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MANAGING SAFETY STOCKS IN A MULTI-NATIONAL COMPANY: A STUDY ON INVENTORY MANAGEMENT THAT TENDS TO MAXIMIZE THE COMPANY'S PROFIT MARGIN

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ABSTRACT

This paper is based on a case study conducted in a prominent multi-national company (MNC) in Bangladesh, that simply looks into how successfully the placement of the safety stocks can be done through some scientific measurements. Managing safety stocks has been a key concern in the context of inventory systems. While it seems to be very easy to place the safety stocks in inventory management in black and white, it becomes extremely complicated when varying situations are involved. Deriving an exact formulation and solving it for general inventory systems remains an extremely difficult task. The objective of this study is to examine inventory systems with a view to efficient and effective management of safety stocks under different operating conditions. For the purpose of the study, the inventory problems are analyzed based on the nature of demand. The complexity of the problems dealt with lead-time analysis from order placement to arrival at warehouse as the lead-time holds a great importance for the placement of safety stock. For the problem, an exhaustive survey of the literature is carried out to identify the research gaps, and mathematical models are solved based on the research gaps for deciding the placement of safety stocks that minimizes the overall cost of the system.

Keywords:

Multi-national company, inventory system, safety stocks, lead-time, cost reduction, profit maximization.

1. INTRODUCTION

Inventory may be desirable, even necessary, for smooth operation and good customer service in many situations. For instance, inventory can be used to reduce the lead time to respond to customer demand, to smooth out the production rate when there are variations in demand, and to protect the company from underestimates of demand (forecast errors) or shortage of supply. An inventory control is to provide means of exercising a closed control over the flow of materials or goods into inventory and the flow of inventory into production or sales, thereby only preventing loss but also ensuring that adequate inventory levels are maintained. Reasons such as these, plus the fact that inventory is considered an asset on a company's balance sheet, have led many company's to carry excessive amounts of inventory. Some companies for example, the Japanese manufacturer Toyota, have become known for their ability to operate with low inventories and to achieve a high inventory turnover. Being able to respond quickly to demand, companies can work from a shorter range forecast, which is more accurate, so they need less safety stock to protect from uncertainty. The more effective a company's inventory system, the better able it is to manage its resources and to compete effectively [1].

2. BACKGROUND AND SIGNIFICANCE

Inventory is very important to many companies because it helps the company response quickly to customer demand, which is important element of competitive strategy. Inventories of raw materials or partially processed goods can help a company complete the production cycle in much shorter time than would otherwise be possible. Inventories of finished goods (that is, independent-demand inventories) of the correct items, within a reasonable distance of points of demand, play an important role in a company's ability to compete in a market for standardized products. A second reason for the importance of inventory is that it represents one of the largest controllable resources in many companies. For some companies, such as wholesaler or retailer, particularly if the operates in leased facilities, inventory may be the primary asset. Capital investments in such assets as facilities or equipment are relatively fixed in comparison to investments in inventory. A company normally cannot add units in facilities and sell them as easily or as profitably as it can build up and reduce its inventory. The more effective a company's inventory system, the better able it is to manage its resources and to compete effectively [1].

3. AIMS AND OBJECTIVES

Logical classification of stock control problem is very difficult, because factors vary considerable from industry to industry [2]. Inventory management is an important concern for managers in all types of businesses. For companies that operate on relatively low profit margins, poor inventory management can seriously undermine the business. The challenge is not to pare inventories to the bone to reduce costs or to have plenty around to satisfy all demands, but to have the right amount to achieve the competitive priorities for the business most efficiently [3].

Aims and objectives of this thesis are as follows:

- Deciding where to position inventory
- Determining when to replenish inventory
- Calculating how much to order
- Determining the placement of safety stock
- Refacilitating the use of business resources for profitable business results
- Ensuring the target level of inventory is available to support demand.

4. METHODOLOGY

A case study has been performed in British American Tobacco, Bangladesh for the year 2012-2011. The focal point of the research work was to find out the actual scenario regarding the placement of safety stock in inventory management for BATB Imported Leaf. The following is the step-by-step methodology of data and interpretations.

Step 1: Conducting a primary survey
Step 2: Preparing primary questionnaire
Step 3: Modification of the questionnaire

1. Open-ended questions:
   This type of questions found out the view of the decisions makers out for gathering information regarding the subject topic.
2. Close-ended questions:
   These type of questions were designed to extract information which are related to the preparation of a realistic forecast

Step 4: Performing the case study and conducting the interview
Step 5: Data processing and analysis

After conduction of the case study as per the steps demonstrated above on the selected company, the findings resulting from the case study and its analysis are presented in some following sections.

