

The management and control of inventory is a problem common to all organisations in any sector of the economy. The problems of inventory do not confine themselves to profit making business firms. The same type of problems are encountered by social and non-profit organisations too. Inventories are common to besides industries - agriculture, wholesalers, retailers, hospitals, temples, churches, prisons, zoos, universities, and national, state and local governments.

Inventory problems have been encountered by every society, but it was not until the 20th century that analytical techniques were developed to study them. The initial impetus, for analysis expectedly came from manufacturing sector. It was not until after World War II that a concerted effort on risk and uncertainty aspects of inventory was made. In theory, inventory is an area of organisational operation that is well developed. In practice, it is very backward. This gap will narrow as educational institutions integrate materials management into their course structures.

I MEANING AND DEFINITION

The term inventory includes raw material, work-in-process, finished goods and stores and spares.

The term 'Inventory' originates from the French word 'Inventaire' and Latin word 'Inventarium', which implies a list of things found.

The term *inventory* has been defined by several authors. The more popular of them are: *'the term inventory includes materials - raw, in process, finished packaging, spares and others stocked in order to meet an unexpected demand or distribution in the future'*.

Another definition of inventory is that it *'can be used to refer to the stock on hand at a particular time of raw materials, goods-in-process of manufacture, finished products, merchandise purchased for resale, and the like, tangible assets which can be seen, measured and counted... In connection with financial statements and accounting records, the reference may be to the amount assigned to the stock of goods owned by an enterprise at a particular time'*.

Yet another definition is that the term inventory includes the following categories of items:

1. **Production Inventories** : Raw materials, parts, and components which enter the firm's product in the production process. These may consist of two general types: (a) special items manufactured to company specifications, and (b) standard industrial items purchased 'off the shelf'.
2. **MRO Inventories** : Maintenance, repair, and operating supplies which are consumed in the production process but which do not become part of the product. (e.g., lubricating oil, soap, machine repair parts).
3. **In-process Inventories** : Semi-finished products found at various stages in the production operation.
4. **Finished goods Inventories** : Completed products ready for shipment.

Merchandise meant for resale is not included in the above classification of inventories. The exclusion of merchandise is justified on the ground that a manufacturing establishment does not buy anything for resale in the same condition. It buys raw materials and other items for their conversion into finished products. A trading concern, however, buys finished goods for resale. The present study is concerned with industrial establishments and not with trading concerns.

I OBJECTIVES OF INVENTORIES

Inventory is as old as man. The primitive man's inventory consisted of a few tools; as a shepherd, man had to tend his flocks and herds; later, he had his granaries and warehouses; today, with industrialisation, his inventories cover a very wide range. As man has progressed

MRO inventories required for maintenance, repair and operating machinery.

and his needs and activities have multiplied, the range of inventory has become larger and more diversified.

As of today inventories include, among others, raw materials, semi-finished goods, finished goods and operating supplies. Each of these serve specific purposes. The raw materials inventories are held for later conversion into semi-finished or finished goods. Raw material inventories must exist because generally it is not always economically feasible either to purchase or to schedule the delivery of raw materials as they are needed in the production process.

Since manufacturing or processing always takes time, there is need for finished goods inventory. In some industries, materials must be processed in lots or batches. In other industries the flow of material may be steady, with the product existing simultaneously in several stages of completion. In still other types of manufacturing it is desirable, from economic considerations, to process or schedule material in lots.

The nature of the product, the nature of the customer demand, and the nature of the manufacturing process determine, to a considerable extent, the need for finished goods inventories. If the customer is willing to wait for the product to be manufactured, there is need for finished goods inventories. Sometimes, the nature of the product prohibits expensive finished goods inventories. Fresh fruits, vegetables and some other foods have limited storage life, so the extensive inventories of these products are not desirable. If the material must be processed in lots or batches, finished goods inventories will usually exist.

Supplies inventories do not directly go into the product. But they exist to facilitate smooth operation of the manufacturing process.

In general, inventory facilitates transit and handling. Materials may be transported thousands of kilometres before they are incorporated into an end product. All the time, materials are in transit, which may be a period of several months. During this transit, materials constitute someone's inventory.

Furthermore, inventories serve to isolate the supplier, the producer and the consumer. Inventories permit the procurement of raw materials in economic lot sizes as well as processing of these raw materials into finished goods in the most economical quantities. Raw material inventories isolate the supplier of raw materials from the user of these raw materials. Finished goods inventories isolate the user from the producer of the goods. In process the inventories isolate the departments within the plant.

