CHAPTER VI

MANAGEMENT OF INVENTORY

The present chapter attempts to examine the concept of inventory management system and the efficacy of the practices followed by the selected tyre companies in India in the management of inventory.

Inventories represent a significant part of most of a company's assets, and accordingly, require substantial investments, so that this investment may not become unnecessarily large. Inventories should be managed effectively and efficiently. In this context, it is rightly remarked, "With the development of the computer, there have been considerable advances in the management of inventories during the last thirty years. As information on sales and inventory levels has become more reliable and more quickly obtainable, the need for inventory to buffer information has been greatly reduced. Moreover, there have been major improvements in inventory control, transportation and warehousing. All of these developments have made possible a greater turnover of inventories."1

The present chapter has been divided in two sectors, section I deals with theoretical aspects of inventory management and section II discusses the performance evaluation of selected tyre companies in India with regard to inventory components of the working capital.

SECTION I

WHAT IS INVENTORY

In financial parlance, inventory is defined as, "The sum of the value of raw materials, fuels and lubricants, spare parts, maintenance, consumables,

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semi-processed materials and finished goods stock at any given point of time.\(^1\)

Inventory is generally known as stock of the product a company is manufacturing for sale and the components that make up the product. Various forms in which inventories exist in a manufacturing company are raw materials, work in process (or semi-finished good) and finished goods. Raw materials are those basic input materials that are converted into finished product through manufacturing process. Raw material inventories are those units of input which have been purchased and stored for future productions. Works in process inventories are semi-manufactured products. They represent products that need more work before they become finished products for sale. Finished goods which are ready for sale. Stocks of raw materials and finished goods are required for smooth and successful marketing operations. Thus, inventories serve as a link between the production and consumption of goods.

The levels of three kinds of inventories differ depending on the nature of business. A manufacturing firm will have substantially high levels of all three kinds of inventories, while a retail, or wholesale, firm will have a very high level of finished goods inventories and no raw material and work in process inventories. Supplies is also maintained by firms. Supplies include office and plant cleaning material (Soap brooms etc.), oil, fuel, light, bulbs and the like. These materials do not directly enter into, the production, but they are necessary for production process. Usually these supplies do not require significant investment. Therefore, the sophisticated system of inventory control may not be maintained for them.

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Inventories constitute the most significant part of current assets of a large majority of companies in India. For example, on an average inventories are approximately 60 per cent of current assets in public plantation, edible vegetables and hydrogenated oils, sugar, tobacco, cotton, jute and woolen textiles, nonferrous metals (other than aluminum) transport equipments and foundries and engineering workshops, inventories form more than 60 per cent of current assets. It is about 30 per cent and below in printing and publishing, electricity generation and supply, trading and shipping industries. It is as high 76 per cent in tobacco industry. Because of the large size of inventories maintained by firms, a considerable amount of funds is required to be committed in them. It is, therefore, absolutely imperative to manage inventories efficiently and effectively in order to avoid unnecessary investments in them. An undertaking neglecting the management of inventories will be jeopardizing its long run profitability and may fail ultimately. It is for a company to reduce its levels of inventories to a considerable degree, without any adverse effect on production and sales, by using simple inventory planning and control techniques. The reduction in "excessive" inventories carries a favourable impact on the company’s profitability.

NEED TO HOLDING INVENTORY

The question of managing inventories arises only when the company holds inventories. Maintaining inventories involves tying up of the company’s funds and storage and handling costs. If it is expensive to maintain inventories why do companies hold inventories? There are three general motives for holding inventories:¹

1. The transactions motive which emphasizes the need to maintain inventories to facilities smooth production and sales operations.

2. The precautionary motive which necessitates holding of inventories to guard against the risk of unpredictable changes in demand and supply forces and other factors.

3. The speculative motive which influences the decision to increase or reduce inventory levels to take advantage of price fluctuations.

In addition to the above three motives, there are some other motives why firms hold inventories.

4. Avoiding losses of Sales

If the firm does not have goods available for sale, it will lose sales. Customers requiring immediate delivery will purchase their goods from the firm’s competitors. The ability of firm to give quick service and provide prompt delivery is closely tied to the proper management of inventory.

5. Gaining Quantity Discounts

It a firm is willing to maintain large inventories is selected product lines, it may be able to bulk purchases of goods at large discounts. By paying loss for its goods, the firm can increase profits, as long as the cost of maintaining the inventories is less than the amount of the discount received.

6. Reducing order costs

Every time a firm places an order, and it incurs certain costs. Forms must be typed, checked, approved and mailed. When goods arrive, they must be accepted, inspected and counted. The invoice must be checked with the
goods and then sent to the accounting department for payment. The variable costs associated with individual orders can be reduced if the firm places a few large rather than numerous small orders.

