Inventory control an important aspect in paper industry

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SUMMARY

Per capita consumption of Paper and Board, excluding Newsprint, being approximately 1.5 Kg., we are at bottom of the ladder. Per capita demand can be expected to rise to about 2.5 Kg. by 98 -89 provided the present installed capacity of about 1.25 million tonnes per annum is augmented by an additional capacity of about 1 25 million tonnes per annum. In the monetary value over the next 7 to 8 years, we have to raise the resources for additional investment to the tune of Rs. 2.000 Crores. Both these are essential if the paper famine is to be avoided in the next decade.

Existing Paper MIlls in our Country have a large capital locked up in the form of invêntory. On net sales ot paper worth Rs 500 Crores, it is estmated that the capital locked up in inventory is around Rs. 100 to 150 Crores i. e. 20% to 30%.

In an analysis carried by the "Economic Times of India" over 18 large paper mills, it has been revealed that for a net sales of Rs. 41,517 lakhs, the expenditure towards rawmaterials and other manufacturing items is Rs. 20,389 lakhs, which comes out to be about 49% of net sales, while the inventory locked up in these industries comes out to be Rs. 8,926 lakhs i.e. about 21.5%, excluding the finished goods and work-in-progress inventory. Comparative figures showing the inventory as percentage of net sales of 11 major Paper Mills are given below, which clearly indicates that on an average 27% of net sales value is locked up in these industries as inventory.

Sl. No.	Name of the Mill	Inventory as % of net Sales
1.	Ballarpur Industries Ltd.	20.64
2.	Orient Paper Mills	26.02
3.	Straw Products Ltd.	30.81
4.	Titagarh Paper Mills	28.71
5.	Seshasayee Paper Mills	19.11
6.	Andhra Pradesh Paper Mills	26.40
7.	West Coast Paper Mills	37.52
8.	Tribeni Tissues	27 23
9.	Sirpur Paper Mills	23.83
10.	Star Paper Mills	48 41
11.	Bengal Paper Mills	31.76

This is a huge amount of money not generating any profit. Reduction on inventory means additional capital available for reinvestment, thereby yeilding returns and improving the cash flow.

WHAT IS INVENTORY

'Inventory' means a stock of some kind of physical commodity having economic value. It includes stock of raw materials, finished and semi-finished goods, spare parts etc. The inventory is required to be maintained to meet the future demand. Whenever an item is needed, materials management should be able to provide it economically. Hence the inventory theory deals with determination of optimum procedure for procuring stock of material to meet future demand. It attempts to strike a balance between opposing costs involved in inventory problems. In this article, inventory problems regarding raw-materials, spare parts and other manufacturing materials only will be dealt with.

RELEVENT COSTS

In any genuine inventory problem, there must be certain opposing costs. These cost factors are associated in answering two basic questions

a) How much to order, and

b) When to order

Other factors related to the above two questions are the variability of demand and lead time. If the fluctuations in demand/consumption rate and lead times are large, then there will be occassions of excess stock or under stock i.e. stock out position, resulting in associated penalties. This introduces a certain element of risk in the inventory management. This risk is inevitable and the procurement policies are to be worked out with a specified risk. As mentioned above there are various costs associated with inventory problems. But all types of costs do not exist in all types of

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inventory problems. In some cases, some of the cost factors are so insignificant that they are neglected for all practical purposes. However, some of the major costs are discussed as follows :

Procurement cost

This cost is basically the cost of procuring an item, which does not include the cost of the item itself. The procurement cost is an over head cost, which varies from item to item and organisation to organisation. It also varies with the size of the order and the type of items; such as imported items, indigenous items etc. For practical purposes, it is reasonable to consider one procurement cost as far as possible. When a large number of items are considered, the variation in procurement cost from item to item tends to cancel out and leaves the solution unaffected.

Inventory Carrying Cost

This includes a number of components of cost viz. cost of capital tied up in inventory, storage cost, insurance cost etc. Though the inventory carrying cost varies from item to item, it is perfectly all right to assume a uniform carrying cost as a percentage of the unit cost of the item.

