

CHAPTER : 7

7. Inventory Decisions

- (i) Economic order quantity
- (ii) Inventory level and control points
- (ii) Inventory policies
- (iv) Safety stock

ECONOMIC ORDER QUANTITY

The ordering decision is stated in terms of economic order quantity (EOQ) models or lot size models. The concept of EOQ was first developed by Ford W. Harris in 1913 for finding the optimum order quantity in order to balance costs of holding excess stock against that of ordering small quantities too frequently. The model that he developed for finding the optimum order quantity has become the basic economic order quantity (EOQ) formula and it serves as the basis for many of the inventory policies currently used in practice.

“Economic Order Quantity is the size of the order representing standard quality of material and it is the one for which the aggregate of the costs of procuring the inventory and costs of holding the inventory is minimum”¹. The determination of order quantities (or batch size for production) raises the question of what lot size provides the most economical trade-off between relevant inventory costs, viz., ordering, carrying and shortage costs. The costs of carrying or holding costs can be estimated by the management on the basis of sales of past years but costs of not carrying enough are only estimated. In determining the economic order quantity the problem is one to set a balance between two opposing costs, namely ordering costs and carrying costs. The ordering costs are basically the costs of getting an item into the firm’s inventory. They are also known as acquisition costs or procurement costs. Carrying costs, sometimes also known as holding costs or cost of possessing the materials. These costs are

tempted on one hand to order huge quantity but, holding costs are also to be considered. Either of these two courses will have an adverse effect on the profits of the firm. Hence the management tries to reconcile them and this reconciliation point is economic order quantity.

Both the selected plants calculate neither carrying cost nor ordering cost formally because they do not apply EOQ system.

INVENTORY LEVEL AND CONTROL POINTS

Optimal stock level implies the order quantity that will result in the total amount of ordering and carrying cost being minimized. The disadvantages of high level of inventories and lower level of inventories are as under :

Chart No. 7(i)

High Level Vs. Low Level

High level of inventories	Low level of inventories
(i) Locking up of working capital.	(i) It will result in stockout resulting into production stoppages.
(ii) High insurance charges.	(ii) Idle production capacity.
(iii) More storage space.	(iii) Idle labour time.
(iv) Deterioration in the quantity of materials.	(iv) Liability of fixed overheads.
(v) Chances of theft and pilferage.	(v) Failure to meet delivery order etc.

Maintenance of various stock levels is thus very important. Concerns fix up stock level for every item of stores for of stores for efficient control of stock. The various levels fixed for effective stock control may be broadly classified into the following broad categories.

- 1. Maximum Stock Level**
- 2. Minimum Stock Level**

3. Reorder Stock Level
4. Average Stock Level
5. Danger Stock Level

1. Maximum Stock Level : “It is level above which stocks are
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In fixing up maximum level the following factors should be taken into consideration.

- (a) The rate of consumption of the material.
- (b) The time necessary in obtaining supplies from the supplier.
- (c) Godown space available.
- (d) Possibilities of loss in stores by deterioration evaporation etc. These are certain stores which deteriorate in quality if they are stores over a long period.
- (e) Cost of maintaining stores.
- (f) Likely fluctuation in prices. For instance, if there is possibilities of substantial increase in prices in the coming period a comparatively large maximum stock level will be fixed. On the other hand, if there is the possibilities of decrease in prices in the near future stock are kept at a very reduced level.
- (g) The seasonal nature of supply of material, certain materials are available only during specific, period of the year so these have to be stocked heavily during these periods.
- (h) Restrictions imposed by Government or local authority in regard to materials in which there are inherent risk, e.g. fire and explosion.
- (i) Possibility of change in fashion and habit which will necessitate change in requirement of materials.

Lamentably both the selected steel plants do not calculate maximum stock level in statistical order ;they keep it according to their requirement.

2. Minimum Stock Level

“It is the level which available supplies should never drop. The exact quantity which the minimum represents is determined by the rate at which an item is used, its importance in the process the normal procurement time, whether substitutes are available by similar factors.”³

It is the level below which the stocks are not allowed to fall. Production will stop if the stock goes down this level. This level is sometimes referred to as “Buffer Stock” level. The following factors are taken into account while fixing the minimum stock level.

1. Average rate of consumption of the material.
2. Average lead-time. The shorter the lead time, the lower is the minimum level.
3. Reorder level.
4. Nature of the item.
5. Stock out cost.

The formula for minimum stock level is given as under :

$$\text{Minimum Level} = \text{Re-order Level} + \text{Average Usage} \times \text{Average Lead-time}$$

Both BSSL & RIL generally keep their stock for seven days and for indigenous goods, and three to six months for imported goods.

