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Inventory Management Practices in Manufacturing Firms

PROFESSOR S.O. UNYIMADU
Director General
Centre For Research In Banking, Finance And Management
Suite 57, E.D.P.A Shopping Complex,P.O. Box 10147,Ugboowo, Benin City,Edo State, Nigeria

MR. KIFORDU ANTHONY ANYIBUOFU
Department of Business Education,College of Education, Agbor,Delta State, Nigeria

ABSTRACT
Inventories have been described as the lifewire of any manufacturing organization. Inventories represent investment designed to assist in production activities and/or serve customers, without any doubt, inadequate supply of inventories may grind manufacturing operations into a halt. The mode of control and management of inventories can be a crucial factor in the success or failure of any manufacturing concern. For example, insufficient inventory can seriously disrupt the production-distribution cycle that is so crucial to the survival of all manufacturing organizations. On the other hand, excessive inventory can cripple a firm's cash flow and thus endanger its liquidity position. Either way, poor inventory management can present a serious challenge to the productive capacity of a manufacturing organization.

INTRODUCTION

The problem of inventory management is to maintain adequate, but not excessive levels of inventories. Financially, inventories are very important to manufacturing companies. On the balance sheet they usually represent from 20 to 60 percent of total assets when inventories are reduced, their value is converted into cash, which improves cash flow and return on investment. Also, there is a cost of carrying inventories, which increases operating costs and decreases profit of the company. (Arnold, 1991:141). Hence, good inventory management is essential for manufacturing organizations.

Kothari (2001) defines inventory as the physical stock of goods which though remain idle in a store but is essential for smooth sailing of the company and hence has economic value. In similar vein, Monk 2006 (1996:229) defines an inventory as a stock of item or idle resource held for future use. He thus made a comparism between the inventory of a refinery which is in form of oil and that of an airline which is in the form of available seating.

Chase et al (2005:513) define inventory as the stock of any item or resources used in an organization. They further define an inventory system as the set of policies and control that monitor levels of inventory and determine what level should be maintained, when stock should be replenished, and how large orders should be.

Inventories can be classified in a number of ways. But according to Arnold, (1991:142), one often used is related to the flow of material into, through and out of a manufacturing organization. He thus classifies inventories in manufacturing firms as follows:

1. **Raw Materials** – These are purchased items that have been received but have not entered the production process. They include purchased materials, components parts and subassemblies.
2. **Work in Process (WIP)** – Raw materials that have entered the manufacturing process and are being worked on or are waiting to be worked on.
3. **Finished Goods** – The finished products of the production process that are ready to be sold as completed items. They may be held at a factory or central warehouse or at various points in the distribution system.
4. **Distribution Inventories** – Finished goods that is located in the distribution system.
5. **Maintenance, Repair and Operational Supplies (MROS)** – Items that are used in production but do not become part of the product. These include hand tools, spare parts, lubricants, cleaning supplies, and so on.

However, classification of item into a particular inventory depends on the production environment. For instance, sheets steel or tires are finished goods to the supplier but are raw materials and components parts to the car manufacturers.

The specific objectives of the study are to do a theoretical review of inventory management practices, to review the functions of inventories in the manufacturing process and to review some inventory models.

Purpose of Inventories

If supply were able to meet demand exactly, there would have been little need for inventory. Goods could be

made at the same rate as demand and no inventory need be build up. But unfortunately in the real world of manufacturing this has not often been the case.

Chase et al (2001:513) assert that all firms keep a supply of inventory for the following reasons.

1. ***To maintain independence of operations***. A supply of materials at a work centre allows the centre flexibility in operations. For example, because there are costs for making each new production set up, this inventory allows management to reduce the number of set ups. Independence of workstations is desirable on assembly lines as well. The time that it takes to do identical operations will naturally vary from one unit to the next. Therefore, it is desirable to have a cushion of several parts within the workstation so that shorter performance times can compensate for longer performances times. This way the average output can be fairly stable.
2. ***To meet variation in product demand***. If the demand for the product is known precisely, it may be possible (though not necessarily economical) to produce the product to exactly meet the demand. Usually, however, demand is not completely known, and a safety or buffer stock must be maintained to absorb variation.
3. ***To allow flexibility in production scheduling***. A stock of inventory relieves the pressure on the production system to get the goods out. This causes longer lead times, which permit production planning for smoother flow and lower-cost operation through larger low-cost production. High set up cost for example, favour producing a larger number of units once the set up has been made.
4. ***To provide a safeguard for variation in raw materials delivery time***. When material is ordered from a vendor, delays can occur for a variety of reasons; normal variation in shipping time, a shortage of material at the vendor's plant causing backlogs, an unexpected strike at the vendor's plant or at one of the shipping companies, a lost order, or a shipment of incorrect or defective materials.
5. ***To take advantage of economic purchase order size***. There are costs to place an order, labour, phone calls, typing, postage, and so on. Therefore, the larger each order is, the fewer the orders that needs be written. Also, shipping costs favour larger orders, the larger the shipment, the lower the per-unit cost.