Isolating, also called decoupling, of producer from supplier, one production department from another, and consumer from producer is necessary for two reasons. First is to reduce dependencies of one another, and second, to enable each organisation schedule its operations independently of another.

Yet another purpose of holding inventories is to reduce material handling costs. In some manufacturing and service operations, material handling cost can be reduced by accumulating parts between operations. This is particularly true of intermittent systems, since they involve less automation of material handling than do continuous systems. Parts can be accumulated and inventoried into the boxes or baskets and transported by hand-jack dollies or fork-lift trucks much more economically than they can be carried by hand. In continuous manufacturing, automated material handling systems, rather than larger work-in-process inventories, are designed to reduce overall handling costs.

Another reason for holding inventories is to obtain a reasonable utilisation of people and equipment.

Finally, inventories are held to facilitate product display and service to customers, batching in production in order to take advantage of longer production runs and provide flexibility in production scheduling.

The primary objective of inventory management is to ensure continuous supply of raw materials and facilitate uninterrupted production.

Obtaining a reasonable utilisation of people and equipment is one of the reasons for holding inventories.

Box 23.1 depicts the objectives more clearly.

Box 23.1 : Objectives of Inventory Management

1. Ensure a continuous supply raw materials and supplies to facilitate uninterrupted production.
2. Maintain sufficient finished goods for smooth sales operation and efficient customer service.
3. Inventories permit the procurement of raw materials in economic lot sizes as well as processing of these raw materials into finished goods is the most economical quantity known as "economic lot size".
4. Reduce dependencies of one another and enable the organisations to schedule its operations independently of another.
5. Inventory management helps to reduce material handling costs.
6. It helps to utilise people and equipment reasonably.
7. It facilitates product display and service to customers.

I INVENTORY COSTS

Inventory costs includes ordering cost plus carrying costs.

Inventories cost money. The cost factor must be considered while taking any decision regarding inventories. Inventory cost includes ordering cost, carrying cost, out of stock or shortage cost, and capacity cost. Each of these comprises several elements as shown below:

1. Ordering Costs

A. Cost of placing an order with a vendor of materials:

1. Preparing a purchase order.
2. Processing payments.
3. Receiving and inspecting the material.

B. Ordering from the plant:

1. Machine setup.
2. Start-up scrap generated from getting a production run started.

2. Carrying Costs

A. Costs connected directly with materials:

1. Obsolescence
2. Depreciation
3. Pilferage

B. Financial Costs

1. Taxes
2. Insurance
3. Storage

When carrying the cost of capital borrowed to finance and manage the inventory, the carrying cost increases and the carrying cost is as follows:

Capital Cost

Interest on money invested in inventory.

Interest on money invested in plant and building in total investment.

Interest on money invested in inventory holding and carrying cost.

When carrying the cost of capital borrowed to finance and manage the inventory, the carrying cost increases and the carrying cost is as follows:

Storage Space Costs

- Rent on building.
- Taxes and insurance on building.
- Depreciation on building.
- Depreciation on warehouse installation.
- Cost of maintenance and repairs.
- Utility charges, including heat, light and water.
- Salaries of security and maintenance personnel.

Inventory Service Costs

- Taxes on inventory.
- Labour costs in handling and maintaining stocks.
- Clerical expenses in keeping records.
- Employee benefits for warehouse and administrative personnel.

Handling-equipment Costs

- Taxes and insurance on equipment.
- Depreciation on equipment.
- Fuel expense.
- Cost of maintenance and repairs.

Inventory Risk Costs

- Obsolescence of inventory.
- Insurance on inventory.
- Physical deterioration of inventory.
- Losses from pilferage.

3. Out-of-stock Costs

- A. Back ordering.
- B. Lost sales.

4. Capacity Costs

- A. Overtime payments when capacity is too small.
- B. Lay-offs and idle time when capacity is too large.

Some of the components of inventory costs are conflicting, ordering costs and carrying costs, for example. If ordering costs are more carrying costs are less and vice versa.

Further, identifying and assessing some items of cost poses difficulty. Stock out cost is one such example. In a seller's market an unsatisfied customer will not be lost as easily as in a buyer's market, and who will say what the cost of not satisfying this customer at this time will be in the long run?

Two approaches have been suggested to overcome the difficulty. It is possible to trace and cumulate the individual costs attributable to individual items and use these for decision making. For example, what is the cost of issuing a purchase order for this item? Hopefully, such tracing would be applicable to a class or a number of different items and might, therefore, have a broader applicability.

