tracking the 3-way task between (what was ordered i.e. the Purchase orders, what has arrived i.e. Inventory receipts and what the vendor has invoiced, i.e. costing).
- ERP helps to decrease the total costs: order processing, material handling, distribution, direct labor, overhead, etc.
- ERP helps in increasing profitability while maintaining product quality and increase value-added relationships.
- Since complete computer security is included within an ERP system, hence protection against cyber crimes like industrial espionage, or embezzlement is expected. ERP security helps to prevent several online abuses as well.
- ERP helps to increase customer service/handle customer expectation.

4. What is Supply chain management? Explain its characteristics.

[MODEL QUESTION]

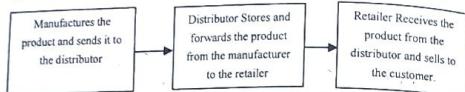
Answer:

Supply Chain Management is a set of integrating processes which helps the organization to develop and deliver products and customized service. Separate disciplines such as

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sales forecasting, purchasing, operations, information management, transportation and logistics are integrated in SCM and this helps process optimization and integration which help to reduce costs. SCM also owes its genesis to business of just-in-time production, total quality management and continues improvement. Council members define SCM as including "Managing supply and demand, sourcing raw materials and market, warehousing and inventory tracking, order entry and order management and thus delivering a final product from supplier's supplier to the customer's customer."



Characteristics of Supply Chain Management:

The various characteristics of SCM are:

- An ability to source raw material or finished goods from anywhere in the world
- A centralized, global business and management strategy with flawless local execution
- Online, real time distributed information processing to the desktop, proving total supply chain information visibility.
- The ability to manage information not only within a company but across industries and enterprises.
- The seamless integration of all supply chain processes and measurements including the third party suppliers, information systems, cost accounting standards, and measurement system.
- The development and implementation of accounting models such as activity based costing that link cost to performance are used as tools for cost reduction.
- A reconfiguration of the supply chain organization into high performance teams going from the shop floor to the senior management.

5. Explain the concept of JIT (Just In Time).

[MODEL QUESTION]

Answer:

JIT is a manufacturing management process. It was first developed and applied in the Toyota manufacturing plants in order to meet consumer demands with minimum delays. Just-in-time also known as JIT is an inventory management method whereby labour, material and goods (to be used in manufacturing) are re-filled or scheduled to arrive exactly when needed in the manufacturing process. The main focus of JIT is to identify and correct the obstacles in the production process. It shows the hidden problems of inventory. Just In Time method prevents a company from using excessive inventory and smoothes production operations if a specific task takes longer than expected or a defective part is discovered in the system. This is also one of the main reason why the companies (which are opted for JIT) invest in preventive maintenance; when a

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part/equipment breaks down, the entire production process stops. The prime objective of JIT is to increase the inventory turnover and reduce the holding and all connected cost.¹

6. Define SMED. Discuss the important of SMED in JIT system.

[MODEL QUESTION]

Answer:

Single minute exchange of dies, or SMED as it's commonly known, is defined as "the time elapsed between when the last good piece of product A comes off and the first good piece of product B starts." SMED is probably one of the most important lean manufacturing tools, if not the most important, for enabling just-in-time (JIT) production. With lean manufacturing and JIT, we aim to reduce waste within the system. The Toyota Production System (TPS) further defines this waste as *muda* (nonvalue-adding), *mura* (unevenness), and *muri* (overburden). SMED tackles all of these waste areas, but its greatest strength is in helping us eliminate *mura*. This is particularly true when working with small batches where a greater number of change-overs is the norm. SMED approach may be termed as Lean approach as

- It is often the case that creativity and simplicity is the best solution to these problems
- Generally several smaller/simpler machines will be more beneficial

The importance of SMED in JIT manufacturing system can be stated as follows:

- Reduced setup time
- Higher efficiencies
- Increased capacity
- Reduced WIP's
- Lower batch sizes
- Increased safety
- Increased flexibility
- Elimination of waiting
- Operators preference
- Stockless production

7. Why logistics is fundamental to successful supply chain management?

[MODEL QUESTION]

Answer:

Logistics is an essential component of supply chain management. It involves the planning, carrying out and management of goods, services, and information from the point of origin to the point of consumption. Logistics aligns the complex pattern of traffic and transportation, shipping and receiving, import and export operations, warehousing, inventory management, purchasing, production planning, and customer service. Companies see logistics as a critical blueprint of the supply chain. It is used to manage, coordinate and monitor resources needed to move products in a smooth, timely, cost-effective and reliable manner.

