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Impact Of Reduction In Administrative Lead Time On Inventory Levels And Subsequent Savings That Can Be Achieved In Cath Lab Stores In A Tertiary Care Teaching Hospital

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Abstract: *Lead time is defined as "Whatever the time that elapses between recognition and need".Administrative lead time is defined as, "The time that elapses between recognition of need to placement of order".The study was conducted in cath lab stores of Nizam's Institute of Medical Sciences, a tertiary care teaching Hospital in Hyderabad. A retrospective study of the data during the period of April 1, 2013 to March 31, 2014 was done. A realistic study was done with the gathered information to arrive at the lead time of the various items. The following was observed:**Administrative lead time -** 10 days to 20 days**Supplier lead time –** 1 day to 5 days Maximum, minimum and average inventory levels were determined at the present lead times. For the purpose of the study a standard reduced lead time of 1 week (which is practically possible) was considered and the inventory levels were determined. The savings at max, min and avg inventory levels that can be achieved by reduction in lead time from present levels to 1 week was calculated. The savings at average inventory level was Rs 1083601 and savings at minimum inventory level was Rs 279009.*

Background: *Nizam's Institute of Medical Sciences is a 1300 bedded autonomous super specialty teaching institute. Its procurement policies are framed by the top management. Rate contract is finalized by a committee constituted by the management. As per the present policy, all the purchases (including RC and non RC) require the approval of the top management. Purchase files have to pass through several levels before it reaches the final approving authority. This and several other reasons are resulting in a prolonged administrative lead time.*

I. Introduction

Inventory is a part and parcel of every facet of business life [1]. Supply costs are of particular concern, and according to, a typical hospital spends 25-30% of its budget on medical supplies and their handling[2]. The principle goal of inventory management in overall materials management involves having to balance the conflicting economics of not wanting to hold too much stock [3]. Lead time is defined as "Whatever the time that elapses between recognition and need"[4].Administrative lead time is defined as, "The time that elapses between recognition of need to placement of order"[5]. In their studies (Ben-Daya and Raouf [6]; Ouyang et al[7]. Hariga, M. and Ben Daya, M [8]), they assumed that the lead-time demand follows the normal distribution. There are mainly two categories demands in the present studies, one is deterministic demand and the other is stochastic (probabilistic) demand .Harrington [9] proposes by eliminating the non-value adding activities from the processes and streamlining the information flow significant optimization results can be realized. Further, it has been shown that lead time is correlated with financial performance indicators, such as ROI (Return of Investment) or average profit [10]

Time and cost are the most important competitive factors in business[12]By shortening the lead time, they can lower the safety stock, reduce the loss caused by stockout, improve customer service level, and increase the competition ability in business[11]. A variety of studies illustrate that reducing replenishment lead time may lower the safety stock, reduce the stock out loss, and improve the customer service level, which results in lower expected total costs[12]A common mistake in determining the lead time is to ignore the time between when the requisition is generated and actual order placement.[4]

II. Objectives

To calculate the savings that can be achieved with the lower inventory levels which can be achieved by reduction in administrative lead time.

III. Methodology

The study was carried out in the Cath lab stores of Nizam's institute of medical sciences.

Cath lab stores inventory consists of about 85 items (stents are purchased on consignment basis and pacemakers are purchased through JIT concept) .For the purpose of this study only the cath lab items procured through buy and supply indent (36 items) (buy and supply inents are used for items which are specific to a certain department) have been taken into consideration.

A retrospective study of the data during the period of April 1, 2013 to March 31, 2014 was done. The data required for the study was collected from the stock records made available of the various stores. The following information was gathered from the stock records - Opening balance of stock, Closing balance of stock, Issues, Receipts and Unit Price.

Information was also gathered by personal interviews of the cath lab and surgical stores personnel. Files of the purchases were reviewed and data gathered from them. A realistic study was done with the gathered information to arrive at the lead time of the various items. The following was observed:

Administrative lead time - 10 days to 20 days

Supplier lead time – 1 day to 5 days

Maximum, minimum and average inventory levels were determined at the present lead times.

For the purpose of the study a standard reduced lead time of 1 week (which is practically possible) was considered and the inventory levels were determined.

The savings at max, min and avg inventory levels that can be achieved by reduction in lead time from present levels to 1 week was calculated.

