
UNIT 17 INVENTORY MANAGEMENT

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17.1 INTRODUCTION

Inventory constitutes a significant part of current asset of manufacturing companies. Inventory can be defined as the stock of goods, the companies' holds with them. All firms invest in inventories- raw material, work-in progress and finished goods. Because inventory is a significant part of current assets, it requires a considerable amount tied with them. Given the size of the fund invested in holding inventory, it is, therefore, imperative to manage it efficiently and effectively.

17.2 OBJECTIVES

After going through this unit, the reader should be able to

- Understand the meaning of inventory
- Understand the motive behind holding inventory
- Discuss various types of inventory

- Analyze various cost associated with inventory
- Understand how to determine optimal level inventory usage
- Economic Order Quantity (EOQ) Model
- Understand the concept and determination of re-order point and safety stock
- Understand and analyze inventory management techniques

17.3 ABOUT INVENTORY

L.R observed that- “The proper management and control of inventory not only solves the acute problem of liquidity but also increases annual profits and causes substantial reduction in the working capital of the firm”. Presently business action has expanded and the issue of inventory has also become more complex. The business-man needs more money to lead his everyday business exercises. Therefore, the higher the degree of inventory, lower the degree of money. So, the requirement for inventory must be adjusted against the preference for liquidity. If the inventory is more in stock then it will save the cost of idle time of machinery and the cost of idle time of men.

17.4 TYPES OF INVENTORY

Broadly, based on the manufacturing firms, inventory is categorized into raw material; semi finished goods and finished products.

17.4.1 RAW MATERIAL: Raw material is basic material input of the production process. For example, a construction business, cement, bricks, iron rods etc are raw material. For a food processing unit, grain, oil, salt, seasoning etc are the raw material. All firms maintain a stock of raw material with them. Normally, a large amount is invested in maintaining the stock of raw material. It is done because of the following reasons-

a) To decouple the production function from purchasing function: The firm wants to make these two functions independent from each other, they want a smooth flow of raw material ready for their production process. They do not want to interrupt the production because of delay or non-availability of raw material.

b) Secondly, firms find it economical to purchase the raw material in bulk/ large quantity. Also, firms want to maintain a large quantity of raw material, if they sense an increase in the price of it in the future.

17.4.2 WORK-IN-PROGRESS (WIP): It is termed as semi finished goods. It is the types of goods on which some works are done but they need to further go in the production process in order to manufacture final product. Like- in construction business, doors, windows and fittings are the W-I-P goods which need to fit in the buildings.

17.4.3 FINISHED GOODS: Finished goods are ready materials which are good to sold in the market. The firm holds these types of stock with them so that as and when the product is demanded by the customers, they can be readily available with them. Finished products are requisite in smooth functioning of marketing operations.

17.5 THE MOTIVE BEHIND HOLDING INVENTORY

Holding an inventory is a cost to the organization. The firm has to invest the fund to procure the raw material, require proper storage to keep them in a safe and proper condition and also take care of them to refrain inventory from any wear and tear or spoilage. Despite these costs, it is imperative for any manufacturing firm to hold inventories, because of the following motives-

Transaction Motive- It underlines the purpose of keeping up stock to encourage smooth operation, and sales activities.

If the raw material or semi-finished goods are not available at the time of production, it hampers the operation of the business and can be detrimental of the business. So, it is essential to provide raw material instantly whenever required so that there should not be any delay in the production.

Precautionary Motive- The firm holds the stock with them to avoid any untoward change in the demand and supply situation. Suppose, because of the strike, on bad weather in case of agricultural product, raw material cannot be source, in that case the firm will have to halt the operation, which in turn results in short supply of the product in the market.

Likewise, if there is sudden spurt of demand of the product in the market and if the stock of finished product is not available with the firm, the will have to lose the customer. To not to caught in these types of situations, firms prefer to keep the stock with themselves.

Speculative Motive- Sometimes, firms hold the stock to take advantage of the price fluctuations. Like, confectionary firms purchase potatoes in bulk to take advantage of low price at the time of harvesting.

