**CHAPTER FIVE**

**INVENTORY MANAGEMENT**

**Introduction**

Inventories constitute the most significant part of current assets. Because of the larger size of investments in current assets, considerable funds are committed on inventories. It is essential for every firm to minimize such investments by avoiding unnecessary storing costs, obsolescence costs, and purchasing costs. Business units that are unable to control inventories investment, end-up with decrease in profitability in the long run. The primary objective of inventory management is to ensure sufficient levels of inventories to maintain an acceptable level of availability on demand, and minimizing the associated holding and administrative costs.

**The Financial Manager and Inventory Policy**

Despite the size of a typical firm’s investment in inventories, the financial manager of a firm will not normally have primary control over inventory management. Instead, other functional areas such as purchasing, production, and marketing will usually share decision-making authority regarding inventory. Inventory management has become an increasingly important specialty in its own right, and financial management will often only have input into the decision

**Inventory Types**

For a manufacturer, inventory is normally classified into one of three categories. The first category is *raw material.* This is whatever the firm uses as a starting point in its production process. Raw materials might be something as basic as iron ore for a steel manufacturer or something as sophisticated as disk drives for a computer manufacturer. The second type of inventory is *work-in-progress,* which is just what the name suggests— unfinished product. How big this portion of inventory is depends in large part on the length of the production process. For an airframe manufacturer, for example, work-in-progress can be substantial. The third and final type of inventory is *finished goods,* that is, products ready to ship or sell.

Raw-materials inventory gives the firm flexibility in its purchasing. Without it, the firm must exist on a hand-to-mouth basis, buying raw materials strictly in keeping with its production schedule. Finished-goods inventory allows the firm flexibility in its production scheduling and in its marketing. Production does not need to be geared directly to sales. Large inventories allow efficient servicing of customer demands. If a certain product is temporarily out of stock, present as well as future sales to the customer may be lost. Thus there is an incentive to maintain stocks of all types of inventory.

**Inventory Costs**

There are two basic types of costs associated with current assets in general and with inventory in particular. The first of these is *carrying* *costs.* Here, carrying costs represent all of the direct and opportunity costs of keeping inventory on hand. These include:

* Storage and tracking costs
* Insurance and taxes
* Losses due to obsolescence, deterioration, or theft
* The opportunity cost of capital on the invested amount

The other type of costs associated with inventory is *shortage costs.* Shortage costs are costs associated with having inadequate inventory on hand. The two components of shortage costs are restocking costs and costs related to safety reserves. Depending on the firm’s business, restocking or order costs are either the costs of placing an order with suppliers or the costs of setting up a production run. The costs related to safety reserves are opportunity losses such as lost sales and loss of customer goodwill that result from having inadequate inventory.

A basic trade-off exists in inventory management because carrying costs increase with inventory levels, whereas shortage or restocking costs decline with inventory levels. The basic goal of inventory management is thus to minimize the sum of these two costs. We consider ways to reach this goal in the next section.

**Objectives of inventories management**

An efficient inventory management should always aim for the following objectives:

* Ensure a continuous supply of materials to facilitate un-interrupted production.
* Maintain sufficient quantities of inventories in period of short supply and un-anticipated price changes.
* Maintain sufficient volume of finished goods inventories for smooth sales operations, and efficient customer services.
* Minimize the carrying cost of inventories.
* Control investments in inventories and maintain optimum level.

**Inventory management techniques**

In managing inventories, the firms’ objective should be in consonance with the wealth maximization principle. One can achieve this, by determining the optimum level of inventory. Efficiently controlled inventory makes the firm flexible, and inefficiently controlled inventories results in unbalanced inventories and inflexibility in production and operational activities.

A successful inventory management should always aim for two basic conditions. The first being the identification of quantity to be ordered, minimizing the investments in inventories. The second one is the using pattern of inventory, which determines the timing interval for the replenishment of inventories.

* **The ABC Approach**

The ABC approach is a simple approach to inventory management in which the basic idea is to divide inventory into three (or more) groups. The underlying rationale is that a small portion of inventory in terms of quantity might represent a large portion in terms of inventory value.

Usually a firm has to maintain multiple types of inventories. Control over operations of such inventories will be quite difficult. Therefore a firm should be selective in its approach in inventories controlling system. This selective approach is also called as ABC analysis that tends to measure significance of each item of inventories in terms of its value. Inventories with high vale (in terms of investment) are called as ‘A’ class items and are expected to keep under tight control. Inventories with low value of investments are expected to have limited or no control called as ‘C’ class items. Finally, inventories with moderate investment are called as ‘B’ class items are kept under moderate control measures.

ABC analysis concentrates on important items and is also known as ***control by importance and exception [CIF].*** As the items, are classified in the importance of their relative value, this approach is also called as ***proportional value analysis*** [PVA].

* **The Economic Order Quantity Model**

The **economic order quantity (EOQ)** is an important concept in the purchase of raw materials and in the storage of finished-goods and in-transit inventories. In our analysis, we determine the optimal order quantity for a particular item of inventory, given its forecast usage, ordering cost, and carrying cost.

Determination of optimum inventories level or quantity of inventory to be injected depends on the trade-off between inventory carrying cost and inventory ordering costs. Economic order quantity is that level of inventory, which minimizes the total *ordering costs, and also carrying costs.*

If usage of an inventory item is at a steady rate over a period of time and there is no safety stock, average inventory (in units) can be expressed as

 Average inventory = *Q*/2

where *Q* is the quantity ordered and is assumed to be constant for the planning period.