Obsolescence and physical deterioration of inventory and losses from pilferage are the inventory risk costs.

The second approach would be to forecast the impact of a major change in operations and predict the impact on various cost centres. For example, if for half of the 'C' items we use systems contracting, what will be the impact on stores operations? Since most inventory models and these are based on finding an optimal cost level, weighing carrying costs against ordering costs or stock-out costs, the quality and availability of cost data are relevant considerations.

In practice it is only the carrying costs and ordering costs which are considered for calculating inventory costs. In one of the Bangalore based large industrial undertakings, the carrying cost and ordering cost are calculated as follows:

Calculation of Carrying Cost		(Rs. in lakhs)
Opening inventory		2974.60
Closing inventory		3004.30
Average inventory		2989.45
Cost of carrying		.
Salaries or wages (stores dept.)		24.84
Rent of stores building		7.40
Computer services		15.50
Administration overheads		21.70
Insurance		8.25
Other expenses (power, fuel, etc.)		16.60
Maintenance of transport vehicle used in stores		1.80
Material accounts		1.07
Total		<u>97.16</u>
% of carrying cost on average inventory		$\frac{97.16 \times 100}{2989.45} = 3.25\%$
+ Interest charges		= 18.00%
Total inventory carrying cost (%ge)		= 21.25%
Calculation of Ordering Cost		(Rs. Lakhs)
Salaries or wages of purchasing department		12.96
Receiving and shipping of orders		5.40
Receiving/inspection		2.85
Follow-up costs		0.52
Provisioning		6.80
Audit		0.63
Total		<u>29.16</u>
Total number of orders during the year		= 3,600
Ordering cost per order		= $\frac{29,16,000}{3,600} = 810$
Total items ordered during the year		= 10,800
Therefore ordering cost per item		= $\frac{29,16,000}{10,800} = \text{Rs. } 270.0$

Together it is estimated that the carrying and ordering costs came to around 25% to 30% of the total inventory.

INVENTORY MANAGEMENT AND CONTROL

Because of high costs involved in inventories, their proper management and control assume considerable importance. In fact, the management of inventory is given such an importance, that, it is often treated synonymous with materials management. Literature wise, there are more number of books and articles written on inventory management than on materials management.

Inventory management involves the 'development and administration of policies, systems, and procedures which will minimise total costs relative to inventory decisions and related functions such as customer service requirements, production scheduling, purchasing and traffic'. Viewed in that perspective, inventory management is broad in scope and affects a great number of activities in a company's organisation. Because of these numerous inter-relationships, inventory management stresses the need for integrated information flow and decision making, as it relates to inventory policies and overall systems.

Inventory control, on the other hand, is defined in a narrower sense than inventory management and pertains primarily to the administration of established policies, systems and procedures. For example, the actual steps taken to maintain the stock levels or stock records refer to inventory control.

Factors Influencing Inventory Management and Control

Several factors influence inventory management and control. The principal effects of these factors are reflected most strongly in the levels of inventory and the degree of control, planned in the inventory control system. The factors include type of product, type of manufacture, volume of output and others.

Type of Product

Among the factors influencing inventory management and control, the type of product is fundamental. If the materials used in the manufacture of the product have a high unit value when purchased, a much closer control is usually in order. Jewellers are much more careful of their stock of diamonds than they are with display cases full of low-priced costume jewellery. This same principle holds in manufacturing also.

If the material used in the product is in short supply or is rationed by the government, this may influence the purchase of this material and its stock maintained.

The manufacture of standard products as compared to custom-made items, will influence inventories. Material needed to manufacture a standard produce is easy to obtain and a close control on the stock is not necessary. Material required to product made-to-order items needs strict control to ensure that no item is lost in the process of manufacture. Such materials and tools are of special and expensive type and a loss of any small part will hold up the production.

Type of Manufacture

Besides type of product, type of manufacture also influences inventory management and control. Where continuous manufacture is employed the rate of production is the key factor. Here inventory control is of major importance and in reality controls the production of the product. The economic advantage of this type of manufacture is the uninterrupted operation of the machines and assembly lines in the plant. It is a major offence on the part of the

Inventory management involves administration, policies and procedures to reduce in inventory cost.

Type of product refers high unit and low unit value.

inventory personnel to have the plant shut down for the lack of material. Intermittent manufacture, on the other hand, permits greater flexibility in the control of material.

