CHAPTER - II

HISTORICAL AND THEORETICAL ASPECTS OF INVENTORY MODELS.

Historical & Theoretical Aspects of Inventory Models

INTRODUCTION:

In simple terms inventory means the stock of a commodity to meet future demands. Inventories constitute the largest component of current assets in many organisations. Poor management of inventories therefore may result in business failures. A stockout creates an unpleasent situation for the organisation. In case of manufacturing organisation, the stockout (inability to supply an item from inventory) could in extreme cases, bring production process to a halt. Conversely, if a firm carries excessive inventories, the added carrying cost may represent the difference between profit and loss. The two basic issues one must consider while dealing with inventories are i) when to order and ii) how much to order. Inventory management involves deciding the number of items to be stocked to meet the uncertain future demand and supply so that the relevant cost per unit time is minimum.

An Engineering Industry generally carries following seven major kinds of inventories:

1. RAW MATERIAL — Raw Materials are those basic unfabricated materials which have undergone no conversion whatsoever since their receipt from the suppliers. They include items like steel (angles, channels, tees, flats tubes,etc.) Raw materials in other words, are those basic materials from which components, parts, and products are manufactured by the company.

2. FINISHED PARTS— Which may either be bought-out-parts or piece parts. Bought-out-parts are those finished parts, sub-assemblies or assemblies which are purchased from outside supp-liers. These include standard parts as well as parts produced by suppliers to buyer's design. Piece parts are those parts which are manufactured at the company's own plant from the basic raw materials.

3. WORK-IN-PROCESS— Comprises of items or materials in partial-ly completed condition of manufacture. Raw materials become work-in-process at the end of first operation and remain in that classification until they become piece parts or finished goods. Work-in-process can be found on the conveyors, trucks, pallests, in and around the machines and in temporary areas of storage

awaiting to be worked upon or assembled.

4. FINISHED GOODS — are the final products ready to be shipped.
Products usually leave work-in-process classification and enter
into the classification of finished goods at the point of final
inspection when they are ready for delivery to the customer or
to finished goods store.

5. TOOLS COMPRISE :-

a) Standard tools used on machines such as saws, drills, remers,
taps, chasers, milling cutters,hobs,broachers, form tools,
itserts etc.

b). Hand tools such as hand-saws, chisels, drill guns, hammers,
mallets, needles, pliers, punches, spanners, wrenches etc.

6. SUPPLIES-   Supplies include materials used in running the
plant or in making company's products but do not themselves go
into the product. Supplies, therefore, include--

a) Miscellaneous consumable stores such as brooms, cottonwaste,
clothwaste,toilet paper. vim powder, jute twine etc.

b) Welding, soldering and tinning materials such as electrodes,

welding rods, solder, spelter, etc.

c)   Abrasive materials such as emery cloth, emery belts, sand paper, emery graphite etc.

d). Brushes, mops and bobs such as artist's brushes, cleaning brushes, paint brushes, etc.

e). Empties such as bags, glass bottles, cardboard boxes, car-boys, drums, jars, tins, etc.

f). Oils and greases such as kerosene oil, transformer oil, petrol, diesel oil, lubricating and cutting oils.

g) General office supplies such as blotters, candles, sealing wax, ink and ink-pads, nibs, pencils and refills, files, pins, clips, carbon paper, stencil paper, tracing paper, erasers tec.

h) Printed forms such as envelopes, letter heads, enquiry forms, order acceptance forms, purchase order forms, order amendment forms, goods receipt reports, discrepancy notes, vouchers, debit notes, credit notes, invoices, etc.

i)   Ledgers and journals such as goods inward register, goods receipt   register,   sales   register,   sundry   creditors register,sundry debtors register, cash book, loan register, sales journal, purchase journal, general ledger etc.

j) Electric supplies such as cables, clips, cut-outs, fuses, lamps, lampholders, plugs, hoses, shades, switches etc.

7. MACHINERY SPARES- Such as ball bearings, v-belts, oil seals, springs, etc.

REASONS FOR CARRYING INVENTORIES :-

There are seven major reasons as to why an Engineering firms carry inventories:

1. TO GAIN ECONOMY IN PURCHASING:

A certain amount of a fixed cost,ordering cost or set up cost - is incurred whether an item is purchased from outside suppliers or manufactured at the company's own plant to buy or to manufacture goods on day-to-day basis is both impracticable and uneconomical. The firm, therefore, may order beyond the immediate needs of the company to distribute fixed cost over a large number of units.

