Industrial Engineering & Operations Research

Assignment on ;
Inventory Control

Module: Operations Research

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INVENTORY CONTROL

Introduction:

- In majority of the organization, cost of the material is a main part of selling price of the product. The interval between the receiving the purchased parts and transforming them into final products varies from industries to industries depending upon cycle time of manufacture.
- Materials are procured and held in the form of inventories.
- It acts as a buffer between supply and demand for efficient operation of the system.
- Stocking of anything that is tangible in order to meet the future demand is called inventory theory.

Inventory:

- Inventory is a detailed list of those movable items which are necessary to manufacture a product and to maintain the equipment and machinery in good working order.
- It represents those items which are either stocked for sale or they are in the process of manufacturing or they are in the form of materials which are yet to be utilized.

Ex – money kept in the shape of HSS bit MS rod milling

Inventory control:

- It may be defined as the scientific method of finding out how much stock should be maintained in order to meet the production demands and be able to provide the right type of material at the right time in the right quantities and at competitive prices.
- The objectives are
    - To minimize investment in inventory
    - To maximize the service levels to the firm's customers and its own operating department.

Types of inventories:

- Raw inventories (raw materials):
    - Raw materials and semifinished products supplied by another firm which are raw items for present industry.
    - Raw materials are those basic unfabricated materials which have not undergone any operation since they are received from the suppliers. Ex – round bars, angles, channels, pipes etc
- Work-in-progress inventories:
    - Semifinished products at various storages of manufacturing cycle
    - The items or materials in partially completed condition of manufacturing
- Finished inventories:
    - They are the finished goods lying in stock rooms and waiting dispatch.
- Indirect inventories:
    - The inventories refer to those items which do not form the part or the final product but consumed in the production process.
      Eg – machine spares, oil, grease, spare parts, lubricants
    - For proper operation, repair and maintenance during manufacturing cycle.

Reasons for keeping inventories:

- To stabilize production
- To take advertise of price discount
- To meet the demand during replenishment period
- To prevent loss of orders
- To keep pace with changing market conditions

Inventory control:

- Keeping track of inventory
- It is a planned approach of determining what to order, when to order and how much to order and how much to stock so that costs associated with buying and storing are optimal without interrupting production and sales.

- When should an order placed
- How much should be ordered order quantity

Objective of inventory control:

- Purchasing material at economical price at proper time and in sufficient quantity as not to run slow
- Providing a suitable and secure storage location
- To maintain timely record of inventories of all the items
- A definite inventory identification system
- Adequate and responsible store room staff
- Suitable requisition procedure
- To provide a reserve stock

Advantages or benefits of inventory control

- One does not face shortage of materials
- Materials of good quality and procured in time minimized defect in finished goods.
- Delays in production schedules are avoided
- Production forgets are achieved
- Accurate delivery dates
- Economy in purchasing

Inventory control terminology:

- Demand:
  It is the no. of items (products) required per unit of time. The demand may be either deterministic or probabilistic in nature.
- Order cycle:
  The time period between two successive orders is called order cycle.
- Lead time:
  The length of the time between placing an order and receipt of items is called lead time.
- Safety stock:
  It is also called butter stock or minimum stock. It is the stock or inventory needed to account for delays in materials supply and to account for sudden increase in demand due to rush orders.
- Inventory turnover:
  It the company maintains inventories equal to 3 months consumption it means that inventory turnover is 4 times a year i.e. the entire inventory is used up and replaced 4 times a year.
- Reorder level:
  It is the point at which the replenishment action is initiated. When the stock level reaches ROL the order is placed for the item.
- Reorder quantity:
  This is the quantity of material to be ordered at the reorder level. This quantity equals the EOQ.

Cost associated with inventory

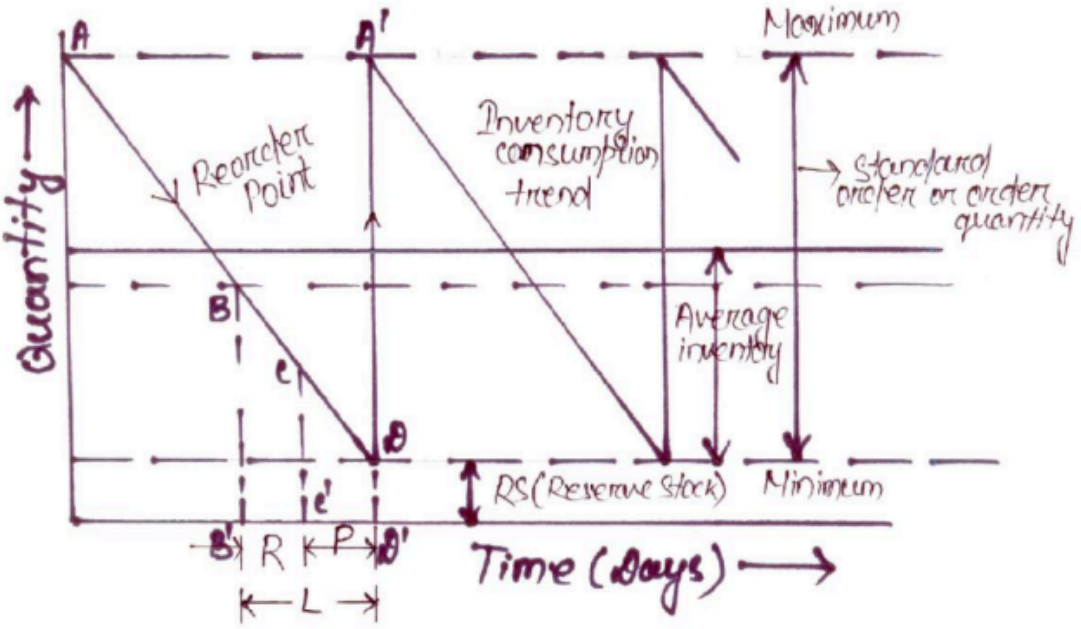
- Purchase (or production) cost:
  The value of an item is its unit purchasing or production cost.
- Capital cost:
  The amount invested in an item is an amount of capital not available for other purchases.
- Ordering cost:
  It is also known as procurement cost or replenishment cost or acquisition cost.
  Two type of costs- Fixed costs and variable costs.
  Fixed costs don’t depend on the no. of orders whereas variable costs change