Volume of Production

The volume of product to be made as represented by the rate of production may have little effect on the complexity of the inventory problem. Literally, millions of brass bases for light bulbs are manufactured each month involving the control of only two principal items of raw material inventory. On the other hand, the manufacture of a large locomotive involves the planning and control of thousands of items of inventory. Both the inventory problem and the difficulty of controlling production increase in difficulty with the number of component parts of the product and not with the quantity of products to be made.

The other factors are :

- (i) The objectives of the company as they relate to inventories and the level of service to be provided to customers.
- (ii) The qualifications of staff personnel who will design and co-ordinate the implementation of the system.
- (iii) The capabilities of personnel who will be responsible for managing the system on a continuing basis.
- (iv) The nature and size of inventories and their relationship to the other functions in the company, such as manufacturing, finance and marketing.
- (v) The capability of present and future data processing equipment.
- (vi) The potential savings that might be anticipated from improved control of inventories.
- (vii) The current, or potential, availability of data that can be used in controlling inventories.
- (viii) The present method for controlling inventories, and for making inventory decisions.
- (ix) The degree of commitment by management personnel to the development of a more effective inventory management system and the results they anticipate from such a system.

Benefits of Inventory Management and Control

Proper management and control of inventories will result in the following benefits to an organisation :

1. Inventory control *ensures an adequate supply of materials, stores, etc.*, minimises stock-outs and shortages, and avoids costly interruptions in operations.
2. It *keeps down investment in inventories*, inventory carrying costs and obsolescence losses to the minimum.
3. It *facilitates purchasing economies* through the measurement of requirements on the basis of recorded experience.
4. It *eliminates duplication in ordering* or in replenishing stocks by centralising the source from which purchase requisitions emanate.
5. It *permits a better utilisation of available stocks* by facilitating inter-department transfers within a company.
6. It *provides a check against the loss of materials* through carelessness or pilferage.
7. It *facilitates cost accounting activities* by providing a means for allocating material costs to products, departments or other operating accounts.
8. It *enables management to make cost and consumption comparisons* between operations and periods.

Ensures an adequate supply of materials and minimises inventory costs.

9. It serves as a means for the location and disposition of inactive and obsolete items of stores.
10. Perpetual inventory values provide a consistent and reliable basis for preparing financial statements.

PROCESS OF INVENTORY MANAGEMENT AND CONTROL

As mentioned earlier, inventory management and control refers to the planning for optimum quantities of materials at all stages in the production cycle and evolving techniques which would ensure the availability of planned inventories. Four steps are involved in the process, viz.,

Step 1. Determination of optimum inventory levels and procedures of their review and adjustment.

Step 2. Determination of the degree of control that is required for the best results.

Step 3. Planning and design of the inventory control system.

Step 4. Planning of the inventory control organisation.

Step 1. Determination of Optimum Inventory Levels

Determination of inventory that an organisation should hold is a significant but difficult step. Too much of inventory results in locking up of working capital accompanied by increased carrying costs (but reduced ordering costs). Excess inventories, however, guarantee uninterrupted supply of materials and components, to meet production schedules and finished goods to meet customers demand. Too less of inventory releases working capital for alternative uses and reduces carrying costs and increases ordering costs. But there is the risk of stock out costs.

A few suggestion may be offered which might help to overcome this problem. The trend of sales must be watched closely and inventories adjusted in advance of the change in rate of production as determined by actual sales.

The actual level of the inventory may also be improved by a close study of the manufacturing cycle. How long does it take to bring out a road roller or a rail coach or an electric motor from the raw materials stage to the finishing stage? A study in co-operation with the manufacturing function of the ratio of actual processing time to waiting time may be most revealing, and when unnecessary details are eliminated, the work in process inventory can be considerably reduced.

All these and other related factors must be considered to determine a level of inventory which an organisation should hold. An interesting aspect is that the level of inventories is not static. What is the optimum level today may not be so tomorrow. Hence, inventory management must plan for the review of the stock often.

Step 2. Determination of Degree of Control

The second aspect of inventory management is to decide just how much control is needed to realise the objectives of inventory management. The difficulty is best overcome by classification of inventory on the basis of value. Popularly called the ABC classification, this approach is useful in deciding the degree of control. 'A' class items are 'high' in value but 'low' in quantity, 'C' class inventories are the opposite of 'A' group, i.e., 'high' in quantity and 'low' in value. In between are the 'B' group stock which are more or less equal in quantity and value proportion to the total inventory. Tight control is exercised on 'A' category items through accurate records of receipts and issues and by co-ordination of incoming