**WHAT IS INVENTORY MANAGEMENT?**

The modern concept of inventory management can be dated back to 1915 when several authors developed an economic lot size equation which minimised the sum of inventory carrying cost and holding cost. The early inventory management models had little significance after World War-II. The extensive development of inventory theory and its application dates back from 1950.

Inventory management can be defined as that coordinated function responsible to plan for, acquire, store, move, and control materials and final products to optimise usage of facilities, personnel, capital goods and to provide customer service in line with corporate goal.¹ Functionally materials management connotes:

(i) **ADMINISTRATION** of the complex materials related activities that are often part-time responsibilities of other busy managers.

(ii) **COORDINATION AND INTEGRATION** of fragmented individual materials functions to suppress the conflicts that result from each other often performing in an operational vacuum.

(iii) **CONTROL** of the ever rising costs associated with materials planning, procurement, inventories storage, usage, handling and distribution, because materials related costs range from 16% to 60% of sales and cost leaks must be checked.

¹ Robert B. Ballot: Materials Management - A Result Approach
The following are the important factors affecting inventory management:

(a) Availability of credit in the economy.

(b) Government policy and role of canalising agencies in procurement and distribution of materials; and

(c) Complexities of business.

The financial manager is confronted with the task of

(i) Meeting an ever increasing demand for prompt customer service.

(ii) Maintaining smooth flow of production operation; and

(iii) Keeping investment in inventories reasonably low.

The first two objectives favour larger stocks of inventory, whereas the third one favours smaller stocks of inventory. The concerned manager has, thus, to reconcile these two conflicting objectives. Both the situations of over-investment and underinvestment in the inventory are to be avoided for sustained and profitable functioning of the concern. In other words, the aim of efficient inventory management is to achieve the optimum level of inventory where associated costs of inventory are minimum and the resultant benefits of inventory are maximum.

**IMPORTANCE OF INVENTORY MANAGEMENT**

Inventories provide a very important link in production and sale of a product. Inventories of raw materials, work in process, and finished goods

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1 V.R. Ramamoorthy "Working Capital Management": Chapter- 7
typically carried by manufacturing firms. For wholesalers and retailers, the only inventories are finished goods that firms buy and resell. For manufacturers, work in process inventories necessarily result because production of goods takes time to complete. Raw materials inventories aid the production process by preventing costly variation or shut downs because raw materials are in limited supply or temporarily not available. Finished goods inventories fulfill customer demands when they exceed the rate of production and so avoid possible loss of sales. They also make it less necessary to vary the rate of production to accommodate sudden changes in customer demand. In order to find out an optimal inventory level, the advantages of carrying inventories must be weighed against the cost of storing, finishing and potential obsolescence.

In the sphere of working capital, the efficient and effective management of inventory poses a challenging problem. It constitutes the large component of current assets in many business organizations. The turnover of working capital is much more dependent upon inventory turnover. Thus inventory management is of considerable significance to all business enterprises. The basic financial problem is to determine the proper level and how much inventory must be acquired during each period to maintain that level.¹

**OBJECTIVES OF INVENTORY MANAGEMENT**

In the context of inventory management the firm is faced with the problem of meeting two conflicting needs.

1. To maintain a large size of inventory for efficient and smooth production and sales operations and,

2. To maintain only a minimum possible inventory because of inventory holding costs and the opportunity cost of funds invested in inventory and to maximize profitability.

Both excessive and inadequate inventories are not desirable. They are two danger points within which the firms should operate. The objective of inventory management should be to determine and maintain the optimum level of inventory investment. The optimum level of inventory will lie between the two danger points of excessive and inadequate inventories.

**DANGER OF OVER AND UNDER INVESTMENT IN INVENTORIES**

The firm should always avoid a situation of overinvestment or underinvestment in inventories.

**Danger of Over Investment in Inventories**

The major dangers of overinvestment are as follows:

(a) The unnecessary tie up of the firm’s funds and loss of profit. The excessive level of inventories consumes the funds of the firm, which cannot be used for any other purpose and, thus, involves an opportunity cost.

(b) Excessive carrying costs: The carrying costs such as the costs of storage, handling, insurance, recording and inspection also increase in proportion to the volume of inventory. These costs will impair the firm’s profitability further.
The Risk of Liquidity: Excessive inventories carried for a long period increase the chances of loss of liquidity. It may not be possible to sell the inventories in time and at full value. Raw materials are generally difficult to sell as the holding period increases. There are exceptional circumstances where it may pay to the company to hold stocks of raw materials. This is possible under the conditions of inflation and scarcity. Work in process is far more difficult to sell. Similarly, difficulties may be faced to dispose of the finished goods inventories as time lengthens. The downward shifts in market and the factors may cause finished goods to be sold at low prices.

