Chapter VI

Tools and Techniques of Inventory Management

The various concepts of inventories like inventory: a major cost component, lead time influences on inventories and productivity of inventories have been discussed in the fifth chapter.

The basic problem of inventory management is to strike a balance between the operating efficiency and the cost of investment and other associated costs with large inventories, with the object of keeping the basic conflicts at the minimum while optimizing the inventory holding. The decisions as to which item to make and when to keep inventories in balance require application of a wide range of techniques from simple graphical methods to more sophisticated and complex quantitative techniques. Many of these techniques employ concepts and tools of mathematics and statistics and make use of various control theories from engineering and other fields. They are primarily aimed at helping to make better decisions and getting people employed and follow a wiser policy.
Inventory Management Techniques

Various techniques applied for inventory management are as follows:

(1) Selective Inventory Control
(2) Setting of Various Stock Levels
(3) Systems of Inventory Control
(4) Economic Ordering Quantity or E.O.Q. Formula
(5) Re-order Point and Safety Stock
(6) Application of Computers for Inventory
(7) Just-in-Time Inventory Management
(8) Inventory Audit.

(1) Selective Inventory Control

Effective inventory management requires understanding and knowledge of the nature of inventories and, to gain this understanding, some analysis and classification of inventory are required. They are:

(a) A.B.C. Analysis
(b) H.M.L. Analysis
(c) X.Y.Z. Analysis
(d) V.E.D. Analysis
(e) F.S.N. Analysis
(f) S.D.E. Analysis
(g) G.O.L.F. Analysis
(h) S.O.S. Analysis.
### Table 6.1
**Classification of Inventories**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Title</th>
<th>Basis</th>
<th>Main use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A.B.C. (Always Better Control)</td>
<td>Value of consumption</td>
<td>To control raw material components and work-in-progress inventories in the normal course of business</td>
</tr>
<tr>
<td>2.</td>
<td>H.M.L. (High, Medium Low)</td>
<td>Unit price of the material</td>
<td>Mainly to control purchases</td>
</tr>
<tr>
<td>3.</td>
<td>X.Y.Z.</td>
<td>Value of items in storage</td>
<td>To review the inventories and their uses at scheduled intervals</td>
</tr>
<tr>
<td>4.</td>
<td>V.E.D. (Vital, Essential Desirable)</td>
<td>Criticality of the component</td>
<td>To determine the stocking levels of spare parts</td>
</tr>
<tr>
<td>5.</td>
<td>F.S.N. (Fast moving, Slow moving, Non-moving)</td>
<td>Consumption pattern of the component</td>
<td>To control obsolescence</td>
</tr>
<tr>
<td>6.</td>
<td>S.D.E. (Scarce, Difficult, Easy to obtain)</td>
<td>Problems faced in procurement</td>
<td>Lead time analysis and purchasing strategies</td>
</tr>
<tr>
<td>7.</td>
<td>G.O.L.F. (Government, Ordinary, Local, Foreign Sources)</td>
<td>Source of the material</td>
<td>Procurement strategies</td>
</tr>
<tr>
<td>8.</td>
<td>S.O.S. (Seasonal, Off-Seasonal)</td>
<td>Nature of supplies</td>
<td>Procurement/holding strategies for seasonal items like agricultural products</td>
</tr>
</tbody>
</table>

The motive behind the above analyses and classifications is to tackle important aspects more rigorously. Moreover, an equally critical analysis of all items will be very expensive and will have a diffused effect regardless of priorities. Table 6.1 shows the available classifications, their bases and their uses.

A.B.C. Analysis

The method follows the general principles of Pareto (Wilfredo Pareto, Italy, 1896) that "in any series of elements to be controlled, a selected small fraction in terms of numbers of elements would always account for a large fraction in terms of effect." With some practices, the limits of 'A', 'B' and 'C' can be easily determined by a Pareto Analysis; namely 'A' items do not exceed more than 70 per cent of the investment, 'B' items account for only a moderate share, and 'C' items for less than 10 per cent of total investment.

The A.B.C. Analysis is a rational approach for determining the degree of control that should be exercised on each item in inventories. Obviously, 'A' class items should be subjected to strict management control under either continuous review or periodic review with short review cycles. 'C' class items require little attention and
can be relegated down the line for periodic review say, just once a year. Control over 'B' class items should be somewhere in-between.

