

# 4

## MATERIALS MANAGEMENT

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### 4.1 INTRODUCTION AND MEANING

Materials management is a function, which aims for integrated approach towards the management of materials in an industrial undertaking. Its main objective is cost reduction and efficient handling of materials at all stages and in all sections of the undertaking. Its function includes several important aspects connected with material, such as, purchasing, storage, inventory control, material handling, standardisation etc.

### 4.2 SCOPE OR FUNCTIONS OF MATERIALS MANAGEMENT

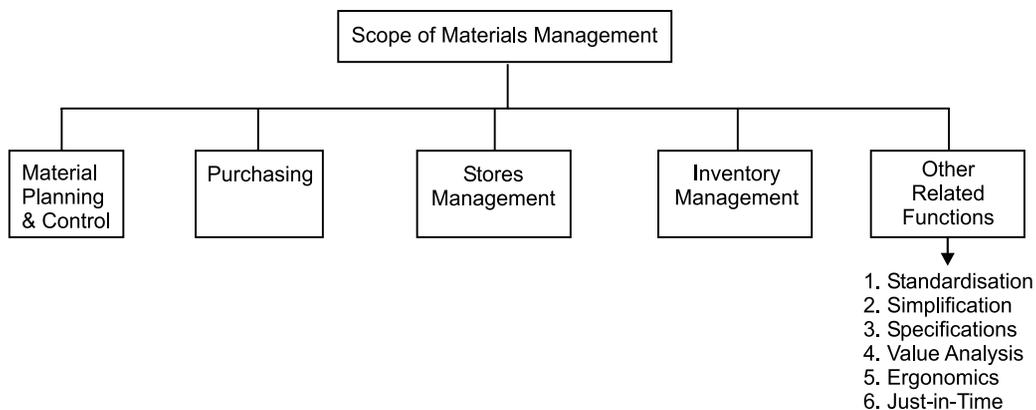
Materials management is defined as “*the function responsible for the coordination of planning, sourcing, purchasing, moving, storing and controlling materials in an optimum manner so as to provide a pre-decided service to the customer at a minimum cost*”.

From the definition it is clear that the scope of materials management is vast. The functions of materials management can be categorized in the following ways: (as shown in Fig. 4.1.)

1. Material Planning and Control

2. Purchasing
3. Stores Management
4. Inventory Control or Management
5. Standardisation
6. Simplification
7. Value Analysis
8. Ergonomics
9. Just-in-Time (JIT)

All the above mentioned functions of materials management has been discussed in detail in this chapter.



**Fig. 4.1** *Scope of materials management*

1. **Materials planning and control:** Based on the sales forecast and production plans, the materials planning and control is done. This involves estimating the individual requirements of parts, preparing materials budget, forecasting the levels of inventories, scheduling the orders and monitoring the performance in relation to production and sales.

2. **Purchasing:** This includes selection of sources of supply finalization in terms of purchase, placement of purchase orders, follow-up, maintenance of smooth relations with suppliers, approval of payments to suppliers, evaluating and rating suppliers.

3. **Stores management or management:** This involves physical control of materials, preservation of stores, minimization of obsolescence and damage through timely disposal and efficient handling, maintenance of stores records, proper location and stocking. A store is also responsible for the physical verification of stocks and reconciling them with book figures. A store plays a vital role in the operations of a company.

4. **Inventory control or management:** Inventory generally refers to the materials in stock. It is also called the idle resource of an enterprise. Inventories represent those items, which are either stocked for sale or they are in the process of manufacturing or they are in the form of

materials, which are yet to be utilized. The interval between receiving the purchased parts and transforming them into final products varies from industries to industries depending upon the cycle time of manufacture. It is, therefore, necessary to hold inventories of various kinds to act as a buffer between supply and demand for efficient operation of the system. Thus, an effective control on inventory is a must for smooth and efficient running of the production cycle with least interruptions.

#### 5. Other related activities

##### (a) 3S

(i) *Standardization*: Standardization means producing maximum variety of products from the minimum variety of materials, parts, tools and processes. It is the process of establishing standards or units of measure by which extent, quality, quantity, value, performance etc. may be compared and measured.

(ii) *Simplification*: The concept of simplification is closely related to standardization. Simplification is the process of reducing the variety of products manufactured. Simplification is concerned with the reduction of product range, assemblies, parts, materials and design.

(iii) *Specifications*: It refers to a precise statement that formulizes the requirements of the customer. It may relate to a product, process or a service.

**Example:** Specifications of an axle block are Inside Dia. =  $2 \pm 0.1$  cm, Outside Dia. =  $4 \pm 0.2$  cm and Length =  $10 \pm 0.5$  cm.

(b) *Value analysis*: Value analysis is concerned with the costs added due to inefficient or unnecessary specifications and features. It makes its contribution in the last stage of product cycle, namely, the maturity stage. At this stage research and development no longer make positive contributions in terms of improving the efficiency of the functions of the product or adding new functions to it.

(c) *Ergonomics (Human Engineering)*: The human factors or human engineering is concerned with man-machine system. Ergonomics is “the design of human tasks, man-machine system, and effective accomplishment of the job, including displays for presenting information to human sensors, controls for human operations and complex man-machine systems.” Each of the above functions are dealt in detail.

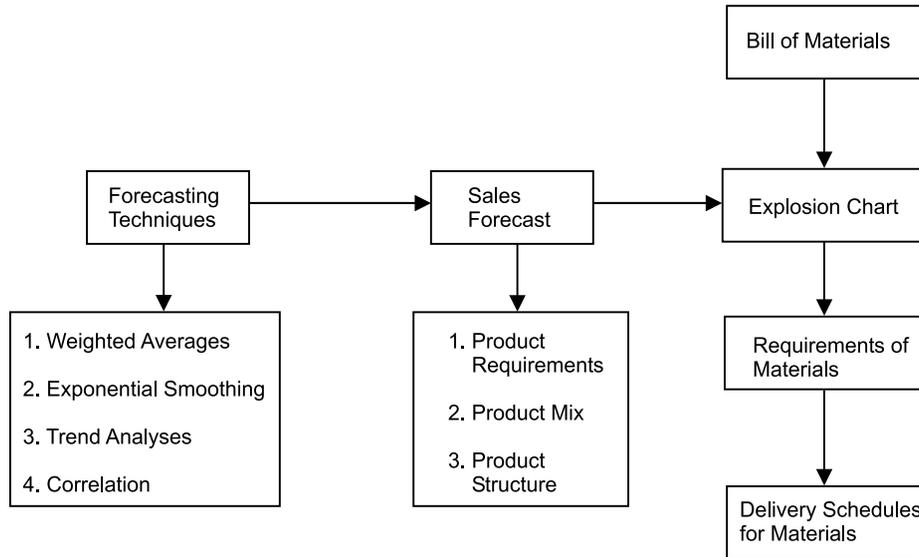
### 4.3 MATERIAL PLANNING AND CONTROL

Material planning is a scientific technique of determining in advance the requirements of raw materials, ancillary parts and components, spares etc. as directed by the production programme. It is a sub-system in the overall planning activity. There are many factors, which influence the activity of material planning. These factors can be classified as macro and micro systems.

1. *Macro factors*: Some of the micro factors which affect material planning, are price trends, business cycles Govt. import policy etc.
2. *Micro factors*: Some of the micro factors that affect material planning are plant capacity utilization, rejection rates, lead times, inventory levels, working capital, delegation of powers and communication.

### 4.3.1 Techniques of Material Planning

One of the techniques of material planning is bill of material explosion. Material planning through bill of material explosion is shown below in Fig. 4.2.



**Fig. 4.2** Material planning

The basis for material planning is the forecast demand for the end products. Forecasting techniques such as weighted average method, exponential smoothing and time series models are used for the same. Once the demand forecast is made, it is possible to go through the exercise of material planning. Bill of materials is a document which shows list of materials required, unit consumption location code for a given product. An explosive chart is a series of bill of material grouped in a matrix form so that combined requirements for different components can be done. Requirements of various materials are arrived at from the demand forecast, using bill of materials, through explosion charts. Thus material requirement plan will lead to the development of delivery schedule of the materials and purchasing of those material requirements.

## 4.4 PURCHASING

Purchasing is an important function of materials management. In any industry purchase means buying of equipments, materials, tools, parts etc. required for industry. The importance of the purchase function varies with nature and size of industry. In small industry, this function is performed by works manager and in large manufacturing concern; this function is done by a separate department. The moment a buyer places an order he commits a substantial portion of the finance of the corporation which affects the working capital and cash flow position. He is a highly responsible person who meets various salesmen and thus can be considered to have been contributing to the public relations efforts of the company. Thus, the buyer can make or mar the company's image by his excellent or poor relations with the vendors.

#### 4.4.1 Objectives of Purchasing

The basic objective of the purchasing function is to ensure continuity of supply of raw materials, sub-contracted items and spare parts and to reduce the ultimate cost of the finished goods. In other words, the objective is not only to procure the raw materials at the lowest price but to reduce the cost of the final product.