Physical Deterioration: Another danger of carrying excessive inventory is the physical deterioration of inventories while in storage. In case of certain goods or raw materials deterioration occurs with the passage of time. Or it may be due to mishandling and improper storage facilities. These factors are within the control of management. The unnecessary investment in inventories can, thus, be cut down.

Dangers of Underinvestment in Inventories

Maintaining an inadequate level of inventories is also dangerous. The consequences of underinvestment in inventories are given below:

(i) Production hold-ups, inadequate raw materials and work in process inventories will result in frequent production interruptions.

(ii) Failure to meet delivery commitments: Similarly, if the finished goods inventories are not sufficient to meet the demands of the customers regularly, the customers may shift to the competitors, which will amount to a permanent loss to the firm.
The aim of inventory management, thus, should be to avoid maintaining excessive and inadequate levels of inventories and maintaining sufficient inventory for the smooth production and sales operations. Efforts should be made to place an order at the right time with the price and quality. An effective inventory management should

(A) Ensure a continuous supply of material to facilitate uninterrupted productions. Maintain sufficient stocks of raw material in periods of short supply and anticipate prices changes.

(B) Maintain sufficient finished goods inventory for smooth sales operation, and efficient customer service;

(C) Minimize the carrying costs and lead time; and,

(D) Control investment in inventories to keep it at optimum level.

PRINCIPLES OF INVENTORY MANAGEMENT

For practically all firms, investment in inventory constitutes a very substantial portion of the total assets of the company. This would apply to both manufacturing companies as well as to mercantile business enterprises. “In the case of manufacturing companies, the ratio of inventory investment to total assets for the enterprises averages in excess of twenty percent.”¹ These statistics indicate that very substantial amount of investment are involved in inventories as current assets. There is a pertinent axiom of financial management that most of the firms are forced out of business due to poor inventory management. Many economic trends and forecasts base their determinants on the amount of investment in inventories, policy objectives

involved in inventory management call for an ideal amount of inventory investment in a given situation for an enterprises. This so-called right amount will help the financial manager minimize his financing Problems related to inventory management by striving to reduce over investment’ in inventories.”

What makes the problem of inventory management more complicated is that circumstances and the inherent problem of inventory management are continuously changing with the growth and contraction of a business.

INVENTORY MANAGEMENT TECHNIQUES

In managing inventories, the firms objectives should in consonance with the wealth maximization principle. To achieve this, the firm should determine the optimum level of inventory. Sufficient inventories should be maintained, neither excessive nor inadequate. Efficiently controlled inventories make the firm flexible. Inefficient inventory control results in unbalanced inventory and inflexibility. The firm may sometimes out of stock land sometimes it may pile up necessary stocks. Thus, it increases the level of investment and makes the firm unprofitable. To attain the objective of wealth maximization firm should determine the optimum level of inventory.

TECHNIQUES OF INVENTORY MANAGEMENT

The various techniques of inventory management have been analysed hereunder.

Selective Control Techniques

Selective control means variations in method of control from the items based on selective basis. The criterion used for the purpose may be the cost of the item, criticality, lead-time, consumption, procurement, difficulties, or

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1 Harry Gross, Financing for Small and Medium sized Business. op. cit., p.62.
something else. Various classifications are employed to render selective treatment to different types of materials, each' classification emphasizes usage value (i.e. consumption of the items in terms of money), VED analysis considers criticality, HML employs price criterion, and SDE analysis is based on procurement difficulties. The various classification of selective control are as follows:

**HML Analysis:** HML Analysis is similar to ABC Analysis except for the difference that instead of “usage value” “Price” criterion is used. The items under this analysis are classified into three groups which are called “high” “medium” and “low”. To classify, the items are listed in the descending order of their unit price. The cut off lines are then fixed by the management for deciding the three categories.

HML Analysis helps in

i. Assessing the storage and security requirements

ii. Keeping control over consumption at the departmental head level

iii. Determining the frequency of stock verification

iv. To evolving buying policies o control purchases

v. To delegating authorities to different buyers to make petty cash purchases

**VED Analysis:** VED Analysis represents classifications of items based on criticality. The analysis classified the items into three groups called vital, essential and desirable. “
Vital category encompasses those items for want of which production would come to a halt. "Essential" group includes items whose stock out cost is very high. And "Desirable" group composes items which do not cause any immediate loss of production. The stock out of these items entails nominal expenditure and causes minor disruptions for a short duration.

VED Analysis is best suited for spare 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.

SDE Analysis: SDE Analysis is based on the problems of procurement namely:

- Non Availability
- Scarcity
- Longer lead time
- Geographical location of suppliers, and
- Reliability of suppliers, etc.

SDE analysis classifies the items into three groups called "Scarce" "Difficult" and "Easy". The information so developed is then used to decide purchasing strategies.