The method of A.B.C. classification for managing inventories has been adopted in the public sector electrical industrial units in Kerala. Inventories of these undertakings are classified into various categories on the basis of their importance, namely their value and frequency of replenishment during a period. One category called group 'A' items, consists of only a small percentage of the total items handled but has a combined value that constitutes a major or large portion of the total stock holding of the concern. The second category consisting of group 'B' items is relatively less important. The third category consisting of 'C' items is of least importance, i.e., the group consists of a very large number of items, the value of which is not very high.

A.B.C. Analysis of UEI

For the purpose of A.B.C. classification of inventories and the method of control to be adopted for each category of items, the company first of all lists out all the items of inventory and values of each item. The value is obtained by multiplying the average annual consumption of an item during
a period by its unit cost. The items in the list are then rearranged in the descending order of their values irrespective of their quantities. Thus 200 kg. of an item valued at ₹.2,00,000/- should be ranked earlier than 20,000 kg. of another item, the value of which is ₹.18,000/-. A running total of all the values is then taken. It is found that a large percentage of the total value is covered by the first few items in the list. They are grouped in the 'A' category, the next few items which have the next least value under 'B' group and the last value items are grouped under 'C' category. So, by controlling the 'A' group items only, a better inventory control is possible. Table 6.2 shows the classification of inventories and its annual consumption value of the United Electrical Industries Limited.

An analysis of the annual consumption of the UEI shows that 80 per cent of the total number of items are under category 'A'. Similarly five per cent of the total annual consumption value accounts for more than 70 per cent of the total number of items under category 'C' and 15 per cent of the total annual consumption value accounts for nearly 20 per cent of the total number of items under category 'B'. Table 6.3 shows the above characteristics.
### Table 6.2

#### Classification of Inventories and its Annual Consumption Value of United Electrical Industries Limited

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of Item</th>
<th>Annual Consumption Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>A Group</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Magnet</td>
<td>74,00,000</td>
</tr>
<tr>
<td>2.</td>
<td>41 S.N.G.</td>
<td>55,00,000</td>
</tr>
<tr>
<td>3.</td>
<td>Lamination</td>
<td>41,00,000</td>
</tr>
<tr>
<td>4.</td>
<td>Brass Terminals</td>
<td>22,00,000</td>
</tr>
<tr>
<td>5.</td>
<td>Magnet Yoke</td>
<td>10,00,000</td>
</tr>
<tr>
<td></td>
<td><strong>B Group</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Copper Strips</td>
<td>73,000</td>
</tr>
<tr>
<td>2.</td>
<td>M.S. Screws H1</td>
<td>72,000</td>
</tr>
<tr>
<td>3.</td>
<td>Sealing Led</td>
<td>71,000</td>
</tr>
<tr>
<td>4.</td>
<td>Press-Phan Sheet</td>
<td>70,000</td>
</tr>
<tr>
<td>5.</td>
<td>Charcoal</td>
<td>68,000</td>
</tr>
<tr>
<td></td>
<td><strong>C Group</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Grinding Wheel</td>
<td>14,000</td>
</tr>
<tr>
<td>2.</td>
<td>Leather Glouse</td>
<td>14,000</td>
</tr>
<tr>
<td>3.</td>
<td>Screw Drivers</td>
<td>13,000</td>
</tr>
<tr>
<td>4.</td>
<td>Insulation Tape</td>
<td>12,000</td>
</tr>
<tr>
<td>5.</td>
<td>Acid</td>
<td>11,000</td>
</tr>
</tbody>
</table>

Source: Annual Consumption File, U.E.I.
Table 6.3

A.B.C. Analysis of United Electrical Industries Limited

<table>
<thead>
<tr>
<th>Class</th>
<th>Number of Item (% of total)</th>
<th>Value of Item (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>80</td>
</tr>
<tr>
<td>B</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>C</td>
<td>70</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Annual Consumption File, U.E.I.

Table 6.3 is depicted graphically in Figure 6.1.

(2) Setting of Various Stock Levels

The various stock levels fixed for effective management of inventories are maximum level, minimum level, ordering or reorder level and danger level. These levels serve as indices for initiating action on time so that the quantity of each item of material, i.e., the inventory holding is controlled.