Experimental Analysis:

The following were estimated

Ordering Cost (CO)

$$\text{Cost per order} = \frac{\text{Total cost incurred on purchasing activity in a year}}{\text{Number of orders issued in the year}}$$

Total expenditure incurred on Ordering Inventory

Salaries	3368700
PF and other statutory payments	330000 (10 % of salaries)
Follow up cost (mails, postage ,stationary, internet)	90000 (3 % of avg inventory)
Depreciation (furniture, equipment and area occupied)	25000
Expenses on tender formalities	100000
Travelling expenses	0 (no travelling requirements of purchase personnel)
Cost of receiving	0 (consignments are directly delivered by the vendor)
Total Expenditure	3913700

Total expenditure – 3913700

No of purchase orders issued last year – 5048

Ordering Cost = Total expenditure / No. of purchase orders

= Rs 3913700 / 5048 = Rs 775

Inventory Carrying Cost :

Inventory carrying cost is usually represented as a percentage on average value of inventory held.

Total expenses incurred on

$$\text{Cost per order} = \frac{\text{Stores Activity in a year}}{\text{Value of average inventories held in a year}} \times 100$$

Average inventory could be calculated by adding up inventories held and the end of each months and dividing by 12 gives average.

In some cases stock as on 1st of April and as on 31st March are added and divided by two(2) this type of calculation is not accurate.

The following factors are taking into account to calculate carrying cost-

Total expenditure incurred on carrying inventory

Salaries	412200
PF and other statutory payments	40000
Maintenance of inventory record	25000
Material handling	32000 (1 % of avg inventory)
Depreciation of store area	25000
Losses (breakage ,pilferage)	64000 (2 % of avg inventory)
Bank interest (considered as opportunity cost as NIMS does not lend money from the bank.)	352000 (11 % of avg inventory)
TOTAL	950280

Total expenditure - 950280
Avg inventory – Value of opening stock - 3914050
Value of closing stock - 2653870
Avg inventory is 6567920 / 2 = 3283960

$$\text{Carrying cost} = \frac{\text{Total expenditure} * 100}{\text{Avg inventory}}$$

$$= 950280 * 100 / 3283960 = 29\ \%$$

Economic Order Quantity (EOQ)
The economic order quantity is worked out for by making use of the formula

$$EOQ = \sqrt{\frac{2x \text{ Annual Demand in Units x ordering cost}}{\text{Price per unit x carrying cost}}}$$

EOQ of the individual items is mentioned in the annexure 1.

Service levels
Service level is a measure of stock control effectiveness.

$$\text{Service Level} = \frac{Ku}{(Ku + Ko)}$$

Ku is cost of under stocking and Ko is cost of over stocking. The service level is generally expressed in terms of percentage. K is the service factor.
Service level of the various items is mentioned in annexure 1.

Buffer stock (BS)
Buffer stock is determined on the basis of average consumption during average lead time.
It is calculated using the formula
Buffer Stock = L.T (in days or weeks) x D (avg demand per day or week)
Buffer stock of various items is shown in the annexure 1.

Safety Stock (SS)
It is calculated using the formula

$$\text{Safety stock} = K \sqrt{BS}$$

$$= K \sqrt{LT * D}$$

Safety stock of various items is shown in the annexure 1.

Reorder levels (ROL)
It is calculated using the formula
Re Order level = Buffer Stock (BS) + Safety Stock (SS)
Reorder levels of various items is shown in the annexure 1.

Maximum and Minimum inventory
Maximum Inventory = ROL + EOQ
Minimum inventory = ROL – BS
Average inventory = ROL + (EOQ/2)

Maximum, Minimum and Average inventories of various items are shown in the annexure 1.
Buffer stock , Safety stock, Reorder levels , and inventory levels at reduced lead time is shown in annexure 2.

IV. Results

The following savings can be achieved with reduction in lead times from the present level to 1 week.

	Present lead times	**Lead time of 1 week**	**Savings**	**Carrying Cost**	**Total savings**
Maximum inv value	1835701	986701	849000	246210	1095210
Minimum inv value	509662	293376	216286	62722	279009
Average inv value	1572201	732200	840001	243600	1083601

V. Conclusion

This additional amount which is being blocked in the inventory can be used for other purposes which can help in improving the quality of the hospital.If administrative lead time is long, one has to investigate further. In order to arrive at the causes of long administrative lead time, the manager has to examine the delays in each stage of purchasing cycle.

After finding out reasons for delay at each stage, one must initiate corrective action in regard to each element where unnecessary delays occur and lay down normal time for processing at each stage.

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