17.6 OBJECTIVES OF INVENTORY MANAGEMENT

The motivation behind the inventory management is to maintain the stocks in such a manner so that there will be neither over stocking nor under stocking. The aim of inventory management is to make the raw material and W-I-P accessible to the production process in adequate amount so that work isn't interrupted for need of stock and also, provides finished products to the sales team in desired numbers/quantity. According to I.M. Pandey-

“Both excessive and inadequate inventories are not desirable. Therefore, optimum level of inventory will lie between the two danger points of excessive and inadequate inventories”.

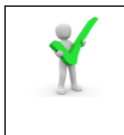
According to L.R. Howard “The efficient management of inventories enables the industries to achieve better working results and reduction in working capital. An undertaking neglecting the management of inventories will be jeopardizing its long-term profitability and may fail ultimately. It is possible for an undertaking to reduce its level of inventories to a considerable degree e.g. 10% to 20%, without any adverse effect on production and sales, by using simple inventory planning and control techniques”.

The firms need to make a trade off in two conflicting decisions-

- a) Maintain a size of raw material enough to not to hamper the production flow and finished goods to support sales operations and
- b) The minimum level of fund to minimize the cost of the production.

The following are the objectives of Inventory Management-

- a) To maintain company inventory at an appropriate level to escape from excessive or shortage of stock.
- b) To maintain inventory at the proper level so that production and sales going smooth.
- c) To provide the accurate quantity and quality of goods in time and at right time.
- d) To minimize wastage, damages, theft etc.
- e) To minimize carrying and ordering costs of inventory.
- f) To design the proper organizations for Inventory Management.



Check Your Progress-A

Q1. What is inventory?

Q2. What are the types of inventory?

Q3. What is transaction motive of holding inventory?

17.7 COST ASSOCIATED WITH HOLDING THE INVENTORY

Though, holding stock provides a safety net to the firms against any untoward situations, it also attracts cost tied with it.

17.7.1 ORDERING COST

It is also known as setting cost. These are the variable expenses of submitting a request to purchase the raw material. Requests are set by the firm to replenish the stock of raw material, which are ought to go into production process. Ordering costs incorporate the expense of asses the quantity or number of the goods required, ordering, examining and getting. The ordering cost change in relation to the number of orders placed. They likewise incorporate administrative expenses and stationery costs (That is the reason it is known as a set-up cost.). Although, these expenses are nearly fixed in nature, the bigger the order set, or the more continuous the procurement of inventory made, the higher are such expenses. Also, the less the requests, the lower the request cost will be for the firm. In this way, the ordering/acquistion costs are contrarily identified with the degree of inventory.

17.7.2 CARRYING COST

Carrying costs, otherwise called holding cost and inventory carrying costs, are the costs a business pays for holding inventory. A business can bring about an assortment of carrying costs, including charge of taxes, insurance charges, representative costs, devaluation, the expense of keeping goods in proper condition, the expense of risk of spoilage of short-lived things and opportunity costs. Opportunity cost, here, is defined as the fund, which is tied in holding inventory, which could be otherwise used in the other productive activates.

17.8 ADVANTAGES AND DISADVANTAGES OF INVENTORY MANAGEMENT

17.8.1 ADVANTAGES

- a) Every material can be obtained in the most affordable amount. Because if customer wants that product in bulk in that case possibility of discount are also there.
- b) Buying and stock control individuals consequently gives their consideration regarding those things which are required just when are needed.
- c) Positive control can maintain inventory at the ideal level just by computing the foreordained greatest and least qualities.
- d) It facilitates regular and timely supply to customers through adequate stocks of finished products. If our order is delivered on time to the customers then it will be good for the company.

