

Inventory Management

Inventory is needed as supplies for operations, raw materials and work-in-progress for production, and finished goods for sale. Inventory does not earn interest, and is costly to store, order, insure, protect, and be without (stock-out costs), so inventory should be held so as to hold enough to operate, but not too much. Stock-out costs are the hardest to measure since it is uncertain how many customers are lost as a result of being turned away for lack of products in inventory.

Inventory management thus consists of deciding on the appropriate level of inventory to hold. Too less or too much inventory is harmful for any concern because it will increase the overall inventory cost. Let us now discuss the need for carrying inventory and the nature of inventory management.

Need & nature of inventory management

NATURE OF INVENTORIES

Inventories as you know are stock of the product a company is manufacturing for sale and components that make up the product. Various forms in which inventories exist in a manufacturing company are: raw materials, work-in-process and finished goods.

- Raw materials are those basic inputs that are converted into finished product through the manufacturing process. Thus, raw materials inventories are those units, which have been purchased and stored for future production.
- Work-in-process inventories are semi-manufactured products. They represent products that need more work before they become finished products for sale.
- Finished goods inventories are those completely manufactured products, which are ready for sale. Stocks of raw materials and work-in-process facilitate production, while stock of finished goods is required for smooth marketing operations. Thus, inventories serve as a link between the production and consumption of goods.

The levels of three kinds of inventories for a firm depend on the **nature of its 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. Within manufacturing firms, there will be differences. Large heavy engineering companies produce long production cycle products; therefore, they carry large inventories. On the other hand, inventories of a consumer product company will not be large because of short production cycle and fast turnover.

A fourth kind of inventory, supplies (or stores and spares), is also maintained by firms. Supplies include office and plant cleaning materials like soap, brooms, oil, fuel, light bulbs etc. These materials do not directly enter production, but are necessary for production process. Usually, these supplies are small part of the total inventory and do not involve significant investment. Therefore, a sophisticated system of inventory control may not be maintained for them. Maintaining inventories involves tying up of the company's funds and incurrence of storage and handling costs. There are three general motives for holding inventories:

- Transactions motive emphasizes the need to maintain inventories to facilitate smooth production and sales operations. For uninterrupted and proper running of any firm it is necessary to have an appropriate level of inventory.

- Precautionary motive necessitates holding of inventories to guard against the risk of unpredictable changes in demand and supply forces and other factors.

- Speculative motive influences the decision to increase or reduce inventory levels to take advantage of price fluctuations.

A company should maintain adequate stock of materials for a continuous supply to the factory for an uninterrupted production. It is not possible for a company to procure raw materials whenever it is needed. A time lag exists between demand for materials and its supply. Also, there exists uncertainty in procuring raw materials in time on many occasions. The procurement of materials may be delayed because of such factors as strike, transport disruption or short supply. Therefore, the firm should maintain sufficient stock of raw materials at a given time to streamline production. The firm may purchase large quantities of raw materials than needed for the desired production and sales levels to obtain quantity discounts of bulk purchasing. At times, the firm would like to accumulate raw materials in anticipation of price rise.

Work-in-process inventory builds up because of the production cycle. Production cycle is the time span between introduction of raw material into production and emergence of finished product at the completion of production cycle. Till production cycle completes, stock of work-in-process has to be maintained. Efficient firms constantly try to make production cycle smaller by improving their production techniques.

Stock of finished goods has to be held because production and sales are not instantaneous. A firm cannot produce immediately when customers demand goods. Therefore, to supply finished goods on a regular basis, their stock has to be maintained. Stock of finished goods has also to be maintained for sudden demands from customers. In case the firm's sales are seasonal in nature, substantial finished goods inventories should be kept to meet the peak demand. Failure to supply products to customers, when demanded, would mean loss of the firm's sales to competitors. The level of finished goods inventories would depend upon the coordination between sales and production as well as on production time.

OBJECTIVES OF INVENTORY MANAGEMENT

No activity is undertaken without some aim/objective. Let's now come to the objectives of inventory management.

