Chapter 4: Inventory Management

Objectives

- Understand why inventory is important in logistics.
- Understand the reasons for carrying inventory.
- Know the costs of carrying inventory.
- Able to compute the optimum quantity using a simple inventory model.

1. Introduction

It is important to have a general understanding of the importance of inventory. A brief discussion of inventory and how it relates to the overall economy leads into a discussion of several specific ways in which inventory is critical to the company.

Firms are becoming more aware of the need to manage and maintain reasonable levels of inventory. Some factors such as product differentiation, new product developments and other factors have led firms to seriously consider the impact inventories have on its business activities and profits.

2. Inventory as an Asset

Inventory often represents a large significant proportion of the firm's assets. If the value of inventory is reduced by $500k, then the cost saving is $500k x 25% = $125k.

If the profit ratio is 5% of sales, then a reduction of $ 125k would be equivalent with an increase of sales of$125k/5% = $2.5m.

3. Reasons for Carrying Inventory

The reasons for carrying inventory are:

- **Purchase economies**

  One reason for accumulating inventory of raw materials is that the company may be able to realize purchase economies. In other words, firms may buy raw materials in large quantities because of the price discounts that are available.

- **Transportation savings**

  Frequently, the opportunity to realize transport savings is associated with the purchase economies. When large quantities are purchased, large quantities can be shipped. Many firms ship raw materials in carload, truckload etc because they can decrease transportation costs.

- **Safety stock**

  A firm will usually hold a certain amount of inventory as buffer or safety stock in case there is a delay in shipping or some problem in filling orders.

- **Seasonal supply**

  Some products such as wheat are good examples of items that are only available at a certain 6me of the year. With such products, an accumulation of supply is needed to meet demand throughout the year.

- **Promotional stock**

  These are held so that the firm's logistical system may respond quickly to a marketing promotion.

4. Inventory carrying costs.

- **Order cost**

  Ordering or acquisition cost encompasses direct costs such as clerical personnel, paper and supplies, as well as indirect costs such as managerial costs and other costs of securing and maintaining sources of' supply.

- **Holding cost**

  This is the cost of keeping inventory in the warehouse.

5. Holding Cost versus Ordering Cost

Figure 4-1 below shows carrying cost is increasing with increasing order sizes and order cost is decreasing. Total costs take a U-shape, indicating positive trade-off up to a point, and then negative trade-offs.

In other words, total cost is decreasing initially because the savings from order costs are more than the increase in carrying cost.

However, there reach a point where this is no longer true; that is, the savings from decreasing order cost is not enough to offset the increase carrying costs.

Then, total costs go up.

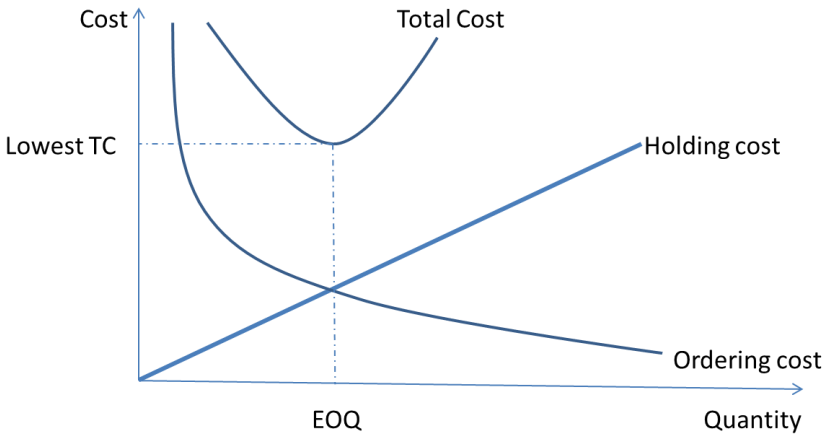

Figure 4-1: Order Cost versus Carrying Cost

When firms use this approach, they generally need to develop a minimum stock level to determine when the fixed quantity is to be re-ordered. This is usually called the reorder point. When the number of items in inventory reaches the predetermined level, the fixed order quantity (also called the economic order quantity or EOQ) is "automatically" ordered.

The level (number of units) at which stock will be ordered depends upon the:

- Length of time it takes to get the new order
- Demand for the product or the sales rate during that time - that is, how many units are sold per unit of time.

For example, if it takes a month for a new order to arrive and 10 units per day are sold, the reorder point will be 300 units (30 days x 10 units/day).

