

A study on effective inventory management decisions for material required in educational institutes with reference to educational institutes across Pune city

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Abstract

Material management function of conservation of materials and their optimum utilization has great importance in overall efficiency of any industry. Inventory management is the soul of materials management aims at optimization of inventory investment to ensure continuity in availability of materials. Inventory management has been one of many analytical aspects of management. This involves optimizing the resources available to store various materials. Lack of inventory may lead to stock-outs, resulting in customer dissatisfaction, opportunity loss. Very high inventory on the other hand may lead to increase in investment and may lead to liquidity death. Thus, inventory optimization should ensure that stocks are neither too low nor too high. It appears that any effort to rationalize inventories can lead to substantial savings. Hence, scientific management of inventory can help in reduction of excessive inventory and hence the investment in inventory.

This paper deals with the study of various materials required by educational institutes for their day to day operations and setting up the effective inventory strategy for these educational institutes with the help of selective control techniques, economic order quantity and by minimization of annual total costs (procurement and inventory carrying cost).

Keywords: Inventory Management, Selective control techniques, Economic order quantity (EOQ), Annual total cost.

1. Introduction:

For every organization, inventory management is extremely important. Especially in educational institutes where the size of required material inventory to run an organization is very large, inventory management is extremely important. Over the last 65 years the global literacy rate increased by 4% every 5 years – from 42% in 1960 to 86% in 2015. With rapid

increase in literacy rate, number of educational institutes is also increasing. With this increase in number of educational institutes across the globe, inventory planning for them has become very critical. Regardless of whether you are delivering a performance or products, you need to know where your inventory is and where you are going. As organization's needs grow, they need to increase demand from suppliers. In order for suppliers to have customer's goods, it is necessary to maintain excellent and accurate inventory management. Inventory management is defined as the function responsible for the coordination of planning, sourcing, purchasing, moving, storing and controlling inventories in an optimum manner so as to provide a pre-decided service to the customer at a minimum cost. Optimization of inventory is important as balancing between overstocking and under stocking can save large amount of money for organizations. There are various aspects associated with inventory management such as minimization of ordering costs, minimization of inventory carrying costs, reduction in losses due to overstocking, reduction in losses due to non-availability of material.

2. Objectives:

- i. To Study the material requirement for day to day operations of educational institutes.
- ii. To study and prioritize different category of materials with the help of selective control techniques.
- iii. To decide the economic order quantity and number of orders required per year for particular item.
- iv. To study the total annual inventory cost and efforts to minimize it.

3. Literature Review:

To carry out this research study, firstly we need to understand what are annual total costs, how to compute economic order quantity. Also, we need to understand different selective control techniques.

There are different costs involved in inventory management decisions. The costs affected by company's inventory policy [4] are:

- i. Inventory carrying cost
- ii. Procurement cost
- iii. Setup cost
- iv. Stock out cost

Inventory carrying costs are the costs incurred in connection with holding of stocks and they include capital cost, loss due to obsolescence and deterioration, taxes and insurance, storage and holding expenses.

Procurement costs are costs incurred in connection with the replenishment of stocks and they include all costs incurred from raising the purchase order to receiving the order.

Setup costs represent the costs of production stoppage to enable a machine for change over from one job to other and include cost elements like idle time cost, cost of idle wages, foregone profit and cost of work order.

Stock out cost is the cost incurred in the event of non-availability of the item when required.

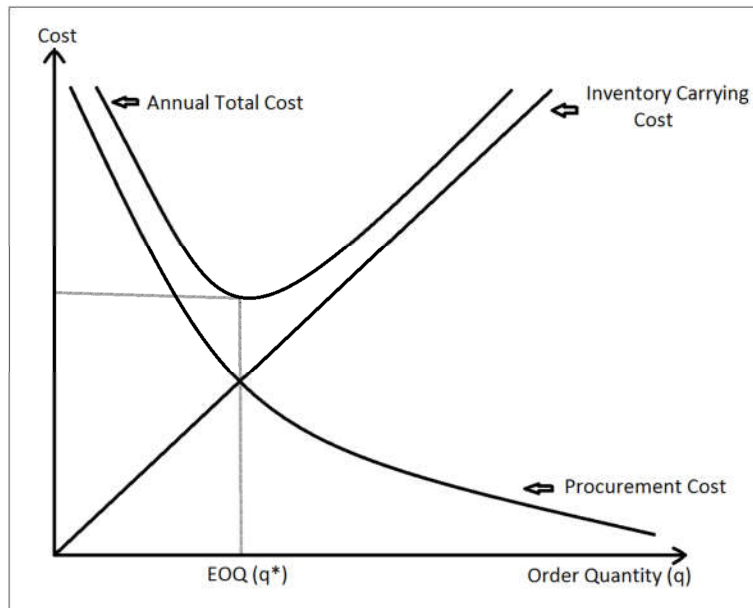


Figure 1. Inventory costs

There are two major costs associated with any order quantity, procurement cost and Inventory carrying cost. The two costs are diametrically opposite to each other. The right quantity to order will be the one that strikes an optimal balance between these two costs.