Stock levels are not fixed on a permanent basis but are liable to revision in accordance with the changes in the factors determining the levels.
Figure 6.1

A B C Analysis in U.E.I

- A Items: (10% of items - 80% of value)
- B Items: (20% of items - 15% of value)
- C Items: (70% of items - 5% of value)
The formulae used for fixing various levels are:

**Maximum Level**

\[
\text{Maximum Level} = \text{Re-order level} - \frac{\text{Expected minimum} + \text{Re-order consumption in quantity units during minimum weeks to obtain delivery}}{2}
\]

**Minimum Level**

\[
\text{Minimum Level} = \text{Re-order level} - \left(\text{Average usage per period} \times \text{Average time to obtain delivery}\right)
\]

**Re-order Level**

\[
\text{Re-order Level} = \text{Maximum re-order period} \times \text{Maximum usage}
\]

**Average Stock Level**

\[
\text{Average Stock Level} = \frac{\text{Maximum level} + \text{Minimum level}}{2}
\]

Danger level is fixed usually below the minimum level. When the stock reaches this level, very urgent action for purchase is indicated. This presupposes that the minimum level contains a cushion to cover such contingencies.

**Procedure of Determining Stock Levels in UEI**

In UEI the stock control is made on the basis of three levels such as:

(a) Minimum level

(b) Maximum level

(c) Mean level.
A safety stock (minimum stock) is maintained for each stock item to provide a cushion for the following emergencies:

(i) Supplies being delayed beyond normal lead time.
(ii) Consumption rate exceeding estimated average rate.

(a) Minimum Level

A formula which is used by the company for fixing minimum level is:

\[
S_{\text{min}} = (C_{\text{max}} \times L_{\text{max}}) - (C_{\text{av}} \times L_{\text{av}})
\]

Where

- \( S_{\text{min}} \) = Minimum stock
- \( C_{\text{max}} \) = Maximum rate of consumption per month
- \( L_{\text{max}} \) = Average rate of consumption per month
- \( C_{\text{av}} \) = Maximum lead time in month or maximum period between two consecutive phased supplies
- \( L_{\text{av}} \) = Average lead time.

(b) Maximum Level

Maximum stock is the minimum stock plus the phased supply quantity plus one or two months consumption (to allow for receipt of the phased supply arriving ahead of the expected time or before the stock reaches the minimum level).
If the actual stock of any item exceeds the maximum level then the next phased supply is deferred or revoked as found necessary.

Formula used for fixing maximum level is

\[ S_{\text{min}} = (C_{\text{max}} \times L_{\text{max}}) + Q_a + B \]

Where

- \( S_{\text{min}} \) = Minimum stock
- \( C_{\text{max}} \) = Maximum consumption per month
- \( L_{\text{max}} \) = Maximum lead time
- \( Q_a \) = Quantity receivable for phased supply against annual indent.
- \( B \) = Extra quantity to be provided for special indent.

(c) Mean Level

Mean level is the average of maximum and minimum stock levels. In UEI in the case of 'B' items a review of the next phased supply is made when stocks in hand touch this mean level and necessary action is taken as follows:

(i) If the stocks are not adequate to meet the requirements till the expected time of receiving the next phased supply, the next phased supply will be advanced or extra quantity will be procured by special indent.
(ii) If the receipt of the next supply is likely to result in exceeding the maximum level, the next supply will be deferred or the quantity reduced. It is found that stock levels are fixed for all the stores items on the basis of anticipated annual consumption by January of every year.

The formula used for fixing mean level is:

\[
S_{con} = \frac{S_{\text{max}} + S_{\text{min}}}{2}
\]

Where

- \(S_{con}\) = Control stock level
- \(S_{\text{max}}\) = Maximum stock
- \(S_{\text{min}}\) = Minimum stock

Ready reckoner tables for fixing maximum, minimum and average stock levels are given in Appendixes 6.1, 6.2 and 6.3.

(3) Systems of Inventory Control

The main systems of inventory control are:

(a) Perpetual Inventory (Automatic Inventory) System
(b) Double Bin System.
(a) **Perpetual Inventory System**

The control of inventories while in storage is effected through what is known as the perpetual inventory. Thus the two main functions of the perpetual inventory are:

(i) Recording store receipts and issues so as to determine at any time the stock in hand, in quantity or value or both, without the need for physical count of stock.

(ii) Continuous verification of the physical stock with reference to the balance recorded in the stores records, at any frequency, as convenient for the management.

In KEL, TELK and UEI, a senior clerk is responsible to the cost accountant for organising perpetual verification of the stores. Various stocks which come under A.B.C. classes are checked in the following ways:

- **Class 'A' items** — Three times per year
- **Class 'B' items** — Once a year
- **Class 'C' items** — Once in every two years.