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

- To maintain a large size of inventory for efficient and smooth production and sales operations.
- To maintain a minimum investment in inventories to maximize profitability because idle blocking of funds earn nothing.

As we discussed earlier, both excessive and inadequate inventories are not desirable. These are two danger points within which the firm should operate. The objective of inventory management should be to determine and maintain optimum level of inventory investment. The optimum level of inventory will lie between the two danger points of excessive and inadequate inventories.

Firms should always avoid a situation of over investment or under-investment in inventories. The major dangers of over investment are:

- (a) Unnecessary tie-up of the firm's funds and loss of profit,
- (b) Excessive carrying costs, and
- (c) Risk of liquidity.

The excessive level of inventories consumes funds of the firm, which cannot be used for any other purpose, and thus, it involves an opportunity cost. 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. You have to understand that excessive inventories carried for long-period increase chances of loss of liquidity. It may not be possible to sell 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 conditions of inflation and scarcity. Work-in-process is far more difficult to sell. Similarly, difficulties may be faced to dispose off finished goods inventories as time lengthens. The downward shifts in market and the seasonal factors may cause finished goods to be sold at low prices.

Another danger of carrying excessive inventory is the physical deterioration of inventories while in storage. Such loss is as you know a complicated issue for any business. 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; unnecessary investment in inventories can, thus, be cut down maintaining an inadequate level of inventories is also dangerous.

The consequences of underinvestment in inventories are:

- (a) Production hold-ups and
- (b) Failure to meet delivery commitments. Inadequate raw materials and work-in-process inventories will result in frequent production interruptions.

Similarly, if finished goods inventories are not sufficient to meet the demand of customers regularly, they may shift to competitors, which will amount to a permanent loss to the firm. The aim of inventory management, thus, should be to avoid excessive and inadequate levels of inventories and to maintain sufficient inventory for the smooth production and sales operations.

Efforts should be made to place an order at the right time with the right source to acquire the right quantity at the right price and quality.

As you can gather from our discussion, inventory management to be effective should:

- Ensure a continuous supply of raw materials to facilitate uninterrupted production,
- Maintain sufficient stocks of raw materials in periods of short supply and anticipate price changes,
- Maintain sufficient finished goods inventory for smooth sales operation, and efficient customer service,
- Minimise the carrying cost and time, and
- Control investment in inventories and keep it at an optimum level.

Till now, we have discussed the need & nature of inventory management. Let's move on to discuss the various techniques of inventory management.

INVENTORY MANAGEMENT TECHNIQUES Inventories are stock of the product a company is manufacturing for sale and components that make up the product. Inventory management involves the control of the assets used in the production process or produced to be sold in the normal course of the firm's operations. As we have already discussed that every management technique should be in consonance with the shareholders, wealth maximization principle. To achieve this, the firm should determine the optimum level of inventory.

Efficiently controlled inventories make the firm flexible. Inefficient inventory control results in unbalanced inventory and inflexibility-the firm may sometimes run out of stock and sometimes may pile up unnecessary stocks. This increases the level of investment and makes the firm unprofitable.

To manage inventories efficiently, we should seek answers to the following two questions:

- How much should be ordered?
- When should it be ordered?

The first question, how much to order, relates to the problem of determining economic order quantity (EOQ), and is answered with an analysis of costs of maintaining certain level of inventories.

The second question, when to order, arises because of uncertainty and is a problem of determining the re-order point.

Economic Order Quantity (EOQ)

Inventory Management Techniques

■ **Economic order quantity (EOQ)**

One of major problem with inventory management is how much inventory should be added when inventory is replenished. The quantity to be purchased should neither be small nor big because cost of buying and carrying is very high. EOQ is the size of the lot to be purchased which is economically viable. This is the quantity of materials which can be purchased at minimum costs.

