

Effective Inventory Management: An Overview

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Abstract

This paper gives a brief introduction about the basic concepts involved in effective inventory management.

Key Words: Inventory control, costs, EOQ,

Introduction

The term "Operations Research" (OR) was first introduced in 1940 by two scientists Trefthen and Mc Closkig of UK as a result of research on military operations during Second World War. Generally, it is considered that Operations Research came into actualities during Second World War to manage scarce military resources. However, during the First World War Thomas Edison (1914-1915) made an effort to use tactical game board to minimize the shipping losses from the enemy submarines instead of risking the ships in actual war conditions. Tremendous success of Operations Research in military operations attracted industrial managers and civilians to use Operations Research as a tool for optimizing profit.

In the present era application of O.R. can be seen in every quarter of life such as agriculture, construction, manufacturing, marketing, finance, etc. For using techniques one has to go through different phases. First one is the formulation of the problem. Second is formulation of mathematical model. Next phase is to determine the optimal solution to the problem. Once the solution is obtained the utility of the model is assessed by comparing the optimal solution with the previously existing models.

Inventory:

In words of David Viale "Inventory is a very expensive asset that can be replaced with a less expensive asset called 'information'. In order to do this, the information must be timely, accurate, reliable and consistent. When this happens you carry less inventory, reduce cost and get products to customers faster."

Inventory may be defined as a kind of a resource having economic value and is maintained to fulfil the present and future needs of an organization and thus ensuring the smooth and efficient working of business affairs. Such resources may be classified into the following 3 categories

- (i) Physical Resources – It includes raw materials, semi finished goods, spare parts, lubricants, etc.
- (ii) Human Resources – It includes unused labour.
- (iii) Financial Resources – It includes working capital.

Inventories are common to agriculture, wholesalers, retailers, hospitals, etc. and also to family units in relation to food, clothing, pharmaceuticals products and so on. Thus inventories are important and deserve attention to achieve utmost organisation objective.

The Objective of maintaining inventory

The main objective of maintaining inventory is efficient and smooth running of business affairs. In addition to this inventory provides service to the customers immediately or at short notice at the lowest possible cost. With the help of inventory an organisation may earn price discount because of bulk purchasing. Inventory also helps in maintaining the economy by absorbing some of the fluctuations when the demand for an item fluctuates or is seasonal.

Inventory control

Inventory control refers to the events or activities that affect inventory during the process of transforming input resources and materials to output goods. It coordinates the purchasing, manufacturing and distribution functions to meet market needs. Proper relation between sales and inventory can also be maintained by inventory control.

Historical Sketch

There is a history of inventory management. Inventory management principles can be traced back at least to biblical times, as evidenced by the story of Joseph interpreting the Pharaoh's dream as being seven years of plentiful harvests followed by seven years of crop failures and his associated advice to the Pharaoh to stockpile enough harvested grain during the plentiful years to ensure adequate food during the subsequent famine. Ford Harris (1915) of the Westinghouse Corporation was the pioneer researcher to derive simple lot-size formula. Military applications and the formation of associated research teams led to considerable research and development work after World War II. One of the earliest papers in this era was 'Optimal inventory policy' by Arrow et al. (1951).

Other important publications in the 1950's, with at least elements related to inventory management, included Dvoretzky et al. (1952a, 1952b, 1953) Karr and Geisler (1956), Wagner And Whitin (1958) several articles in Arrow et al. (1958a,

1958b), Galliher et al.(1959), Simpson (1959), and Scarf (1959). From the 1960's onward there was a rapid proliferation of publications devoted to inventory systems. Text books on inventory management began to appear in the 1960's. Early publications include Wagner (1962), Hadley and Whitin (1963), Naddor (1966) and Brown (1967). In addition, Eilon and Lampkin (1968) published a compilation of abstracts of papers that had appeared in the period 1953-1965. Other recent textbooks have been authored by Silver et al (1998), Axsater (2006) and Zipkin (2000).