But in the Metropolitan Engineering Company Limited and the Traco Cable Company Limited, the assistant production manager is responsible for organising perpetual verification of the stores. Various stocks of these units that come under A.B.C. classes are verified in the following manner.
Class 'A' items - Two times per year
Class 'B' items - Once in every two years
Class 'C' items - Once in every three years.

Physical verification of an item is carried out when the stock is at minimum so that the quantity checked is as small as possible. The programme for verification is arranged in such a way that physical checking is carried out just prior to the next anticipated phased supply. Whenever feasible, incoming supplies are stored and stocked separately and will not be issued out until the earlier stocks are completely exhausted.

Perpetual inventory system consists of:
(i) Bin cards
(ii) Stores ledger, and
(iii) Continuous stock taking.

(i) Bin Cards

Bin cards are printed cards used for accounting stock of materials in store. For every item of materials separate bin cards are kept by the concerns (Figure 6.2).
Figure 6.2
Specimen of Bin Card in U.E.I

<table>
<thead>
<tr>
<th>DATE</th>
<th>REF. No</th>
<th>SUPPLIER'S NAME</th>
<th>RECEIPTS</th>
<th>ISSUES</th>
<th>RATE</th>
<th>BALANCE</th>
<th>INITIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>QUANTITY</td>
<td>AMOUNT</td>
<td></td>
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</tbody>
</table>

Source: Annual Consumption File, U.E.I
Details regarding the material such as name of material, part number, date of receipt and issue, reference number, name of supplier, quantity received and issued, value of material, rate, balance quantity etc., are recorded in the bin cards. The bin cards are kept in the bin serially according to part number of the component. At the end of the financial year the balance quantity in the bin cards is taken as closing stock, and it is valued at rates in the bin cards.

Bin Card Valuation

Stocks in the public sector electrical industrial units in Kerala are valued under the weighted average system. In this system, the average rate of the item is arrived at by taking into account the value of previous stock. The quantity of the previous stock is added to the receipt. The total value of the previous stock and new receipt is divided by the total quantity. The resultant figure is the weighted average rate of that item, i.e.,

\[
\text{Weighted average} = \frac{\text{Value of stock in hand} + \text{Value of the materials received/purchased}}{\text{Quantity of material in hand} + \text{Quantity of material received/purchased}}
\]
(ii) Stores Ledger

Like bin cards, stores ledger is maintained to record all receipts and issues in respect of materials with the difference that along with the quantities, the values are entered in the receipt, issue and balance columns. Additional information as noted in the bin cards regarding quantity on order and quantity reserved, together with their values may also be recorded in the stores ledger.

(iii) Continuous Stock Taking

The perpetual inventory system is not complete without a systematic procedure for physical verification of stores. The bin cards and stores ledger record the balances but their correctness can be verified by means of physical verification only.

There is a proper procedure for the physical verification of stocks in the public sector electrical industrial units in Kerala. The excess/shortage found in the verification is reported to higher authorities for action and to avoid differences in stock.
In the Auditors Report for the financial year 1990-91, it is recorded that "the procedures of physical verification of stocks followed by the management are reasonable and adequate in relation to the size of the undertakings and the nature of its (sic) business. The discrepancies as shown by the records, between the physical stocks and the book stocks, which were not material, have been properly dealt with in the books of account."

Physical Verification Report

It is necessary to record the result of stock verification in a separate record or report (Figure 6.3). These reports are maintained date-wise so that when arranged together they give a chronological list of the items verified. The quantity actually found on stock verification is noted in the proper column by the stock verifier who also enters the verification report, the balance on date as shown in the bin card. The report, is then sent to the stores ledger clerk who enters the balance as recorded in the stores ledger. Thus for each item of store in the stock verification report, there are three sets of entries for the quantity (Figure 6.3).
Value Analysis

Value analysis is a recently developed technique in the UEI, TELK and KEL to obtain optimum benefit from materials. This implies the minimizing of the value of materials consumed which, in turn, enables reduction of the inventory to be carried out.6

Value analysis investigation is usually carried out every year for 'A' and 'B' items in order to:
(i) minimize its consumption
(ii) substitute it with cheaper materials in all or some of the application for which it is presently used.

Disposal of Surplus and Deteriorated Items

In the UEI, TELK and KEL, a committee is formed for the disposal of surplus and deteriorated items whenever required.