The objectives of the purchasing department can be outlined as under:

1. **To avail the materials, suppliers and equipments at the minimum possible costs:** These are the inputs in the manufacturing operations. The minimization of the input cost increases the productivity and resultantly the profitability of the operations.
2. **To ensure the continuous flow of production** through continuous supply of raw materials, components, tools etc. with repair and maintenance service.
3. **To increase the asset turnover:** The investment in the inventories should be kept minimum in relation to the volume of sales. This will increase the turnover of the assets and thus the profitability of the company.
4. **To develop an alternative source of supply:** Exploration of alternative sources of supply of materials increases the bargaining ability of the buyer, minimisation of cost of materials and increases the ability to meet the emergencies.
5. **To establish and maintain the good relations with the suppliers:** Maintenance of good relations with the supplier helps in evolving a favourable image in the business circles. Such relations are beneficial to the buyer in terms of changing the reasonable price, preferential allocation of material in case of material shortages, etc.
6. **To achieve maximum integration with other department of the company:** The purchase function is related with **production department** for specifications and flow of material, **engineering department** for the purchase of tools, equipments and machines, **marketing department** for the forecasts of sales and its impact on procurement of materials, **financial department** for the purpose of maintaining levels of materials and estimating the working capital required, **personnel department** for the purpose of manning and developing the personnel of purchase department and maintaining good vendor relationship.
7. **To train and develop the personnel:** Purchasing department is manned with varied types of personnel. The company should try to build the imaginative employee force through training and development.
8. **Efficient record keeping and management reporting:** Paper processing is inherent in the purchase function. Such paper processing should be standardised so that record keeping can be facilitated. Periodic reporting to the management about the purchase activities justifies the independent existence of the department.

#### 4.4.2 Parameters of Purchasing

The success of any manufacturing activity is largely dependent on the procurement of raw materials of right quality, in the right quantities, from right source, at the right time and at right

price popularly known as **ten 'R's'** of the art of efficient purchasing. They are described as the basic principles of purchasing. There are other well known parameters such as right contractual terms, right material, right place, right mode of transportation and right attitude are also considered for purchasing.

### **1. RIGHT PRICE**

It is the primary concern of any manufacturing organization to get an item at the right price. But right price need not be the lowest price. It is very difficult to determine the right price; general guidance can be had from the cost structure of the product. The 'tender system' of buying is normally used in public sector organizations but the objective should be to identify the lowest 'responsible' bidder and not the lowest bidder. The technique of 'learning curve' also helps the purchase agent to determine the price of items with high labour content. The price can be kept low by proper planning and not by rush buying. Price negotiation also helps to determine the right prices.

### **2. RIGHT QUALITY**

Right quality implies that quality should be available, measurable and understandable as far as practicable. In order to determine the quality of a product sampling schemes will be useful. The right quality is determined by the cost of materials and the technical characteristics as suited to the specific requirements. The quality particulars are normally obtained from the indents. Since the objective of purchasing is to ensure continuity of supply to the user departments, the time at which the material is provided to the user department assumes great importance.

### **3. RIGHT TIME**

For determining the right time, the purchase manager should have lead time information for all products and analyse its components for reducing the same. Lead time is the total time elapsed between the recognition of the need of an item till the item arrives and is provided for use. This covers the entire duration of the materials cycle and consists of pre-contractual administrative lead time, manufacturing and transporting lead time and inspection lead time. Since the inventory increases with higher lead time, it is desirable to analyse each component of the lead time so as to reduce the first and third components which are controllable. While determining the purchases, the buyer has to consider emergency situations like floods, strikes, etc. He should have 'contingency plans' when force major clauses become operative, for instance, the material is not available due to strike, lock-out, floods, and earthquakes.

### **4. RIGHT SOURCE**

The source from which the material is procured should be dependable and capable of supplying items of uniform quality. The buyer has to decide which item should be directly obtained from the manufacturer. Source selection, source development and vendor rating play an important role in buyer-seller relationships. In emergencies, open market purchases and bazaar purchases are restored to.

### **5. RIGHT QUANTITY**

The right quantity is the most important parameter in buying. Concepts, such as, economic order quantity, economic purchase quantity, fixed period and fixed quantity systems, will serve as broad guidelines. But the buyer has to use his knowledge, experience and common sense to determine

the quantity after considering factors such as price structure, discounts, availability of the item, favourable reciprocal relations, and make or buy consideration.

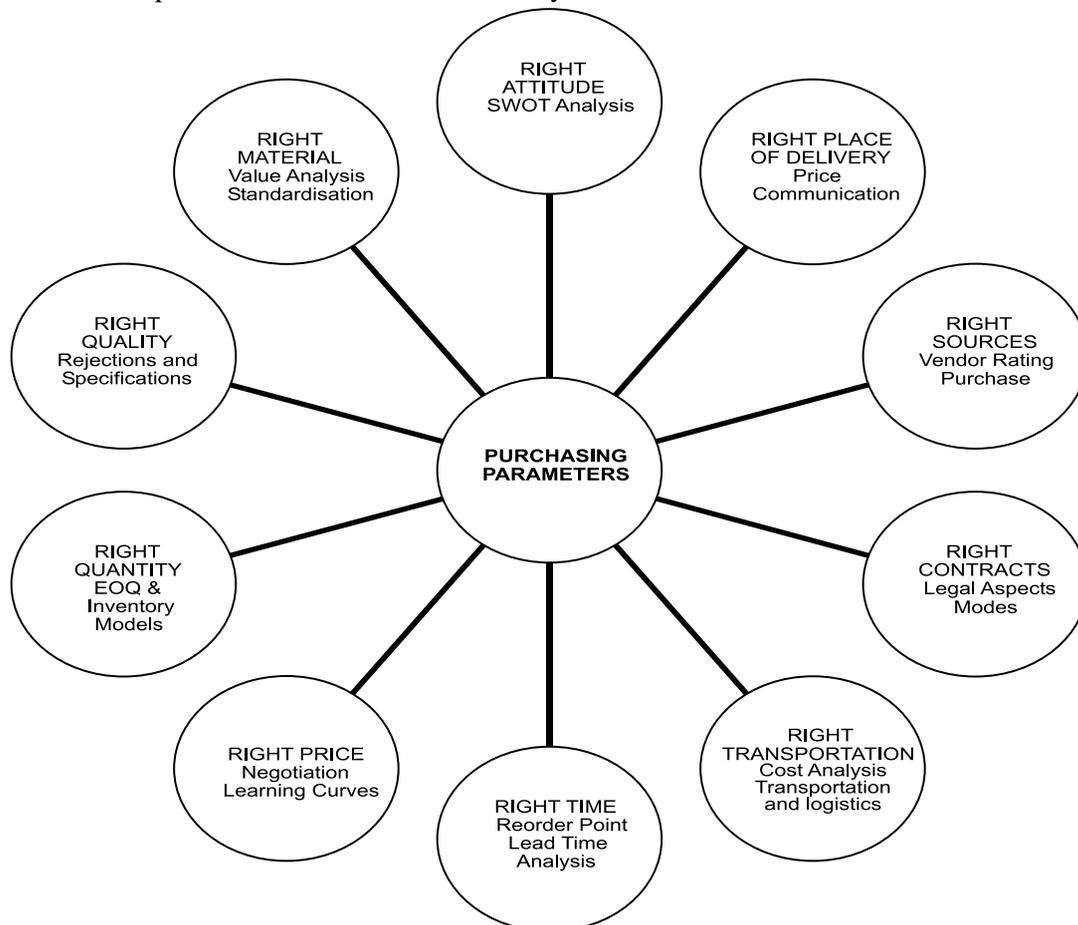


Fig. 4.3 Purchase parameters

## 6. RIGHT ATTITUDE

Developing the right attitude, too, is necessary as one often comes across such statement: 'Purchasing knows the price of everything and value of nothing'; 'We buy price and not cost'; 'When will our order placers become purchase managers?'; 'Purchasing acts like a post box'. Therefore, purchasing should keep 'progress' as its key activity and should be future-oriented. The purchase manager should be innovative and his long-term objective should be to minimise the cost of the ultimate product. He will be able to achieve this if he aims himself with techniques, such as, value analysis, materials intelligence, purchases research, SWOT analysis, purchase budget lead time analysis, etc.

## 7. RIGHT CONTRACTS

The buyer has to adopt separate policies and procedures for capital and consumer items. He should be able to distinguish between indigenous and international purchasing procedures. He should be aware of the legal and contractual aspects in international practices.

**8. RIGHT MATERIAL**

Right type of material required for the production is an important parameter in purchasing. Techniques, such as, value analysis will enable the buyer to locate the right material.

**9. RIGHT TRANSPORTATION**

Right mode of transportation have to be identified as this forms a critical segment in the cost profile of an item. It is an established fact that the cost of the shipping of ore, gravel, sand, etc., is normally more than the cost of the item itself.

**10. RIGHT PLACE OF DELIVERY**

Specifying the right place of delivery, like head office or works, would often minimize the handling and transportation cost.

**4.4.3 Purchasing Procedure**

The procedure describes the sequence of steps leading to the completion of an identified specific task. The purchasing procedure comprises the following steps as indicated in Fig. 4.4.

**1. RECOGNITION OF THE NEED**

The initiation of procedure starts with the recognition of the need by the needy section. The demand is lodged with the purchase department in the prescribed Purchase Requisition Form forwarded by the authorised person either directly or through the Stores Department. The purchase requisition clearly specifies the details, such as, specification of materials, quality and quantity, suggested supplier, etc. Generally, the low value sundries and items of common use are purchased for stock while costlier and special items are purchased according the production programmes. Generally, the corporate level executives are authorized signatories to such demands. Such purchases are approved by the Board of Directors. The reference of the approval is made on requisition and a copy of the requisition is sent to the secretary for the purpose of overall planning and budgeting.