3. Reorder Stock Level

It is the quantity level at which a replenishment order should be issued to ensure that fresh supplies will arrive in time to keep

the item from running out of stock. “This logically consists of : (i) the average volume of use during the normal procurement time, and (ii) an additional quantity or the safety factor to cover any unanticipated increase in the rate of use or in the

⁴. The following factors are taken into account while fixing the re-order level.

1. Maximum usage of materials.
2. Maximum lead time.
3. Maximum stock level.
4. Minimum stock level.

The formula for re-order level is given below : Re-order Level = Maximum Usage × Maximum Lead-time

4. Average Stock Level

This average stock level is average of maximum stock level and minimum stock level in formula we can describe it : Average stock level = maximum stock level + minimum stock level/2.

5. Danger Level

Danger level of stock is fixed below the minimum stock level and if stock reaches below this level, urgent action for replenishment of stock should be taken to prevent stockout position.

It is the level below the minimum stock level. When the stock reaches this level, immediate action is needed or replenishment of stock. As the normal lead-time is not available, regular purchase procedure cannot be adopted resulting into higher purchase cost. Hence, this level is useful for taking corrective action only.

INVENTORY POLICIES

Inventory policies have a direct bearing on the financial needs of a firm. The financial executive should anticipate changes in the need for funds and should have a knowledge of the implications of changing inventory policies and positions.

(i) Re-order Level Policy : Under this policy, concerning replenishments are based on the level of inventory. Here the order for replenishment is placed when the stock in hand equals or falls below the fixed value which is known as the re-order level, subject to constant review. In case the replenishment is placed within a re-order level, it is generally for a fixed quantity. The most common practical implementation of the re-order level policy is the two bin system. This is the oldest system still in common use. It separates the stock of each item into two bins. One bin contains stocks sufficient to satisfy demand between the arrival of one order and the placing of the next order. The two-bin system is ideal for those items whose demand and lead time are fairly regular and established. This method is applicable to low-cost, high-volume items which have consistent usage. This method does not involve any record keeping. In both steel plants this policy is adopted only for some spare parts items.

(ii) Re-order Cycle Policy : Under such policy decisions are made on the time basis. Here the stock on hand is reviewed at fixed periods and a replenishment order is placed at every review.

“The size of replenishment order may vary from time to time. It is equal to ‘sum fixed maximum level’ less the inventory

⁵: Under this system, the reordering is made at regular time intervals. The maximum level of each item is predetermined.

In practical both industry fixed period, say after one week, a fresh collective order for all the items will be placed. The size of the order will be decided on the basis of the shortages indicated by the existing stock in relation to the maximum level. Thus, the quantity of replenishment will exactly equate the quantity consumed during the period. The size of the order will vary considerably.

(iii) Min-Max Policy : Under this policy the stock on hand is reviewed periodically. If on review the stock on hand is at or below certain minimum level a replenishment order is placed. this method is applied in respect of some spare parts item like oxygen cylinder, furnace oil, ferro silicon, ferro manganese to low-cost high-volume parts in constant use.

Factors affecting Inventory Control Policy

The inventory policy of an organization has an impact on the whole system. There are a number of factors which can affect the inventory decisions. These can be broadly divided into the following categories : (A) Characteristics of the manufacturing system ; The nature of the production process, the product design, production planning and plant layout have significant affect on inventory policy. (B) Amount of Protection against Shortages; There is always variation in demand and supply of the product. The protection against such unpredictable variations can be done by means of buffer stocks. (C) Organizational Factors : There are certain factors which are related to the policies, traditions and environment of any enterprise. Some of these are (i) Labour relation policies of the organization. (ii) Amount of capital available for stock. (iii) Rate of return on capital available if invested

elsewhere. (D) Other Factors : There are certain factors which are related to the policies, traditions and environment of any enterprise. Some of these are (i) Inflation (ii) Strike situation in communication facilities (iii) Wars or some other natural calamite like famines, floods etc. (iv) Differences between input and output.

Both units are affected more or less from the above factors and are also following other techniques of inventory management such as HML, FSN, SDE, and GOLF etc. These technique are being used for central purchase and formulating purchase strategies of raw material and spare parts items.

SAFETY STOCK

The term safety stock refers to extra inventory held as a hedge, or protection, against the possibility of a stock out. It will decrease the cost of stockouts but increase carrying cost. The cost of stockout multiplied by the number of stockout prevented by the safety gives the cost reduction figure. The value of the safety stock multiplied by the carrying cost percentage gives the cost addition figure. It is to be noted that this cost addition is continuing even permanent in nature because the safety stock is always a part of total inventory. It is to be further noted that because the safety stock does not often decline in quantity, we do not divide it by 2 to get Average inventory.

The optimum safety stock to carry depends upon two conflicting objectives : (1) to minimize the cost of stockout (2) minimizing carrying cost on the safety stock. The decision of how much safety stock to carry is not an easy one. Every approach to this problem has it own limitations.