w. r. t the no. of orders placed.

- Purchasing:
  - The clerical and administrative cost associated with the purchasing, the cost of requisition material, placing the order, follow up, receiving and evaluating quotations.
- Inspection:
  - The cost of checking material after they are received by the supplier for quantity and quality and maintaining records of the receipts.
- Accounting:
  - The cost of checking supply against a given level of hand and this cost vary in direct proportion to the amount of holding and period of holding the stock in stores.
    This includes-
    - Storage costs (rent, heating, lighting etc.)
    - Handling costs (associated with moving the items. Such as labour cost, equipment for handling)
    - Depreciation, taxes and insurance
    - Product deterioration and obsolescence
    - Spoilage, breakage

Economic order quantity:

How much materials may be ordered at a time. An industry making bolts will definitely like to know the length of steel bars to be purchased at any one time. i.e. called EOQ.
An economic order quantity is one which permits lowest cost per unit and is most advantageous.
Starting from an instant when inventory OA is in the stores, it consumes gradually in quantity from A along AD at a uniform rate. We know it takes L no. of days between initiating order and receiving the required inventory. As quantity reaches point B, purchase requisition is initiated which takes form B to C that is time R. from C to D is the procurement time P. At the point D when only resource stock is left, the ordered material is supposed to reach and again the total quantity shoots to its maximum value i.e. the point A'(A=A')



Maximum quantity- OA is the upper or max limit to which the inventory can be kept in the stores at any time.

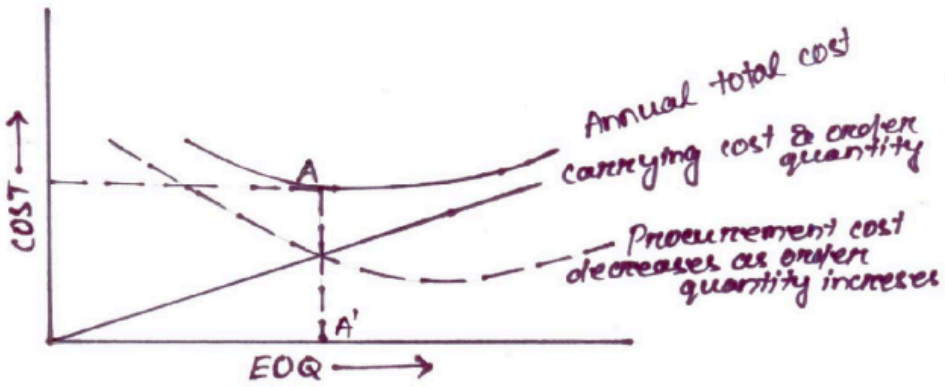
Minimum quantity- OE is the lower or minimum limit of the inventory which must be kept in the stores at any time.

Standard order (A'D) - It is the difference between maximum and minimum quantity and is known as economical purchase inventory size.

Reorder point (B)- It indicates that it is high time to initiate a purchase order if not done so the inventory may exhaust, even reserve stock utilized before the new material arrives.

From B' to D' it is lead time and it may be calculated on the basis of past experience. It includes-

- Time to prepare purchase requisition and placing the order.
- Time taken to deliver purchase order to the seller
- Time for seller to get or prepare inventory
- Time for inventory to be dispatched from the vendor's end and to reach the costumer



Inventory procurement cost:

- Receiving quotations
- Processing purchase requisition
- Following up and expediting purchase order
- Receiving material and then inspect it
- Processing seller's invoice

Procurement costs decrease as order quantity increases.

Inventory carrying cost:

- Interest on capital investment
- Cost of storage facility, up-keep of material, record keeping
- Cost involving deterioration and obsolescence
- Cost of insurance, property tax.

Carrying cost directly proportional to the order size or order quantity.

Mathematical derivation of EOQ:

Let Q is the economic lot size or EOQ

C is the cost for one item.
I is the cost of carrying inventory in percentage per period
P is the procurement cost associated with one order
U is the total quantity used per period.