Stock Out Cost

This is the cost associated with an item not being available when required as it is extremely difficult to assess the stock out cost in many practical situations. It is desirable to assume an acceptable risk of stock out expressed as a number of years in which a stock out is tolerable.

Systemic Cost

It takes care of variation in the cost involved in data processing implementation and follow-up of various inventory control systems used. It also takes care of the potential savings, which might occur from the amalgamation of orders for several items.

ECONOMIC ORDERING QUANTITY MODELS

Inventory models are the representation of inventory problems in graphical or analogous form for solution. Such solutions refer to determination of decision variables by considering the various aspects of the problems, the decision variables are economic ordering quantity, safety stock and reorder level. In any industry, there will be a large number of items most of which are different in nature and hence requiring individual treatment from inventory control point of view. But this is extremely costly and time consuming. On the other hand use of single inventory model for all items is easier and less time consuming, but does not satisfy the different nature of items. As an example, three models are given below :

Model-I

In practical situations, neither the lead time nor the consumption is deterministic. It is also recognised that it is much more economical to allow a limited number of short stock outs with less stock holding than absolute protection against stock out with very high inventory.

Assuming that the lead times and consumptions during lead time are normally distributed and a risk of stock out in r years, the model is as follows:—

$$OQ = \sqrt{\frac{D\left[2\,Cp + \frac{Ci.\ I.\ r}{24}\,(Km-Ka)\right]}{Ci.\ I}}$$

$$SS = \frac{rn-2}{48}\,(Km-Ka)$$

$$ROL = Ka + SS$$

Where

OQ = Economic ordering quantity
SS = Safety Stock
ROL = Re-Order Level
D = Anticipated Annual Demand (Units)
Cp = Procurement Cost (Rs. per order)
Ci = Unit price of the item (Rs.)
I = Annual Inventory carrying Cost
r = Permissible risk of run out.
n = Number of orders per year
Km = Normal maximum consumption during normal maximum lead time.
Ka = Average consumption during average lead time

Model II

For some items, it is observed that the material is not supplied at a time. Whatever the quantity is ordered or contracted, the material is despatched at a more or less regular rate. This leads to a production inventory model.

Assuming normal distribution for lead times and consumption during lead times, model-I is modified as shown below:—

$$OQ = \sqrt{\frac{D\left[2\,Cp + \frac{Ci.\ n\ I}{24}\,(Km-Ka)\right]}{Ci.\ I\left(1-\frac{da}{R}\right)}}$$

$$SS = \frac{rn-2}{48} (Km \quad Ka)$$

$$ROL = Ka + SS$$

Where

da = Daily average consumption

R = Replenishment rate

Other notations are the same as model – I

The above two models belong to perpetual reviewing system, where stocks are continuously reviewed. As soon as the level reaches re-order level, procurement action is taken for a fixed quantity equal to OQ. In cases where the lead time is larger than the cyclic period as decided by the number of orders per year, replenishment action is taken at the cyclic period until the stock level is raised to reorder level.

Model—III

For C Class items enough informations are not generally recorded. Morever, as they are numurous in number it is much time consuming to analyse their demand or lead time distribution for inventory control purpose. For these items it is well known that there may be an infinite number of probability distributions with the same average and variance. Hence no optimal inventory policy can be made with specific distribution. Also owing to large number of items in C class having different possible distributions it is required to have a probability statement which will be true for every specific probability distribution having the same average and variance. The answer is given by Tohebycheff. The Tohebycheff's inequality states that any probability distribution whatsoever there is a simple relationship expressing the probability that the given variable will differ from it's mean by multiple of it's standard deviation expressed mathematically:—

$$P\left(|Y-\bar{Z}| \geqslant^{Ks}\right) \leqslant \frac{1}{K^2} \text{ for } K > 0$$

Where $|Y-\bar{Z}|$ = absolute value of difference

$\bar{Z}$ = mean

s = Standard deviation

K = A factor determined on the basis of acceptable risk of service level.