■ **Economic order quantity (EOQ)**

- ordering costs: requisitioning, order placing, transportation, receiving, inspecting and storing, administration
- carrying costs: warehousing, handling, clerical and staff, insurance, depreciation and obsolescence

$$EOQ = \sqrt{2ao/c}$$

Suppose a firm expects total demand for its product over the planning period to be 5,000 units, whereas the ordering cost per order is Rs 200, and the carrying cost per unit is Rs 2. The EOQ will be

$$\begin{aligned} EOQ &= \sqrt{2 \times 5,000 \times 200} \\ &= \sqrt{2,000,000} \\ &= 1,000 \text{ units} \end{aligned}$$

Inventory Investment Analysis

- Estimation of incremental operating profit
- Estimation of incremental investment in inventory
- Estimation of the incremental rate of return (IRR)
- Comparison of the incremental rate of return with the required rate of return (RRR)
- Optimum inventory:

$$IRR = RRR$$

1. If the firm is buying raw materials, it has to decide lots in which it has to be purchased on replenishment.
2. If the firm is planning a production run, the issue is how much production to schedule (or how much to make).

These problems are called order quantity problems, and the task of the firm is to determine the optimum or economic order quantity (or economic lot size).

Determining an optimum inventory level involves two types of costs:

- (a) Ordering costs and
- (b) Carrying costs.

The economic order quantity is that inventory level, which minimizes the total of ordering and carrying costs.

Ordering Costs

Let's see if you remember what ordering costs are?

The term ordering costs is used in case of raw materials (or supplies) and includes the entire costs of acquiring raw materials. They include costs incurred in the following activities: requisitioning, purchase ordering, transporting, receiving, inspecting and storing (store placement).

Ordering costs increase in proportion to the number of orders placed.

The clerical and staff costs, however, do not vary in proportion to the number of orders placed, and one view is that so long as they are committed costs, they need not be reckoned in computing ordering cost. Alternatively, it may be argued that as the number of orders increases, the clerical and staff costs tend to increase. If the number of orders are drastically reduced, the clerical and staff force released now can be used in other departments. Thus, these costs may be included in the ordering costs. It is more appropriate to include clerical and staff costs on a pro rata basis. Ordering costs increase with the number of orders; thus the more frequently inventory is acquired, the higher the firm's ordering costs. On the other hand, if the firm maintains large inventory levels, there will be few orders placed and ordering costs will be relatively small. Thus, ordering costs decrease with increasing size of inventory.

Carrying Costs

Do you have any idea what carrying costs are?

Costs incurred for maintaining a given level of inventory are called carrying costs. They include storage, insurance, taxes, deterioration and obsolescence. The storage costs comprise cost of storage space (warehousing cost), stores handling costs and clerical and staff service costs (administrative costs) incurred in recording and providing special facilities such as fencing, lines, racks etc.

ORDERING AND CARRYING COSTS

Let's take a quick look at the various cost items that come under ordering and carrying costs respectively.

Ordering Costs

- Requisitioning
- Order placing
- Transportation
- Receiving, inspecting and storing
- Clerical and staff

Carrying Costs

- Warehousing
- Handling
- Clerical and staff
- Insurance
- Deterioration and obsolescence

Carrying costs vary with inventory size. This behavior is contrary to that of ordering costs, which decline with increase in inventory size. The economic size of inventory would thus depend on trade-off between carrying costs and ordering costs.

Where,

Formula:

$$EOQ = \sqrt{\frac{2AO}{C}}$$

Let's take an example so that you understand it better.

Example:

Your firm buys casting equipment from outside suppliers @Rs.30/unit. Total annual needs are 800 units. You have with you following further data:

Annual return on investment, 10%

Rent, insurance, taxes per unit per year, Re.1

Cost of placing an order, Rs.100

How will you determine the economic order quantity?

This can be solved as follows:

We already know the formula for EOQ,

$$EOQ = \sqrt{\frac{2AO}{C}}$$

C

In this problem, the annual demand i.e. A = 800 units.

Ordering cost i.e. O = Rs.100.