"Scarce" classification comprises items which are in short supply, imported or canalized through government agencies. Such items are best to procure once a year in lieu of effort and expenditure involved in the procedure for import. "Difficult" classification includes those items which are available indigenously but are not easy to procure. Also items, which come from far off distance and for which reliable sources do not exist, fall into this category. Even the items which are difficult to manufacture and only one or two
manufactures are available belong to this group. Suppliers of such items require several months of advance notice.

"Easy" classification covers those items which are readily available items produced to commercial standards, items where supply exceeds demand and others which are locally available fall into this group.

G-NG-LG Analysis /Golf Analysis : The G-NG-LG analysis (or GOLF Analysis) like S-D-E analysis is based on the nature of suppliers which determine quality, lead-time, terms of payment, continuity or otherwise of supply and administrative work involved. The analysis classifies the items into four groups, namely, G, NG, L and G.

"G" group covers items procured from "Government" suppliers such as the STC, the MMTC and the public sector undertakings. Transactions with this category of suppliers involve long lead-time and payments in advance or against delivery.

"NG" (O in GOLF analysis) group comprises items procured from 'Non-Movement' (Or ordinary) suppliers. Transactions with this category of suppliers involve moderate delivery time, and availability of credit, usually in the range of 30 to 45 days.

"L" group contains items bought from "Local suppliers". The items bought from local [suppliers are those which are cash purchases or purchased on blanket orders.

"F" groups contain those items which are purchased from "Foreign suppliers". The transactions with such suppliers:

- involve a lot of administrative and procedural work;
require initial clearance from government agencies such as DGTD:
- necessitate search of foreign suppliers;
- require opening of the letter of credit, and,
- require making of arrangement for shipping and port clearance.

**S-OS Analysis:** S-OS analysis is based on seasonality or otherwise of the items. The analysis classifies the items into two groups: S (i.e. seasonal) and OS (i.e. off-seasonal). The analysis identifies items which are:

(i) Seasonal and are available only for a limited period. For example, agriculture produce like raw mangoes, raw material for cigarette and paper industries, etc. are available for a limited time and, therefore, such items are procured to last for the whole year.

(ii) Seasonal but re-available throughout the year. Their prices however, are lower during the harvest time. The quantity of such items requires to be fixed after comparing the cost savings due to lower prices against higher cost of carrying inventories.

(iii) Non-seasonal items whose quantity is decided on different considerations.

**F-S-N Analysis:** 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 the number of months, that has elapsed since the last movement is recorded.
Such as analysis helps to identify:

(a) the active items which require to be reviewed regularly.
(b) surplus items whose stocks are higher than their rate of consumption; and,
(c) 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 the company’s productive capital.

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

**ABC ANALYSIS OF INVENTORY ITEMS**

ABC (Always Better Control) analysis is the most widely used and the effective technique of inventory management. This technique aims at minimising investment in inventory and avoiding frequent stock-outs by purposeful gradation of various inventory items in store based upon Pareto’s law of distribution of income and wealth where by 20 percent of the items (in terms of quantity) account for roughly 80 percent of total cost of inventory. These items are designated as ‘A’ category items; and the next 30 percent items account for 15 percent of cost. Which are designated as ‘B’ category items. The remaining 50 percent items account for the 5 percent of cost, which are designated as ‘C’ category items. The idea behind such classification is to apply the bulk of planning and control resources to relatively more important
items i.e. 'A' category items. The ABC concept is implemented by controlling 'A' category items more tightly than 'B' category and 'C' category items. However, in the present computer age, the rationale behind ABC categorisation of inventory items i.e. according high degree of attention to relatively more important items and vice-versa, due to limited processing time and capacity is delegated. Now equal treatment of all inventory items is possible. However, physical inventory control continues to be a problem in inventory management and the basic concept of ABC inventory management remains valid.

XYZ ANALYSIS OF INVENTORY

A slightly deviating approach of inventory management is XYZ technique. Unlike ABC analysis, here categorisation of inventory items is done not on the basis of consumption value, rather on the basis of what is in store as on a particular date i.e. month end.

'X' category items being the most important and critical to the concern call for tightest control in terms of minimum holding, maximum turnover and utmost speed in processing.\(^1\) Low safety stock with frequent ordering is suggested for 'X' category items. 'Y' category items may not command such close attention as category 'X' items yet have to be continuously managed with a reasonable degree of control, category 'Z' items, constituting small value of total, do not call for close watch and tighter control. Simple control will suffice.

\(^1\) V.E. Ramamoorthy: Working Capital Management: Ch-7
PERPETUAL INVENTORY SYSTEM

Perpetual Inventory System is concerned with

(i) Recording store receipts and issues so as to determine at any time the inventory in hand in terms of quantity or value or both without resorting to physical stock-taking of inventory. This is done by maintaining the following records

(a) Bin Cards (Quantitative Perpetual Inventory).
(b) Stores Ledger (Quantitative & Valued Perpetual Inventory).