Types of Inventory

1. Transportation or Pipeline Inventory – This type of inventory consists of items in transit or in transportation from the manufacturing points to the stocking point distribution centre or to the customers.
2. Lot-Size Inventory or Cycle Stock – Inventory of this category is maintained to meet the average demand during the successive replenishments. The quantity of such inventory depends on warehouse space available, lead-time, price quantity discounts etc.
3. Anticipation Inventory or Seasonal Inventory – This includes finished goods, work in process and raw materials and is usually applied to inventory build-ups for a seasonal demand or for the items whose production (or supply) is not uniform i.e. it varies with time.
4. Safety Stock – A specific level of extra stock of inventory items is maintained for protection against the fluctuations in demand or supply / uncertain future requirements, lead-time and unpredictable shortage with high penalty cost is known as safety stock.
5. Decoupling inventory – When various manufacturing process operates simultaneously then breakdown in any affects the entire system. A certain degree of independence can be achieved among stages of production by creating stocking points between a multistage production system.
Decoupling inventory mainly includes raw materials, work in process, finished goods and spare parts.

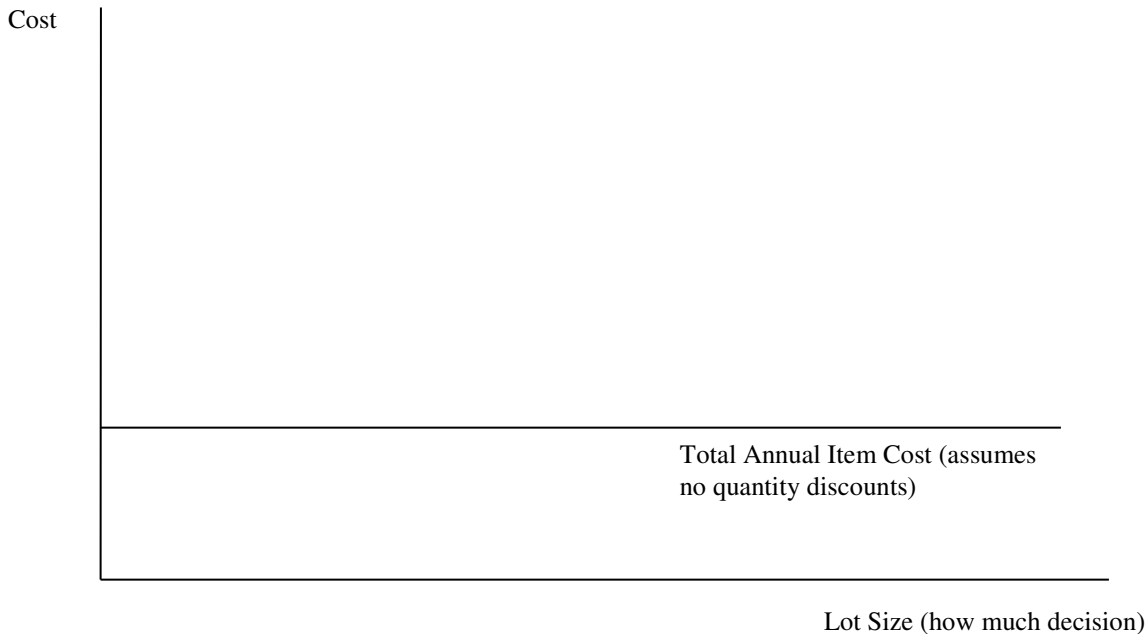
Relevant Costs (Inventory Cost Components)

The costs that are affected by the firm's decisions to maintain a particular level of inventory are called relevant costs. These costs play an important role in the study of an inventory system.

In case of inventory management only variable cost are taken into consideration since these costs vary with the level of inventory and fixed costs which do not change with the amount of stock hold are neglected.