When these costs are properly balanced, the total cost becomes minimum and the resultant quantity is termed as economic order quantity.

Let,

Annual consumption of the item (units) =D

Price per unit (Rs) = C

Procurement cost per order (Rs) = S

Inventory carrying cost component= i

Order quantity (units) = q

Economic order quantity= q*

Annual procurement cost= No. of orders per year X Procurement cost per order
= DS/q

Annual inventory carrying cost= Average inventory investment X inventory carrying cost
= $qCi/2$

Annual total cost= $(DS/q) + (qCi/2)$

Economic order quantity= $\sqrt{(2DS/Ci)}$

Various classification are employed to render selective treatment to different types of materials, each classification emphasizes on particular aspects like cost of item, criticality, lead time, consumption, procurement difficulties.

Table 1. Selective Control Techniques

Sr. No.	Control Technique	Criteria Employed
1	ABC analysis	Usage value(i.e. consumption per period X price per unit)
2	HML analysis (High-Medium-Low)	Unit price (i.e. it does not take consumption into account)
3	VED analysis (Vital-Essential-Desirable)	Criticality of the item
4	SDE analysis (Scarce-Difficult-Easy)	Procurement Difficulties
5	GOLF analysis (Government-Ordinary-Local-	Source of Procurement

	Foreign)	
6	S-OS analysis (Seasonal- Off seasonal)	Seasonality
7	FSN analysis (Fast-Slow-Non-moving)	Issues from stores
8	XYZ analysis	Inventory Investment

Source: Inventory Management, L.C. Jhamb

A. Mechanism of ABC Analysis

The mechanics of classifying the items into 'A', 'B' and 'C' categories is described in the following steps:

- i. Calculate rupee annual issues for each item in inventory by multiplying the unit cost by the number of units issued in a year. It is assumed that the issues and consumption are the same.
- ii. Sort all items by rupee annual issues in descending sequence.
- iii. Prepare a list from these ranked items showing item no. , unit cost, annual units issued and annual rupee value of units issued.
- iv. Starting at the top of the list, compute a running total, item-by-item issue value and the rupee consumption value.
- v. Compute and print for each item the cumulative percentages for the item count and cumulative annual issue value.

The normal items in most organizations show the following pattern:

- a. 5 percent to 10 percent of the items on top account about 70 per cent of the total consumption value. These items are called 'A' class items.
- b. 15 percent to 20 percent of items below 'A' class items account for 20 per cent of the total consumption value. These items are called 'B' items.
- c. The remaining number of items account for the balance 15 per cent of the total issue value. These items are called 'C' items.

4. Research Methodology:

Inventories required for different educational institutes are different. There are possibilities that items required in one institute may not be required in other institute. We need to select items for analysis in such a way that the selected item should be common requirement for maximum institutes. To carry out this study, we need to consider all these constraints. It

becomes very essential to define the methodology so as all the constraints will get covered and final conclusion can be drawn.