(ii) Continuous verification of stock physically available in stores with reference to the Quantity as per stores records. This is known as physical perpetual inventory or continuous stock taking.

MANAGEMENT THROUGH VARIOUS INVENTORY RATIOS

Besides scientific inventory planning, there is need for continuous evaluation and reporting of the existing inventory status techniques on the liquidity and profitability of the concern. Inventory may be categorised as:

(a) Raw Materials
(b) Work-in-Progress
(c) Finished Goods.
(d) Stores & Spares

These different types of inventory do not call for same degree of control. The stocks of raw materials can be reduced to a level as warranted by smooth production process. The stock of work-in-progress depends upon the
length of production-cycle. The stock of finished goods depends upon the nature of industry and the market forces.

Various important ratios that are helpful for such evaluation are

(i) Inventory Turnover Ratio
(ii) Raw Material Turnover Ratio.
(iii) Work-in-Progress Turnover Ratio.
(iv) Finished Goods Turnover Ratio.
(v) Stores & Spares Turnover Ratio.

These ratios have been used a little later in this chapter for evaluation purposes.

MODERN TECHNIQUES

The various modern techniques of inventory management are as follows:

Economic Order Quantity (EOQ)

The economic order quantity, alternatively called as the fixed order quantity system is based on selecting that order size which will result in minimum total inventory cost. For determining this, the model assumes that the cost of managing inventory is made up solely of two parts Ordering cost and Carrying Cost.

Ordering Cost: Ordering Cost is the cost of placing an order. It is a cost which is considered to be independent of the order size of a range of order. If C is the cost of placing an order and q is the order size, the unit cost of placing
An order is \( C_0/q \), and this decreases at a decreasing rate as the order size increases. The annual cost of ordering can be determined by multiplying this unit ordering cost by the annual sales (S) in units. The annual ordering cost i.e. \( C_0/q \times S \) decreases with increasing order size in the same manner in which the unit cost decreases, which is picturised as follow:

![Graph showing annual ordering cost vs order size]

**Carrying Cost**: is the cost of physical storage of inventory plus the opportunity cost of the money tied up in the inventory. The cost of carrying an item in inventory is usually expressed as a percentage of the unit purchase cost of the item and in relation to a certain period of time e.g. 15% per annum. If \( C_u \) is the unit purchase price of an item and \( i \) is the carrying cost expressed as an annual percentage of this unit cost, then \( C_u \times i \) is the annual carrying cost per unit of inventory. But this has not been related to order quantity. Assuming that inventory decreases at a constant rate from order quantity to zero and is replenished by a fresh order, then with the given order size, the average inventory is equal to one half of the order size i.e. \( q/2 \). The carrying costs are
based on this average inventory which is to be carried throughout the year. Thus the annual carrying cost comes out to be $C_u i q/2$. This cost increases linearly with increasing order quantity as picturised below:

![Graph showing linear relationship between carrying cost and order quantity.]

The total annual cost of managing an item of inventory decreases as the order quantity increases because of rapid reduction in annual ordering cost. The total annual cost curve is picturised below:

![Graph showing the total, carrying, and ordering costs as functions of order quantity.]

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Economic order quantity can be determined in two ways

(a) By the hit and trial method, and

(b) By the mathematical model.

Under the first method, various order sizes are tested for the total inventory cost and the size which results into minimum total inventory cost shall be the economic order size. This method being tricky and time consuming is not very popular among the users.

The second method, the mathematical model, being scientific and unique in results is more popular among the users. The formula for economic order quantity is

\[ EOQ = \sqrt{\frac{2C_0S}{Cu_i}} \]

Where \( C_0 \) = Cost of placing an order

\( S \) = Annual sales in units

\( Cu \) = Unit Cost of an item

\( i \) = Cost of carrying inventory in percent per year

The EOQ model is based upon the assumption the annual inventory requirement is known in advance with certainty and inventory is consumed uniformly throughout the year. Further, ordering cost is fixed per order, irrespective of the order size and carrying cost is fixed per unit for the year. To this extent the EOQ model suffers from the practical limitations and does not have practical applicability.
THE REORDER POINT

The second part of inventory decision making is determining that level of inventory at which fresh order is to be placed i.e. Re-order point. The carrying cost as discussed earlier is based upon the assumption that the inventory is consumed at a constant rate until it reaches zero and immediately the stock is replenished by placing a fresh order. The average inventory to be carried by the organisation under such inventory behaviour is q/2.