5. PURPOSES OF INVENTORY

Inventory is defined as the stock of any item or resource used in organization [4]. When a firm adopts a level strategy, an inventory of finished goods is required to buffer the cyclic demand for product from the level output generated by the transformation process. . If the demand for a product were to be known precisely, then it could be possible to produce products so that demand would be exactly met Organizations maintain inventories for several reasons.

1. To protect against uncertainty
2. To support a strategic plan
3. To take advantage of economic of scale

Each time a company places an order or does a setup to perform an operation, there incurs a fixed cost, regardless of the quantity involved. Thus the larger the quantity ordered or produced, the lower the average total cost per unit.

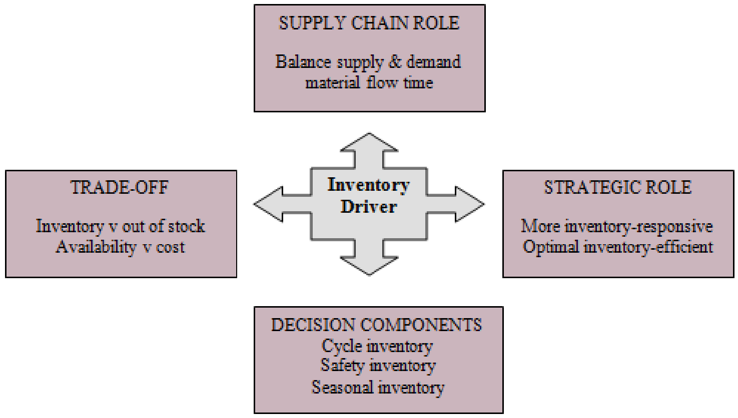

Figure 1. Role of Inventory

6. SAFETY STOCK

Usually one does not know precisely the number of units that will be demanded each day during the lead-time. Also the duration of lead times may have unexplained or unexpected variation. Adequate safety stock levels permit business operations to proceed according to their plans [5]. Various methods exist to reduce safety stock, these include better use of technology, increased collaboration with suppliers, and more accurate forecasting [6][7].

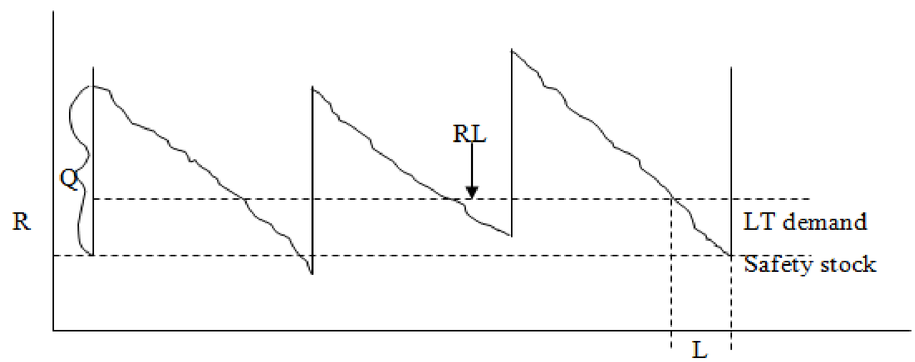

Figure 2. Inventory Level When Safety Stock is Present

Safety stock is the average amount one hand when replenishment orders arrive. Sometime demand during the lead-time is less than expected extra stock is on hand. Sometimes demand is greater than expected and some of the safety stock is used. Safety stock can be thought of as remaining in inventory all year, on the average. Figure illustrates over time when safety stock is present. Safety stock (SS) is established simply by raising the reorder level above the expected lead-time demand. For probabilistic demand during lead-time, the reorder level is given by the following equation where $\overline{d}$ represents the mean demand per unit of time.

$$RL = (\overline{d} \times LT) + SS$$

It seems that around 1880 there was a change in manufacturing practice from companies with relatively homogeneous lines of products to vertically integrated companies with unprecedented diversity in processes and products [8].

6.1 FACTORS AFFECTING THE SAFETY STOCK LEVEL

Following conditions tend to encourage safety stock level.

- Stockout cost
- Cost of carrying safety stock
- Variability or uncertainty of demand
- Number of annual exposure to the risk of stockout

6.2 WHY HOLD STOCK?

There are several reasons to hold safety stocks

To protect against the unknown, maintain stability and optimize cost all along the supply chain.

Decouple supply and demand through creation of buffer stocks.

