INVENTORY MANAGEMENT AND CONTROL

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LECTURE CONTENT

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- Function of Inventory
- Types of Inventory
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- Techniques of Inventory Management

Inventory – Meaning

- Inventory can be described as an expensive and important current asset of the manufacturing company, representing as much as fifty percent of the total invested capital.
- It can also be described as any stored resource used to satisfy the current or future needs of the customers.

Examples – Raw Materials, Work-in-progress, Finished Goods

Functions of Inventory

- To “decouple” or separate various parts of the production process.
- To provide a stock of goods that will provide a “selection” for the customers.
- To take advantage of quantity discount.
- To hedge against inflation and upward price changes.

Types of Inventory

Four kinds of inventories may be identified:

1. **Raw materials Inventory:** This consists of basic materials that have not yet been committed to production in a manufacturing firm. Raw materials that are purchased from firms to be used in the firm's production operations range from iron ore awaiting processing into steel to electronic components to be incorporated into stereo amplifiers. The purpose of maintaining raw material inventory is to uncouple the production function from the purchasing function so that delays in shipment of raw materials do not cause production delays.

2. **Stores and Spares:** This category includes those products, which are accessories to the main products produced for the purpose of sale. Examples of stores and spares items are bolts, nuts, clamps, screws etc. These spare parts are usually bought from outside or some times they are manufactured in the company also.

3. **Work-in-Process/Semi-Finished Goods Inventory:** This category includes those materials that have been committed to the production process but have not been completed. The more complex and lengthy the production process, the larger will be the investment in work-in-process inventory. Its purpose is to uncouple the various operations in the production process so that machine failures and work stoppages in one operation will not affect the other operations.

4. **Finished Goods Inventory:** These are completed products awaiting sale. The purpose of finished goods inventory is to uncouple the productions and sales functions so that it no longer is necessary to produce the goods before a sale can occur.

Cost Associated with Inventory

Usually there are 4 types of cost associated with any types of Inventory which are given as below:

- Ordering Cost
- Holding Cost
- Purchase Cost
- Set-up Cost

1. Ordering Cost: -The cost which is incurred in placing and receiving the order for the inventory is called as Ordering Cost. It includes various expense heads such as Ordering Form, Tender Cost, Cost of Stationary, Clerical support etc.

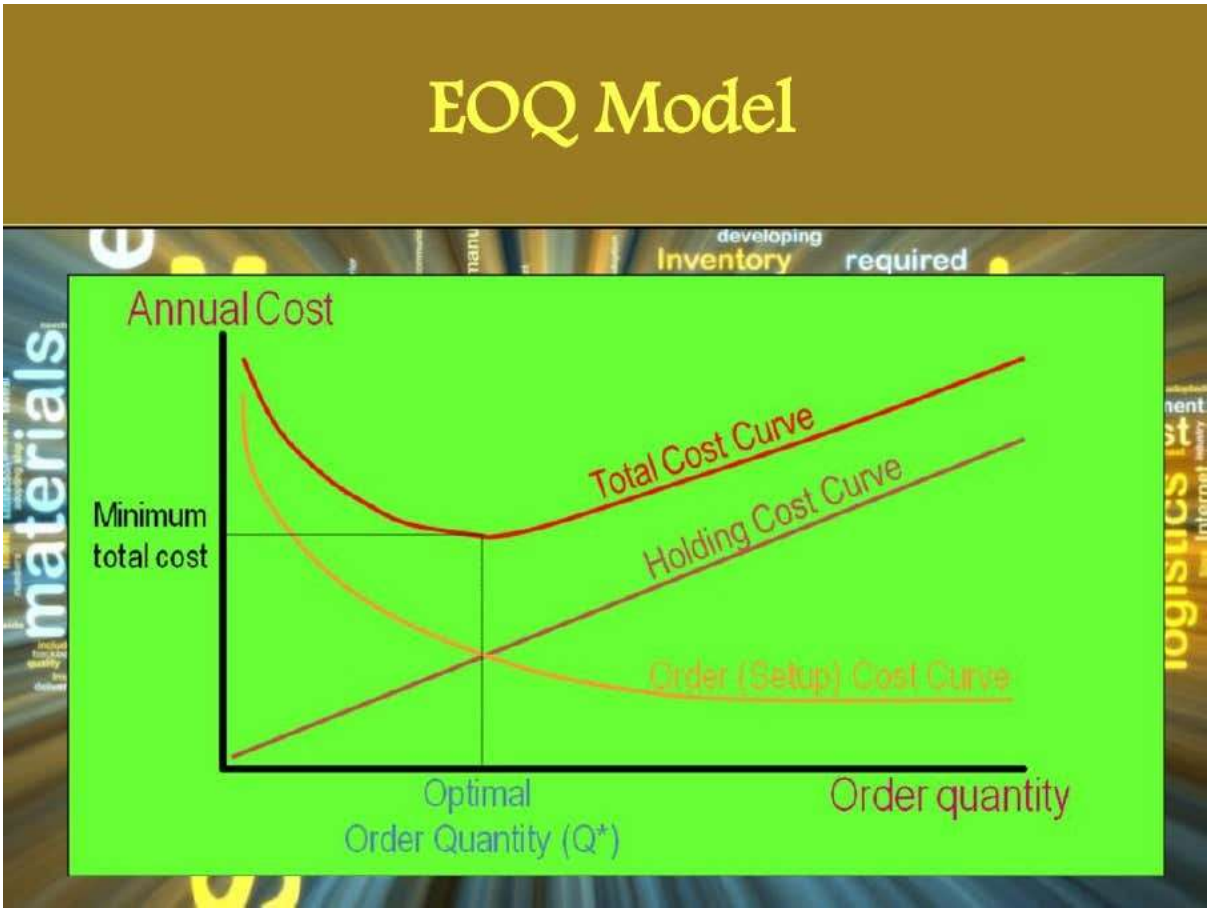
2. Holding Cost: - The cost which is associated with holding or carrying the inventory in proper conditions is called as Holding or Carrying cost. It includes various expense heads such as Cost of Warehousing, Security, Insurance, Interest, Pilferage, Obsolescence etc.