Though both demand and lead times are probabilistic, the demand has been assumed to be constant for the purpose of analysis in this model and distribution is applied for lead time distribution. Safety stock may thus be calculated

as S. S. = da Tm when $Tm \leqslant (Ta + Ks)$ or

= da Y when $Tm > (Ta + Ks)$

where $Y = Ta + Ks$

da = Daily average consumption

Ta = Average lead time.

Tm = Maximum lead time.

It has been observed that many of the lead time distributions for 'C' class items are approaching poission's distribution. However, assuming poission's distributions for lead times standard deviation is taken as square root of average lead time. The factor K is taken as 5 which gives 98% protection against stock out due to higher lead time.

The economic ordering quantity (OQ) is calculated by using Wilson's formula:—

$$OQ = \sqrt{\frac{2 \quad Cp \quad D}{Ci \quad I}}$$

Replenished inventory level is defined to be replenished every time an order is placed and is calculated as :

$$RIL = SS + OQ$$

According to this model, the stock is reviewed at the end of each cycle time and procurement action is taken for the quantity determined by :

$$OQ = RIL - Stock$$

If the demand is uniform as predicted, then the stock at the time of cyclic review will be equal to safety stock. But in practice there will be some variation from time to time and cycle to cycle. Some times the safety stock may be reached earlier to the cyclic due to unusual consumption. In such cases the procurement action is to be taken for the balance quantity when the level comes down to safety stock or 20% of RIL, which ever is reached earlier.

As a matter of fact these three models (Model-I and II for AB Class and Model-III for C class items) have been used successfully to control the inventory of about 2,000 items in a paper industry, which account for about 95% of total consumption on revenue account.

ADDITIONAL SUGGESTIONS FOR PROCUREMENT POLICY

Items like Caesin, which comes under A.B. Class and its unit cost varies considerably during season and off-season. In such cases it is desirable to calculate the inventory carrying cost for procuring higher quantity at a cheaper cost and lower quantity at a higher cost. Higher order quantity is adopted if there is saving in carrying cost without deteriorating the quality of the item.

For general C class items, multiple purchase order should be released with one sound and reliable party for convenience in supply, reduction in lead time and price discount.

For general maintenance supplies, mostly the C class items, where a large number of items of varying importance and widely differing patterns of usage are involved, the advantage of quantity price discount should also be considered. In determining whether a quantity price discount is justified by ordering a quantity larger than the economic order quantity or not, the following thumb rule can be applied.

Order OQ' when $A \geqslant 2/3$ em

where A = price reduction per unit expressed as a percentage

$$\text{i.e. } A = \frac{Ci - Ci'}{Ci} \times 100$$

where Ci = unit cost without discount
Ci' = unit cost with discount

em = Extra purchase quantity necessary to obtain the discount expressed as Number of month's supply.

$$\text{i.e. : em} = \frac{OQ' - OQ}{dm}$$

where OQ = Economic order quantity

OQ' = Large order quantity to avail discount.

dm = Average monthly usage in units

RATIOS FOR MATERIALS MANAGEMENT

The following few ratios can be utilised as Management information systems for better materials management function.

$$\frac{\text{Purchases}}{\text{Sales value of production}} \text{ as \%}$$

$$\frac{\text{Stock}}{\text{Materials issued for Production}} \text{ as days}$$

$$\frac{\text{Purchases}}{\text{No. of Purchases}} \text{ as cost per order}$$

SPECIFIC PROBLEMS/DIFFICULTIES FACED BY PULP AND PAPER INDUSTRY

Plant Location

Paper Industry in general are located in remote areas away from big cities due to the availability of raw-materials, water and waste and effluent disposal etc. Due to the remote locations of these industries, the purchase departments are located in big cities. This results in increased internal lead times, which in turn increases safety stocks and hence the higher inventory. More over, due to this disadvantageous location, the paper mills are required to keep the stock of castings, shafts, flanges, and engineering supplies which are easily available in big industrial cities This makes it advisable that the paper Mills should try to develop ancilliary industries for fast moving spares required, at a nearer place.