Build up investment stocks to meet planned or expected demand.

Build up investment stocks to take advantage of market opportunities.

Stabilize production and labor force together with effective use of capital equipment.

7. THE BASIC ECONOMIC ORDER QUANTITY MODEL

Since some costs increase as inventory increases and others decreases, the decision as to the best size of an order is seldom obvious. The best lot size will result in adequate inventory to reduce some costs; yet will not be so large that it results in needless expenses for holding inventory [9]. A compromise must be made between conflicting costs. The economic order quantity (EOQ) model provides assistance in reaching a decision when the conditions are appropriate for its use. Some of these assumptions differ from the typical real- world situation. The basic EOQ model is oversimplified for some situations, but it is used successfully by many firms with only a few embellishments [10]. Since we are concerned with cost, the following equation would pertain:

Total annual cost = (Annual purchase cost) + (Annual ordering cost) + (Annual holding cost)

Or, $$TC = DC + (\frac{D}{Q}) \times S + (\frac{Q}{2}) \times H$$

Where, TC = Total Annual Cost, D = Demand (annual)

Q = Quantity to be ordered (the optimum amount is termed the economic order quantity-EOQ)

S = Setup cost or cost of placing an order, R = Reorder point, L = Lead time

H = Annual holding and storage cost per unit of average inventory.

On the right side of the equation, DC is the annual purchase cost for the units, (D/Q)S is the annual ordering cost (the actual number of orders placed, D/Q, times the cost of each order, S), and (Q/2)H is the annual holding cost (the average inventory, Q/2, times the cost per unit for holding and storage, H). these cost relationships are shown graphically in the figure below.

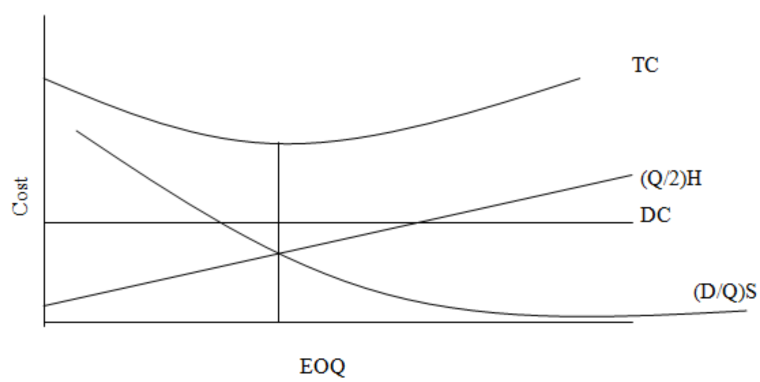

Figure 3. Annual Product Cost Based on Size of the Order

The second step in model development is to find that order quantity, Q, for which total cost is minimum. In the above figure at the point where the slope of the curve is zero. Using calculus, the appropriate procedure involves taking the derivative of total cost with respect to Q and setting this equal to zero. For the basic model considered here, the calculations to obtain the economic order quantity (EOQ) would be as follows:

TC = DC +

$\frac{D}{Q} \times S + \frac{Q}{2} \times H$ — —

$$\frac{dTC}{dQ} = 0 + (-\frac{DS}{Q^2}) + \frac{H}{2} = 0$$

Solving for Q gives us the economic order quantity, or EOQ,

$$EOQ = \sqrt{\frac{2DS}{H}}$$

Because this simple model assumes constant demand and lead-time, no safety stock is necessary, and the reorder point, R, is simply

$R = \bar{d}L$, where $\bar{d}$ = average demand per time period, L = Lead time

8. BAT, BANGLADESH

British American Tobacco Bangladesh (BATB) is the company where the case study conducted. British American Tobacco Bangladesh (BATB) Company Limited is the recognized leader in Bangladesh cigarette market, with a long established reputation for providing its consumers with consistently high quality brands. The journey of this company started long back. BATB was established back in 1910 as Imperial Tobacco Company Ltd. with head office in Calcutta. In the very beginning Imperial Tobacco Company (ITC) launched a branch office at Moulvibazar, Dhaka in 1926.

8.1 BAT INVENTORY MANAGEMENT

There are some standard management theories as we described earlier in chapter two. The operational environment varies firms to firms, companies to companies. Based on the different varying conditions most companies do manage the inventory at their own. They do not follow exactly what the theory implies but analyzing the theories they go for the decisions that suit them most effectively and efficiently. The goal should not be to minimize inventory or to maximize customer service but rather to have the right amount to support the competitive priorities of the company.