Functions of Inventories in Manufacturing Process

In batch or lot manufacturing, the basic purpose of inventories is to decouple supply and demand. The purpose of inventories is thus to serve as a buffer:

1. Between customer demands and finished goods
2. Between finished goods, and components availability.
3. Between requirements for an operation and the output from the preceding operation.
4. Between parts and materials to begin production and the supplies of materials.

On the basis of the above, Arnold (1991:144) classified inventories according to functions they perform as follows:

a. *Anticipation inventory* – These inventories are built up in advance of a peak selling season, a promotion program, vacation shutdown, or possibly the threat of a strike. They are built up to help level production and to reduce the cost of changing production rates.
b. *Fluctuation Inventory* – Inventory is held to cover random unpredictable fluctuations in supply and demand or lead time. If demand or lead time is greater that forecast, then a stock-out will occur. Safety stock is carried to protect against the possibility of a stock-out. Its purpose is to prevent disruptions in manufacturing or deliveries to customers.
c. *Lot Size Inventory* – Items that are purchased or manufactured in quantities greater than needed immediately create lot size inventories. Items will be ordered in lots or batches to get quantity discounts to reduce shipping, clerical, and setup costs and in cases where it is impossible to make or purchase items at the same rate they will be used or sold.
d. *Transportation Inventory* – These inventories exist because of the time required to move stock from one location to another such as from a plant to a distribution centre or a customer. They are sometimes referred to as pipeline or movement inventories.

Other functions of inventories identified by Kothari (2001:324) include:

i. It reduces losses caused by inadequate inspection of incoming materials and losses due to obsolesces, deterioration, waste and theft while in storage.
ii. It ensures proper execution of policies covering procurement and use of materials. It also facilitates timely adjustments with changing conditions in the market.
iii. It also serves, through 'balance of stores' records, as a reliable basis for production planning and preparation of financial reports.
iv. Inventories allow manufacturing to purchase in larger quantities which results in lower ordering costs per unit and quantity discounts.
v. Inventories permits manufacturing to run longer production runs, which result in lower set up cost per item.

Inventory Cost Components

Lapin (1994:203) suggests that the following costs are relevant to inventory management decisions:

a. *Inventory ordering and procurement costs* – These represent all expenses incurred in ordering or manufacturing items, including not the acquisition costs but also the cost of transporting, collecting and sorting and placing the items in storage. Also included in this category are any managerial and clerical costs associated with placing an order. These costs often vary with the size of the order; for example, this occurs when products are priced with quantity discounts. Ordering and procurement costs are of two kinds: (i) a fixed portion for each other that is independent of the number of items stocked, and (ii) a variable portion for each order that is dependent on the number of items stocked. The fixed portion will be referred to as ordering cost and to variable portion as the procurement cost.
b. *Inventory holding or carrying costs* – These are the expenses incurred during the storage of items. This includes physical costs – the most common being the operation of warehouse facilities – as well as the costs of insurance and property taxes. Other components might be expenses arising from pilferage, spoilage, and obsolescence.
c. *Inventory shortage costs* – These occur whenever there is a demand for items that are not currently in stock. For items that are usually backordered, such as new car of a particular colour with special options, shortage costs may have only a fixed component – the extra paperwork and managerial expenses incurred in processing the order. This cost is largely due to the potential loss of customer goodwill that may be expected to increase in proportion to the length of the delay; such a decline in goodwill might be reflected in the loss of future business.

Inventory Models

The basic objective of an inventory policy is to reflect or choose an order quantity that will ensure that the annual inventory cost is minimized.

There are two types of inventory models: fixed-order quantity models or Economic order quantity (EQQ) and fixed-time period models.

Chase et al (2001:515) opine that the basic distinction between the two models is that the fixed-order quantity models are event triggered and the fixed-time period models are time triggered. That is the fixed order quantity model initiates an order when the event of reaching a specified order level occurs. This event may take place at any time, the fixed time period model is limited to placing orders at the end of a predetermined time period.

The Economic Order Quantity (EOQ) Model

EOQ attempts to determine the specific points, R at which an order will be placed and the size of the order, Q. the order points, R is always a specified number of units. In inventory system, as the order quantity increases, the average inventory and the annual cost of carrying inventory increases; but the number of orders per year and the ordering cost decreases. It is a bit like a see-saw where one cost can be reduced but only at the expense of increasing the other.

The problem that therefore arises is to find the particular order quantity where the total cost of carrying inventory and the cost of ordering will be a minimum. The order quantity is referred to as optimal order quantity (Arnold, 1991:156).

Agbadudu (1996:188) posits the EQQ model is based on certain assumptions which include:

i. Demand and lead time are known.
ii. Orders are placed instantaneously.
iii. Holding costs per unit is known and is constant.
iv. Ordering cost per order is known and is constant.
v. No shortage is allowed, and hence no shortage cost.