Seasonal Constraints

During monsoons, the movement of raw-materials, heavy chemicals like Alum, S. S. Powder, Lime etc. becomes quite difficult. The transportation of Bamboo, Hardwood etc. from the interior forests to the railheads has to be suspended as the plying of trucks on 'kuchha' roads is not possible. Therefore, the inventory of these items increases substantially before monsoons. Over and above the cost of certain items increases considerably during monsoons for which the paper industries to take the advantage of this rate variation are required to procure larger quantities, thereby increasing the inventory level temporarily.

Non-availability of Railway Wagons

The bulk quantity of materials are required to be transported over long distances. For this, railway wagons are the cheapest means of transportation. Non-availilabity and uncertainity of wagons allotment in the present situation forces these industries to build up higher inventory for catering to uncertainity in lead time. This high inventory in turn requires more material handling facilities more storage space and the other costs associated with. What manner of inventory control a paper industry can practise when it can not get the railways to transport its materials ? Recently the railway authorities have issued the orders not to allow the movement of petroleum product in piece meal tankers i.e. these products are to be moved in the form of rakes. Due to this decision, the inventory of furnace oil has increased substantially and with the inventory the cost of creating extra storage space and the unloading facilities has also increased. Such decisions are also responsible for high inventory cost.

Production Programme

The requirement of days for making coloured papers are decided as per the production programme. Due to sudden changes in production programme,

the paper industry is ought to maintain high inventory of costly dyes. This irregular pattern of consumption of dyes will always pose a tricky problem for a materials manager in a paper industry.

Spares

Paper factories are having imported machinery and therefore require more imported spare parts, which not only cost exhorbitantly but also require much time to fulfill the import formalities. Even such imported parts, which may not be required for next 4 to 5 years are to be kept in stock. Since paper manufacturing is a process industry, the stock out cost of plant spares is too high, so we have to install standby equipment or stock imported spares for various critical equipment.

Since the technological advancement is rapid, so the equipments installed one or two decades ago are becoming obsolete, for which manufacturers are not making parts any longer. Keeping this in view, we are required to keep sufficient inventory of spares of old equipments.

Generally, difficulty is experienced in developing sources due to small quantities of spares involved. More over, indegenous machines and insurance spares are many a times costlier than the landed cost of imported ones. To save time and money the paper industries prefer to import such items and keep in stock. Inventory can be reduced in such cases if the Government takes the realistic view.

Government Study Groups

In both the 'Tandon Committee' and Chore Committee' reports, proper analytical approach towards paper industry has not been considered. The norms of inventory levels in general as suggested by these committees to curb inflation, hoarding, and appy pressure on industries to plough back their own earnings for working capital requirements is quite impracticable for capital intensive process industries like pulp and paper industries. These reports are to be reviewed keeping in view the practical problems of paper industries and some relaxations are to be made as regards the inventory norms, especially when spare parts are concerned.

CONCLUSION

The cost of material constitutes a major portion of production cost, which has to be reduced if more returns are sought. The way the external factors like the cost of labour, over heads and other expenses are increasing, in which management has little control, the scientific inventory management can reduce the cost of material and release capital for other useful investments. Not only in India, also in international paper industry it has been found that the improvement in materials management is just mediocore. Many of our industries are loaded with inventory because of fear of stock outs or ignorance. Inventory control in a Pulp and Paper industry is really tricky and difficult. If materials management section tries to solve this problem all alone chances of achieving the results are remote. The results of inventory control can be best achieved if there will be conceousness among production, engineering and marketing sections of the industry. Even after gaining the coordination of the above sections, the materials management section should also keep proper liasion with the Government, Railway authorities and other service agencies.

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