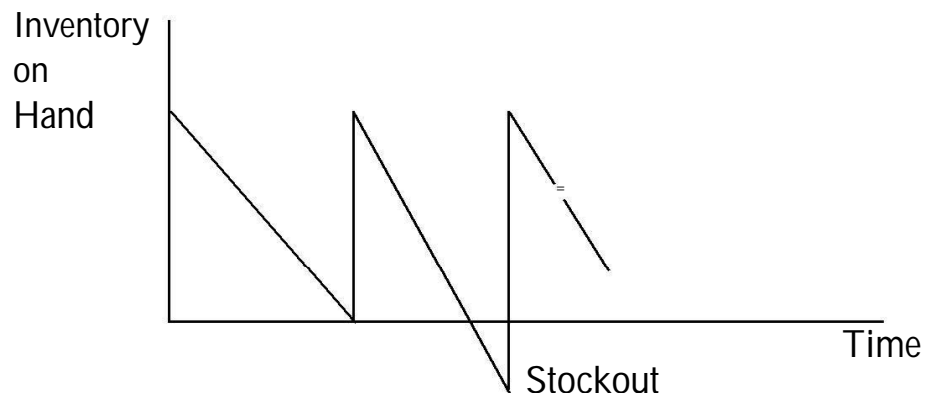
Use of safety stock : “Safety stock helps in avoiding stockouts. It is extra stock kept on hand.”⁶ The main purpose of safety stock is to avoid stockout when the demand is higher than expected or when demand is usually high during the lead time. If the demand or lead time is uncertain the exact demand during lead time will not be know with certainty. Therefore, to prevent stockout it is necessary to carry additional inventory called safety stock. “Although stockout can often be avoided by using safety stock, one of the best ways to implement a

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This can be accomplished by adding the number of unit of safety stock as a buffer to the Reorder Point. We can calculate Reorder Point in different situations as given below :

1. When demand and lead time are constant

Chart No. 7(ii)



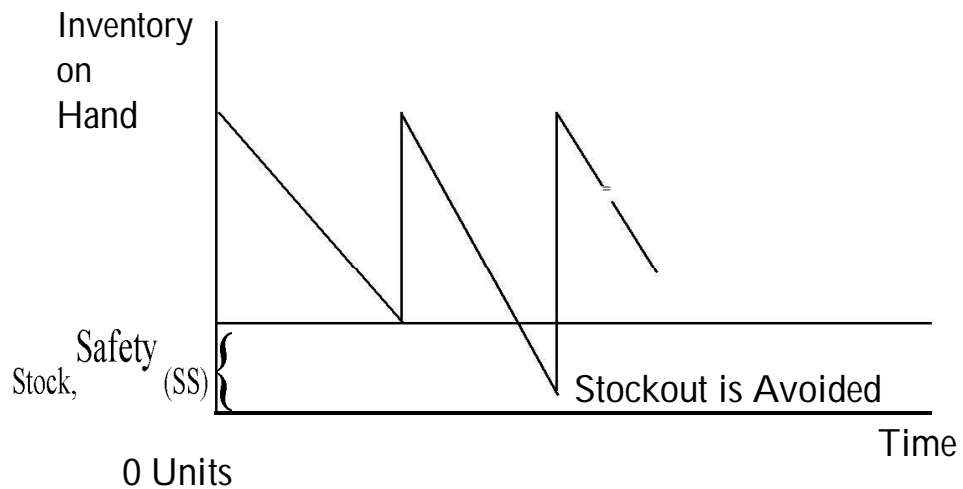
$$ROP = D \times L$$

D = Daily Demand

L = Order lead time or number of working days it takes to deliver an order (or average lead time)

2. When demand during the lead time is uncertain and safety stock is necessary then reorder point

Chart No. 7(iii)



$$ROP = D \times L + SS$$

$$SS = \text{Safety stock}$$

$$D = \text{Daily Demand}$$

$$L = \text{Order lead time or number of working days it}$$

The demand and supply rates can never be assessed exactly. There is bound to be discrepancy between actual and estimated demand and supply quantities with a fair degree of uncertainty. The organization with a policy of safeguarding their interest against these uncertainties maintain the level of inventory at some desired minimum level. This minimum level of inventory to cover some unforeseen and uncalled for situations is known as Safety or Buffer Stock. Generally, buffer stock is maintained at the desired level by continuous replenishments at varying intervals of time.

Factors affecting choice of buffer stocks are :

- (i) uncertainty in demand.
- (ii) degree of insurance for any item.

- (iii) uncertainty in lead time, and
- (iv) size of the batch.

Larger the uncertainty associated with any factor, larger should be the buffer stock. The buffer stock situation, as well as its relation with other factors relevant in inventory analysis can be described with the graph in fig. 7(iii) The pattern is given for one inventory cycle only.