Re-order point under simplified assumption

However, this kind of idealised inventory behaviour does not occur in practice. There is usually, a time gap between placing an order and receiving the order, which is technically called as the lead time. This type of inventory behaviour is picturised below:
Further the economic conditions are highly fluctuating. It is not always possible to determine the lead time with certainty, the sales rate and thus the consumption rate may not be uniform throughout the year. It is the practice to maintain a safety stock (buffer-stock) to guard against such uncertainties. How much safety stock should be maintained? This differs from the concern to concern depending upon the management’s policy towards safety stock. The safety stock is revised with the passage of time based upon the experience.

Thus for calculating the re-order point, the expected sales during the lead time and a buffer stock are added to zero.

That is, Re-order Point = Lead time consumption + buffer stock.

Still, a more realistic view of inventory behaviour is depicted in the following picture, where sales rate is not constant. The inventory level may fall above or below the buffer level at the time a Re-order is received. Had there been no buffer stock, these sales might have been lost.
The replenishment system is exhibited in the following picture.

**Replenishment Model of Inventory**

In the above diagram daily sales have been assumed to be 2 units/day, buffer stock 10 units and lead time plus the period between two reviews is 10 days. This gives the replenishment level equal to 30 units (i.e. 10+2×10=30). On the fifth day we have placed an order for 20 units so as to reach the inventory level equal to replenishment level i.e. 30 units. At point Q (time for first review, the actual level of inventory is 15 units, thus giving the order size equal to 15 units (30 units - 15 units). At point R (the time for second review) the inventory level is 10 units thus giving the figure for order size as 20 units. Similarly at point S, the order size comes to 25 units. In this case, therefore, there is no re-order point, we only have re-order period, which explicitly determines re-order quantity depending upon the lead time, the daily sales and the desired replenishment level.
The Optional Replenishment System

The optional replenishment system is a modified system so as to place a lower limit on the size of the re-order quantity. It makes use of both of the replenishment level and the re-order point. In this system, at the time of periodic review, the order is placed provided the order quantity (which is fixed EOQ) plus the inventory in hand falls short of re—order point. That is

\[ Q = M - (I + q_0) \text{ when } I + q_0 < P \]

Where \( M \) = Replenishment level

\( I \) — inventory in hand

\( q \) = Order size

\( P \) = Re-order Point

This system combines the features of both the fixed order quantity system and the replenishment system.

STRATEGIES FOR ACHIEVING SUCCESS IN INVENTORY MANAGEMENT AND CONTROL

The main objectives of inventory management and control system are:

(i) to keep the total inventory carrying costs to the minimal level and, at the same time,

(ii) to keep the stock-out risk, too, at the lowest.

With a view to achieving these objectives, the following strategies may be of immense help:
Rationality

Complete Understanding and Commitment of One and All: The most important pre-requisite for the success of any monitoring and control system of inventory is that all the members of the staff, at various levels, must be fully aware of the various steps that are to be taken for the purpose. They should also be able to appreciate fully well the rationale behind meticulous application of various monitoring strategies.

2. Flexibility

The inventory control system should be flexible enough so as to be able to adapt to the changing circumstances and conditions with ease, wills minor adjustments and modifications in the system, as and when required. Here, it must be realised that it may not be too practical to expect that such a system could be evolved which may take care of all the contingencies and complexities. It would be sufficient if the system is able to adapt itself to about 90% of the changed situations and conditions and the remaining 10% could very well be handled on case to case basis, or by introducing some slight modification/relaxation in the systems, as and when required.

3. Punctuality

Timely and effective action is of essence in management of inventory. As we have seen, the value of inventory decline mostly for the following reasons:

(i) Obsolescence, specially in the modern technological advancements and fast changes in technology.

(ii) Change in the fashion or the taste of the people.
(iii) Deterioration in the quality, due to the passage of time, like those of paper, medicines, and a variety of other stocks, which have a limited shelf-life.

(iv) Sharp fluctuations in price, due to some inherent volatility of some goods or else due to the changes in the government policies of import and export, excise and custom duties, selective credit control by the Reserve Bank of India (RBI), etc.

It would augur well if some in-built mechanism/system is in place so as to give a warning signal in respect of ensuing deterioration in the quality or obsolescence or price fluctuations, etc., so that all the people concerned may be alerted well in time to take the required remedial actions, promptly and effectively.

SECTION II

This section of the study deals with the performance evaluation of tyre companies under study with regard to the management of inventory.

PERFORMANCE EVALUATION OF INVENTORY MANAGEMENT IN THE SELECTED COMPANIES

As stated earlier in this chapter success or failure of a business to a large extent depends upon its inventory management performance, as inventory occupies predominant position in the components of working capital.

The proportion of raw material, stores and spares, semi finished goods and finished goods in the total inventory varies from company to company and the behaviour of inventory component influences to a greater extent the total
inventory turnover and determines the role of working capital in maximising the profit of the concern. It is therefore useful to examine the behaviour of each component of inventory.