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Logistics within supply chain management is constantly changing to meet consumer demands. Consumers frequently order products using iPods, iPhones, Smartphones, and Tablets, expecting to receive their product within 24-48 hours. To meet these expectations, companies have to improve the logistics of their supply chain to expedite order fulfillment and quickly ship the item via the most reliable, yet cost-effective and timely means. When companies create a blueprint that outlines the logistics of the supply chain, each component within that logistics model stays focused, reduces costs and moves quickly and efficiently resulting in higher customer satisfaction. Logistics helps companies understand the key metrics, core processes and long-term goals of their supply chain so they can get the right item to the right place at the right time.

Long Answer Type Questions

1. Explain the advantages and disadvantages of Open source ERP. [MODEL QUESTION]

Answer:

Advantages of Open Source ERP

- Open source ERP Software can be downloaded from the Internet and run in any business environment in order to meet business needs without the need to pay for it. So lots of costs can be saved.
- The largest benefit of using an open source ERP system is that once downloaded, the software belongs to the company only. So ownership is an essential factor.
- The ability to customize and modify an open source ERP product according to the specific needs of the organization denotes, that one can make the software as efficient as possible.
- The open source ERP software allows the company to create more personalized and specific tools and options to run the business effectively.
- Open Source ERP is able to meet the needs of the small businesses, small and medium-sized companies and others.
- Maintenance costs are lowered for those small companies and that results in additional cost cutting.

Disadvantages of open source ERP

Nevertheless, there are disadvantages of using open ERP. They are:

- The open source ERP unlike commercial, is not a licensed software. Hence the business may not be able to maximize the use of the application.
- The extra features included in the package of commercial ERP software provided by the vendor are not there in open source. Hence issues may not be addressed properly.
- Professional assistance could not be achieved in Open Source ERP, by the vendors, as in Commercial ERP.

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• The features are very standardized so they may not be applicable to all companies or businesses. If the clients of the business use a commercial software unlike them, the lack of compatibility may lead to serious issues.

Examples of Open Source ERP:
i) opernads ERP Software, ii) Compiere ERP Software and iii) Lokad ERP Software.

[MODEL QUESTION]

2. What are the features of MS Project?

Answer:
There are plenty of features that project managers and their teams need to manage their work better, and MSP has a number of them. However, to get a full picture, here is a list of all features available to customers who put up the big bucks.

- **Grid View:** A project view that is used to plan and manage projects with a task list.
- **Board View:** A visual kanban board view that helps with managing workflow and status.
- **Timeline View:** The traditional Gantt chart used for scheduling tasks over a project timeline.
- **Communication & Collaboration:** Teams can work together on projects.
- **Coauthoring:** Stakeholders and team members work together to edit and update task lists and schedules.
- **Reporting:** Pre-built reports that can track progress, resources, programs and portfolios.
- **Roadmap:** Track programs and project portfolios.
- **Timesheets:** Collect project and non-project time for payroll and invoicing.
- **Resource Management:** Manage resources by requesting and assigning tasks.

[MODEL QUESTION]

3. Compare between ERP and SCM.

Answer:
A comparison of ERP and supply-chain management is given in the table below:

S.N.	ERP	SCM
1.	Primary function of ERP is to generate data	SCM provides capability to the enterprise so that it can make sense out of data to help to make decisions.
2.	ERP is the body of the enterprise	SCM is the brain of the enterprise.
3.	ERP systems are linear and interactive	SCM is constraint-based and optimized.
4.	ERP generates data	Data generated in ERP are used in the best possible way by optimizing the system in a SCM.
5.	ERP excels in the transaction management	SCM afford forecasting and the decision-support.
6.	ERP links processes only within the organization	SCM goes beyond the conventional boundaries of the organization and spans in the entire supply chain.