8.2 BAT Inventory System

BATB inventory system can be compared with a two-bin system in which an item's inventory is stored at two different locations. Inventory is first withdrawn from one-bin. The two-bin system implies that if the first bin is empty, the second bin provides backup to cover demand until a reenlistment arrives [3]. The demand manager and the MPS manager reviews the inventory positions on the daily basis and then go for receiving the lot from the pipeline inventory. This indicates that they are maintaining the pipeline inventory. It helps them reduce the lot size to be stocked at warehouse.

8.3 BAT Inventory

BAT inventory includes finished goods, bled sets, filter rods, wrapping materials, leaf , tax stamps and bundle rolls. The study is mainly focused on the leaf. Because this is the major concern in any cigarette manufacturing company as it holds the maximum cycle time. We will work with the raw materials inventory. Mainly BATB has two types of materials. These are wrapping material and Tobacco. They receive raw materials from both local and foreign suppliers. Foreign suppliers are mainly from Brazil, Argentina, Canada, South Africa and Zimbabwe. For local suppliers average lead-time is 10 to 15 days and for the foreign suppliers lead-time is 90 to 120 days. Leaf is supplied by both the local and foreign supplier. But ignoring the local leaf as it takes less time, we will take the imported leaf in account to analyze.

9. DEMAND FORECASTING STRATEGY

Demand manager receives the sales history of the previous 4/5 years. He observes the trend that every month undergoes. There are some seasonal impacts in the cigarette market. But overall the market is a stable one.

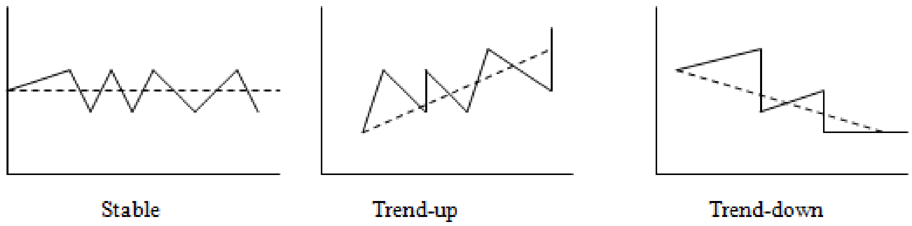

Figure 4. Trends of Demand

Following the trend of previous 4/5 years and considering the marketing activities, the demand manager goes for a rolling forecast over the next 18 months. The term 'rolling' here implies that the forecast is updated every month for the next 18 months. By this, the demand manager feels flexible enough to consider any new promotional activity or any assumption from the marketing department and any seasonal impact, which has not been included earlier. The main focus of forecasting is based on the trend. If the trend is decreasing the forecasted sales goes down and vice versa [11].

10. FINDINGS

10.1 Imported leaf stock:

Year end 2012 imported leaf stock was 317 million Taka and average 2012 leaf stock was 334 million Taka (~ 4 months duration) as shown in the following figure.

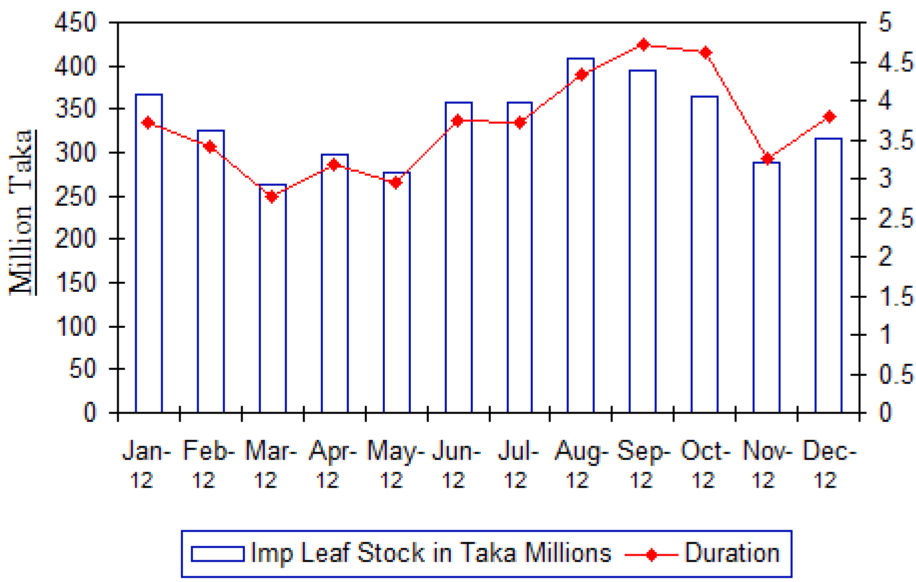

Figure 5. Monthly leaf stock, 2012

Currently, they are following an inventory policy of maintaining a 90 day safety stock which varies in quantity and value terms over the year with fluctuation in demand