17.8.1 DISADVANTAGES

- If inventory is more in the company then more space is required and the spaces are accounts for rent.
- Chances of damage are also there.
- Insurance charges are also increased
- Sometimes order is placed at an inappropriate time then it will not be good for the company or the suppliers.
- Increased chance of obsolesce

17.9 EOQ MODEL

Economic Order Quantity (EOQ) is the ideal quantity ordered for an organization should buy to limit stock costs, for example, holding costs, shortage costs, and order costs. This model was created by Ford W. Harris in 1913 and has been refined several times. The economic order quantity is a noteworthy idea in acquisition of raw materials and in the capacity of finished goods and in-transit inventories. In this framework of ordering, the quantity to be ordered is resolved with the assistance of 'EOQ' equation which considers three variables:

- Handling of the materials during the given time frame
- Ordering cost; and
- Carrying cost of stock

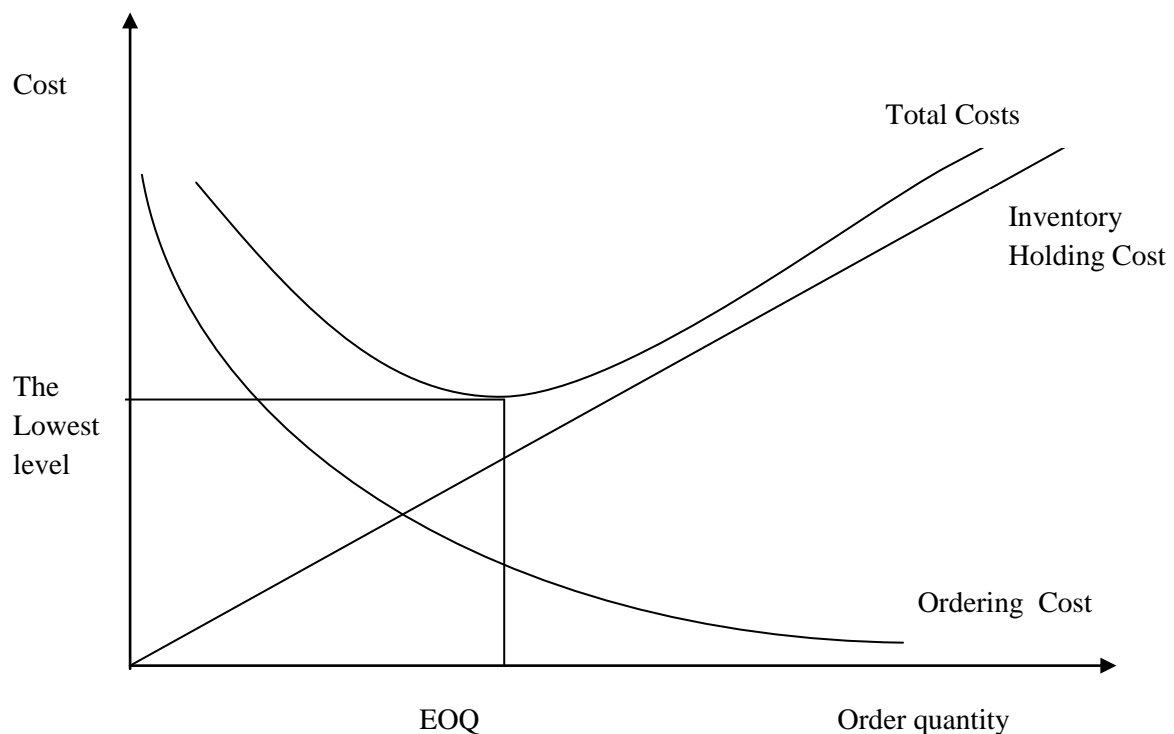


Fig 17.1 EOQ Graphical Representation

Assumptions

The EOQ model works under following assumptions

i) Demand remains constant

The model assumes that the demand of the product remains same. Because the demand of the product remains same, so the quantity of the production also constant and the requirement of the raw material is same. This model also assumes that as the stock exhaust, new stock arrives just at time, therefore, no requirement of safety stock.

ii) Delivery is Immediate-

This model also assumes that as the stock exhaust, new stock arrives just at time; there is no delay in delivery. Because there is no delay in delivery, therefore, no requirement of safety stock.