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4. Explain the advantages and disadvantages of Just-In-Time Systems.
[MODEL QUESTION]

Answer:

Advantages of Adopting Just-In-Time include:

- Just-in-time approach keeps stock holding costs to a minimum level. The released capacity results in better utilization of space and bears a favourable impact on the insurance premiums and rent that would otherwise be needed to be made.
- The just-in-time approach helps to eliminate waste. Chances of expired or out of date products; do not arise at all.
- As under this management method, only essential stocks which are required for manufacturing are obtained, thus less working capital is required. Under this approach, a minimum re-ordering level is set, and only when that level is reached, order for fresh stocks are made and thus this becomes a boon to inventory management too.
- Due to the abovementioned low level of stocks held, the ROI (Return On Investment) of the organizations are high in general.
- As this approach works on a demand-pull basis, all goods produced would be sold, and thus it includes changes in demand with unanticipated ease. This makes JIT appealing today, where the market demand is fickle and somewhat volatile.
- JIT emphasizes the 'right-first-time' concept, so that rework costs and the cost of inspection is minimized.
- By following JIT greater efficiency and High-quality products can be derived.
- Better relationships are fostered along the production chain under a JIT system.
- Higher customer satisfaction due to continuous communication with the customer.
- Just In Time adoption result in the elimination of overproduction.

Disadvantages of Adopting JIT Systems

- JIT approach states ZERO tolerance for mistakes, making re-work difficult in practice, as inventory is kept to a minimum level.
- A successful application of JIT requires a high reliance on suppliers, whose performance is outside the purview of the manufacturer.
- Due to no buffers in JIT, production line idling and downtime can occur which would have an unfavourable effect on the production process and also on the finances.
- Chances are quite high of not meeting an unexpected increase in orders as there will be no excess inventory of finished goods.
- Transaction costs would be comparatively high depending upon the frequency of transactions.
- JIT may have certain negative effects on the environment due to the frequent deliveries as the same would result in higher use and cost of transportation, which in turn would consume more fossil fuels.

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5. State the latest concept of Just-in-Time technique of purchasing. Explain its scope and opportunities in Indian situation.
[MODEL QUESTION]

Answer:

Just-In-Time (JIT) Production

Just-in-time (JIT) is defined as "a philosophy of manufacturing based on planned elimination of all waste and on continuous improvement of productivity". It also has been described as an approach with the objective of producing the right part in the right place at the right time (in other words, "just in time"). Waste results from any activity that adds cost without adding value, such as the unnecessary moving of materials, the accumulation of excess inventory, or the use of faulty production methods that create products requiring subsequent rework.

JIT (also known as *lean production* or *stockless production*) should improve profits and return on investment by reducing inventory levels (increasing the inventory turnover rate), reducing variability, improving product quality, reducing production and delivery lead times, and reducing other costs (such as those associated with machine setup and equipment breakdown). In a JIT system, underutilized (excess) capacity is used instead of buffer inventories to hedge against problems that may arise.

JIT applies primarily to repetitive manufacturing processes in which the same products and components are produced over and over again. The general idea is to establish flow processes (even when the facility uses a jobbing or batch process layout) by linking work centers so that there is an even, balanced flow of materials throughout the entire production process, similar to that found in an assembly line. To accomplish this, an attempt is made to reach the goals of driving all inventory buffers toward zero, and achieving the ideal lot size of one unit.

The basic elements of JIT were developed by Toyota in the 1950's, and became known as the Toyota Production System (TPS).

JIT was well-established in many Japanese factories by the early 1970's. JIT began to be adopted in the U.S. in the 1980's (General

Electric was an early adopter), and the JIT/lean concepts are now widely accepted and used.

The philosophy of JIT in short, "*the right material, at the right time, at the right place, and in the exact amount.*"

Characteristics of JIT:

- This is an acronym for Just In Time or Toyota product system and is also known as Zero Inventory System.
- The Zero Inventory system does not mean literally nil inventory, small amount of inventories are maintained, which is required to sustain production activity between two operation in an organization.
- This philosophy initiated in Japanese industry for industrial growth and captured a major share of world market.
- The aim is elimination of all waste, being anything not essential such as scrap etc.
- Production part, component or sub assembling must occur Just In Time, not earlier or not later.
- This is accompanied by a "pull" strategy instead of "push" strategy.

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- "pull system works without the need of costly and integrated procedures, thereby minimize the WIP inventory.