Table 6.1, 6.2 and 6.3 annexed to this chapter show investment in inventories and its composition in the Apollo Tyres Ltd., Ceat Ltd. and MRF respectively. In terms of rupees, investment in inventories in all the three companies has increased under the study period. In Apollo it has increased from Rs.126.12 crore to 296.39 or crores, in Ceat it has increased from 148.28 crores to 170.26 crores and in MRF this has gone up from 192.34 crore to 442.61 crores. This increase in investment is because of increase in production, sales and increase in prices of material.

Table 6.1 shows share of different components of inventory in Apollo Tyres Ltd. During the entire study period proportion of raw material to the total inventory in maximum on an average basis it is 44.74% of total inventory, followed by 35.24% finished goods, 11.02% of stores and spares and 9.02% of semi finished goods. It further reveals that proportion of raw material stores and spares and semi finished goods in total inventory has declined in the study period from 60.59% to 51.41%, 11.07% to 6.86%, and 11.9% to 7.02% respectively. But share of stock of finished goods in total inventory has increased from 16.44% to 34.71%. It shows increasing importance of stock of finished goods in the total inventory of Apollo Tyres Ltd.

Table 6.2 depicts different components of inventory in Ceat Ltd. Unlike Apollo, here stock of finished goods is 51.44% of total inventory followed by 29.34% raw material 11.1% semi-finished goods and 8.12 stores and spares over the entire study period on an average basis. The relative share of finished goods in the total inventory has declined in the company from 1995-96 to
2004-05 and relative share of raw material has increased in this period. There is no significant change in relative share of stores and spares and semi finished goods. Co-efficient of variation is maximum in raw materials showing fluctuation in investment in raw material.

Table 6.3 shows components of inventory in MRF Ltd. Like Ceat Ltd., here also stock of finished goods constitutes most important component of total inventory. On an average, over the study period, 53.08% is in form of finished goods, 2.53% in raw material, 14.46% in semi-finished goods and 3.92% in stores and spares. From the year 1995 to 2005 the relative share of finished goods in total inventory has increased from 40% to 56%, on the other hand, relative share of all the other 3 main components in total inventory has declined i.e. from 32.97% to 27.22% for raw material, from 8.03% to 3.76% for stores and spares and from 18.75% to 12.23% for semi-finished goods.

Above analysis shows variation in the composition of inventories in the tyre companies over the study period.

INVENTORY TURNOVER

The extent of the effectiveness of the inventory management techniques is depicted by the turnover ratios. Turnover of inventory directly effect the profitability of a concern. The higher the turnover the better it is for the concern. A higher turnover also indicates that the concern has conducted more business with proportionately less amount of inventory, this results in saving of inventory costs. Therefore, management should speed up the turnover of inventories by controlling their volume to the extent possible. Table 6.4, 6.5 and 6.5 shows various inventory ratios of Apollo, Ceat and MRF respectively. From these tables it is clear that the average inventory turnover during the year 1995-96 to 2004-2005 is 6.36 times for MRF, 7.05
times for Apollo Tyres and 8.18 times for Ceat Ltd. this ratio is fairly consistent in Apollo over the years period, declined marginally in MRF Ltd. from 7.63 in 1995-96 to 6.31 in 2004-05 but has improved significantly in Ceat Ltd., i.e. from 6.22 times in 1995-96 to 13.02 times in 2004-05. This clearly indicates that Ceat Ltd. has improved its inventory management over the study period.

**RAW MATERIAL TURNOVER RATE**

70% of production cost of tyre and 55% of the turnover of tyre industry is accounted for by raw-material cost. It shows the importance of raw material in the tyre industry. Table 6.4, 6.5 and 6.6 show raw material turnover rate on an average is approx. 34 days for Apollo, 25 days for Ceat and 22 days for MRF. Amongst the three companies raw material turnover is highest in Apollo tyres but this ratio has declined from Approx. 41 days in 1995-96 to 37 days in 2004-05. Same is the case of MRF where it has declined from 23 days to 21 days in the same period. In case of Ceat this ratio has increased in the study period, from 23 days to 25 days. Lower coefficient of variation shows better control on inventory of raw-material. Coefficient of variation is lowest in MRF (10.97%), co-efficient of variation of this ratio is 15.3% in Apollo Tyres and 17.12% in Ceat Ltd., which is not very significant. Our study further reveals that raw material has direct relationship with the sale by the companies.