Manufacturers of certain items offer discounts if more units are purchased. The buyer, therefore, may buy quantities beyond the current requirements to take advantage of the price discounts.

2. TO KEEP PACE WITH CHANGING MARKET CONDITIONS:

Inventories are created when larger quantites of items are purchased and stocked in anticipation of their non- availability in future or in anticipation of spurt in their prices.

3. TO SATISFY DEMAND DURING PERIOD OF REPLENISHMENT:

If production and delivery of goods could be instantaneous, there would be no need or atleast a very little need for the inventories. No firms can obtain the items that it requires, whetherr purchased or manufactured, within zero time-lag. It generally takes few days or weeks to push through each work-order and make the items available for the assembly. The company, therefore, must maintain sufficient inventory of parts to ensure their smooth outflow for assembly.

4. TO CARRY RESERVE STOCKS TO AVOID STOCK-OUTS:

A company may suffer a substantial loss on account of items being out of stock. The stockouts of a critical item and especially of an item going into the final assembly, generally mean big losses. A stockout in such a category of item result due to one or more of the following:

1) to do certain operations second time.

2) to rob parts from one assembly to finish a second assembly.

3) to shut down the complete operation.

A stockout results when the rate of consumption is more than the estimated usage rate or when there is delay in delivery. To prevent the occurrence of stockouts and protect the company against an interruption in the scheduled flow of deliveries, certain extra stock, called saftey stock, is maintained. This forms a fixed portion of the inventories.

5. TO STABILIZE PRODUCTION:

A product is produced to meet customer's orders. Rarely a company has a continuous stream of orders. Usually orders and the shipment of orders are subjected to fluctuations. The problem is very severe in case of seasonal products. How should the peaks and valleys of the demand be satisfied ? One method of adjusting the fluctuations in business volume is to adopt policy of "hiring and firing" people. Will such a policy be acceptable to the labour unions? will such a policy be acceptable to the labour unions? Will such a policy be conducive to the morale of the workers? No labour union would accept such a policy. Workers cannot be expected to give their best if they are constantly reminded of the unemployment which awaits them. Moreover, the policy of hiring and firing puts an additional cost burden on the company the cost of training new workers when business expands or the cost of compensation on account or retrenchment,

layoff when business declines.

A rational approach would be to produce at a uniform rate throughout the year. The inventory will increase gradually and reach at peak before the season after which the products will begin moving to the market and inventory will decline.

6. TO PREVENT LOSS OF SALES:

Finished goods inventory is maintained to match requirements of the customers for prompt execution of their orders. The need for maintaining the finished goods inventory attains still greater importance when the products are very competitive. The failure of the company to make such products available may result in loss of sale or even the loss of customer.

7. TO SATISFY OTHER BUSINESS CONSTRAINTS:

Sometimes, the company is forced to buy quantities more than the current requirements and lock-up its productive capital. Few of such situations are:

i) Supplier's condition of minimum quantity:

Many a times the supplier insists on certain minimum quantity.

This can happen under one of the following conditions:-

a) The supplier has the monopoly in the field and hence order quantites to buyer are dictated to by the seller.

b) The set-up cost is very high as in case of manufacturing of forgings.

ii) GOVERNMENT REGULATIONS:

Too much capital gets locked up in creating inventories of items that are subjected to government regulations; more so, in case of imported items. The company, therefore, buys quantites allotted by the government.

iii) SEASONAL AVAILABILITY:

There are certain items which:-

a) are available in plenty and hence cheaply only during certain months and

b) are not available during certain months. The company is thus forced to buy large quantity and create inventories.

OBJECTIVES OF SCIENTIFIC INVENTORY CONTROL SYSTEM :

An inventory control system is to be adopted to achieve

the basic purposes for which the inventories are created. The fundamental objective of a goods inventory control system is to be able to determine what to order, when to order, how much to order, and how much to carry in stock so as to gain economy in purchasing, storing, manufacturing and selling. These fundamental objectives may be amplified into the following objectives, to be considered by the analyst while designing the system :

1.SERVICE TO THE CUSTOMERS:

Adequate stock of finished product should be maintained to match reasonable requirements of the customers so as to ensure promt execution of their orders.

2. CONTINUITY OF PRODUCTIVE OPERATIONS:

Every attempt should be made to ensure the continuity of productive operations through an uniform flow of materials and eliminate the possibility of stock-outs.