**2. THE SELECTION OF THE SUPPLIER**

The process of selection of supplier involves two basic aspects: searching for all possible sources and short listing out of the identified sources. The complete information about the supplier is available from various sources, such as, trade directories, advertisement in trade journals, direct mailing by the suppliers, interview with suppliers, salesmen, suggestions from business associates, visit to trade fair, participation in industries convention, etc. Identification of more and more sources helps in selecting better and economical supplier. It should be noted that the low bidder is not always the best bidder. When everything except price is equal, the low bidder will be selected. The important considerations in the selection are the price, ability to supply the required quantity, maintenance of quality standards, financial standing etc. It should be noted that it is not necessary to go for this process for all types of purchases. For the repetitive orders and for the purchases of low-value, small lot items, generally the previous suppliers with good records are preferred.

**3. PLACING THE ORDER**

Once the supplier is selected the next step is to place the purchase order. Purchase order is a letter sent to the supplier asking to supply the said material. At least six copies of purchase order

are prepared by the purchase section and each copy is separately signed by the purchase officer. Out these copies, one copy each is sent to store-keeper, supplier, accounts section, inspection department and to the department placing the requisition and one copy is retained by the purchase department for record.

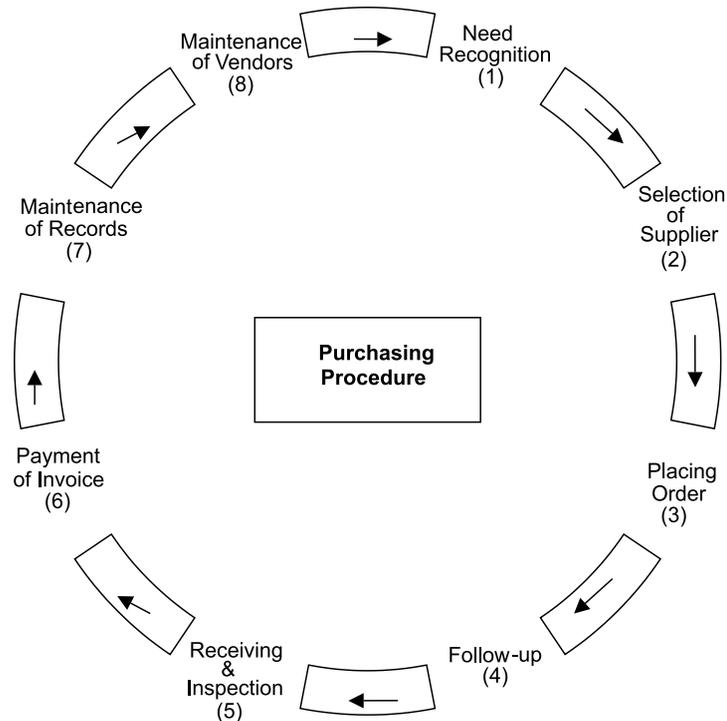


Fig. 4.4 Purchasing procedure

#### 4. FOLLOW-UP OF THE ORDER

Follow-up procedure should be employed wherever the costs and risks resulting from the delayed deliveries of materials are greater than the cost of follow-up procedure, the follow-up procedure tries to see that the purchase order is confirmed by the supplier and the delivery is promised. It is also necessary to review the outstanding orders at regular intervals and to communicate with the supplier in case of need. Generally, a routine urge is made to the supplier by sending a printed post card or a circular letter asking him to confirm that the delivery is on the way or will be made as per agreement. In absence of any reply or unsatisfactory reply, the supplier may be contact through personal letter, phone, telegram and/or even personal visit.

#### 5. RECEIVING AND INSPECTION OF THE MATERIALS

The receiving department receives the materials supplied by the vendor. The quantity are verified and tallied with the purchase order. The receipt of the materials is recorded on the specially designed receiving slips or forms which also specify the name of the vendor and the purchase order number. It also records any discrepancy, damaged condition of the consignment or inferiority of the materials. The purchase department is informed immediately about the receipt of the materials. Usually a copy of the receiving slip is sent to the purchase department.

**6. PAYMENT OF THE INVOICE**

When the goods are received in satisfactory condition, the invoice is checked before it is approved for the payment. The invoice is checked to see that the goods were duly authorised to purchase, they were properly ordered, they are priced as per the agreed terms, the quantity and quality confirm to the order, the calculations are arithmetically correct etc.

**7. MAINTENANCE OF THE RECORDS**

Maintenance of the records is an important part and parcel of the efficient purchase function. In the industrial firms, most of the purchases are repeat orders and hence the past records serve as a good guide for the future action. They are very useful for deciding the timings of the purchases and in selecting the best source of the supply.

**8. MAINTENANCE OF VENDOR RELATIONS**

The quantum and frequency of the transactions with the same key suppliers provide a platform for the purchase department to establish and maintain good relations with them. Good relations develop mutual trust and confidence in the course of the time which is beneficial to both the parties. The efficiency of the purchase department can be measured by the amount of the goodwill it has with its suppliers.

**4.4.4 Selection of Suppliers**

Selection of the right supplier is the responsibility of the purchase department. It can contribute substantially to the fundamental objectives of the business enterprise. Different strategies are required for acquiring different types of materials. The selection of supplier for standardised products will differ from non-standardised products. Following factors are considered for the selection of suppliers:

**A. SOURCES OF SUPPLIER**

The best buying is possible only when the decision maker is familiar with all possible sources of supply and their respective terms and conditions. The purchase department should try to locate the appropriate sources of the supplier of various types of materials. This is known as 'survey stage'. A survey of the following will help in developing the possible sources of supply:

1. Specialised trade directories.
2. Assistance of professional bodies or consultants.
3. The buyer's guide or purchase handbook.
4. The manufacturer's or distributor's catalogue.
5. Advertisements in dailies.
6. Advertisement in specialised trade journals.
7. Trade fair exhibitions.

**B. DEVELOPMENT OF APPROVED LIST OF SUPPLIERS**

The survey stage highlights the existence of the source. A business inquiry is made with the appropriate supplier. It is known as 'Inquiry Stage'. Here a short listing is made out of the given sources of suppliers in terms of production facilities and capacity, financial standing, product

quality, possibility of timely supply, technical competence, manufacturing efficiency, general business policies followed, standing in the industry, competitive attitude, and interest in buying orders etc.

### **C. EVALUATION AND SELECTION OF THE SUPPLIER**

The purchase policy and procedure differ according to the type of items to be purchased. Hence, evolution and selection of the supplier differ accordingly. In the 'purchasing handbook' edited by Aljian, it has been described that the following variables to be considered while evaluating the quotations of the suppliers:

#### **1. Cost Factors**

Price, transportation cost, installation cost if any, tooling and other operations cost, incidence of sales tax and excise duty, terms of payment and cash discount are considered in cost factor.

#### **2. Delivery**

Routing and F.O.B. terms are important in determining the point at which the title to the goods passes from vendor to the buyer and the responsibility for the payment of the payment charges.

#### **3. Design and Specification Factors**

Specification compliance, specification deviations, specification advantages, important dimensions and weights are considered in line with the demonstration of sample, experience of other users, after sale services etc.

#### **4. Legal Factors**

Legal factors include warranty, cancellation provision, patent protection, public liability, federal laws and reputation compliance.

#### **5. Vendor Rating**

The evaluation of supplier or vendor rating provides valuable information which help in improving the quality of the decision. In the vendor rating three basic aspects are considered namely quality, service and price. How much weight should be given to each of these factors is a matter of judgment and is decided according to the specific need of the organization. Quality would be the main consideration in the manufacturing of the electrical equipments while price would be the prime consideration in the product having a tense competitive market and for a company procuring its requirements under the blanket contract with agreed price, the supplier rating would be done on the basis of two variables namely quality and delivery.

The Development Project Committee of the National Association of Purchasing Agents (U.S.A.) has suggested following methods for evaluating the performance of past suppliers.

1. **The categorical plan:** Under this method the members of the buying staff related with the supplier like receiving section, quality control department, manufacturing department etc., are required to assess the performance of each supplier. The rating sheets are provided with the record of the supplier, their product and the list of factors for the evaluation purposes. The members of the buying staff are required to assign the plus or minus notations against each factor. The periodic meetings, usually at the interval of one month, are held by senior man of the buying staff to consider the individual rating of each section. The consolidation of the individual rating is done on the basis of the net plus value and accordingly, the suppliers are assigned the categories such as 'preferred', 'neutral' or 'unsatisfactory'. Such ratings are used for the future guidance.

This is a very simple and inexpensive method. However, it is not precise. Its quality heavily depends on the experience and ability of the buyer to judge the situation. As compared to other methods, the degree of subjective judgment is very high as rating is based on personal whim and the vague impressions of the buyer. As the quantitative data supported by the profits do not exist, it is not possible to institute any corrective action with the vendor. The rating is done on the basis of memory, and thus it becomes only a routine exercise without any critical analysis.

2. **The weighted-point method:** The weighted-point method provides the quantitative data for each factor of evaluation. The weights are assigned to each factor of evaluation according to the need of the organization, e.g., a company decides the three factors to be considered—quality, price and timely delivery. It assigns the relative weight to each of these factors as under:

<b>Quality</b>	.....	50 points
<b>Price</b>	.....	30 points
<b>Timely delivery</b>	.....	20 points

The evaluation of each supplier is made in accordance with the aforesaid factors and weights and the composite weighted-points are ascertained for each suppliers—A, B and C—are rated under this method. First of all the specific rating under each factor will be made and then the consolidation of all the factors will be made for the purpose of judgment.

**Quality rating:** Percentage of quantity accepted among the total quantity is called quality rating. In other words, the quality of the materials is judged on the basis of the degree of acceptance and rejections. For the purpose of comparison, the percentage degree of acceptance will be calculated in relation to the total lots received. **Price rating** is done on the basis of net price charged by the supplier. **Timely delivery** rating will be done comparing with the average delivery schedule of the supplier.