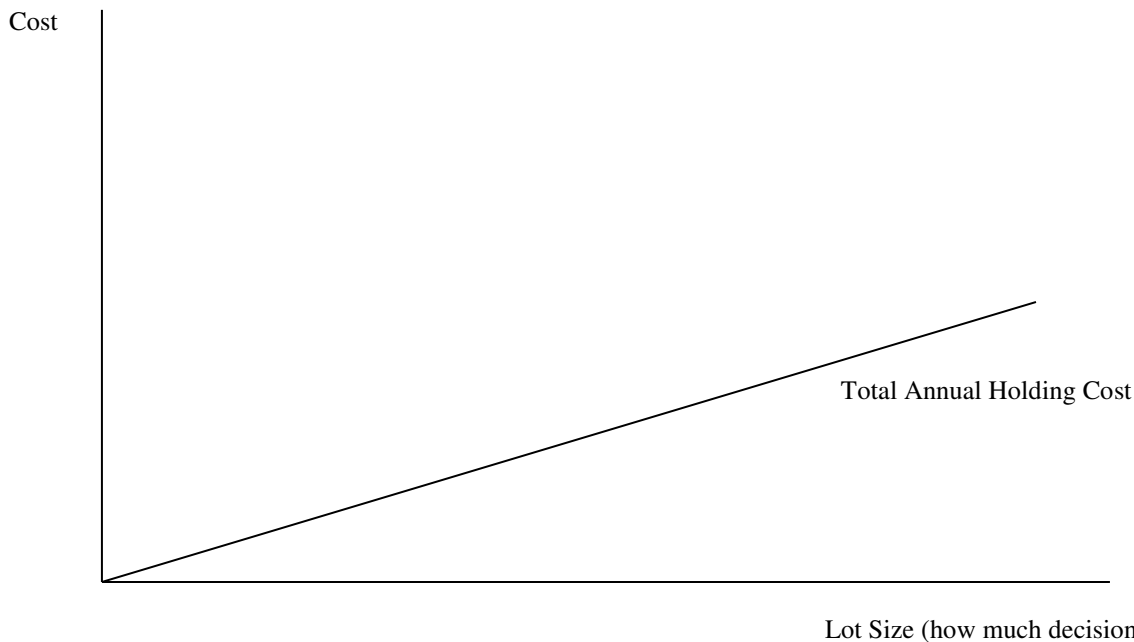
The various costs which are necessary in inventory management are:-

1. **Purchase cost** – This cost consists of the actual price paid for the procurement of items and is independent of the size of the quantity ordered.

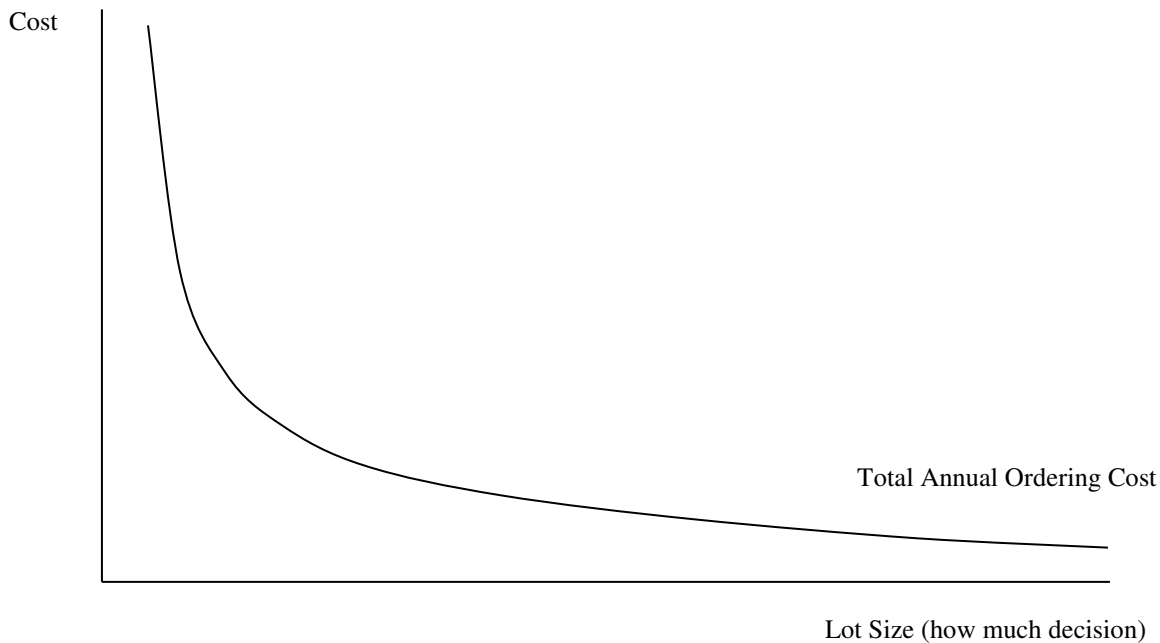


2. **Carrying or holding cost** – This cost incorporates the cost involved with maintenance of the stock and interest paid on the capital associated with the stock. Various components of holding costs are
- (i) Interest on Capital associated with inventory.
 - (ii) Cost of Storage space – Rent of the space as well as lightning, cooling and other atmospheric control expenses are included in this cost.
 - (iii) Depreciation or Deterioration cost – Such costs arise due to the items in stock being out of fashion or the items going chemical changes during storage.
 - (iv) Pilferage (Theft) cost
 - (v) Obsolescence Cost – It depends on the nature of the item.
 - (vi) Handling cost – These include all costs associated with the movement of stock such as cost of labour, overhead cranes, gantries and other machinery used for this purpose.
 - (vii) Record Keeping and administrative costs
 - (viii) Taxes and Insurance.