(b) Double Bin System

Double bin system is a recently developed technique in the KEL in respect of low consumption value items i.e., items belonging to class 'C' in A.B.C. analysis. This system separates the stock of each item into two bins, one to store the quantity equal to minimum quantity and the
other to store the remaining quantity. The staff has instructions not to use the quantity in the smaller portion as long as there is stock in the other portion. As soon as it becomes necessary to use the quantity marked as minimum, it is a signal to place new orders. When the fresh order is received, the minimum quantity is segregated.

Double bin system is ideal for items for which demand and lead time are fairly regular and established. It also avoids the necessity of taking physical inventories as in the case of perpetual inventory system. Since the storekeeper knows automatically when to initiate replenishment action, this being the time when he is forced to dip his hand into the minimum stock bin.

In the fixed order quantity or double bin system, there is built-in safety in that the replenishment interval between two successive orders varies and hence adequate arrangements are required to take care of variations in the rate of demand. If the usage rate rises, the re-order level is reached earlier than expected so that the replenishment interval is shortened. On the other hand, if the rate of usage goes down the replenishment interval is lightened. In either case, safety stock has to provide protection against variation in demand in lead time only.
This is explained with the following illustration relating to an item of low consumption value on which replenishments are obtained.  

Let  

Expected monthly usage of the item = 200 units  
Provision of safety stock at 2 months supply = 400 units  
Lead time for procurement of the item = 3 months  
Order quantity at 6 months supply = 1200 units  
Actual monthly usage in a period of 6 months = 300 units  

Here order level is 1000 units comprising 400 units of safety stock and 600 units of expected usage during the lead time of three months. As a result of rise in usage rate, the position would be as shown in Figure 6.4. The re-order level will be reached after two months in lieu of the expected three months. A fresh order will then be placed for 1200 units. The shipment will arrive after another three months, i.e., at the end of the fifth month. By that time $5 \times 300 = 1500$ units will have been consumed. In other words, all of the 1,200 units of working inventory and 300 units of safety stock will be consumed by the time the new shipment arrives. The amount of safety stock at the time of receiving fresh supplies will be 100 units. The safety stock will be largely eaten up but there will be no stock out.
Figure 6.4
Double Bin System in KEL

EXPECTED MONTHLY USAGE = 200 UNITS
LEAD TIME = 3 MONTHS
RE-ORDER QUANTITY LEVEL = 1000 UNITS
ACTUAL MONTHLY USAGE = 300 UNITS
(4) Economic Ordering Quantity or E.O.Q. Formula

In the fixed order quantity system the re-order quantity is the economic order quantity that is fixed in such a manner that would minimize the total variable cost of managing the inventory. The various components of this cost are as follows:
(a) Procurement cost (this includes administrative and provisioning costs)
(b) Storage cost (this includes carrying, handling etc.)
(c) Stock out cost (this may be laid down by management according to its policy).

The appropriate term economic order quantity appears to be "economic lot size" meaning thereby the quantity that should be accepted per occasion so as to make the inventory procurement cost equal to the inventory carrying cost.8

A company is said to be on a point of minimum cost when its ordering cost is just equal to the carrying cost. In other words, a company should neither store excess quantity of material nor should it frequently place too many orders for the same material. When unit price is same regardless of the quantity purchased, the following formula is used. Then it is found that the order quantity varies in proportion to the square root of the demand. There are indices given on scientific basis to order quantity, keeping in view the position costs of inventories,
viz., the set up costs, ordering costs and carrying costs. This is known as Economic Order Quantity (EOQ) or Square Root Formula, developed by R.H. Wilson around the thirties and may be modified according to necessity. 

\[
\text{EOQ or } D = \sqrt{\frac{2Q(a)}{c}}
\]

Where

- \( Q \) = Annual requirement in units
- \( a \) = Unit cost of placing an order
- \( c \) = Annual carrying cost
- \( D \) = Optimum lot quantity or batch size.

This can be verified with reference to the following table assumptions:

Cost of each article is one rupee. Annual demand is 40,000 units. Cost of carrying inventory is 20 per cent. Cost per order is ₹.10/-. Using the formula

\[
D = \sqrt{\frac{2Q(a)}{c}}
\]

\[
D = \sqrt{\frac{2 \times 10 \times 40,000}{1 \times 0.20}}
\]

\[D = \sqrt{40,000,000}\]

\[D = 2,000 \text{ units.}\]
Here the economic order quantity is 2,000 units. When EOQ is 2,000 units, the number of orders to be placed in a year is 20 and the total cost is ₹.400/- (both total ordering cost and inventory carrying cost are the same, i.e., ₹.200/- + ₹.200/-) (Table 6.4).