***Carrying costs*** are cost of storing the raw materials and finished goods in the stores. The costs incurred for maintaining a given level of inventory are called ***carrying costs or storing costs***. Carrying costs includes storing expenses, handling, insurance, taxes, deterioration and obsolescence of materials. Storage expenses also include expenses on warehousing, handling and clerical staff maintenance expenses. Behavior of carrying costs is in directly proportional to the inventory volume. Increase in the volume of inventories increases carrying costs and vice-versa. Inventory carrying cost is always expected to maintain on the assumption of average volume, as the events under the two extreme points will give biased results. Inventory volume under at the time of beginning of the year (BOY) will be maximum in volume thereby the inventory ratio will lower, while the inventory volume during the end of year (EOY) will be low reducing the inventory ratio. Therefore the average inventory principle should be used in arriving the carrying costs, which minimizes the variances of excess/deficit volumes of inventory over a period of time.

Total carrying costs = Average inventory x Carrying costs per unit

 = (*Q*/2) x CC

***Ordering cost*** of inventory is also called as purchasing costs of inventory. Costs that are associated with purchasing activities are called as ***ordering costs***. Usually costs like material requisition, receiving, inspecting and pre-storing arrangements are part of ordering costs. Ordering costs increases with increase in the number of purchases and decreases on decrease in the number of purchases.

Total ordering cost = Fixed cost per order x Number of orders

 = O x (T/Q)

**The Total Costs** The total costs associated with holding inventory are the sum of the carrying costs and the restocking costs:

 Total costs = Carrying costs + Ordering costs

 = (*Q*/2) x CC + O x (*T/Q*)

The optimum size of inventory is commonly referred as economic order quantity. It is that size of inventory where inventory carrying cost will be equal to the inventory ordering costs.

Before attaining this trade-off, inventory-carrying cost will be more than ordering costs, and after this, carrying cost will be less than the ordering costs. This can be explained with the following figure more clearly.

 Total cost curve Total Inventory cost

Costs and Benefits

 Total carrying cost

 Total ordering cost

 Q\* optimal level of inventory

**Optimal Order Quantity**: the optimal quantity of an inventory item to order at any one time is that quantity, *Q*\*, that minimizes total inventory costs over our planning period. The optimal quantity, or EOQ, is

 EOQ =$\sqrt{\frac{2 x T x O}{CC}}$

Where, T = Annual consumption of quantity

 O = Ordering cost per single order placed

 CC = annual carrying cost per single unit of inventory

 EOQ = Economic ordering quantity

To illustrate the use of this EOQ equation, suppose that usage of an inventory item is 2,000 during a 100-day planning period, ordering costs are $100 per order, and carrying costs are $10 per unit per 100 days. The EOQ amount, then, is

EOQ =$\sqrt{\frac{2 x T x O}{CC}}$ =$\sqrt{\frac{2 x 2,000 x 100}{10}}$ = 200 Units

Usually suppliers encourage placing larger orders by offering discount. Firms will save big margins on the purchase prices on accepting discount offers. Basic equation of economic ordering quantity will not resolve this issue. Therefore the discount offer is to analyze separately. Under this option, benefits on decrease in price should compare with incremental costs of inventory. If the net benefit is positive discount offer will be profitable, if it is negative discount offer will be not worth accepting.

**Order Point: When to Order?**

Economic order quantity solves the problem of how much inventory level has to be maintained, but when to order can be determined effectively by reorder point. The reorder point is that inventory level at which an order should be placed to replenish the inventory. To determine the reorder point under certainty one should know (a) lead time, (b) average usage of inventory and (c) economic order quantity or quantity replenished. Lead-time is the normal time taken to replenish inventory after placing an order of the same inventory. Under certainty assumption, lead-time will not fluctuate. Average usage of inventory is the quantity consumed by the production process. Therefore reorder point can be calculated using the following formula:

***Reorder point*** = Lead-time X Average usage on inventory (units)

***To illustration,*** from the following information given below calculate the inventory reorder point both under the certainty assumption and under uncertainty assumptions.

 Economic order quantity 2,000 unit

 Lead-time 1 week

 Average consumption 400 units per week

***Solution:***

 **Reorder point** = Lead-time X Average usage on inventory (units)

 **Reorder point** = 1 week X 400 units per week = **400 units**

* **Materials Requirements Planning**

Production and inventory specialists have developed computer-based systems for ordering and/or scheduling production of demand-dependent types of inventories. These systems fall under the general heading of **materials** **requirements planning (MRP)**. The basic idea behind MRP is that, once finished goods inventory levels are set, it is possible to determine what levels of work-in-progress inventories must exist to meet the need for finished goods. From there, it is possible to calculate the quantity of raw materials that must be on hand. This ability to schedule backwards from finished goods inventories stems from the dependent nature of work-in-progress

and raw materials inventories. MRP is particularly important for complicated products for which a variety of components are needed to create the finished product.

* **Just- in Time(JIT) System**

**Just- in Time (JIT)** is a production and inventory control system in which materials are purchased and units are produced only as needed to meet actual customer demand.In just in time manufacturing system inventories are reduced to the minimum and in some cases is **zero**. JIT approach can be used in both manufacturing and merchandising companies.