6. Inventory Ordering Cycles

As shown in Figure 4-2 below, three inventory cycles, or periods are depicted.

In each instance, the cycle begins with 400 units, which is the fixed quantity ordered or produced, and reordering takes place when inventory on hand is depleted to a level of 200 units.

Assuming that the demand or usage rate and the lead time length are constant and known in advance, the length of time in each cycle will be a constant 20 days.

This is an example of a fixed quantity model application in the case of certainty.

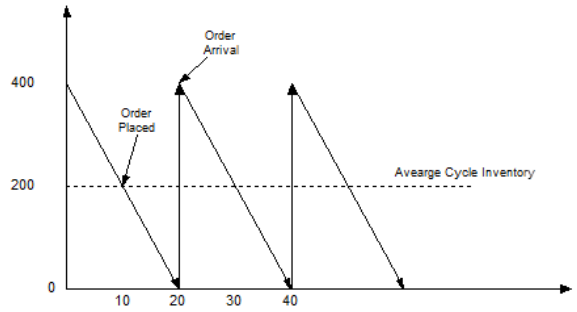

Figure 4-2: Order Cycle

The re-order point is based upon the concept of lead time or replenishment time, the length of time it takes for an order to be replenished or for the fixed quantity to be manufactured.

7. Simple EOQ Model

Demand in each relevant time period (daily, weekly, or monthly) is known. Inventory on hand will be used or depleted at a constant rate. The length of time needed to replenish stock is also known.

The simple EOQ model considers only two basic types of cost:

- Inventory carrying cost.
- Ordering cost.

The decision reached in the simple model analyses trade-offs between these two types of cost:

- If attention is focused only on inventory carrying cost, which is directly variable with increases in lot size, the order quantity would be as small as possible.

- If only order or set-up costs were considered, large orders would help to decrease the total order costs.