Scope of JIT in Indian Situation:

Since is a developing country, and its industries trying to compete with global giant since '90s. JIT concept needs some infrastructural support from govt. end. But, It was untouched after 65 years of independence. Now after globalization, to survive in the market, industry had to take necessary action to enhance the quality upto global standard in optimum cost. Then they were trying to implement JIT concept to their organization. From this concept of SEZ has been evolved and that has been taken care of by the different state government and central govt.

After making the golden quadrilateral (Road ways) the fundamental infrastructure for JIT is clear and that can be implemented by different industry in different part of the country. JIT concept in basic principle assumes the processes carried out at your supplier's end as extended operations of the process. It is difficult for the traditional firm to grasp the changed vision of new manufacturing concept.

For success of JIT, it is essential that manufacturer and suppliers understand and grasp JIT concept and unanimously agree to work on it. This is most important in case of Automotive assembly line (Example: Tata Nano), where uninterrupted ancillary supply of spares is essential.

"Just In Time" philosophy is just opposite of "Just In Case" philosophy. JIC philosophy causes building up of safety stocks at each step and causes delays in production and swelling of In-process stocks. JIT philosophy negates the effects of JIC. One should find the "Mean" of both the philosophies (or BEP of JIT), so that, the opportunity cost of failure of "JIT" concept will not outweigh its benefits.

JIT concept works on "exposing" the delays, rather than covering them with safety margin, and take corrective action to eliminate the root causes of delays, and convert the process into "lean process".

One must take care that, with experiment of "JIT" on, the mechanism for finding root causes and taking corrective action is in place. But, at the end of the discussion it can be said that India is gradually moving towards the JIT concept.

Competitive analysis between Traditional buying and JIT

Characteristics	Traditional	JIT
1. Supplier /Buyer Relationship	Adversarial	Partnership
2. Contract Period	Short or long term	Long term
3. Communication	Written purchase order	Verbal or telephonic
4. Quality	Inspection	No inspection
5. Quantity	Bulk/large	Small
6. No. of supplier	Many	Few
7. Design process	Print then quote	Ask for supplier ideas.
8. Ordering cost	Negotiation + open order cost	+ Negotiation + transportation

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	expediting cost + Receiving cost + cost. Inspection cost + Transportation cost.	
9. lead time	High	Low
10. Transportation	Full truck of single item	Full truck with multiple item

6. State the key elements of JIT System. Explain the salient features of JIT system. Explain the differences between JIT & MRP Approach. What are the advantages of JIT system? [MODEL QUESTION]

Answer:

Some Key Elements of JIT

1. **Stabilize and level the MPS with uniform plant loading:** Create a uniform load on all work centers through constant daily production and mixed model assembly. Meet demand fluctuations through end-item inventory rather than through fluctuations in production level. Use of a stable production schedule also permits the use of **backflushing** to manage inventory: an end item's bill of materials is periodically exploded to calculate the usage quantities of the various components that were used to make the item, eliminating the need to collect detailed usage information on the shop floor.
2. **Reduce or eliminate setup times:** Aim for single digit setup times (less than 10 minutes) or "one-touch" setup -- this can be done through better planning, process redesign, and product redesign.
3. **Reduce lot sizes (manufacturing and purchase):** Reducing setup times allows economical production of smaller lots; close cooperation with suppliers is necessary to achieve reductions in order lot sizes for purchased items, since this will require more frequent deliveries.
4. **Reduce lead times (production and delivery):** Production lead times can be reduced by moving work stations closer together, applying group technology and cellular manufacturing concepts, reducing queue length (reducing the number of jobs waiting to be processed at a given machine), and improving the coordination and cooperation between successive processes; delivery lead times can be reduced through close cooperation with suppliers, possibly by inducing suppliers to locate closer to the factory.
5. **Preventive maintenance:** Use machine and worker idle time to maintain equipment and prevent breakdowns.
6. **Flexible work force:** Workers should be trained to operate several machines, to perform maintenance tasks, and to perform quality inspections.
7. **Require supplier quality assurance and implement a zero defects quality program:** Errors leading to defective items must be eliminated, since there are no buffers of excess parts.
8. **Small-lot (single unit) conveyance:** Use a control system such as a **kanban** (card) system (or other signaling system) to convey parts between work stations in small quantities (ideally, one unit at a time).