Table 6.4

<table>
<thead>
<tr>
<th>Number of orders placed</th>
<th>Order Quantity</th>
<th>Average Stock Holding</th>
<th>Inventory Carrying Cost (₹.)</th>
<th>Ordering Cost (₹.)</th>
<th>Total Cost (₹.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40,000</td>
<td>20,000</td>
<td>4,000</td>
<td>10</td>
<td>4,010</td>
</tr>
<tr>
<td>2</td>
<td>20,000</td>
<td>10,000</td>
<td>2,000</td>
<td>20</td>
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</tr>
<tr>
<td>3</td>
<td>13,333</td>
<td>6,667</td>
<td>1,333</td>
<td>30</td>
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<td>5,000</td>
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</tr>
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</tr>
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</tr>
<tr>
<td>15</td>
<td>2,667</td>
<td>1,334</td>
<td>267</td>
<td>150</td>
<td>417</td>
</tr>
<tr>
<td>20</td>
<td>2,000</td>
<td>1,000</td>
<td>200</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>25</td>
<td>1,600</td>
<td>800</td>
<td>160</td>
<td>250</td>
<td>410</td>
</tr>
<tr>
<td>30</td>
<td>1,333</td>
<td>667</td>
<td>133</td>
<td>300</td>
<td>433</td>
</tr>
</tbody>
</table>

The graphical presentation of the behaviour of ordering and carrying costs is shown in Figure 6.5.
Figure 6.5

Behaviour of Ordering and Carrying Costs
(5) Re-order Point and Safety Stock

The computation re-order point in the public sector electrical industrial units in Kerala is expressed in terms of number of units per day, multiplied by the lead time in days with adjustments to provide safety stock. Thus the formula followed is:

Re-order point

= Average daily usage x lead time in days + safety stock

Safety stock refers to extra inventory held as a protection against the possibility of a stock out. Stock outs are not only costly but also highly embarrassing to the concern. Thus the safety stock is to be provided to avoid stock out situation that may arise due to unforeseen increase in the rate of consumption during lead time and also increase in the lead time itself.

The problem of safety stock usually does not occur with regard to certain items which are readily available from local sources and those for which substitutes are available. Therefore, the level of safety stock of an item would depend upon whether its shortage would promptly be met, and if not what the stock out cost would be.
The quantity of safety stock to be carried depends upon how much of safety is to be secured or stock outs incurred. Instances are not rare in the public sector electrical industrial units in Kerala where at each level of decision making, an adhoc safety of 10 per cent is added. Such an approach will automatically result in undue overstocking. A larger inventory of safety stock means higher inventory carrying cost. While fixing safety stock in these industrial units the following considerations are to be made:

(a) Analysis of lead time in terms of fluctuations.
(b) Usage behaviour—study of fluctuations in rate of consumption.
(c) Importance of the item in the manufacturing programme.
(d) Frequency of the suppliers not honouring commitments on delivery.
(e) Stock out cost.

Safety stock level can also be determined through statistical formula, although there is a good deal of controversy regarding its outright application. There are two commonly employed probability approaches to inventory control in which demand varies. They are:

(a) Fixed Quantity-Variable Cycle System, and
(b) Fixed Cycle-Variable Quantity System.
Fixed quantity-variable cycle system considers buying a fixed lot size at varying intervals. The fixed quantity may be determined by the use of the EOQ formula. This approach is most often used for medium and low value items, where lesser control is allowable.

Fixed cycle-variable quantity system is followed for controlling of high value, critical and rapidly depreciable inventory items where close control is a must. Under this system, it is necessary to vary the lot size as demand changes, while keeping the interval for placement orders constant.

Figure 6.6 demonstrates how inventory should fluctuate when forecasts of lead time and usage are accurate. When stock level reaches the order point 'P', the quantity to be ordered is 'Q'. It arrives exactly when stock reaches 'zero' balance. The maximum stock, therefore, is 'Q' and the minimum stock is 'Zero'. In such ideal conditions, there would be no fear of shortages and no need for safety stocks. A fixed amount would be re-ordered at fixed intervals.
Figure 6.6
Fluctuation of Inventory

```
MAXIMUM STOCK (Q)

Q
P

RE-ORDER LEVEL

MINIMUM STOCK (ZERO)

TIME
```

QUANTITY
(6) Application of Computers for Inventory

The scope of application of computers in areas like inventory management is really immense. But very few of the public sector electrical undertakings in India have applied the computer for inventory management and other decision making purposes. The bulk of the applications are in the areas of mundane pay-roll accounting and billing where the computer has been turned into an efficient clerk and printing machine.