We experience in our real life that because of strike, unavailability of the product etc, there is a time lag, so the firm need to keep a safety stock with them.

iii) Constant Ordering Cost

It says that whatever is the size of order, the ordering cost remains constant.

iv) Constant Carrying Cost

On the same line, this model assumes that carrying cost is fixed as a percentage of the inventory. There is no percentage change in carrying cost, if the size of inventory increases or decreases.

v) Purchase Price remains Constant

One of the assumptions of this model is constant unit price of the raw materials. It does not consider the change in the price of the products because of any reason.

But in real life, there are fluctuations in the price because of inflation, availability of the product in the market, quantity of the product- in small quantity or in bulk, etc.

Formula:

$$EOQ = \sqrt{2DXS/H}$$

Where

Q= EOQ units

D= ordered units (annual basis)

S= per unit cost

H= holding cost

The objective behind EOQ formula is to distinguish the ideal quantity of item to be arranged. Whenever accomplished, a business can limit its costs for purchasing, conveyance, and putting away units. The EOQ equation can be changed to decide diverse generation levels or order intervals, and organizations with huge stock chains and high factor costs utilize a calculation in their computer programming to decide EOQ.

The EOQ is a significant cash flow tool. The equation can enable an organization to manage the measure of money tied up in the inventory equalization. For some of the organizations, stock is considered as most important resource other than its human resources. So these organizations must suggest adequate stock to address the issues of clients. On the off chance that EOQ can help in limiting the level of inventory, the reserved funds can be utilized for some other different business reasons or investment.

The EOQ framework finds some kind of balance between the ordering cost and carrying cost what's more, recommended the optimal order quantity for which order ought to be put. The economic order quantity is that inventory level which minimizes the aggregate of ordering costs and inventory costs.

For example-

A shoes shop conveys a line of kid's shoes, and the shop sells 600 pairs of shoes every year. It costs the organization Rs.5 every year to hold a couple of shoes in stock, and the fixed cost to put in an order is Rs 15.

The EOQ formula is the square root of $(2 \times 600 \text{ sets} \times 5 \text{ order cost})$ divided by $(15 \text{ holding cost})$ equals to 400. The ideal order size to limit expenses and fulfill customer need is marginally in excess of 400 of shoes.

Re-order point

EOQ solves the problem-how much to order? Now, the question rises is- when to order? A firm must decide that level of inventory at which firm should place an order to replenish the inventory, so that the remaining stock does not reach to zero. The level of inventory at which the order is placed is called reorder point and time between placing an order and arrival of the same called lead time.

In EOQ model, under the assumption of certainty, the reorder point is simply –

The average demand (d)* Lead Time (L)

If the average demand – 150 Units

Lead time is- 7 Days

Reorder point= $d \times L$

$$= 150 \times 7 = 1050 \text{ units}$$

So, when the current stock level reaches to 1050 units, the firm should place an order.

Safety stock

EOQ model assumes that there is certainty. It assumes that the order will reach on the exact time and the production happen at a uniform rate. But, in real life, there is many a reason, because of which it seldom happens. If the order does not reaches on time or if the consumption of raw material increases to meet the raised demand the firm will have to face the situation of stock out.

The situation of stock out not only put a hindrance on the production side; it also jeopardizes the reputation of the firm. Safety stock provides a cushion to observe the shock of stock out. But, again, it involves carrying cost. A firm must strike a trade off between the stock out cost and carrying cost.

Safety Stock= (Maximum Daily uses+ Maximum Lead time)- (Avg. daily uses-Avg. lead time)

Ex- If the daily uses vary between 40 units to 80 units and the maximum possible lead time is 40 Days

$$\begin{aligned}\text{Safety Stock} &= (80 \times 40) - (60 \times 20) \\ &= 3200 - 1200 = 3,000 \text{ units}\end{aligned}$$

In case of maintaining safety stock, the reorder point would be

$$\begin{aligned}\text{Reorder point} &= (\text{Lead time} \times \text{Average Uses}) + \text{Safety Stock} \\ &= (40 \times 60) + 3,000 \\ &= 2,400 + 3,000 = 5,400 \text{ units}\end{aligned}$$



Check Your Progress-B

Q1. What is inventory planning?