The EOQ Formula

The total cost of stocking inventory is the sum of the cost of ordering plus the cost of carrying.

Total Ordering Cost = Co (D/Q)

Total Carrying Cost = Ch (Q/2)

Hence

T.C = Co (D/Q) + Ch (Q/2)

Where T.C = Total Cost

Co = Ordering Cost

Q = Order quantity

Ch = Carrying Cost

D = Annual Demand

Arnold (1991:158) writes that the EOQ occurred at an order quantity where the ordering cost equals the carrying cost. Hence if the two costs are equal, the following formula can be derived.

Carrying cost = Ordering Cost

Ch (Q/2) = Co (D/Q)

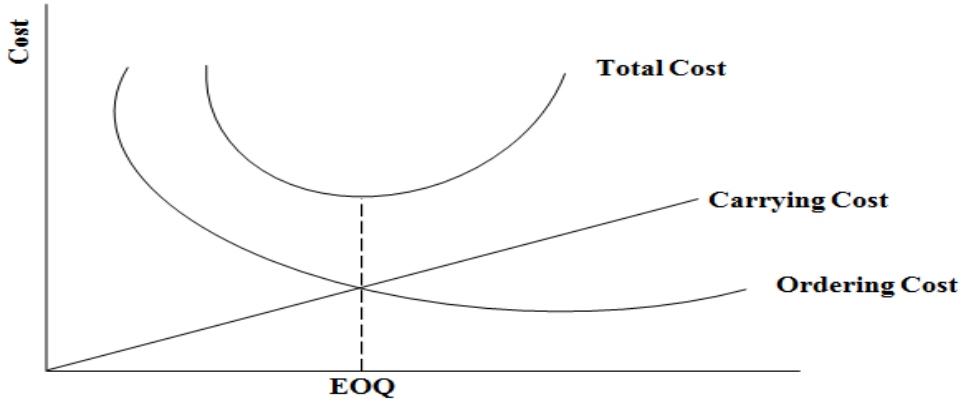
Solving for Q gives

$$Q^2 = \frac{2\ Co(D/Q)}{Ch}$$

$$Q = \sqrt{\frac{2CoD}{Ch}}$$

The above equation is used to determine the Economic Order equality which is often referred to as Wilson Formula in honour of R.H. Wilson, who first proposed it. (Lapin, 1994:208)

The EOQ mode can also be represented graphically and shown below:



Source Lapin 1994:209

According to Lapin (1994:209), a study of the EOQ formula allows us to draw some interesting conclusions. The economic order quantity increases with the square root of the annual demand (D) instead of becoming proportional to it. Also, it is inversely proportional to the square root of the unit of procurement cost. (Co), indicating that all things being equal, fewer expensive items should be ordered than would be the case for cheaper items.

Thus, the various parameters Co, Ch and D really serve to determine optimal inventory policy, and widely different results may be obtained for different levels of these constants.

Example

Suppose the annual demand of a manufacturing company is 25,000 units per time period. If its costs N50 to process and receive an order, and inventory can be carried at a cost N.78 per unit – year

a. How many units of items should be ordered at a time
b. How many orders per year should be placed?

a. D = 25000, Co = 50, Ch = 0.78

$$EOQ = Q = \sqrt{\frac{2CoD}{ch}} \qquad \sqrt{\frac{2(25000)50}{.78}}$$

= 17990units

b. Orders per year = $\frac{Demand}{Order\ Quantity}$

$$= \frac{25000}{1790}$$

$$= 14\ Orders\ per\ year$$

Limitations of Inventory Control

Kothari (2004) opines that inspite of the tremendous usefulness of the inventory control system to manufacturing firms; there are nonetheless some important limitations to its use as follows:

i. Strictly mathematical approach at times does not allow for certain considerations such as physical bulk, limited storage facilities, the possibility of a major change in price, etc, which may affect certain EOQ's.
ii. Since the variables (such as expected consumption over a given period of time, unit cost, etc.) are subject to frequent changes, so that to optimize once is not enough; EOQs must be calculated as the variables change.
iii. Various calculations involved are tidious and time consuming and the experts say that in many cases much of the work of optimizing order quantities was never accomplished.

But, the development of data processing system has been able to lessen all the above stated limitations and has enabled the management to apply the system of inventory control more effectively.

Summary and Conclusion

The common objective of the EOQ models for inventory decisions is to choose that order quantity (Q) that minimizes total annual relevant inventory cost. In the simplest model, there are two components, the annual ordering cost and the annual holding cost. The annual procurement cost is treated as irrelevant because the same amount will be spent on items regardless of the size of Q.

Determining the order quantity is often referred to as a trade-off problem that is trading off holding cost for ordering cost. But companies really want to reduce both. The fact is that firms have very large investments in inventory, and the cost to carry the inventory runs fro 25 to 35 percent of the inventories worth annually. Therefore, a major goal of most manufacturing firms today is to reduce inventory.

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