Regular inventory management operations can be easily computerised. With the basic issues and receipts document, the materials ledger can be kept up-to-date. Inventory planning, material budgeting and inventory valuation can be very efficiently computerised. Applications such as bill of materials, A.B.C., X.Y.Z. and F.S.N. analysis can be done periodically. Similarly, the minimum, maximum and safety stock levels can be fixed with the help of computers. Moreover, if the manual or mechanised system has been properly designed, the implementation of a computerised system will not pose any problem.

The changeover from a mechanised to a computerised system depends on the volume of the work involved.
On an average, about one per cent to two per cent of the turnover can be spent on data processing. If a computer facility can undertake to perform the required job at this cost, the change over would be advisable. In addition to the job performed by the mechanised process, the computer's access to memory can store data.

The computerised systems for managing inventories have not so far been introduced in the public sector electrical industrial units in Kerala.

(7) Just-in-Time Inventory Management

Many successful Japanese companies use a radically different manufacturing philosophy popularly and descriptively termed "just-in-time". It is not just a battery of technique but a grand manufacturing philosophy. The purpose behind the technique is to eliminate waste—not only the conventional form of waste such as scrap, rework and equipment downtime, but also excess lead time, overproduction and poor space utilisation.
JIT as a philosophy has apparently worked well in Japanese manufacturing context but its applicability in the public sector electrical industrial units in Kerala needs to be investigated.\textsuperscript{11} The basic principal of this philosophy is to produce at each manufacturing stage only the necessary products at the necessary time in the necessary quantity to hold the successive manufacturing stages together. It provides a smoother production flow with the goal to achieve a single unit lot size. An organisation cannot adopt JIT in isolation from its environment—both internal and external. Hence it is important to identify the environmental parameters relevant to the success of JIT programme.

\textbf{A Comparison of the Japanese and the Indian Situation}

JIT has been developed and implemented in Japan. The system of production and quality management that the Japanese have developed has deep cultural and national roots. Hence a comparison of Japanese and Indian industries will help examine the applicability of JIT in Indian environment and also identify the possible problem areas and steps to be taken to tackle those problems. Table 6.4 shows the comparison of attributes in Japanese and Indian industries.\textsuperscript{12}
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Category</th>
<th>Japanese Industry</th>
<th>Indian Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Takes pride in his company high level of motivation.</td>
<td></td>
<td>Usually does not identify himself with the company, comparative lack of motivation.</td>
</tr>
<tr>
<td></td>
<td>High literacy</td>
<td></td>
<td>Literacy low.</td>
</tr>
<tr>
<td></td>
<td>b. Enterprise Union (Japan is a homogenous society)</td>
<td></td>
<td>b. Interaction between the people at various levels.</td>
</tr>
<tr>
<td>2.</td>
<td>Plants</td>
<td>High-level of automation; CAD/CAM robotics used.</td>
<td>Very less automation; CAD/CAM robotics largely absent.</td>
</tr>
<tr>
<td></td>
<td>Group Technology present</td>
<td></td>
<td>Group Technology absent.</td>
</tr>
<tr>
<td></td>
<td>Autonomous Machining, 100% inspection used.</td>
<td></td>
<td>These techniques absent.</td>
</tr>
<tr>
<td></td>
<td>Lighted displays to highlight trouble spots are used.</td>
<td></td>
<td>Not used</td>
</tr>
</tbody>
</table>
Companies have their own tool makers to build machines. Machines brought from outside usually on the basis of what is available.

Orderliness, cleanliness and arrangement practised

Comparatively untidy and disorganised.

3. Quality Control

Quality at the source, defect prevention.

Statistical sampling after lot has been produced, defect detection.

Workers and Foremen have primary responsibility for quality.

Quality is the responsibility of Quality Control Department.

100% quality present.

Absent.

4. Production Management

Kanban (Pull System).

MRP (Push System).

Preventive maintenance.

100% preventive maintenance absent.

Production line slow up for quality problems, speed up when quality is right.

Production line runs at fixed rate; quality problems are sent offline.

5. Product and its Value

Customer oriented product, provides real value.

R & D lacking, product designs depend upon what is available rather than what the customer demands.

Belief in large term gains, low profit margin.

Strive for shorter term gains.