3. **The cost-ratio plan:** Under this method, the vendor rating is done on the basis of various costs incurred for procuring the materials from various suppliers. The cost-ratios are ascertained delivery etc. The cost-ratios are ascertained for the different rating variables such as quality, price, timely delivery etc. The cost-ratio is calculated in percentage on the basis of total individual cost and total value of purchases. At the end, all such cost-ratios will be adjusted with the quoted price per unit. The plus cost-ratio will increase the unit price while the minus cost-ratio will decrease the unit price. The net adjusted unit price will indicate the vendor rating. The vendor with the lowest net adjusted unit price will be the best supplier and so on. Certain quality costs can be inspection cost, cost of defectives, reworking costs and manufacturing losses on rejected items etc. Certain delivery costs can be postage and telegrams, telephones and extra cost for quick delivery etc.

**VENDER RATING ILLUSTRATIONS**

**ILLUSTRATION 1:** *The following information is available on 3 vendors: A, B and C. Using the data below, determine the best source of supply under weighed-point method and substantiate your solution.*

*Vendor A: Delivered '56' lots, '3' were rejected, '2' were not according to the schedule.  
Vendor B: Supplied '38' lots, '2' were rejected, '3' were late.*

Vendor C: Finished '42' lots, '4' were defective, '5' were delayed deliveries.  
Give 40 for quality and 30 weightage for service.

**SOLUTION: Formula:**

$$\text{Quality performance (weightage 40\%)} = \frac{\text{Quality accepted}}{\text{Total quantity supplied}} \times 40$$

**Delivery performance:**

X Adherence to time schedule (weightage 30%)

$$= \frac{\text{No. of delivery made on the scheduled date}}{\text{Total no. of scheduled deliveries}} \times 30$$

Y Adherence to quantity schedule (weightage 30%)

$$= \frac{\text{No. of correct lot size deliveries}}{\text{Total no. of scheduled deliveries}} \times 30$$

Total vendor rating = X + Y

$$\text{Vendor A} = \frac{53}{56} \times 40 + \frac{54}{56} \times 30 = 66.78$$

$$\text{Vendor B} = \frac{36}{38} \times 40 + \frac{35}{38} \times 30 = 65.52$$

$$\text{Vendor C} = \frac{38}{42} \times 40 + \frac{37}{42} \times 30 = 62.62$$

Vendor 'A' is selected with the best rating.

**ILLUSTRATION 2:** The following information is available from the record of the incoming material department of ABC Co. Ltd.

Vendor code	No. of lots submitted	No. of list accepted	Proportion defectives in lots	Unit price in Rs.	Fraction of delivery commitment
A	15	12	0.08	15.00	0.94
B	10	9	0.12	19.00	0.98
C	1	1	–	21.00	0.90

The factor weightage for quality, delivery and price are 40%, 35% and 25% as per the decision of the *mar.* Rank the performance of the vendors on the QDP basis interpret the result.

**SOLUTION: Formula:**

Total vendor rating = Quality performance + Delivery performance rating + Price rating

$$\text{Vendor A} = \frac{12}{15} \times 40 + 0.94 \times 35 + \frac{15}{15} \times 25 = 89.90$$

$$\text{Vendor B} = \frac{9}{10} \times 40 + 0.98 \times 35 + \frac{15}{19} \times 25 = 90.036$$

$$\text{Vendor C} = 1 \times 40 + 0.90 \times 35 + \frac{15}{21} \times 25 = 89.357$$

**Formal mode:**

$$\begin{aligned}
 &= \frac{\text{No. of lots accepted}}{\text{No. of lots submitted}} \times (\text{weightage for quality}) \\
 &+ \frac{\text{No. of accepted lots}}{\text{No. of lots submitted with time}} \times (\text{weightage for delivery}) \\
 &+ \frac{\text{Lowest price}}{\text{Price of lot}} \times (\text{weightage for price})
 \end{aligned}$$

Vendor B is selected with higher rating.

#### 4.4.5 Special Purchasing Systems

The following are some of the important purchasing systems:

##### 1. FORWARD BUYING

Forward buying or committing an organization far into the future, usually for a year. Depending upon the availability of the item, the financial policies, the economic order quantity, the quantitative discounts, and the staggered delivery, the future commitment is decided. This type of forward buying is different from speculative buying where the motive is to make capital out of the price changes, by selling the purchased items. Manufacturing organizations normally do not indulge in such buying. However, a few organizations do 'Hedge', particularly in the commodity market by selling or buying contracts.

##### 2. TENDER BUYING

In public, all semblance of favouritism, personal preferences should be avoided. As such, it is common for government departments and public sector undertakings to purchase through tenders. Private sector organizations adopt tender buying if the value of purchases is more than the prescribed limits as Rs. 50000 or Rs. 100000. The steps involved are to establish a bidders' list, solicit bids by comparing quotations and place the order with the lowest bidder. However, care has to be taken that the lowest bidder is responsible party and is capable of meeting the delivery schedule and quality requirements. Open tender system or advertisement in newspapers is common in public sector organizations. As advertising bids is costly and time consuming, most private sector organizations solicit tenders only from the renowned suppliers capable of supplying the materials.

##### 3. BLANKET ORDER SYSTEM

This system minimizes the administrative expenses and is useful for 'C' type items. It is an agreement to provide a required quantity of specified items, over a period of time, usually for one year, at an agreed price. Deliveries are made depending upon the buyer's needs. The system relieves the buyers from routine work, giving him more time for focusing attention on high value items. It requires fewer purchase orders and thus reduces clerical work. It often achieves lower prices through quantity discounts by grouping the requirements. The supplier, under the system maintains adequate inventory to meet the blanket orders.

##### 4. ZERO STOCK

Some firms try to operate on the basis of zero stock and the supplier holds the stock for these firms. Usually, the firms of the buyer and seller are close to each other so that the raw materials

of one is the finished products of another. Alternatively, the system could work well if the seller holds the inventory and if the two parties work in close coordination. However, the price per item in this system will be slightly higher as the supplier will include the inventory carrying cost in the price. In this system, the buyer need not lock up the capital and so the purchasing routine is reduced. This is also significantly reduces obsolescence of inventory, lead time and clerical efforts in paper work. Thus, the seller can devote his marketing efforts to other customers and production scheduling becomes easy.

### **5. RATE CONTRACT**

The system of rate contract is prevalent in public sector organizations and government departments. It is common for the suppliers to advertise that they are on 'rate contract' for the specific period. After negotiations, the seller and the buyer agree to the rates of items. Application of rate contract has helped many organizations to cut down the internal administrative lead time as individual firms need to go through the central purchasing departments and can place orders directly with the suppliers. However, suppliers always demand higher prices for prompt delivery, as rate difficulty has been avoided by ensuring the delivery of a minimum quantity at the agreed rates. This procedure of fixing a minimum quantity is called the running contract and is being practised by the railways. The buyer also has an option of increasing the quantity by 25% more than the agreed quantity under this procedure.

### **6. RECIPROCITY**

Reciprocal buying means purchasing from one's customers in preference to others. It is based on the principle "if you kill my cat, I will kill your dog", and "Do unto your customers as you would have them do unto you". Other things, like soundness from the ethics and economics point of view being equal, the principles of reciprocity can be practiced. However, a purchasing executive should not indulge in reciprocity on his initiative when the terms and conditions are not equal with other suppliers. It is often sound that less efficient manufacturers and distributors gain by reciprocity what they are unable to gain by price and quality. Since this tends to discourage competition and might lead to higher process and fewer suppliers, reciprocity should be practised on a selective basis.

### **7. SYSTEMS CONTRACT**

This is a procedure intended to help the buyer and the sellers to reduce administrative expenses and at the same time ensure suitable controls. In this system, the original indent, duly approved by competent authorities, is shipped back with the items and avoids the usual documents like purchase orders, materials requisitions, expediting letters and acknowledgements, delivery period price and invoicing procedure. Carborandum company in the US claims drastic reduction in inventory and elimination of 40000 purchase orders by adopting the system contracting procedure. It is suitable for low unit price items with high consumption.

## **4.5**

### **STORES MANAGEMENT**

Stores play a vital role in the operations of company. It is in direct touch with the user departments in its day-to-day activities. The most important purpose served by the stores is to provide

uninterrupted service to the manufacturing divisions. Further, stores are often equated directly with money, as money is locked up in the stores.

### **FUNCTIONS OF STORES**

The functions of stores can be classified as follows:

1. To receive raw materials, components, tools, equipment's and other items and account for them.
2. To provide adequate and proper storage and preservation to the various items.
3. To meet the demands of the consuming departments by proper issues and account for the consumption.
4. To minimise obsolescence, surplus and scrap through proper codification, preservation and handling.
5. To highlight stock accumulation, discrepancies and abnormal consumption and effect control measures.
6. To ensure good house keeping so that material handling, material preservation, stocking, receipt and issue can be done adequately.
7. To assist in verification and provide supporting information for effective purchase action.

#### **4.5.1 Codification**

It is one of the functions of stores management. Codification is a process of representing each item by a number, the digit of which indicates the group, the sub-group, the type and the dimension of the item. Many organizations in the public and private sectors, railways have their own system of codification, varying from eight to thirteen digits. The first two digits represents the major groups, such as raw materials, spare parts, sub-contracted items, hardware items, packing material, tools, oil, stationery etc. The next two digits indicate the sub-groups, such as, ferrous, non-ferrous etc. Dimensional characteristics of length, width, head diameter etc. constitute further three digits and the last digit is reserved for minor variations.