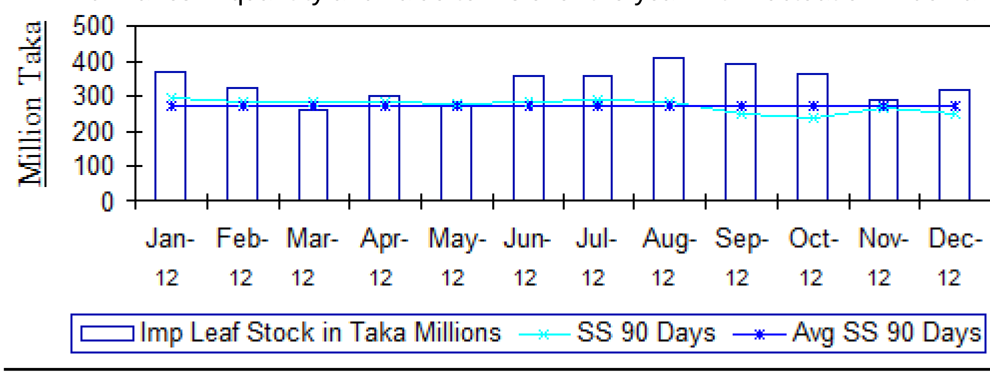

Figure 6. 90-day leaf stock, 2012

Every findings of the case study as well as the overall findings was outlined in structured manner that must favor great in analyzing the case in an accepted manner.

11. ANALYSIS

Following the traditional theory of safety stock a proposal has been made for the reduction of safety stock level for the concerned company. In addition the analysis also presents the impact of reduced safety stock level on the overall working capital.

11.1 DEFINING THE PROBLEM

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; if provided. If a company has adequate storage space and funds are available, the cost to hold stock may not be great. When this is the case, extensive protection from stock out may be a wise use of funds. But if the company has the flexibility to hold the stock at the supplier at comparatively low cost, then why should it go for holding much stock than the requirement.

BAT year-end 2012 imported leaf stock was 317 million Taka and average 2012 leaf stock was 334 million taka. Currently they are following an inventory policy of 90 days safety stock within various in quantity and value terms over the year with fluctuation demand. An analysis could be performed to reduce the safety stock level as it occupies a major working capital. Mainly BAT has six Grades for green leaf. The analysis will be performed around a single Grade and the impact will be shown on the overall leaf policy.

11.2 DEVELOPING EOQ

The basic EOQ model is applicable for a company to purchase an item. The problem is deterministic- that there is no uncertainty or probability to consider- when these conditions are met. Some of these assumptions differ from the typical real world situation. The modeling process involves simplifying actual situations as long as the essential characteristics are included. The basic EOQ model is over simplified for some situations, but many firms with only a few embellishments use it successfully.

Let us develop the EOQ for the BATB imported leaf

11.3 CONSIDERATIONS

- Grade: AN30/104S
- Demand in Kg/Month:

Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
10400	9200	13200	11600	13200	14800	11800	14400	13400	14400	12400	13200

- Annual Demand = 152000 Kg
- Holding Cost = 32 TK/ Kg
- Ordering Cost = 700 TK (Assumed)

$$EOQ = \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2*152000*700}{32}} = 2578.75 \text{Kgs} \quad 2579 \text{ Kgs}$$

11.4 HOW MUCH TO ORDER AND ORDER CYCLE

The analysis shows that the company should order 2579 kg for the particular grade each time, a quality that should be result in 58.93 cycles per year.

Actually, the equation derived doesn't result in actual lot size that must be ordered. This will help to manage lot size and inventory control. The current moves towards the inventory cost and quantities, stress the importance in reducing lot size. That means to reducing lot sizes is to reduce setup time and cost. When smaller lots are run, holding cost is reduced. The point is to understand the logic and where to apply it. The effect on order size resulting from reducing setup cost is shows in the following figure. When the setup cost is reduced, the total cost curve shifts from TC1 to TC2. Correspondingly, the EOQ is reduced from EOQ1 to EOQ2 and the maximum total cost is reduced from TC1min to TC2min [3].