Holding cost varies directly with the lot size and with the time for which the inventory is held. If larger quantities are ordered on average then there will be more units being held in the inventory resulting in higher annual inventory holding costs and vice-versa.



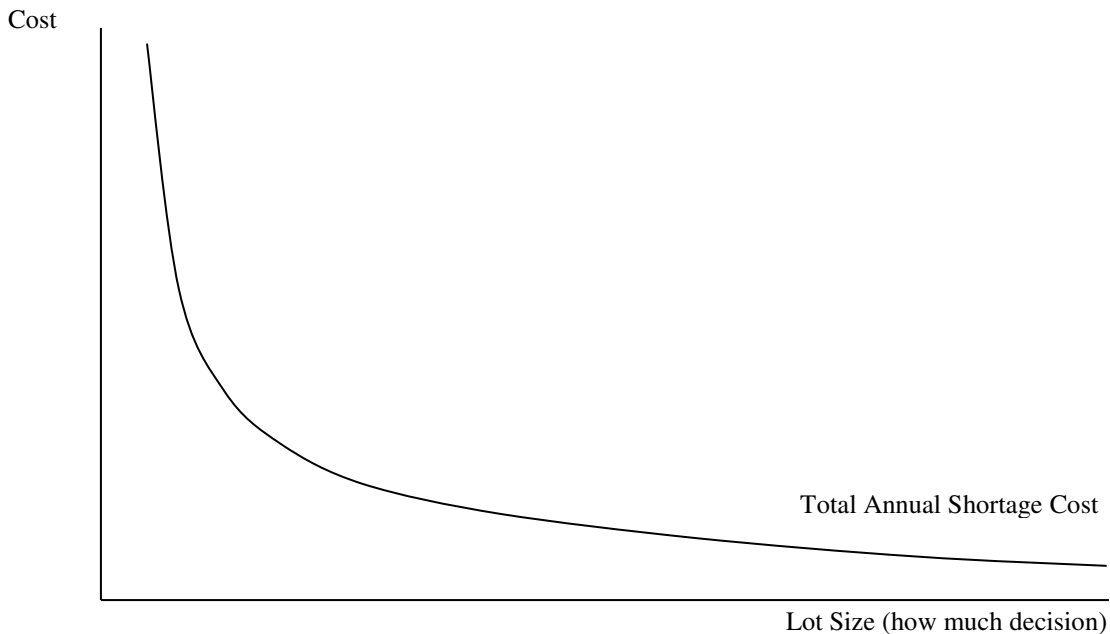
3. **Procurement cost or Setup cost** – This cost is also referred to as ordering cost. These include the fixed cost associated with placing an order. When items are ordered from an external supply source this cost takes into consideration the cost of clerical work to prepare, release, monitor and receive and sort the order. When items are to be manufactured on own the order cost incorporates the set up costs necessary to prepare the machinery for the production of that order. This cost is independent of order size (how many items are manufactured in the batch). As size of order increases for a particular item, fewer orders will have to be placed during the course of the year. In such a case the total annual cost of placing the orders declines.



4. **Shortage cost or stock-out cost** – Shortage cost is associated with a delay in meeting demands or the inability to meet it at all. Hence shortage cost is usually interpreted in two ways.

In case the unsatisfied demand can be satisfied at a later stage, these costs are proportional to the quantity that is short and the delay time. In case if the unsatisfied demand is lost these costs become proportional to only the quantity that is short. Thus shortage cost manifest itself in the form of lost sales, lost profit, lost of good will, customer irritation, backorder etc.

Also the larger order quantities lead to high levels of inventory and correspond to lower likelihood of shortages and their associated costs. Smaller order quantities lead to lower levels of inventory and correspond to higher likelihood of shortages. Above concludes that larger order sizes will lead to lower annual shortage cost.