Whatever may be the basis, each code should uniquely represent one item. It should be simple and capable of being understood by all. Codification should be compact, concise, consistent and flexible enough to accommodate new items. The groupings should be logical, holding similar parts near to one another. Each digit must be significant enough to represent some characteristic of the item.

#### **Objectives of Codification**

The objectives of a rationalized material coding system are:

1. Bringing all items together.
2. To enable putting up of any future item in its proper place.
3. To classify an item according to its characteristics.
4. To give an unique code number to each item to avoid duplication and ambiguity.
5. To reveal excessive variety and promote standardization and variety reduction.
6. To establish a common language for the identification of an item.

7. To fix essential parameters for specifying an item.
8. To specify item as per national and international standards.
9. To enable data processing and analysis.

### Advantages of Codification

As a result of rationalized codification, many firms have reduced the number of items. It enables systematic grouping of similar items and avoids confusion caused by long description of items since standardization of names is achieved through codification, it serves as the starting point of simplification and standardization. It helps in avoiding duplication of items and results in the minimisation of the number of items, leading to accurate record. Codification enables easy recognition of an item in stores, thereby reducing clerical efforts to the minimum. If items are coded according to the sources, it is possible to bulk the items while ordering. To maximise the aforesaid advantages, it is necessary to develop the codes as concerned, namely, personnel from design, production, engineering, inspection, maintenance and materials.

## 4.6 INVENTORY CONTROL OR MANAGEMENT

### 4.6.1 Meaning of Inventory

Inventory generally refers to the materials in stock. It is also called the idle resource of an enterprise. Inventories represent those items which are either stocked for sale or they are in the process of manufacturing or they are in the form of materials, which are yet to be utilised. The interval between receiving the purchased parts and transforming them into final products varies from industries to industries depending upon the cycle time of manufacture. It is, therefore, necessary to hold inventories of various kinds to act as a buffer between supply and demand for efficient operation of the system. Thus, an effective control on inventory is a must for smooth and efficient running of the production cycle with least interruptions.

### 4.6.2 Reasons for Keeping Inventories

1. **To stabilise production:** The demand for an item fluctuates because of the number of factors, *e.g.*, seasonality, production schedule etc. The inventories (raw materials and components) should be made available to the production as per the demand failing which results in stock out and the production stoppage takes place for want of materials. Hence, the inventory is kept to take care of this fluctuation so that the production is smooth.

2. **To take advantage of price discounts:** Usually the manufacturers offer discount for bulk buying and to gain this price advantage the materials are bought in bulk even though it is not required immediately. Thus, inventory is maintained to gain economy in purchasing.

3. **To meet the demand during the replenishment period:** The lead time for procurement of materials depends upon many factors like location of the source, demand supply condition, etc. So inventory is maintained to meet the demand during the procurement (replenishment) period.

4. **To prevent loss of orders (sales):** In this competitive scenario, one has to meet the delivery schedules at 100 per cent service level, means they cannot afford to miss the delivery schedule which may result in loss of sales. To avoid the organizations have to maintain inventory.

5. **To keep pace with changing market conditions:** The organizations have to anticipate the changing market sentiments and they have to stock materials in anticipation of non-availability of materials or sudden increase in prices.

6. Sometimes the organizations have to stock materials due to other reasons like suppliers minimum quantity condition, seasonal availability of materials or sudden increase in prices.

#### 4.6.3 Meaning of Inventory Control

Inventory control is a planned approach of determining what to order, when to order and how much to order and how much to stock so that costs associated with buying and storing are optimal without interrupting production and sales. Inventory control basically deals with two problems: (i) When should an order be placed? (Order level), and (ii) How much should be ordered? (Order quantity).

These questions are answered by the use of inventory models. The scientific inventory control system strikes the balance between the loss due to non-availability of an item and cost of carrying the stock of an item. Scientific inventory control aims at maintaining optimum level of stock of goods required by the company at minimum cost to the company.

#### 4.6.4 Objectives of Inventory Control

1. To ensure adequate supply of products to customer and avoid shortages as far as possible.
2. To make sure that the financial investment in inventories is minimum (*i.e.*, to see that the working capital is blocked to the minimum possible extent).
3. Efficient purchasing, storing, consumption and accounting for materials is an important objective.
4. To maintain timely record of inventories of all the items and to maintain the stock within the desired limits.
5. To ensure timely action for replenishment.
6. To provide a reserve stock for variations in lead times of delivery of materials.
7. To provide a scientific base for both short-term and long-term planning of materials.

#### 4.6.5 Benefits of Inventory Control

It is an established fact that through the practice of scientific inventory control, following are the benefits of inventory control:

1. Improvement in customer's relationship because of the timely delivery of goods and service.
2. Smooth and uninterrupted production and, hence, no stock out.
3. Efficient utilisation of working capital. Helps in minimising loss due to deterioration, obsolescence damage and pilferage.
4. Economy in purchasing.
5. Eliminates the possibility of duplicate ordering.

**4.6.6 Techniques of Inventory Control**

In any organization, depending on the type of business, inventory is maintained. When the number of items in inventory is large and then large amount of money is needed to create such inventory, it becomes the concern of the management to have a proper control over its ordering, procurement, maintenance and consumption. The control can be for order quality and order frequency.

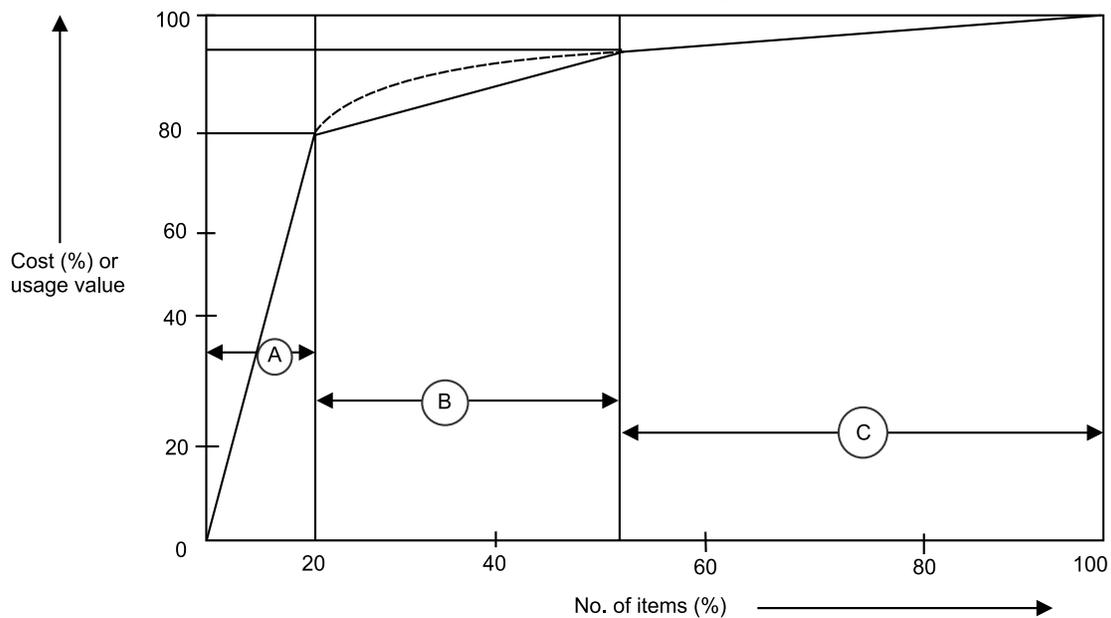
The different techniques of inventory control are: (1) ABC analysis, (2) HML analysis, (3) VED analysis, (4) FSN analysis, (5) SDE analysis, (6) GOLF analysis and (7) SOS analysis. The most widely used method of inventory control is known as ABC analysis. In this technique, the total inventory is categorised into three sub-heads and then proper exercise is exercised for each sub-heads.

1. **ABC analysis:** In this analysis, the classification of existing inventory is based on annual consumption and the annual value of the items. Hence we obtain the quantity of inventory item consumed during the year and multiply it by unit cost to obtain annual usage cost. The items are then arranged in the descending order of such annual usage cost. The analysis is carried out by drawing a graph based on the cumulative number of items and cumulative usage of consumption cost. Classification is done as follows:

**Table 4.1**

<i>Category</i>	<i>Percentage of items</i>	<i>Percentage of annual consumption value</i>
A	10–20	70–80
B	20–30	10–25
C	60–70	5–15

The classification of ABC analysis is shown by the graph given as follows (Fig. 4.5).



**Fig. 4.5 ABC classification**

Once ABC classification has been achieved, the policy control can be formulated as follows:

**A-Item:** Very tight control, the items being of high value. The control need be exercised at higher level of authority.

**B-Item:** Moderate control, the items being of moderate value. The control need be exercised at middle level of authority.

**C-Item:** The items being of low value, the control can be exercised at gross root level of authority, *i.e.*, by respective user department managers.

2. **HML analysis:** In this analysis, the classification of existing inventory is based on unit price of the items. They are classified as high price, medium price and low cost items.

3. **VED analysis:** In this analysis, the classification of existing inventory is based on criticality of the items. They are classified as vital, essential and desirable items. It is mainly used in spare parts inventory.

4. **FSN analysis:** In this analysis, the classification of existing inventory is based consumption of the items. They are classified as fast moving, slow moving and non-moving items.

5. **SDE analysis:** In this analysis, the classification of existing inventory is based on the items.

6. **GOLF analysis:** In this analysis, the classification of existing inventory is based sources of the items. They are classified as Government supply, ordinarily available, local availability and foreign source of supply items.

7. **SOS analysis:** In this analysis, the classification of existing inventory is based nature of supply of items. They are classified as seasonal and off-seasonal items.