Q2. Discuss five objectives of inventory planning?

Q3. What is ordering cost and safety stock.

Q4. Difference between inventory control and management.

17.10 INVENTORY MANAGEMENT SYSTEM

Inventory management system is the way of managing and controlling inventory of any organization. It includes various methods like ABC analysis, VED, JIT analysis.

ABC Analysis:

One of the most preferable techniques in inventory control system is called ABC which implies “*Always better control*” analysis. This analysis is based on annual consumption of inventory items in a year. It helps in reducing working capital and carrying costs

The analyses differentiate the product into three categories: A category defines the high consumption valued product, B defines medium consumption valued product and C defined the least consumption valued product.

✓ To calculate the value of annual usage can be calculated from following formula-

(Annual consumption value = per order cost X Annual ordered item)

The following table presents the number of items and inventory value under ABC analysis.

Category	% of total item	% of total cost of inventory	Control required
A	5-10	70-75	Efficient control
B	20-30	10-25	Usual control
C	60-70	5-15	Developed from experience

✓ **Steps in calculating cost in ABC analysis**

Following are the steps involved in ABC analysis

- Calculate annual consumption value of per item by multiplying the cost of each item.
- Organize the item in descending order according to the consumption value.

- (c) Calculate percentage of total consumption cost of each item.
- (d) Compute the average inventory of each item by dividing the consumption cost with 2 and total number of orders.

Advantages of ABC Analysis-

- Perfect control over costly items
- Efficient planning
- Maintain the stock at optimal level
- Focus on reducing storage expenses
- Helps in planning stocks, results to it firm prevent from unnecessary and surpluses.

Just In Time Analysis:

Another important technique in inventory management system is Just in Time (JIT) analysis. The just-in-time techniques was originally developed by Taichi Okno of Japan, basically this analysis implies that the firm should maintain minimum level of inventory at any stage of production. And the firm should rely on suppliers to provide requirements immediately at any stages of production. This technique is also known as “zero inventory”, “materials as requirement”. Just-in-time is contrast to traditional inventory management known as ‘just-in-case’ system, which advice the firm, should maintain stock on large scale in order to meet emergency of materials at any time. Whereas ‘just-in-time’ advocates providing material when internal, external or customer needed, hence it reduces the inventory and cost related to it.

Difference between inventory management and inventory control:

Inventory management means to manage the stock like how much, when etc., and coordination and formulation of orders Whereas Inventory control means maintaining balance between providing materials and efficient utilization of stock.

Objective of JIT analysis-

- Efficient stock management
- Produce efficient output with minimal waste
- No warehouses
- Supply of exact number of product at required time
- Reduce lead time
- Secure and competitive pricing

VED Analysis:

This analysis is known as “Vital, Essential, and Desirable analysis. In this techniques the products are categorize according to the critical value and shortage cost of an item:

Vital: means where shortage of spare parts cannot be acceptable. Vital spare parts are stocked sufficiently to make sure smooth operation.

Essential: spare part will be considered essential, which is for efficient running of operations. Therefore, it is necessary to keep adequate arrangement of stock in order to meet urgency at short notice.

Desirable: Here there is no need to stock spare part; it can be bought easily from the market when parts are required. Its non-availability neither stops the operation nor reduces its efficiency.

Basically VED analysis helps in smooth functioning of operation by managing and controlling rare spare parts. It is very beneficial for capital intensive and transport industries. According to Gopalkrishnan and Sundaresean VED analysis and ABC analysis can be combined to control the stocking of spare parts. Following matrix shows the combination ABC and VED analysis-

	V	E	D		Item	Cost
A	AV	AE	AD	Category 1	10	70%
B	BV	BE	BD	Category 2	20	20%
C	CV	CE	CD	Category 3	70	10%

Category 1: Require efficient monitoring and controlling

Category 2: Moderate control

Category 3: No need for controlling

17.11 SUMMARY

An inventory is a stock of materials used to facilitate production or to satisfy customer demands. Inventories include raw materials, work-in-progress, and finished goods. Broadly, based on the manufacturing firms, inventory is categorized into raw material; semi-finished goods and finished products. Holding an inventory is a cost to the organization. The motivation behind the inventory management is to maintain the stocks in such a manner so that there will be neither over stocking nor under stocking. Cost associated with holding the inventory

Ordering Cost- It is also known as setting cost. These are the variable expenses of submitting a request to purchase the raw material.