**STORES AND SPARES TURNOVER RATE**

Table 6.4, 6.5 and 6.6 further show the stores and spares turnover rate of Apollo, Ceat and MRF respectively. For Apollo the rate is 5.76 days, for Ceat 3.76 days and for MRF 3.37 days. This ratio is quite consistent over the study period. The overall position of all the three companies is satisfactory.
A perusal of table 6.4, 6.5 and 6.6 show that the average work in progress rate during concerned period is 4.67 days for Apollo tyres, 5.29 days for Ceat Ltd. and 8.3 days for MRF. The maintenance of work in progress technically depends upon the length of the production cycle. So, there should not be much deviation in the rate with in the same industry. This ratio shows a declining trend in all the three companies. Tyre industry does not involve any lengthy processing so semi-finished goods as percentage of inventory do not involve large amount. This fact is amply demonstrated in the above mentioned tables. Lower coefficient variation in Ceat Ltd. shows that the company exercises better control on investment in work in progress.

FINISHED GOODS TURNOVER RATE

Finished goods is very important component of inventory for the tyre industry. Finished goods inventory introduces flexibility in business operation and enables a concern to provide better customer service. Although some finished goods inventory is bound to be created when goods are produced in anticipation of demand and also for show room and sample purpose, its size would depend on the market forces apparently operative. Apollo on an average has been maintaining finished goods of 19 days, Ceat 25 days and MRF for 32 days. In case of Apollo and MRF finished goods turnover has increased from 8 days to 18 days and from 19 days to 32 days respectively, over the study period. It shows that Apollo and MRF are keeping more stock of finished goods in their inventory. On the other hand, this ratio has declined in the case of Ceat. It has come down from 25 days in 1995-96 to 10 days in 2004-05. In the year 2004-05 Ceat’s finished goods turnover rate has fallen steeply. This can not be termed as a better position so far as finished goods
are concerned. Company can face frequent stock-out position. Co-efficient of variation is 46.6% for Apollo 30.83% for Ceat and 32% for MRF.

Thus in general it is inferred that tyre companies are managing their finished goods satisfactorily.

INVENTORY MANAGEMENT PRACTICES PREVALENT IN THE TYRE COMPANIES

Now we will examine the practices that are followed by the tyre companies under study for the management of inventory.

Preparation of Inventory Reports

Preparation of inventory reports on “regular” basis is an effective tool in the management of inventory. These reports are prepared daily, weekly and monthly basis for the effective control. For effective management of inventory these three types of reports are prepared invariably by all the companies. The daily reports keep the management abreast of the inventory stock position, inventory utilisation etc. on daily basis. These reports are prepared for ensuring uninterrupted production. The monthly reports are prepared for taking decisions regarding review of actual inventory levels, rescheduling of order size and timings of placing an order, variations in buffer stock, changing the supplier etc.

Determination of Inventory Levels

How are the maximum inventory levels and minimum inventory levels determined by the tyre companies? The practices followed by tyre companies in this respect are not different from the ones followed by other concerns in other industries. The minimum stock depends upon the length of the lead
time, consumption during the lead time, the buffer stock etc. As some of the raw materials like tyre grade synthetic rubber (IBR), polyester tyre cord (used in radial tyres) and Burtyyl Rubber (used in inner tubes) have to be imported by the tyre companies, these companies have to maintain high minimum stocks all the times in order to ensure uninterrupted production process. The maximum stock depends upon the factors like carrying cost of inventory, opportunity cost of funds invested, economies of bulk buying etc.

CONCLUSIONS

It has been observed that large part of total working capital of tyre companies under study is in the form of inventory. Companies maintain inventory in the form of raw material, stores and spares, work in progress and finished goods. The objective of inventory management happens to be optimising investment in inventory, i.e., minimising the associated costs and maximising the associated benefits. Indian tyre companies have a tendency to stock more than reasonably necessary. It may be because of increasing raw material cost in the recent past and a large number of suppliers in India have been found to be not very reliable and responsible to strictly adhere to the delivery schedule. Because of these reasons companies keep a much higher level of stock to meet the exigencies.

It has also been found that companies are good in planning and analysis but not so good in implementation and execution of there action plan. For example companies have been found to be undertaking inventory turnover analysis, but generally, on an aggregate basis. If, such analysis is done even on individual items of raw materials and finished goods, specially in high value items, it will be of great benefit for the companies.
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<th>AVG RAW MATERIAL</th>
<th>AVG RAW MAT TURNOVER (NO OF DAYS)</th>
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1) INVENTORY TURNOVER RATE = COST OF SALES / AVG INVENTORY

2) RAW MATERIAL TURNOVER RATE = AVG RAW MATERIAL / RAW MATERIAL CONSUMED * 365

3) WORK IN PROGRESS TURNOVER RATE = AVG WORK IN PROGRESS / COST OF SALES * 365

4) FINISHED GOODS TURNOVER RATE = AVG FINISHED GOODS / COST OF SALES * 365

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### Table 6.5
**INVENTORY TURNOVER RATIOS : CEAT LTD**

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