For effective inventory control, combination of the techniques of ABC with VED or ABC with HML or VED with HML analysis is practically used.

#### 4.6.7 Inventory Model

##### ECONOMIC ORDER QUANTITY (EOQ)

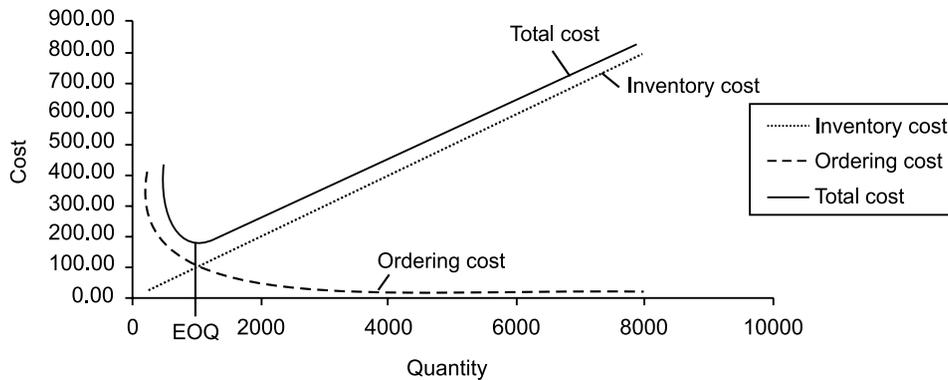
Inventory models deal with idle resources like men, machines, money and materials. These models are concerned with two decisions: how much to order (purchase or produce) and when to order so as to minimize the total cost.

For the first decision—how much to order, there are two basic costs are considered namely, inventory carrying costs and the ordering or acquisition costs. As the quantity ordered is increased, the inventory carrying cost increases while the ordering cost decreases. The ‘order quantity’ means the quantity produced or procured during one production cycle. Economic order quantity is calculated by balancing the two costs. Economic Order Quantity (EOQ) is that size of order which minimizes total costs of carrying and cost of ordering.

*i.e.*, Minimum Total Cost occurs when Inventory Carrying Cost = Ordering Cost

Economic order quantity can be determined by two methods:

1. Tabulation method.
2. Algebraic method.



**Fig. 4.6** Inventory cost curve

**1. Determination of EOQ by Tabulation (Trial & Error) Method**

This method involves the following steps:

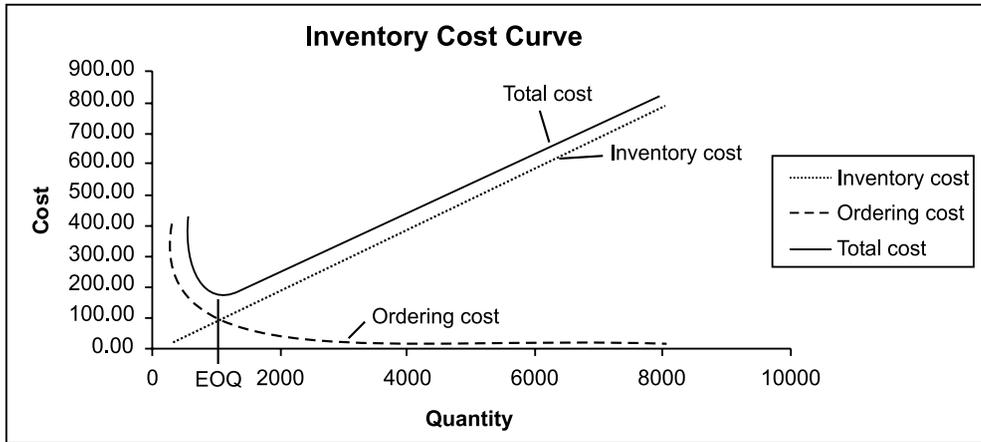
1. Select the number of possible lot sizes to purchase.
2. Determine average inventory carrying cost for the lot purchased.
3. Determine the total ordering cost for the orders placed.
4. Determine the total cost for each lot size chosen which is the summation of inventory carrying cost and ordering cost.
5. Select the ordering quantity, which minimizes the total cost.

The data calculated in a tabular column can plotted showing the nature of total cost, inventory cost and ordering cost curve against the quantity ordered as in Fig. 4.6.

**ILLUSTRATION 3:** *The XYZ Ltd. carries a wide assortment of items for its customers. One of its popular items has annual demand of 8000 units. Ordering cost per order is found to be Rs. 12.5. The carrying cost of average inventory is 20% per year and the cost per unit is Re. 1.00. Determine the optimal economic quantity and make your recommendations.*

**SOLUTION:**

No. of orders/year (1)	Lot size (2)	Average inventory (3)	Carrying cost (4)	Ordering cost (5)	Total cost/year (6) = (4) + (5)
1	8000	4000	800.00	12.5	812.50
2	4000	2000	400.00	25	425.00
4	2000	1000	200.00	50	250.00
8	1000	500	100.00	100	200.00
12	666.667	333.333	66.67	150	216.67
16	500	250	50.00	200	250.00



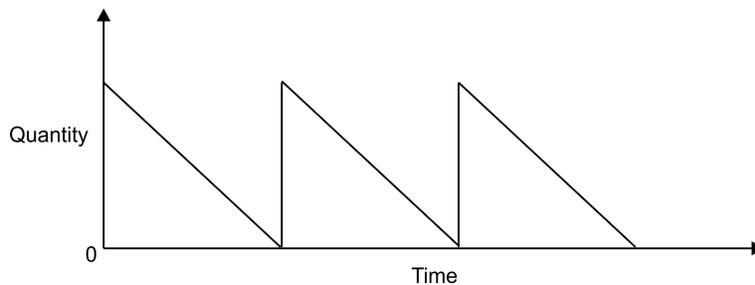
The table and the graph indicates that an order size of 1000 units will gives the lowest total cost among the different alternatives. It also shows that minimum total cost occurs when carrying cost is equal to ordering cost.

**2. Determination of EOQ by Analytical Method**

In order to derive an economic lot size formula following assumptions are made:

1. Demand is known and uniform.
2. Let D denotes the total number of units purchase/produced and Q denotes the lot size in each production run.
3. Shortages are not permitted, *i.e.*, as soon as the level of the inventory reaches zero, the inventory is replenished.
4. Production or supply of commodity is instantaneous.
5. Lead-time is zero.
6. Set-up cost per production run or procurement cost is  $C_3$ .
7. Inventory carrying cost is  $C_1 = CI$ , where C is the unit cost and I is called inventory carrying cost expressed as a percentage of the value of the average inventory.

This fundamental situation can be shown on an inventory-time diagram, (Fig. 4.7) with Q on the vertical axis and the time on the horizontal axis. The total time period (one year) is divided into *n* parts.



**Fig. 4.7**

The most economic point in terms of total inventory cost exists where,

$$\text{Inventory carrying cost} = \text{Annual ordering cost (set-up cost)}$$

$$\begin{aligned} \text{Average inventory} &= 1/2 (\text{maximum level} + \text{minimum level}) \\ &= (Q + 0)/2 = Q/2 \end{aligned}$$

$$\text{Total inventory carrying cost} = \text{Average inventory} \times \text{Inventory carrying cost per unit}$$

$$\text{i.e., Total inventory carrying cost} = Q/2 \times C_1 = QC_1/2 \quad \dots(1)$$

$$\text{Total annual ordering costs} = \text{Number of orders per year} \times \text{Ordering cost per order}$$

$$\text{i.e., Total annual ordering costs} = (D/Q) \times C_3 = (D/Q)C_3 \quad \dots(2)$$

Now, summing up the total inventory cost and the total ordering cost, we get the total inventory cost  $C(Q)$ .

$$\text{i.e., Total cost of production run} = \text{Total inventory carrying cost} \\ + \text{Total annual ordering costs}$$

$$C(Q) = QC_1/2 + (D/Q)C_3 \quad (\text{cost equation}) \quad \dots(3)$$

But, the total cost is minimum when the inventory carrying costs becomes equal to the total annual ordering costs. Therefore,

$$QC_1/2 = (D/Q)C_3$$

$$\text{or} \quad QC_1 = (2D/Q)C_3 \quad \text{or} \quad Q^2 = 2C_3D/C_1$$

$$\text{or} \quad Q = \sqrt{\frac{2C_3D}{C_1}}$$

$$\text{i.e., Optimal quantity (EOQ), } Q_0 = \sqrt{\frac{2C_3D}{C_1}} \quad \dots(4)$$

$$\text{Optimum number of orders, } (N_0) = \frac{D}{Q_0} \quad \dots(5)$$

$$\text{Optimum order interval, } (t_0) = \frac{365}{N_0} \text{ in days} = \frac{1}{N_0} \text{ in years or } (t_0) = \frac{Q_0}{D} \quad \dots(6)$$

$$\text{Average yearly cost (TC)} = \sqrt{2C_3DC_1} \quad \dots(7)$$

**ILLUSTRATION 4:** An oil engine manufacturer purchases lubricants at the rate of Rs. 42 per piece from a vendor. The requirements of these lubricants are 1800 per year. What should be the ordering quantity per order, if the cost per placement of an order is Rs. 16 and inventory carrying charges per rupee per year is 20 paise.