3. Purchase Cost:- It includes the amount which the buyers pays to the supplier for purchasing the inventory item. It takes into consideration any quantity discount being offered by the supplier along with the shipping charges.

4. Setup Cost:- It include the cost which is incurred in preparing a machine or process for manufacturing any order. It includes various expenses such as Clean-up cost, Re-tooling cost etc.

Techniques of Inventory Control

- **Economic Order Quantity or EOQ**: It is one of the oldest and the most popular inventory control technique. The term EOQ can be defined as an order quantity at which the total cost comprising of the ordering and holding cost is at the minimum. It is considered to be an important inventory control technique since it helps the production manager in determining the appropriate order quantity which results in incurring the lower inventory cost in line with estimated market demand.



In the above graph we can notice that when the order quantity (represented on x-axis) increases, the Ordering cost decreases whereas the inventory holding cost (cost of storage, insurance etc.) will increase.

Thus in the production process there are two opposite cost; one encourages the increase in the order size while the other discourages. Economic order quantity or EOQ is therefore that order quantity or

size at which the total annual cost (represented by y-axis) is minimum.

Following are the assumptions to be kept in mind while calculating EOQ:

1. Demand for the product is constant and is uniform throughout the period.
2. Lead time is zero.
3. Total Annual cost comprises of only Ordering and Holding Cost.
4. Holding cost is expressed as % of average inventory.

Formula for calculating Economic Order Quantity (EOQ)

$$EOQ\ (Q) = \sqrt{2DS/HC}$$

Where,

D = Annual Demand of the product

S= Ordering Cost per unit of item

H = Holding cost expressed as % of average inventory

C = Purchase Cost per unit of item

Example 1:

The ABC Co. is planning to stock a new product. The Co. has developed the following information:

Annual usage = 5400 units ; Cost of the product = Rs. 365 per unit; Ordering cost = Rs. 55 per unit/order; Carrying cost = 28% per year of inventory value held.

a Determine the optimal number of units per order.

b. Find the optimal number of orders/year.

c. Find the annual total inventory cost.

Solution:

(a) We know that formula for calculation of EOQ is $\sqrt{2DS/HC}$

Thus, Q = $\sqrt{2*5400*55}$ / 0.28 * 365 = 76 units per order.

(b) The optimum number of order per year would be D/Q

i.e 5400 / 76 = 71 order per year

(c) Annual Total Inventory Cost (TC) = DC + DS/Q + QHC/2

i.e TC = 5400 * 365 + (5400/76) * 55 + (76 * (0.28 * 365) / 2)

=> TC = 1971000 + 3905 + 3876 = 19,78,781

Example 2:

For a certain product purchased from a vendor at Rs. 42 per unit, the ordering cost is Rs. 16 per unit. The inventory carrying cost is 0.20 paisa per rupees per order and sales are relatively constant at 1800 units per year.

a. What is the optimal order quantity?
b. What is the annual total inventory cost?

Solution:

(a) We know that formula for calculation of EOQ is $\sqrt{2DS/HC}$

Thus, Q = $\sqrt{2*1800*16}$ / 0.20 * 42 = 82.8 or 83 units per order.

(b) Annual Total Inventory Cost (TC) = DC + DS/Q + QHC/2

i.e TC = 1800 * 42 + (1800/83) * 16 + (83 * (0.20 * 42) / 2)

= 75600 + 347 + 349 = 76296

- **ABC Analysis of Inventory Control**

Also called as Always Better Control, in this analysis it is presumed that all the items stored in the inventory vary in their importance and hence an appropriate level of control should be exercised on each of these items considering the cost associated with exercising proper level of such control.