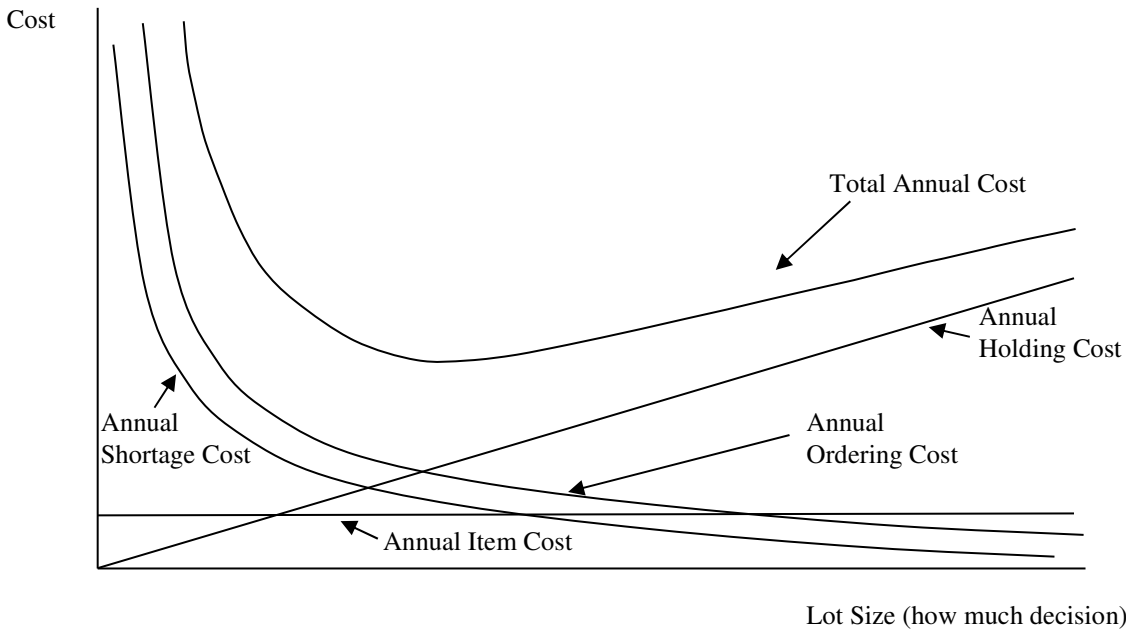
Concept of Economic Order Quantity (EOQ)

The size of replenishment orders affects inventory level to be maintained at various stocking points. Large order quantities may reduce the total ordering cost. But this will increase the carrying cost of inventory. Any decision on replenishment order size which provides economic trade off between relevant inventory costs like ordering, carrying and shortage costs and is stated in terms of Economic Order Quantity.

When all four inventory cost categories are superimposed on the same graph, we obtain the following graph which suggests the best answer to the “how much decision.” The quantity that should be ordered is the lot size that

corresponds to the lowest point on the total annual cost curve. This quantity is referred to as the “economic order quantity,” or EOQ.

Thus the Economic Order Quantity is that size of lot which minimizes total annual cost of carrying inventory and cost of ordering under the assumed conditions of certainty and known annual demand.



Variables in Inventory Problem

The two types of variable involved in inventory theory are as follows

1. Controlled Variables
2. Uncontrolled Variables

Controllable variables

- (i) The quantity acquired by purchase, production or some other means is one of the controlled variable. The ordered quantity may be fixed to q units or as to raise the the stock level to S quantity units.
- (ii) Time of acquisition is another important variable. Whenever the stock is equal to or below S quantity units or the amount stock and the amount of order are equal to or below z then an order may be placed.
- (iii) The completion stage of stocked items may also be controlled in inventory system.

Uncontrolled Variables

- (i) The variable costs like holding cost, shortage cost, set up cost are uncontrollable variables in inventory system.
- (ii) Lead-Time – The time between placing an order and its arrival in stock is called lead time. When lead time is zero there is no need to order in advance. But when it is known and non-zero then one has to place an order in advance.
- (iii) Amount Delievered – The supply of goods may be instantaneous or spread over a period of time.
- (iv) Demand which can be either deterministic or probabilistic may not be in control because demand is not necessarily the amount sold, it is infact the amount that would be sold if all that is required were available. The demand for a product in inventory may also be defined as the number of units that will need to be withdrawn from inventory for some use (e.g., sales) during a specific period.

Conclusion:

In any business, either big or small, we should understand the importance of inventory. We as managers should know the concept of good inventory management, and be familiar with it and its applications. poor inventory management may lead to the failure of any business. To overcome failures one should learn various latest techniques for maintaining and minimizing our inventory.

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