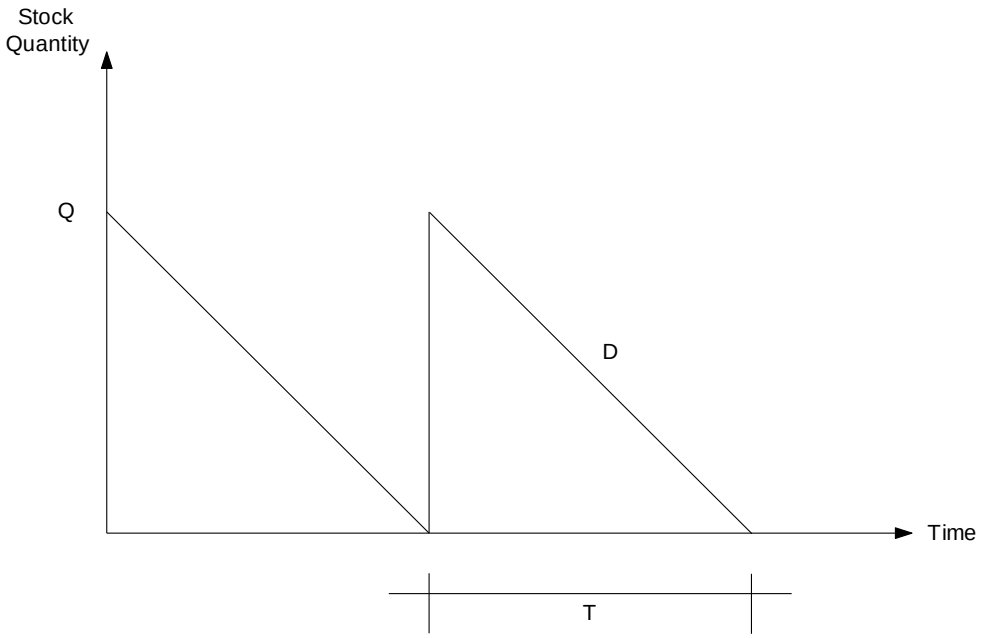

Figure 4-3: Sawtooth Model

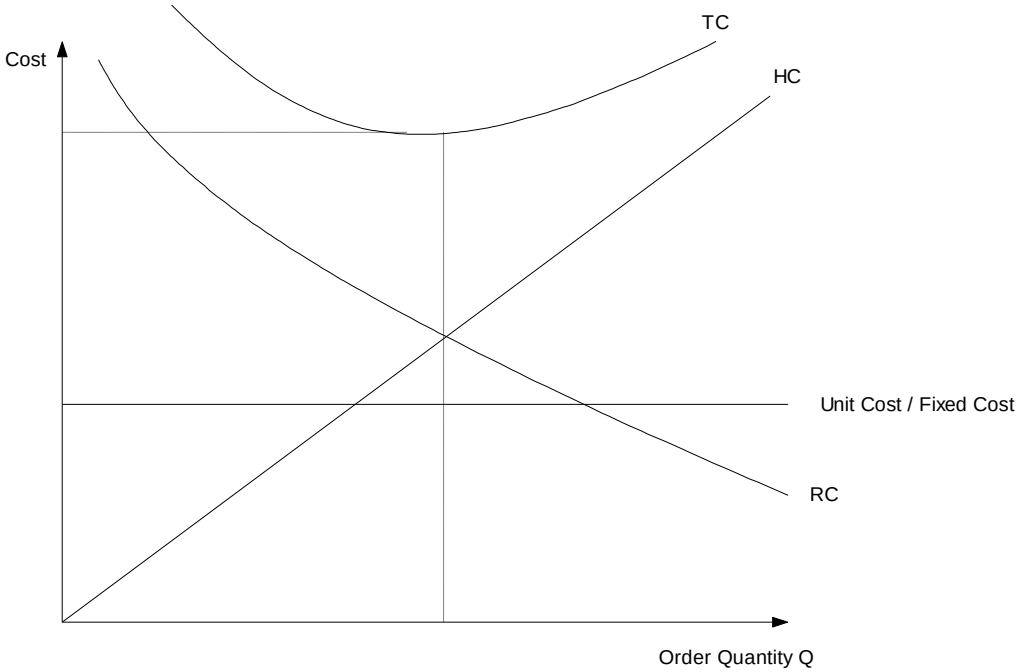

Figure 4-4: EOQ Model

Variables used in EOQ model:

Q = order quantity

D = demand

T = cycle time

UC = unit cost

HC = holding cost

RC = replenishment cost

Formula 1

$$TC = UC * D + \frac{RC * D}{Q} + \frac{HC * Q}{2}$$

If we analyse the formula, it comprises 2 components:

a. Fixed costs (inventory value)
b. Variable cost (reorder cost and holding cost)

8. EOQ Model Formulas

Formula 2

$$\text{Economic Order Quantity } Q_o = \sqrt{\frac{2 * RC * D}{HC}}$$

Formula 3

$$\text{Optimal Cycle Time } T_o = \sqrt{\frac{2 * RC}{D * HC}}$$

Formula 4

$$\text{Optimal Variable Cost } VC_o = \sqrt{2 * RC * HC * D}$$

Formula 5

$$\text{Optimal Total Cost } TC_o = UC * D + VC_o$$

Example 1

ABC firm buys 12,000 units annually. Each unit costs $50. It costs $70 to process and arrange delivery. Holding cost is $12 a year for each unit held. Compute:

a. Economic order quantity
b. Variable cost
c. Total cost
d. Optimal cycle time

Solution

Identify and list all the variables:

D = 12,000 units a year
UC = $50 a unit
RC = $70 an order
HC = $12 a unit a year

Substituting these into the economic order quantity equation gives:

$$Q_o = \sqrt{\frac{2 * RC * D}{HC}} = \sqrt{\frac{2 * 70 * 12000}{12}} = 374 \ units$$

The optimal time between orders is found from:

$$T_o = \sqrt{\frac{2 * RC}{D * HC}} = \sqrt{\frac{2 * 70}{12000 * 12}} = 0.4 \ months$$

The optimal variable cost is:

$$VC_o = \sqrt{2 * RC * HC * D} = \sqrt{2 * 70 * 12 * 12000} = \$4490 \ a \ year$$

The optimal total cost is:

$$TC_o = UC * D + VC_o = 50 * 12000 + 4490 = \$604{,}490 \ a \ year$$

9. Conclusion

In the past, inventory has been considered an asset. It is still an asset only when it does not become excessive. There are opportunities cost and other costs associated with ageing stocks and cost of keeping it in the warehouse where it is subjected to pilferage, poor handling and depreciation.

On the other hand, insufficient inventory can affect customer service level in many ways through lack of availability.

Inventory is temporarily stored in warehouses until they are order picked to meet customers' requirements.

The role of warehouse will be covered next.