Total cost = 800 x 30 i.e. Rs.24000

Total interest cost = 10% of 24000 = Rs.2400

Interest cost per unit = $\frac{2400}{800}$ = Rs.3

800

Carrying cost = 3 + 1 = Rs.4 per unit

$$EOQ = \sqrt{\frac{2 \times 800 \times 100}{4}}$$

= 200 units.

A = annual demand

O = ordering cost per order

C = carrying cost per unit

Re-order Point

We have now solved the problem of “how much to order” by determining the economic order quantity, we have yet to seek the answer to the second problem, “when to order”. This is a problem of determining the re-order point. Let's see what re-order point is? The **re-order point** is that inventory level at which an order should be placed to replenish the inventory.

To determine the re-order point under certainty, we should know:

- (a) Lead time,
- (b) Average usage, and
- (c) Economic orders quantity.

Under such a situation, re-order point is simply that inventory level which will be maintained for consumption during the lead-time. That is:

Reorder point = lead time in days x daily usage

Lead-time

It is the time normally taken in replenishing inventory after the order has been placed. By certainty we mean that usage and lead-time do not fluctuate.

Safety stock

The demand for material may fluctuate from day to day or from week to week. Similarly, the actual delivery time may be different from the normal lead-time. If the actual usage increases or the delivery of inventory is delayed, the firm can face a problem of stock-out, which can

prove to be costly for the firm. Therefore, in order to guard against the stock-out, the firm may maintain a safety-stock-some minimum or buffer inventory as cushion against expected increased usage and/or delay in delivery time.

SELECTIVE INVENTORY CONTROL: ABC ANALYSIS

Usually a firm has to maintain several types of inventories. It is not desirable to keep the same degree of control on all the items. The firm should pay maximum attention to those items whose value is the highest. The firm should, therefore, classify inventories to identify which items should receive the most effort in controlling. The firm should be selective in its approach to control investment in various types of inventories. This analytical approach is called the ABC analysis and tends to measure the significance of each item of inventories in terms of its value.

The high-value items are classified as

'A items' and would be under the tightest control.

'C items' represent relatively least value and would be under simple control.

'B items' fall in between these two categories and require reasonable attention of management.

The ABC analysis concentrates on important items and is also known as control by importance and exception (CIE). As the items are classified in the importance of their relative value, this approach is also known as proportional value analysis. (PVA). .

The following steps are involved in implementing the ABC analysis:

1. Classify the items of inventories, determining the expected use in units and the price per unit for each item.
2. Determine the total value of each item by multiplying the expected units by its units price
3. Rank the items in accordance with the total value, giving first rank to the item with highest total value and so on.
4. Compute the ratios (percentage) of number of units of each item to total units of all items and the ratio of total value of each item to total value of all items.
5. Combine items on the basis of their relative value to form three categories: -A, B and C.

MATERIALS REQUIREMENT PLANNING (MRP) SYSTEM

You have seen in the previous discussions almost about the inventory management. Now let's come to a new area that is materials requirement planning (MRP) system to determine what to order, when to order, and what priorities to assign to ordering materials. Many companies are taking up this process now a day. MRP uses EOQ concepts to determine how much to order. Using a computer, it simulates each product's bill of materials structure, inventory status, and manufacturing process. The bill of materials structure simply refers to every part or material that goes into making the finished product. On the basis of the time it takes for a product that is in process to move through the various production stages and the lead time required to get materials, the MRP system determines when orders should be placed for the various items on the bill of materials.

The advantage of the MRP system is that it forces the firm to more thoughtfully consider its inventory needs and plan accordingly. The objective is to lower the firm's inventory investment without impairing production. If the firm's opportunity cost of capital for investments of equal risk is 15 percent, every Rs.1.00 of investment released from inventory increases before-tax profits by Rs.15.

JUST-IN-TIME (JIT) SYSTEM As you must have guessed from the name, under this system materials arrive exactly at the time they are needed for production.