**SOLUTION:** Given data are:

Number of lubricants to be purchased,  $D = 1800$  per year

Procurement cost,  $C_3 = \text{Rs. } 16$  per order

Inventory carrying cost,  $CI = C_1 = \text{Rs. } 42 \times \text{Re. } 0.20 = \text{Rs. } 8.40$  per year

$$\text{Then, optimal quantity (EOQ), } Q_0 = \sqrt{\frac{2C_3D}{C_1}}$$

$$Q_0 = \sqrt{\frac{2 \times 16 \times 1800}{8.4}} = 82.8 \text{ or } 83 \text{ lubricants (approx).}$$

**ILLUSTRATION 5:** A manufacturing company purchase 9000 parts of a machine for its annual requirements ordering for month usage at a time, each part costs Rs. 20. The ordering cost per order is Rs. 15 and carrying charges are 15% of the average inventory per year. You have been assigned to suggest a more economical purchase policy for the company. What advice you offer and how much would it save the company per year?

**SOLUTION:** Given data are:

Number of lubricants to be purchased,  $D = 9000$  parts per year

Cost of part,  $C_s = \text{Rs. } 20$

Procurement cost,  $C_3 = \text{Rs. } 15$  per order

Inventory carrying cost,  $CI = C_1 = 15\%$  of average inventory per year  
 $= \text{Rs. } 20 \times 0.15 = \text{Rs. } 3$  per each part per year

Then, optimal quantity (EOQ),  $Q_0 = \sqrt{\frac{2C_3D}{C_1}}$

$$Q_0 = \sqrt{\frac{2 \times 15 \times 9000}{3}} = 300 \text{ units}$$

and Optimum order interval,  $(t_0) = \frac{Q_0}{D}$  in years  $= \frac{300}{9000} = \frac{1}{30}$  years  
 $= \frac{1}{30} \times 365 \text{ days} = 122 \text{ Days}$

$$\text{Minimum average cost} = \sqrt{2C_3DC_1} = \sqrt{2 \times 3 \times 15 \times 9000} = \text{Rs. } 900$$

If the company follows the policy of ordering every month, then the annual ordering cost is

$$= \text{Rs } 12 \times 15 = \text{Rs. } 180$$

Lot size of inventory each month  $= 9000/12 = 750$

$$\text{Average inventory at any time} = \frac{Q}{2} = 750/2 = 375$$

Therefore, storage cost at any time  $= 375 \times C_1 = 375 \times 3 = \text{Rs. } 1125$

$$\text{Total annual cost} = 1125 + 180 = \text{Rs. } 1305$$

Hence, the company should purchase 300 parts at time interval of  $1/30$  year instead of ordering 750 parts each month. The net saving of the company will be

$$= \text{Rs. } 1305 - \text{Rs. } 900 = \text{Rs. } 405 \text{ per year.}$$

## 4.7 STANDARDIZATION

Standardization means producing maximum variety of products from the minimum variety of materials, parts, tools and processes. It is the process of establishing standards or units of measure by which extent, quality, quantity, value, performance etc., may be compared and measured.

### 4.7.1 Advantages of Standardization

All the sections of company will be benefited from standardization as mentioned below.

#### **Benefits to Design Department**

1. Fewer specifications, drawings and part list have to prepared and issued.
2. More time is available to develop new design or to improve established design.
3. Better resource allocation.
4. Less qualified personnel can handle routine design work.

#### **Benefits to Manufacturing Department**

1. Lower unit cost.
2. Better quality products.
3. Better methods and tooling.
4. Increased interchangeability of parts.
5. Better utilization of manpower and equipment.
6. Accurate delivery dates.
7. Better services of production control, stock control, purchasing, etc.
8. More effective training.

#### **Benefits to Marketing Department**

1. Better quality products of proven design at reasonable cost leads to greater sales volume.
2. Increased margin of profit.
3. Better product delivery.
4. Easy availability of sales part.
5. Less sales pressure of after-sales services.

#### **Benefits to Production Planning Department**

1. Scope for improved methods, processes and layouts.
2. Opportunities for more efficient tool design.
3. Better resource allocation.
4. Reduction in pre-production activities.

#### **Benefits to Production Control Department**

1. Well proven design and methods improve planning and control.
2. Accurate delivery promises.
3. Fewer delays arise from waiting for materials, tools, etc.
4. Follow-up of small batches consumes less time.

#### **Benefits to Purchase and Stock Control Department**

1. Holding of stock of standard items leads to less paper work and fewer requisitions and orders.

2. Storage and part location can be improved.
3. Newer techniques can be used for better control of stocks.
4. Because of large purchase quantities involved, favourable purchase contracts can be made.

#### **Benefits to Quality Control Department**

1. Better inspection and quality control is possible.
2. Quality standards can be defined more clearly.
3. Operators become familiar with the work and produce jobs of consistent quality.

#### **Other Benefits**

1. Work study section is benefited with efficient break down of operations and effective work measurement.
2. Costing can obtain better control by installing standard costing.
3. More time is available to the supervisors to make useful records and preserve statistics.
4. Reduced reductions and scrap.
5. Helps supervisors to run his department efficiently and effectively.

#### **4.7.2 Disadvantages of Standardization**

Following are the disadvantages of standardization:

1. Reduction in choice because of reduced variety and consequently loss of business or customer.
2. Standard once set, resist change and thus standardization may become an obstacle to progress.
3. It tends to favour only large companies.
4. It becomes very difficult to introduce new models because of less flexible production facilities and due to high cost of specialised production equipment.

### **4.8 SIMPLIFICATION**

The concept of simplification is closely related to standardization. Simplification is the process of reducing the variety of products manufactured. Simplification is concerned with the reduction of product range, assemblies, parts, materials and design.

#### **4.8.1 Advantages of Simplification**

Following are the advantages of simplification:

1. Simplification involves fewer, parts, varieties and changes in products; this reduces manufacturing operations and risk of obsolescence.
2. Simplification reduces variety, volume of remaining products may be increased.
3. Simplification provides quick delivery and better after-sales services.
4. Simplification reduces inventory and thus results in better inventory control.

5. Simplification lowers the production costs.
6. Simplification reduces price of a product.
7. Simplification improves product quality.

## 4.9 VALUE ANALYSIS

Value engineering or value analysis had its birth during the World War II Lawrence D. Miles was responsible for developing the technique and naming it. Value analysis is defined as “an organized creative approach which has its objective, the efficient identification of unnecessary cost-cost which provides neither quality nor use nor life nor appearance nor customer features.” Value analysis focuses engineering, manufacturing and purchasing attention to one objective-equivalent performance at a lower cost.

Value analysis is concerned with the costs added due to inefficient or unnecessary specifications and features. It makes its contribution in the last stage of product cycle, namely, the maturity stage. At this stage, research and development no longer make positive contributions in terms of improving the efficiency of the functions of the product or adding new functions to it.

Value is not inherent in a product, it is a relative term, and value can change with time and place. It can be measured only by comparison with other products which perform the same function. Value is the relationship between what someone wants and what he is willing to pay for it. In fact, the heart of value analysis technique is the functional approach. It relates to cost of function whereas others relate cost to product. It is denoted by the ratio between function and cost.

$$\text{Value} = \frac{\text{Function}}{\text{Cost}}$$

### 4.9.1 Value Analysis Framework

The basic framework for value analysis approach is formed by the following questions, as given by Lawrence D. Miles:

1. What is the item?
2. What does it do?
3. What does it cost?
4. What else would do the job?
5. What would the alternative cost be?

Value analysis requires these questions to be answered for the successful implementation of the technique.

### 4.9.2 Steps in Value Analysis

In order to answer the above questions, three **basic steps** are necessary:

1. **Identifying the function:** Any useful product has some primary function which must be identified—a bulb to give light, a refrigerator to preserve food, etc. In addition it may have secondary functions such as withstanding shock, etc. These two must be identified.

2. **Evaluation of the function by comparison:** Value being a relative term, the comparison

approach must be used to evaluate functions. The basic question is, 'Does the function accomplish reliability at the best cost' and can be answered only comparison.

3. **Develop alternatives:** Realistic situations must be faced, objections should overcome and effective engineering manufacturing and other alternatives must be developed. In order to develop effective alternatives and identify unnecessary cost the following thirteen value analysis principles must be used:

1. Avoid generalities.
2. Get all available costs.
3. Use information only from the best source.
4. Brain-storming sessions.
5. Blast, create and refine: In the blast stage, alternative productive products, materials, processes or ideas are generated. In the 'create' stage the ideas generated in the blast stage are used to generate alternatives which accomplish the function almost totally. In the refining stage the alternatives generated are sifted and refined so as to arrive at the final alternative to be implemented.
6. Identify and overcome road blocks.
7. Use industry specialists to extend specialised knowledge.
8. Key tolerance not to be too light.
9. Utilise the pay for vendors' skills techniques.
10. Utilise vendors' available functional products.
11. Utilise speciality processes.
12. Utilise applicable standards.
13. Use the criterion 'Would I spend my money this way?'

#### 4.10 ERGONOMICS (HUMAN ENGINEERING)

The word 'Ergonomics' has its origin in two Greek words *Ergon* meaning laws. So it is the study of the man in relation to his work. In USA and other countries it is called by the name 'human engineering or human factors engineering'. ILO defines human engineering as, "The application of human biological sciences along with engineering sciences to achieve optimum mutual adjustment of men and his work, the benefits being measured in terms of human efficiency and well-being."

The human factors or human engineering is concerned with man-machine system. Thus another definition which highlights the man-machine system is: "The design of human tasks, man-machine system, and effective accomplishment of the job, including displays for presenting information to human sensors, controls for human operations and complex man-machine systems."

Human engineering focuses on human beings and their interaction with products, equipment facilities and environments used in the work. Human engineering seeks to change the things people use and the environment in which they use the things to match in a better way the capabilities, limitations and needs of people.