3. EFFECTIVE USE OF CAPITAL:

The system should enable the management to make an effective use of its capital. The investment in inventories should be kept at minimum, consistent with the operating sales and

financial requirements of the firm.

4. ECONOMY IN PURCHASING:

The sytstem should enable the management to gain economy in purchasing through quantity buying and favourable market.

5. REDUCTION OF RISK OF LOSS:

The possibility of loss on account of obsolescence and deterioration should be minimised. Inbuilt checks should be provided to weed out obsolete and non-moving items periodically and automatically.

6. REDUCTION OF ADMINISTRATIVE WORKLOAD:

The administrative workload on the purchasing, receiveing, inspection, stores, accounts and other related departments should be bearest minimum.

7. ADMINISTRATIVE SIMPLICITY:

The system should be simple, easy to operate and devoid of tedious calculations.

Some inventory problems are characterised by a single order for the entire demand period. Demand is random but occurs only once. No opportunity is available to replenish deplated stock. A problem of this type is called a "News boy problem." The news boy on the street corner faces an inventory problem daily. He must purchase enough newsspaper to supply to his customer, but he does not precisely know how many papers he will need. If he purchase few news papers from the circulation department, he will loose sales. If he purchase too many, he will be having stock of unsold papers, as a news paper has vary short useful life. Now these unsold papers may have some salvage value, but the salvage value will be vary less than what he paid for the papers. The news boys problem is to buy enough papers to realise as much profit as possible.

A set decision rules which specify when to order and how much to order is called an inventory policy. While determining these two quanitites it is essential to recognize various cost that are envolved in the management of the inventory. The broad classification of various cost that should be considerd are :

1]. Procurement costs,

2]. Holding costs,

3]. Shortage or penalty costs.

1]. PROCUREMENT COSTS:

The procurement costs has usually two basic components, a fixed components that is independent of the quantity order, incurred only if an order is placed for the replenishment but not otherwise, and available componenet that is a function of the quantity order. The fixed cost may included the cost of processing an order (the set up cost for a production run). The variable cost expressed in rupees per unit procurement usually accounts for the cost of units and the cost of the delivery.

2) THE HOLDING COST :

The holding cost expresses the cost of carrying in stock the units of the commodity over time. The cost component in-cludes insurance, taxes, cost of storage and the cost of capital invested in stocking the goods. The holding cost will be assume to be proportional to the cost of stock on hand, and length of time over which such stock is carried.

3]. THE SHORTAGE OR PENALTY COSTS :

The shortage or penalty costs is the cost incurred when required item is out of stock. The cost of back order is usually taken as the penalty associated with a loss of customers good- will and other related costs, and in general will depend on the number of units back ordered and the length of time over which units are back ordered .

For any policy, the total cost of management of inventory for a given period, average cost per unit time or long run cost per unit time can be evaluated. Any policy which the total cost per unit time is minimum is called the "Optimal inventory poli- cy".

Historically, the analysis of the inventory problem as applied to business can be traced to Harris (1915) who formulat- ed and optimised a simple inventory situation and derived the "simple lot size formula" given as the square root function of fixed cost, holding cost and the demand. Since then this formu- la has been rediscovered, apparently independently, by many individuals including Wilson who popularised its use. Hence this formula is often referred to as Wilsion formula. Since this formula is derived so that the total cost per unit time is minimised this is also called Economic order quantity (EOQ)

formula. The first full length book dealing with inventory problems was written by Raymond (1931). In this book Raymond explains how various extensions of simple lot size model can be used in practice. A detailed study of stochastic nature of inventory problem helping initiated since world war II.

The stochastic version of the simple lot size model was developed by Within (1953). Among others who have investigator the stochastic nature of inventory problem mention may be made to the works of Masse (1946), Arrow, Harris & Marschak (1951), Dvoretsky, Kiefer and Wolfowitz (1952). This authors take in to consideration the effect of randomness in the demand and apply the theory of stochastic process and/or dynamic programming to formulate and solve complex inventory problems. Since then a number of peoples by mathematicians in which the mathematical and probabilistic proparties of the inventory models are stud-ied. The book by Arrow, Karlin & Scraff (1958) deals with such a study in detail.

Presently, work on the inventory problems is being carried out at many different levels. At one extremes the work is concerned strictly with practical aplications while at the other end work is being done on mathemantical properties of inventory models without regard to any possible applications.