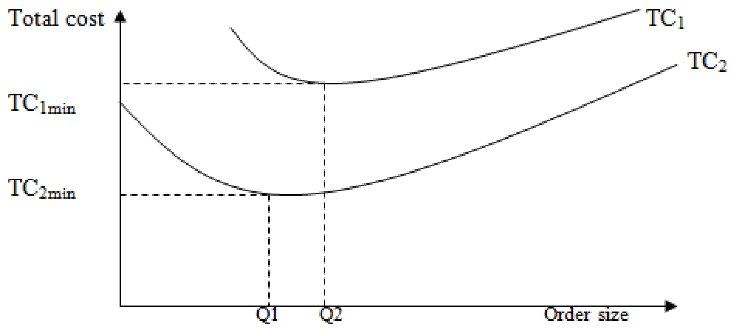

Figure 7: Effect of reduced set up cost on order size and total cost

11.5 REORDER LEVEL

The order quantity and reorder level are interrelated. A large order quantity causes fewer replenishment cycles with fewer exposures to stockout, so the reorder level can be reduced, and vice versa. Theoretically, we would have to find simultaneous solutions to equations for Q and RL to find their normal values. The value of D, S and H are only estimates, and the value of the EOQ will be approximate whether or not an adjustment is made for the expected stockout cost. Consequently, as often as done, we disregard the interrelationship between Q and RL. We solve for the EOQ, ignoring its effect on stockout cost, and then we find the best reorder level for this value of Q. Service level refers to the number of units that can be supplied from stock currently on hand. Safety stock can be defined as inventory carried to assure that the desired service level is met.

Table 1. Safety Factors for Normal distribution

Service Level (Percentage of Order cycles without Stock out)	Safety Factor Using Standard Deviation
90.00	1.28
93.32	1.50
94.00	1.56
94052	1.60
95.00	1.65
96.00	1.75
97.00	1.88
97.72	2.00
98.00	2.05
98.61	2.20
99.00	2.33
99.18	2.40
99.38	2.50
99.50	2.57
99.60	2.65
99.70	2.75
99.80	2.88
99.86	3.00
99.90	3.09
99.93	3.20
99.99	4.00

Assumptions:

- Highest Service Level Factor corresponding to 99.99% satisfaction level used though recommended maximum level is usually 98%; this results in a more than 50% higher safety stock.

- Safety Stock calculated using standard deviation of actual demand rather than variance between forecast and actual giving higher levels of safety buffer.
- Lead time taken to be 4 months for all grades whereas actual lead time is considerably less providing greater safety stock to cover variation in demand during lead time.

Calculation:

RL = $\bar{d}$ L + z $_{L}$

where, RL =Reorder Point in Units, $\bar{d}$ =Average Demand Per Time Period
L = Lead Time, Z = No. of Standard Deviation for a Specified Service Level
$_{L}$ = Standard Deviation of Usages During Lead Time

Annual Demand =152000 kgs
Average Demand/Per Month =12666.66
L = 4 Months
Z = 99.99%

$$_{L} = \ _{d}\sqrt{L}$$

$$_{d} \sqrt{\frac{\sum_{i\ 1}^{12} d_i \quad \bar{d}^{\ 2}}{12}}$$

$$\sqrt{\frac{\begin{matrix} 12666.66 \ \ 10400^{2} & 12666.66 \ \ 9200^{2} & 12666.66 \ \ 13200^{2} & 12666.66 \ \ 11600^{2} \\ 12666.66 \ \ 13200^{2} & 12666.66 \ \ 14800^{2} & 12666.66 \ \ 11800^{2} & 12666.66 \ \ 14400^{2} \\ 12666.66 \ \ 13400^{2} & 12666.66 \ \ 14400^{2} & 12666.66 \ \ 12400^{2} & 12666.66 \ \ 13200^{2} \end{matrix}}{12}} = \sqrt{\frac{31066666.66}{12}}$$

=1609.00

Therefore, $_{L}$ = $_{d}\sqrt{L}$ =1609* $\sqrt{4}$ =3218

From the above calculation RL can be determined as follows:

RL = 12666.66 * 4 + 4*3218 $\mathrm{RL} = \bar{\mathrm{d}}\,\mathrm{L} \quad \mathrm{z} \ _{\mathrm{L}}$ =50666.64 + 12872 = 63538.64

This says that when the stock on hand gets down to 60610.26 kgs order should be placed.