Carrying Cost- Carrying costs, otherwise called holding cost and inventory carrying costs, are the costs a business pays for holding inventory. Functions of inventory management: protection against uncertainties, to cover anticipated changes, to provide cushion, display motivational information, reduce surpluses, effective use of capital, maintaining and promoting efficiency etc.

Economic Order Quantity (EOQ) is the ideal quantity ordered for an organization should buy to limit stock costs, for example, holding costs, shortage costs, and order costs.

Techniques and Methods of Inventory Control ABC analysis, Just in Time, VED analysis.

ABC analysis- ABC implies “Always better control” analysis. This analysis is based on annual consumption of inventory items in a year. It helps in reducing working capital and carrying costs

Just-in –time techniques basically this analysis implies that the firm should maintain minimum level of inventory at any stage of production. The firm should rely on suppliers to provide requirements immediately at any stages of production.

VED analysis- This analysis is known as “Vital, Essential, and Desirable analysis. In this technique the products are categorize according to the critical value and shortage cost of an item.



17.12 GLOSSARY

WIP: Work-in-Progress

EOQ: Economic Order Quantity

AUC: Average Unit Cost

Lot Size: The total number of items ordered for specific date in single production unit.

PO: Purchase Order

ABC: Always Better Control

VED: Vital, Essential, and Desirable

JIT: Just in Time



17.13 REFERENCES

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17.15 TERMINAL QUESTIONS

- Q1. What is inventory? Why it is said that inventory management is a strategic decision?
- Q2. Discuss the types and motives behind holding the inventory.
- Q3. Discuss EOQ model of inventory management. Provide a critical analysis of this model.
- Q4. Discuss the following techniques of Inventory management:
- a) JIT analysis
 - b) VED analysis

- Q5. Discuss the process of ABC analysis.
- Q6. What is inventory management system?
- Q7. What is ABC analysis?
- Q8. What is VED analysis?
- Q9. Differentiate between inventory management system techniques.
- Q10. Explain the objective and importance of inventory management system.
- Q11. What is the importance of inventory management?
- Q12. A company makes motorbikes. It produces 550 bicycles a month. It buys the tires for bicycles from a supplier at a cost of \$15 per tire. The company's inventory carrying cost is estimated to be 10% of cost and the ordering is \$55 per order.
- a)** Calculate the EOQ, **b)** Calculate the number of orders per year? **C)** Calculate the average annual ordering cost, **d)** Compute the average inventory. **e)** What is the average annual carrying cost? **F)** Calculate the total cost
- Q13. We need 2,000 tyre per year. The ordering cost for these is \$90 per order and the carrying cost is assumed to be 45% of per unit cost. In orders of less than 120, tyre cost \$78; for orders of 120 or more, the cost drops to \$50 per unit.
- Should we take advantage of the quantity discount?
- Q14. Malhotra Corp sells 1,500 of its special road light switch per year, and places orders for 400 of these switches at a time. Assuming no safety stocks, Malhotra estimates a 50% chance of no shortages in each cycle, and the probability of shortages of 5, 10, and 15 units as 0.2, 0.15, and 0.15 respectively. The carrying cost per unit per year is calculated as \$6 and the stock out cost is estimated at \$8 (\$3 lost profit per switch and another \$5 lost in goodwill, or future sales loss). What level of safety stock should Malhotra use for this product? (Consider safety stock of 0, 5, 10, and 15 units)
- Q15. Presume that Malhotra carries a modern decorator lamp that is quite popular. The anticipated demand during lead time can be approximated by a normal curve having a mean of 200 units and a standard deviation of 40 units. What safety stock should Malhotra carry to achieve a 95% service level?