No. of purchase orders to be furnished = $\frac{Total\ quantity}{EOQ} = \frac{U}{Q}$

Total procurement cost = No. of orders × cost involved in one order

$$= \frac{U}{Q} \times P$$

Average quantity = Q/2

Inventory carrying cost = average inventory × cost per item × cost of carrying inventory in %

$$= \frac{Q}{2} \times C \times I$$

Total cost (T) = a + b

$$= \frac{U}{Q} \times P + \frac{Q}{2} \times C \times I$$

To minimize cost, $\frac{dT}{dQ} = 0$

$\Rightarrow \frac{d}{dQ}(\frac{U}{Q}P + \frac{Q}{2}CI) = 0$

$\Rightarrow - UQ^{-2}P + CI/2 = 0$

$\Rightarrow Q^2 = \frac{2UP}{CI}$

$\Rightarrow Q = \sqrt{\frac{2UP}{CI}}$

Question 1;

I. Annual usage (U) = 60 units
II. Procurement cost (P) = Rs 15
III. Cost per price (C) = Rs 100
IV. Cost of carrying inventory (I) = 10 %

Calculate EOQ.

Answer:

$$Q = \sqrt{\frac{2UP}{CI}}$$

$$= \sqrt{\frac{2 \times 60 \times 15 \times 100}{100 \times 10}} = 13.41$$

No. of orders per year = $\frac{60}{13.41} = 4.47 \cong 5$

$\therefore$ EOQ = $\frac{60}{5}$ = 12 units (rounded)

Question 2;

The rate of use of a particular raw material from stores is 20 units per year. The cost of placing and receiving on order is Rs 40. The cost of each unit is Rs 100. The cost of carrying inventory in percent per year is 0.16 and it depends upon the average stock.

Determine the order quantity. If the lead time is 3 month, calculate the reorder point.

Answer:

U = 20 units

P = Rs 40 /-

C = Rs 100 /-

I = 0.16

$$EOQ = \sqrt{\frac{2UP}{CI}} = \sqrt{\frac{2 \times 20 \times 40}{100 \times 0.16}} = 10$$

L = 3 months

12 months = 20 units

$$3 \text{ months} = \frac{20}{12} \times 3 = 5 \text{ units}$$

Question 3;
Find economic order quantity from following data.
Average annual demand = 30000 units
Inventory carrying cost = 12 % of the unit value per year
Cost of unit = Rs 2 /-

Answer:

Given, U = 30000

I = 12 %

P = 70

C = 2 /-

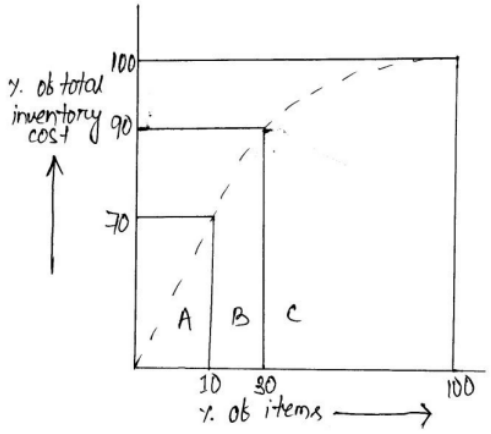
$$EOQ = \sqrt{\frac{2UP}{CI}} = \sqrt{\frac{2 \times 30000 \times 70 \times 100}{2 \times 12}} = 4183.3$$

$$\text{No. of orders} = \frac{30000}{4183.3} = 7.17 \cong 7$$

$$EOQ = \frac{30000}{7} = 4285.7 \cong 4286 \text{ (rounded)}$$

ABC analysis:

ABC analysis helps differentiating the item from one another and tells how much valued the item is and controlling it to what extent is in the interest of an organization.



- A-items:
    - A items are high valued but are limited or few in number. They need careful and close inventory control and proper handling and storage facilities should be provided for them.
    - A items generally 70-80 % of the total inventory cost and 10 % of the total items.
- B-items;
    - B-items are medium valued and their number lies in between A and C items. They need moderate control. They are purchased on the basis of past requirements.
    - B-items generally 20-15 % of total inventory cost and 15-20 % of the total items.
- C-items:
    - C-items are low valued, but maximum numbered items. These items do not need any control. These are the least important items, like clip, all pins, washers, and rubber bands. No record keeping is done.
    - C-items generally 10-5 % of the total inventory cost and constitute 75 % of the total items

Advantage

- Better planning and control
- Increase inventory turnover
- Effective management and control

Disadvantage

- Periodic review to be decided

Procedure

- Identify all the items used In industry
- List all the items as per their value.
- Count the no. of high valued, medium valued and law valued items
- Find the % of high, medium and low valued items
    - High valued contribute – 70% of total inv. Cost
    - Medium valued contribute -20% of total inv. Cost
    - Low valued contribute-10% of total inv. Cost
- A graph can be plotted between % of items and % of total inventory cost

References;

- Industrial Engineering and Management, O.P. Khanna
- Lecture Notes on Industrial Engineering, S. Behera