Thus in this technique all the items available in the inventory are classified into three category A, B and C on the basis of their importance and monetary value. The term importance can be defined from a number of perspective which are as follows:

(a) Unit Purchase Price

(b) Annual Consumption Value

(c) Criticality in manufacturing operation

(d) Consumption Rate

(e) Availability

(f) Inventory level or position

The items which are placed in A category are the ones which are most important and has high consumption value; those placed in B category are relatively less important and has moderate consumption value; while those in C category are not important and has very less consumption value.

The division of items into various categories can be shown with the help of chart given below

Class	No. of item in use (%)	Consumption Value (%)
A	20	80
B	30	15
C	50	5
Total	100	100

Due to its selective approach, this analysis or technique of inventory control is also called as "**Selective technique of Inventory Control"**.

- **VED Analysis of Inventory Control**

In this analysis the items in the inventory are classified according to their criticality in manufacturing process i.e according to the cost of incurring the stock out. The “V” class items are *vital* without which the production process may come to standstill; “E” class items are *essential* and should be given the second priority as their non-availability would adversely impact the efficiency of the overall production system; “D” refers to *desirable* items without which the production operation is unaffected, however, their presence is desirable for the sake of efficiency and less fatigue.

This analysis is mainly done in terms of spare parts.

- **Inventory Management Techniques**

Just in time (**JIT**) is an inventory management strategy that strives to improve a business' return on investment by reducing in-process inventory and associated carrying costs. Just in time is a type of operations management approach which originated in Japan in the 1950s by Toyota Motor Company and other Japanese manufacturing firms, with excellent results.

By using just-in-time concepts, there is a greatly reduced need for raw materials and work-in-process, while finished goods inventories should be close to non-existent. The use of just-in-time inventory has the following advantages:

- Reduced setup time. Cutting setup time allows the company to reduce or eliminate inventory for "changeover" time.
- The flow of goods from warehouse to shelves improves. Small or individual piece lot sizes reduce lot delay inventories, which simplifies inventory flow and its management.
- Employees with multiple skills are used more efficiently. Having employees trained to work on different parts of the process allows companies to move workers where they are needed.

- Production scheduling and work hour consistency synchronized with demand. If there is no demand for a product at the time, it is not made. This saves the company money, either by not having to pay workers overtime or by having them focus on other work or participate in training.
- Increased emphasis on supplier relationships. A company without inventory does not want a supply system problem that creates a part shortage. This makes supplier relationships extremely important.
- Supplies come in at regular intervals throughout the production day. Supply is synchronized with production demand and the optimal amount of inventory is on hand at any time. When parts move directly from the truck to the point of assembly, the need for storage facilities is reduced.
- Minimizes storage space needed.
- Smaller chance of inventory breaking/expiring.

Despite the magnitude of the preceding advantages, there are also some disadvantages associated with just-in-time inventory, which are:

1. A supplier that does not deliver goods to the company exactly on time and in the correct amounts could seriously impact the production process.
2. A natural disaster could interfere with the flow of goods to the company from suppliers, which could halt production almost at once.
3. An investment should be made in information technology to link the computer systems of the company and its suppliers, so that they can coordinate the delivery of parts and materials.
4. A company may not be able to immediately meet the requirements of a massive and unexpected order, since it has few or no stocks of finished goods.

KANBAN System of Inventory Management

Kanban (KAN means Visual ; BAN means Card in in Japanese) is a scheduling system based on billboards for lean manufacturing and just - in- time manufacturing. Kanban is an inventory-control system to control the supply chain. Taiichi Ohno, an industrial engineer at Toyota, developed kanban to improve manufacturing efficiency. Kanban is one method to achieve JIT(just in-time).

Kanban cards are a key component of this inventory management technique and they signal the need to move materials within a production facility or to move materials from an outside supplier into the production facility.

The kanban card is, in effect, a message that signals depletion of product, parts, or inventory. When received, the kanban triggers replenishment of that product, part, or inventory. Consumption, therefore, drives demand for more production, and the kanban card signals demand for more product—so kanban cards help create a demand-driven system.

It is widely held by proponents of lean production and manufacturing that demand-driven systems lead to faster turnarounds in production and lower inventory levels, helping companies implementing such systems be more competitive.

One key indicator of the success of production scheduling based on demand, *pushing*, is the ability of the demand-forecast to create such a *push*. Kanban, by contrast, is part of an approach where the "pull" comes from demand. Re-supply or production is determined according to the actual demand of the customer. In contexts where supply time is lengthy and demand is difficult to forecast, often, the best one can do is to respond quickly to observed demand. This situation is exactly what a kanban system accomplishes, in that it is used as a demand signal that immediately travels through the supply chain. This ensures that intermediate stock held in the supply chain are better managed, and are usually smaller. Where the supply response is not quick enough to meet actual demand fluctuations, thereby causing potential lost sales, stock building may be deemed more appropriate, and is achieved by placing more kanban in the system.