The various problems identified and imperative to be tackled in the public sector electrical industrial units in Kerala for the implementation of JIT are:

(a) Reduction of set-up times
(b) Kanban system
(c) Delivery (from vendor) of exact quantity on exact time
(d) Preventive maintenance, and
(e) Group technology.

All these problems can be tackled only with a very serious planned effort. Workers motivation and literacy need to be enhanced. These are important for reducing set-up time and introducing Kanban systems. Moreover, the involvement and commitment of top management are needed to bring a drastic change in the working environment and change of attitude in people. These changes are difficult but possible.

As there are wide differences in the operating environments of Japanese and Indian industries, the work environments in the public sector electrical industrial units in Kerala are to be improved before the implementation of JIT. It requires almost 10 to 20 years.
(8) **Inventory Audit**

The public sector electrical industrial units in Kerala, particularly face the problem of inventory build-up and consequent locking up of capital. This calls for an inventory audit. The main aspects of this audit may comprise:

(a) The testing and the appraisal of the policy to be pursued by the industrial unit regarding inventory forecasting, planning and control.

(b) Appraisal of inventory valuation method.

(c) Testing and appraisal of the inventory forecasting and planning models.

(d) Testing and appraisal of control aspects.

(e) Testing the maintenance aspects of inventory as well as inventory records.

Like internal audit, the inventory audit should also be made a routine feature of the industrial units and has to be done with qualified hands within the organisation as by an outside inventory audit team.

During inventory audit, certain items should be audited with due care to effect economy in the organisation. They are:
(a) raw materials
(b) work-in-progress
(c) finished goods
(d) stores and spare parts
(e) loose tools and others, and
(f) by-products and scraps.

Inventory audit of an industrial unit is to be chalked out with the following programmes (Figure 6.7):

(a) Auditing the process of manufacture
(b) Audit of raw materials
(c) Audit of stores and spares
(d) Auditors observations and conclusions.

(a) Auditing the Process of Manufacture

The cost auditor should be aware of the technical aspects of the process of manufacture of the main products and by-products and scraps of the industrial unit under audit. He should account the cost aspects involved in the process of manufacture and try to evaluate the possibility of effecting economy of the costs involved in the process of manufacture.
Figure 6.7
Inventory Audit Programme

(b) Audit of Raw Materials

The cost auditor should ascertain whether the industrial unit follows standard purchase procedure for purchasing of raw materials. The cost of major raw materials consumed both in terms of quantity and value should be technically evaluated with similar firms in the industry. This will bring into light the ways and means of utilising scarce resources in a fruitful manner. The quantity and value of imported and indigenous raw materials used in the manufacturing process and/or production purposes may be reviewed and the usage of main raw materials should be evaluated.

The non-moving materials from one to five years should be seriously viewed and a report covering all the above aspects is to be prepared.

(c) Audit of Stores and Spares

The procurement and utilisation of stores and spare parts should be carefully gone through for effecting savings. The movement of stores and spare parts at different intervals should be audited. It should be ascertained whether scientific method of procuring is followed. The non-moving items for more than two years and
the action taken by top management to avoid such redundant investments should be audited. The type of stores and spare parts for want of which production is affected often should also be audited and reported.

(d) Auditors Observations and Conclusions

The cost auditor should observe the following with respect to the inventory audit:

(i) Whether the firm's funds have been used in a negligent or inefficient manner.

(ii) Whether factors due to inventories which could have been controlled but not done resulted in increase in cost of production.

(iii) Whether contracts/agreements relating to purchasing/selling of inventory items had any undue benefits.

(iv) Whether improvement in performance is possible by rectification of general imbalance in production facilities or by concentration on areas offering scope for cost reduction and increased productivity.

(v) Whether improved inventory policies will be useful for effecting improvement and savings in inventory.
Conclusion

The public sector electrical industrial units in Kerala have adopted certain efficient techniques like A.B.C. analysis, perpetual inventory etc., for controlling their inventories. But with the advent of Electronic Data Processing, better selective inventory control measures are available the adoption of which will lead to better control of inventory at a reduced amount of investment. The just-in-time inventory control technique can be implemented only after improving the work environment. The control measures such as EOQ and fixing of material stock levels are not strictly adhered to by the industrial units. So it results in high inventory cost.
Notes


3 Colin, D. Lewis, Demand Analysis and Inventory Control (Great Britain: Saxon House, 1975) p.91.


7 Chadda, R.S., Inventory Management in India (New Delhi: Allied Publishers Pvt. Ltd., 1968) p.171.


12 ibid., pp.251-256.