#### 4.10.1 Objectives of Human Engineering

Human engineering (ergonomics) has two broader objectives:

1. To enhance the efficiency and effectiveness with which the activities (work) is carried out so as to increase the convenience of use, reduced errors and increase in productivity.
2. To enhance certain desirable human values including safety reduced stress and fatigue and improved quality of life.

Thus, in general the scope and objective of ergonomics is “designing for human use and optimising working and living conditions”. Thus human factors (ergonomics) discover and apply information about human behaviour. Abilities and limitations and other characteristics to the design of tools, machines, systems, tasks, jobs and environment for productive, safe, comfortable and effective human use. Ergonomics aims at providing comfort and improved working conditions so as to channelise the energy, skills of the workers into constructive productive work. This accounts for increased productivity, safety and reduces the fatigue. This helps to increase the plant utilisation.

### 4.11 JUST-IN-TIME (JIT) MANUFACTURING

#### Introduction

Just-In-Time (JIT) Manufacturing is a philosophy rather than a technique. By eliminating all waste and seeking continuous improvement, it aims at creating manufacturing system that is response to the market needs.

The phase just in time is used to because this system operates with low WIP (Work-In-Process) inventory and often with very low finished goods inventory. Products are assembled just before they are sold, subassemblies are made just before they are assembled and components are made and fabricated just before subassemblies are made. This leads to lower WIP and reduced lead times. To achieve this organizations have to be excellent in other areas *e.g.* quality.

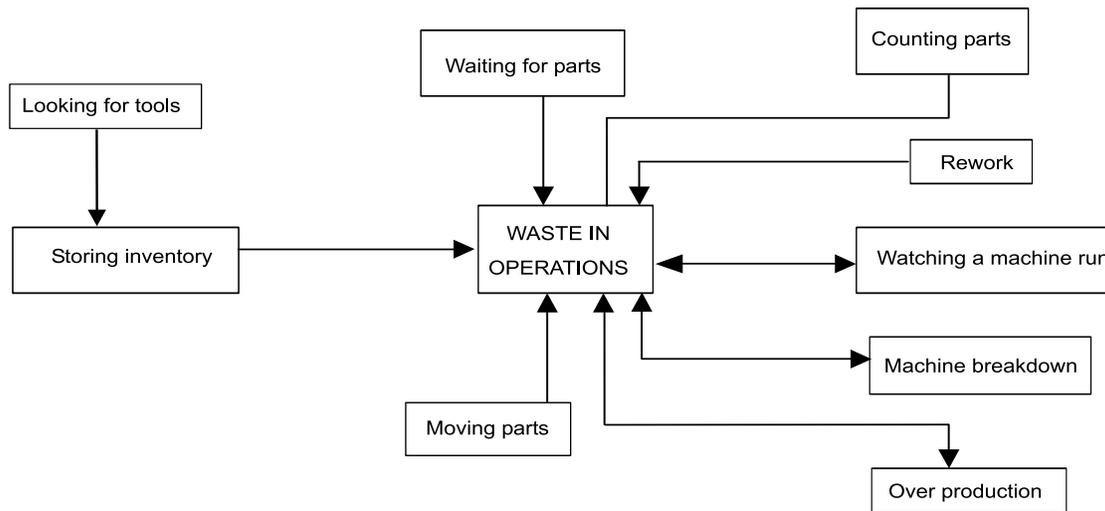
According to Voss, JIT is viewed as a “*Production methodology which aims to improve overall productivity through elimination of waste and which leads to improved quality*”. JIT provides an efficient production in an organization and delivery of only the necessary parts in the right quantity, at the right time and place while using the minimum facilities”.

#### 4.11.1 Seven Wastes

Shiego Shingo, a Japanese JIT authority and engineer at the Toyota Motor Company identifies seven wastes as being the targets of continuous improvement in production process. By attending to these wastes, the improvement is achieved.

1. Waste of over production eliminate by reducing set-up times, synchronizing quantities and timing between processes, layout problems. Make only what is needed now.
2. Waste of waiting eliminate bottlenecks and balance uneven loads by flexible work force and equipment.

3. Waste of transportation establish layouts and locations to make handling and transport unnecessary if possible. Minimise transportation and handling if not possible to eliminate.
4. Waste of processing itself question regarding the reasons for existence of the product and then why each process is necessary.
5. Waste of stocks reducing all other wastes reduces stocks.



**Fig. 4.8** Wastes in operations

6. Waste of motion study for economy and consistency. Economy improves productivity and consistency improves quality. First improve the motions, then mechanise or automate otherwise. There is danger of automating the waste.
7. Waste of making defective products develop the production process to prevent defects from being produced, so as to eliminate inspection. At each process, do not accept defects and makes no defects. Make the process fail-safe. A quantify process always yield quality product.

#### 4.11.2 Benefits of JIT

The most significant benefit is to improve the responsiveness of the firm to the changes in the market place thus providing an advantage in competition. Following are the benefits of JIT:

1. *Product cost*—is greatly reduced due to reduction of manufacturing cycle time, reduction of waste and inventories and elimination of non-value added operation.
2. *Quality*—is improved because of continuous quality improvement programmes.
3. *Design*—Due to fast response to engineering change, alternative designs can be quickly brought on the shop floor.
4. Productivity improvement.
5. Higher production system flexibility.
6. Administrative and ease and simplicity.

## EXERCISES

### Section A

1. What do you mean by materials management?
2. What is material planning and budgeting?
3. What do you mean by purchasing?
4. What do you mean by 'Inventory Management'?
5. What do you mean by 'Inventory Control'?
6. What is codification?
7. What do you mean by 'Standardisation'?
8. What do you mean by 'Simplification'?
9. What is 'Value Analysis'?
10. What do you mean by 'Ergonomics'?
11. What is EOQ?

### Section B

1. Explain the objectives of materials management.
2. What are the functions of stores?
3. Explain the reasons for keeping inventories.
4. What are the objectives of inventory control?
5. What are the benefits of inventory control?
6. What are the objectives of codification?
7. What are the advantages of simplification?
8. Explain the basic steps in value analysis.
9. Explain the objective of 'Ergonomics'.

### Section C

1. Discuss the scope of materials management.
2. Discuss the parameters of purchasing.
3. Discuss the ten 'R' 's of purchasing.
4. Discuss the purchasing procedure.
5. Discuss the selection of suppliers.
6. Discuss the benefits of standardisation.

### Skill Development

**FAST FOOD RESTAURANT VISIT:** Get the information for the following questions:

1. Material Requirement Plan for procurements of Raw material.
2. Purchase procedures adopted.
3. Preparation of Bill of Material.
4. The supplier or vendors selection.
5. In process, spares and etc.
6. Adaptation of Just In Time Manufacturing Technique.

## CASELET

**THE MIXING AND BAGGING COMPANY**

The Mixing and Bagging Company produces a line of commercial animal feeds in 10 mixes. The production process itself is simple. A variety of basic grain and filler ingredients is mixed in batches. The mixture is then fed to an intermediate storage hopper, from which it is conveyed to a bagging operation. The bags of feed are then loaded on pallets and moved to the nearby warehouse for storage.

A foreman supervises the operations. A full-time worker who operates the mixing and blending equipment, plus four full-time and 10 part-time workers provide direct labor. The foreman is paid Rs.15, 000 per year; the mixer-operator, Rs. 5 per hour; the other full-time workers, Rs. 4 per hour; and the 10 part-time workers, Rs. 3 per hour.

The usual routine for a production run is as follows: The foreman receives job tickets from the office indicating the quantities to be run and the formula. The job tickers are placed in the order in which they are to be processed. At the end of a run, the foreman purges the mixing system and ducts of the previous product. This takes 20 minutes.

Meanwhile, the foreman has directed the mixer-operator and the four full-time employees to obtain the required ingredients for the next product from the storeroom. When the mixing equipment has been purged, the mixer and gets it started. This takes about 10 minutes. The total time spent by the mixer-operates in obtaining materials and loading the mixer is 30 minutes. The four full-time employees devote 30 minutes to obtaining materials.

While the previous activities are being performed the foreman turns his attention to the bagger line, which requires minor change over for bag size and the product identifying lable that is sewed to the top of bag as it is sewed closed.

While the foreman is purging the system, the 10 part-time employees transfer what is left of the last run to the warehouse, which requires about 15 minutes. They then idle until the finished goods warehouse is valued according to the sale price of each item, which is about Rs. 5 per 100 kg. The cost of placing items in the warehouse has been calculated as approximately Re. 0.20 per 100 kg, based on the time required for one of the part-time workers to truck it to the warehouse and place it in the proper location. The front office has calculated that the storage space in the owned warehouse is worth about Rs. 10 per square foot per year, but because the bags are palletized and stacked 12 feet high, this cost has been reduced to only Re. 0.20 per 100 kg per year. The product mixes are stable, and there is very little risk of obsolescence. There is some loss because uninvited guests (rats, etc.) come in to dine. The total storage and obsolescence costs ate estimated as 5 per cent of inventory value.

The Mixing and Bagging Company has a factory overhead rate that it applied to materials and direct labor. This overhead rate is currently 100 percent and is applied to the average material cost of Rs. 1.87 per 10 kg plus direct labor costs of Re. 0.13 per 10 kg. The company earns 8 per cent after taxes and can borrow at the local bank at an interest rate of 9 per cent.

The factory manager is currently reviewing the bases for deciding the length of production runs for products. He figures that operations are currently at about 85 per cent of capacity. He has heard of EOQ as a basis for setting the length of production runs. What values should he assign to  $c_p$  and  $c_H$  for his operations?

[Source: *Modern Production/Operations Management by Elwood S.Buffa & Rakesh K.Sarin*]