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Salient features of JIT:

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- This philosophy initiated in Japanese industry for industrial growth and captured a major share of world market.
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- Production part, component or sub assembling must occur Just In Time, not earlier or later.
- This is accompanied by a "pull" strategy instead of "push" strategy.
- "pull" system works without the need of costly and integrated procedures, thereby minimize the WIP inventory.

COMPARISON OF MRP AND JIT

MRP and JIT are compatible and can be used together in certain situations. There are three situations to be considered in comparing MRP and JIT.

- Pure repetitive manufacturing
- Batch manufacturing
- Job shop manufacturing

Main Differences:

MRP	JIT
1) It is a 'Push' System.	1) It is a 'Pull' system.
2) Planning horizon is very long	2) Planning Horizon short
3) Scope of information is Global	3) Scope of information is local
4) No level of demand needed	4) Level of demand needed
5) Large queues possible	5) No large queues necessary
6) Too much inventory not visible	6) too much inventory is visible at the end
7) Long planned lead time	7) No such plan can be observed
8) Customer demand analysis at the beginning is the key input	8) No customer demand can be measured.
9) It is best for non repetitive, batch production, seasonal demand, short product lifecycle, long lead time purchasing	9) It is best for repetitive, high volume manufacturing and stable demand.
10) MRP outperforms JIT when demand is highly random and setup times are long	10) JIT outperforms MRP when demand is stable and setup times are brief

Benefits

As most companies use an inventory system best suited for their company, the Just-In-Time Inventory System (JIT) can have many benefits resulting from it. The main benefits of JIT are listed below.

- better quality products
- quality the responsibility of every worker, not just quality control inspectors
- reduced scrap and rework
- reduced cycle times
- lower setup times
- smoother production flow
- less inventory, of raw materials, work-in-progress and finished goods
- cost savings
- higher productivity
- higher worker participation
- more skilled workforce, able and willing to switch roles
- reduced space requirements
- improved relationships with suppliers

7. "An essential component to success of an industrial system is Logistics. Poor logistics in a business can impact its bottom line." – Discuss the concept of logistics. Its importance to an industry and its benefits in effective supply chain management.

[MODEL QUESTION]

Answer: Logistics refers to the overall process of managing how resources are acquired, stored, and transported to their final destination. Logistics management involves identifying prospective distributors and suppliers and determining their effectiveness and accessibility. Logistics managers are referred to as logisticians.

"Logistics" was initially a military-based term used in reference to how military personnel obtained, stored, and moved equipment and supplies. The term is now used widely in the business sector, particularly by companies in the manufacturing sectors, to refer to how resources are handled and moved along the supply chain.

Today's world economy is connected through social media and the Internet and has raised customer expectations for faster product delivery. Developing logistics strategies that embrace these expectations requires companies to look at things like the physical location of warehouses and the use of sophisticated software systems to receive purchase requests within a matter of seconds rather than days.

Because customer service satisfaction has become a basis on which companies drive business growth and profitability, using the best transportation system strengthens performance trade-offs to reduce shipping costs and ensure timely delivery of goods. These processes and systems are integral parts of a solid logistics management system, emphasizing the importance of warehousing and transportation for customer service excellence for end-user product delivery.

- Effectively coordinated logistics leads to positive business results
- Logistics helps businesses create value
- Logistics helps in reducing costs and improves efficiency
- Logistics helps delivering your product at the right place timely
- Logistics helps with supply chains
- Logistics is the key to success with supply professionals
- Keep your customers satisfied, rely on experienced logistic professionals

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Logistics within supply chain management is constantly changing to meet consumer demands. Consumers frequently order products using iPods, iPhones, Smartphones, and Tablets expecting to receive their product within 24-48 hours. To meet these expectations, companies have to improve the logistics of their supply chain to expedite order fulfillment and quickly ship the item via the most reliable, yet cost-effective and timely means. When companies create a blueprint that outlines the logistics of the supply chain, each component within that logistics model stays focused, reduces costs and moves quickly and efficiently resulting in higher customer satisfaction. Logistics helps companies understand the key metrics, core processes and long-term goals of their supply chain so they can get the right item to the right place at the right time.

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