11.6 LEVEL OF SAFETY STOCK

Safety stock= $\mathrm{z} \ _{\mathrm{L}}$
=4*3218
=12872

It results to a safety stock of 31 days, as the daily demand is 416.43 kgs. But theoretically it is applicable for the particular grade. Though the other grades do not involve so much variation in their demand, considering some logistic capabilities for the overall improved leaf the proposed safety stock is 50 days. This will allow for flexibility during roll out of new safety stock polling while guarding against unanticipated changes in sales and supply scenarios.

The reason for proposing this amount of safety stock is to protect much against the uncertainty of demand. This is due to demand forecasting that takes place over a long period and the order is placed for a particular month very early of the situation it experiences the change in its demand. So immediately it is not possible for the system to respond the sudden change in demand. For this, proper level of safety stock should be placed in a company for its smooth operation. Another fact is that the lead time from order placement to arrival at warehouse involves some events over which the proper control is not possible.

11.7 BENEFITS CALCULATION

GRADE: AN30/104S

- Annual consumption = 152000kgs
- 90 days safety stock = 38000kgs
- 50 days safety stock = 21111.11

Therefore, WC Reduction = (38000-21111.11)*165

=2.78 million Taka

11.7.1 OFFSHORE STOCK COST CALCULATION

Reduction in safety stock = 16888.89 kgs

This amount of excess stock will be held at supplier premises for a maximum additional period of 12 months.

Holding cost at BAT @ 12% = 16888.89×135.11×12% = 273823 Taka

Holding cost at supplier @ 7.2% + Excess Duty =16888.89×135.11×7.2% × 1.22 = 200439Tk. Therefore, Savings =73384 Taka

11.8 IMPACT OF REDUCED LEVEL OF SAFETY STOCK ON WC

Proposed Safety Stock based on lead-time, variability in demand during 2012 and desired service level indicates a substantially lower requirement of safety stock even with very conservative assumptions.

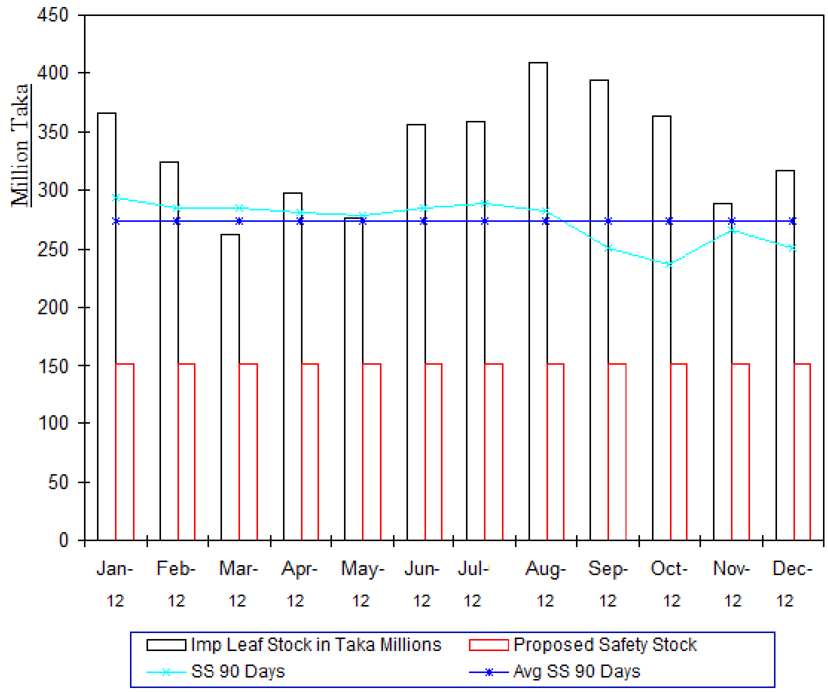

Figure 8. Reduced safety stocks

In maintaining reduced safety stocks, the company's overall production level does not get hampered and thus a very good amount of money can be saved which can be used for other purposes as well.

12. LEAD TIME ANALYSIS

It has been already mentioned that the more the lead time the more the safety stock. Lead time involves the total time from the order placement to arrival at warehouse

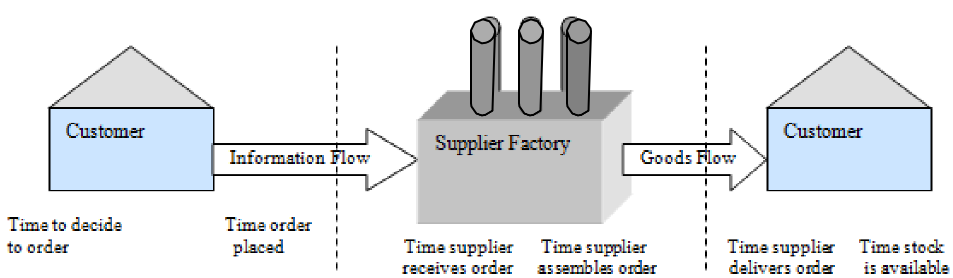

Figure 9. Supply Lead Time

From the appendix A we can develop a pie chart highlighting the time taken on a percentage basis by different events that take place from order placement to arrival at warehouse.