The just-in-time (JIT) system is used to minimize inventory investment. The philosophy is that materials should arrive at exactly the time they are needed for production. Ideally, the firm would have only work-in-process inventory. Because its objective is to minimize inventory investment, a JIT system uses no, or very little, safety stocks. Extensive coordination must exist between the firm, its suppliers, and shipping companies to ensure that material inputs arrive on time. Failure of materials to arrive on time results in a shutdown of the production line until the materials arrive. Likewise, a JIT system requires high-quality parts from suppliers. When quality problems arise, production must be stopped until the problems are resolved.

The goal of the JIT system is manufacturing efficiency. It uses inventory as a tool for attaining efficiency by emphasizing quality in terms of both the materials used and their timely delivery. When JIT is working properly, it forces process inefficiencies to surface and be resolved. A JIT system requires cooperation among all parties involved in the process—suppliers, shipping companies, and the firm's employees.

Now that you have understood the concepts, let's have a review to test your knowledge.

CASE STUDY

Good Customers—Bad Receivables

The normal reaction to learning that a customer is delinquent in their account with your firm is to say "No more credit". This reaction, however, may not be best course of action.

When a firm has a large customer the relationship between the two firms can be very complex. The financial demise of the customer could in fact, lead to the demise of the supplier. For a look at how reliant a firm can be upon an individual customer as well as how a firm can respond to a financially distressful situation facing a large customer, read the article by Howard Brownstein and Edward Gavin. Answer the following questions based on the information provided by the article.

TALKING IT OVER AND THINKING IT THROUGH!

Company A supplies products to Company B. Company B is currently delinquent in the payment of their invoices from Company A. What factors besides the delinquent account balance need to be considered before Company A denies future credit to Company B?

1. Under what circumstances might a customer sue their supplier should the supplier deny future credit?
2. What is a turnaround professional?
3. What are the three key items mentioned in the article that are essential for a distressed firm to successfully turn their business situation around?
4. When a credit manager realizes a key customer is experiencing financial distress, whom should they discuss the situation with prior to taking any action?

THINKING ABOUT THE FUTURE!

Establishing the ideal credit policy is tough. If the credit policy is too stringent, sales and net profits will be forfeited. If the credit policy is too lenient, bad debts will be incurred. To determine the best credit policy, credit managers must work with other managers throughout the firm to determine the benefits and costs of issuing credit and establishing the policy that appears to produce the best results over the long term. These managers must also determine how to handle customers who become delinquent. This is often done on a case-by-case basis with the action taken being determined by the specifics of the situation

Case Study

Just-in-Time Inventory Creates Volatility Just-in-time (JIT) delivery systems have had a dramatic impact on efficiency and profitability. Firms can reduce inventory to bare bones levels. Lead time, the time between ordering and shipping, is down substantially. One manufacturer indicates lead time is now one to three days, less than half what it was five years ago. Lantech, a manufacturer of machines used to wrap plastic around pallets, is an example of a company that has taken substantial advantage of JIT techniques. Lantech can now build a special order machine in ten hours. The same machine took five weeks to build ten years ago. All companies have been forced to adapt to the instantaneous nature of orders. A customer will call in the morning wanting goods for the next day, or even that afternoon. Gone are the days of ordering weeks in advance. Even those companies that can't speed up the manufacturing process are reluctant to stockpile inventory. Worthington Industries, a steel producer, indicated that it will pass on some orders needing quick delivery rather than build up inventory. Many firms no longer attempt to forecast demand for their products, they merely react to new orders as rapidly as possible. The economic result is increased volatility. Excluding defense orders, capital goods orders were up 4.6% in February, down 3.1% in March, and up 1.9% in April.

TALKING IT OVER AND THINKING IT THROUGH!

1. How does JIT increase profits?
2. What impact does JIT have on inventory obsolescence?
3. How does JIT increase volatility?
4. What is the danger of not holding product in inventory?

THINKING ABOUT THE FUTURE!

JIT inventory systems have greatly increased our efficiency. However, they also appear to have increased our economic volatility. In the future, I suspect that this trend will continue and contribute to the development of even more flexible manufacturing systems that can be reconfigured rapidly to accommodate vastly different products. Only those firms that can readily adapt will be able to remain competitive in the new marketplace.