“Evidently the size of buffer stock mainly depends on two factors, variation in the demand during lead time and the duration of lead time. The variation in demand of any item will depend on its nature and behaviour of the con

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Determination of Buffer/Safety Stock

Maintenance of buffer stock is very important for an organization. Its size depends both on lead time and variation in demand. Thus to fix the safety stock level two pieces of information are required:

- (i) a distribution of difference between forecast and actual demand over the lead time.
- (ii) an agreement as to how frequently runouts may be allowed to occur.

Also setting a safety stock implies some sort of management decision/judgement with regard to the maximum uses/demand level to be allowed for, the allowable risk of service factor or the cost of service failure. This must be balanced against inventory cost to determine appropriate level of safety stock.

Determination of safety stock is thus one of the crucial problems of inventory control. The best level of safety stock for a given item depends on how much a stockout costs and on the

variability of usage rates and delivery times. “If the usage rate and delivery time can be forecast with a high degree of accuracy and if the cost of stockout is estimated to be small, then little or no safety stock will be needed. If circumstances are not so favourable, then a significant investment in safety stock will be desirable. Since a financial manager has to see that money invested in inventory should earn at least the cost of capital, total avoidance of stockout by maintaining large stock may not be the best solution”⁹. As the uncertainties are unpredictable, there is no accurate method of determining what should be the most economic safety stock. The most advantageous amount of safety stock to carry depends on the situation, because the cost of carrying safety stock should be compared to the benefits it provides.

Service Level : “Service level can be defined as the percentage of total demand value which can be satisfied when it occurs.”¹⁰

Another definition of the service level is that it is the percentage of order intervals during which no stockout occurs. In practice both plants due to a number of limitations and constraints fail to ascertain the total cost of maintaining a service level cannot be ascertained. Thus the organization can establish its service level requirement on the basis of judgement only. Buffer stock is determined using statistical methods.

- (i) Situation where demand rate varies.

$$\text{Buffer Stock} = (\text{Lead time}) \times (\text{Maximum demand rate} - \text{Average demand rate})$$

- (ii) In cases where both lead time and demand rate are fluctuating, then

Buffer stock to meet abnormal demand = (Maximum lead time × maximum demand rate) – (average lead time × average demand rate)

(iii) In case lead time varies and demand rate is uniform. Buffer stock = (Maximum lead time – Average lead time) × Demand rate

Thus all the items are equally important from production point of view. Shortage of a few paise bolt may be one of the causes for stopping the production process and which may cost heavily. Shortage may occur even when accurate and realistic order points have been computed. Safety stock is provided to safeguard against these shortages. Safety stock should be less for high consumption value items. The possibility of stockouts can considerably be cut down by closer forecasting, frequent reviewing and more processing. Low consumption value items, on the contrary, should have sufficient safety stock to reduce the cost probability of stockouts. A moderate policy is required for moderate value items. Safety stock should neither be too high nor too low.

Every inventory is a link in a chain of inventories stretching from the point of raw-material extraction to the point of consumption. No single index serves to describe the performance of an inventory. Three interrelated factors must be considered in rating the performance, namely (i) the size of inventory in money or unit amounts, averaged over the period. (ii) cost of replenishment i.e. the total re-order cost for purchased goods or setup costs for manufactured goods over the period. (iii) the degree to which it provides stock when demanded i.e. service level-average stock available in money/unit terms-expressed as a fraction of amount demanded.

References

1. Sarkar D.N., Stock Accounting and Control, Academic Publishers, Calcutta, 1971, p. 120.
2. Patel M.D., Chenuwala S.A., Patel D.R., Integrated Material Management, Himalaya Publishing House, Bombay, 1984 p.111
3. Kulkarni, P.V., Financial Management, A Conceptual Approach, Himalaya Publishing House, Bombay, 1981, p. 69.
4. Agarwal, K.K., Inventory Management, Kanishka Publisher and Distributors, 9/2325, Kailash Nagar, Delhi 1993, p. 112.
5. Whitin Thomson, The Theory of of Inventory Management, Princeton University press, New Jersey, 1992, p. 97.
6. Ritchie William E. : Production and Inventory Control. Ronald Press Co. New York, 1995, p. 403.
7. Render, Stair, Hanna, Quantitive Analysis for Management, Pearson Education Pvt. Ltd., Branch Patparganj - 482 Delhi, 2003, pp. 210-211.
8. Kulkarni, P.V., op. cit. 70
9. Panneersclvam R., Production & Operation Management, Prentice Hall of India Pvt. Ltd., New Delhi, 1999, p. 98.
10. Magee, J.F. : Production Planning and Inventory Control, McGraw-Hill Book Co., Inc.; New York 1995, p. 201.