Table 2. Lead Time Analysis

Symbols	Events	Average	%
A	TIME TAKEN BW ORDER PLACE &PRO INVOICE RECORD	14.75	7
B	TIME TAKEN BW LC REQUEST	10.93	5
C	NO. OF DAYS SPENT B/W LC & SHIPMENT DATE	38.90	19
D	ARRIVAL IN CTG (ACTUAL SHIPMENT - ETA CTG)	35.10	17
E	DAYS REQD - CTG TO ICD	6.05	3
F	DAYS REQD - ICD TO WAREHOUSE	8.58	4

The pie chart below shows that a major part of the time from order placement to arrival at warehouse involves the events C and D over which the control cannot be held so easily. They involve some complex as well as time taking procedures.

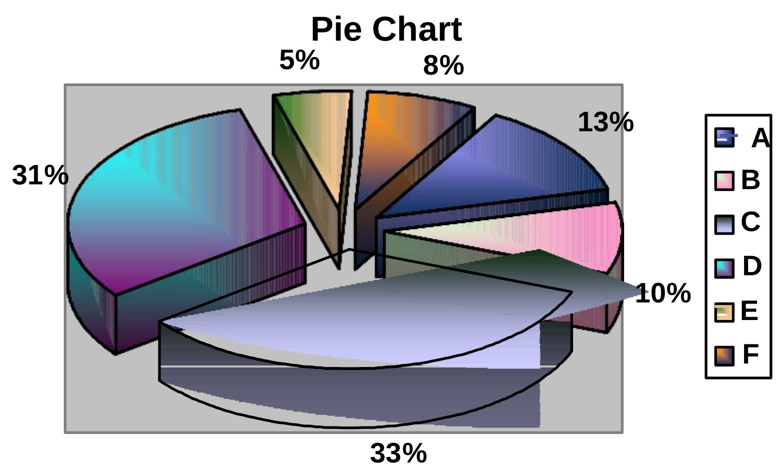

Figure 10. Pie chart for Lead Time

But in case of the rest of the events different action can be issued very effectively. An analysis performed by the BATB personnel is presented in the appendix, which can be very effective for fulfilling the objectives of this study. In addition there are some recommendations for reducing the lead-time in the next chapter. On the basis of different graphical analysis it can be concluded that upon analyzing different key factors the level of safety stock should be placed which is the major concern for obtaining a balanced inventory management system.

13. CONCLUSION AND RECOMMENDATION

13.1 CONCLUSION

Due to lack of available resources specially the relevant data and information, the case study has not reached the specific level which was expected. If the necessary data were available in the greater range it would be possible to find out the proper reflection of the objective that the study holds.

Finally the case study has revealed that the traditional inventory management system needs some modification depending on the situation or the operating environment, while inventory is management by a company. The different inventory models provide a different set of capabilities and opportunities to exploit different competitive priorities. Some members of different industries and consulting firms have already started to criticize classical inventory models seem fashionable. But prior to the operating conditions different classical inventory models can be considered as the decision making tools that will enable a company to take its step under conflicting pressure. All the system needs is proper integration of operation and business. This will smooth the flow of information and thereby implementation of such models would be fruitful.

13.2 RECOMMENDATION

As the analysis shows that the company can reduce the level of safety stock, the first phase of recommendation represents how it can be carried out and the later phase defines the steps, which should be proper monitored and controlled with a view to maintain an optimized inventory management system. This will enable to obtain an effective safety stock level.

- Allowing Inventory Policy Exceptions for certain grades to satisfy requirements for blend changes and brain launches.
- Reviewing and improving the order tracking process as necessary.
- Monitoring orders, delivery performance and safety stock policy adhere continually.
- Gradually moving to safety stock of 2.5 months and then to 50 days, with 6 months duration difference.
- Holding the excess stock at the supplier premises.
- Locating the inventory at different points in the pipeline rather to hold much in the warehouses.
- Developing operational excellence in demand forecasting so that there will be fewer surprises.

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