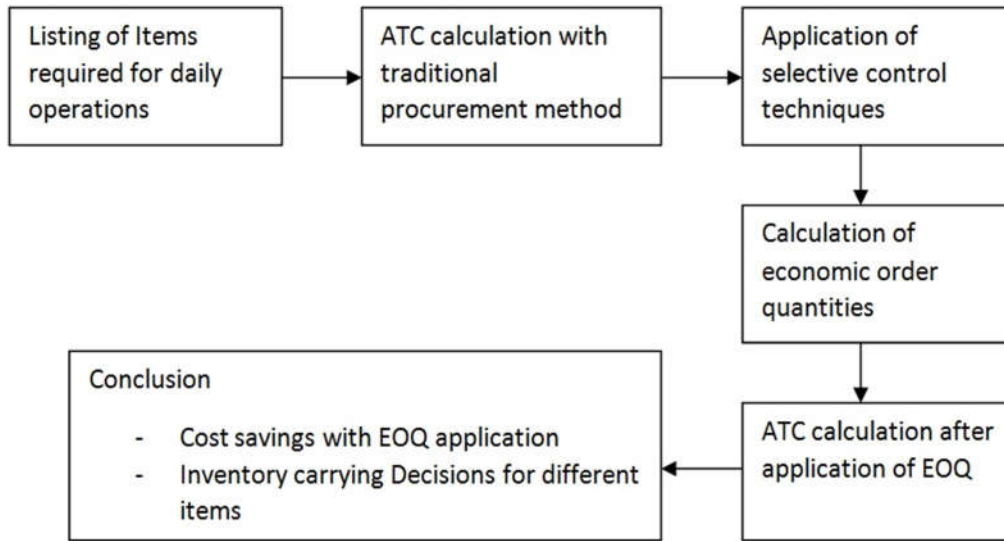


Figure 2. Methodology flowchart

5. Data Analysis:

Data analysis includes the data collected from different educational institutes across Pune city. Inventory of items required for day to day operations of all institutes are sorted according to their area of usage and items which are commonly required for most of the institute are taken for the research study.

In present case, the procurement cost, which includes order raising costs, order chasing costs, order in-wording costs, paperwork cost, is found to be 32 Indian rupees. Also, Inventory carrying cost component for stationery items is 0.18.

Following items are selected for the study.

Table 2. College Stationary Data

Sr. No.	Article	A/Unit	Annual Consumption	Cost/Unit	q	ICC	Procurement Cost	ATC
1	Paper A4 (box of 10)	Box	200	2200	50	9900	128	10028
2	Paper A3	Rim	4	550	4	198	32	230

3	Pencil cell (strip of 10)	Strip	24	110	12	118.8	64	182.8
4	Remote cell (strip of 10)	Strip	8	75	5	33.75	51.2	84.95
5	1.5v AA battery	Strip	16	165	10	148.5	51.2	199.7
6	9 v Battery	Box	80	185	20	333	128	461
7	Big Box File (Packet of 4)	Packet	60	280	20	504	96	600
8	small box file (Packet of 4)	Packet	8	160	8	115.2	32	147.2
9	Flat Cardboard file	No.s	1600	15	1000	1350	51.2	1401.2
10	L folder (Packet of 50)	Packet	40	350	10	315	128	443
11	Paper cutter	Dozen	4	120	4	43.2	32	75.2
12	Whiteboard Duster	Dozen	24	420	12	453.6	64	517.6
13	Whiteboard Duster cloth	Dozen	24	120	2	21.6	384	405.6
14	Whiteboard Markers (Pack of 10)	Pack	30	200	30	540	32	572
15	Office Register (100 pgs)	No.s	40	80	20	144	64	208
16	Office Register (200 pgs)	No.s	40	110	20	198	64	262
17	Stapler	Dozen	4	960	4	345.6	32	377.6
18	Sticky note	Packet	20	175	20	315	32	347
19	Highlighter	Packet	4	120	4	43.2	32	75.2
20	Sketch pen	Packet	60	50	30	135	64	199
21	Stamp pad	No.s	8	40	8	28.8	32	60.8
22	Stamp pad ink	Bottle	2	540	2	97.2	32	129.2
23	C/2 type battery cell	No.s	40	220	50	990	25.6	1015.6
24	Director letter head	No.s	16000	2	16000	2880	32	2912
25	Envelop A3	No.s	1000	6	1000	540	32	572
26	Envelop A4	No.s	2000	5	1000	450	64	514
27	Small envelop	No.s	12000	3	5000	1350	76.8	1426.8
28	Answer sheets (pack of 100)	No.s	190	1100	100	9900	60.8	9960.8
Total						31491	1916.8	33408.3

We will now apply selective control technique (ABC analysis) as defined in methodology to prioritize selected items.

Table 3. ABC Analysis

Sr. No.	Article	A/Unit	Annual Consumption	Cost/Unit	Total price	cumulative	cumulative percentage	Class
1	Paper A4 (box of 10)	Box	200	2200	440000	440000	51.16	A
2	Answer sheets (pack of 100)	No.s	190	1100	209000	649000	75.46	A
3	Small envelop	No.s	12000	3	36000	685000	79.65	B
4	Director letter head	No.s	16000	2	32000	717000	83.37	B
5	Flat Cardboard file	No.s	1600	15	24000	741000	86.16	B
6	Big Box File (Packet of 4)	Packet	60	280	16800	757800	88.11	B
7	9 v Battery	Box	80	185	14800	772600	89.84	B
8	L folder (Packet of 50)	Packet	40	350	14000	786600	91.46	C
9	Whiteboard Duster	Dozen	24	420	10080	796680	92.64	C
10	Envelop A4	No.s	2000	5	10000	806680	93.8	C
11	C/2 type battery cell	No.s	40	220	8800	815480	94.82	C
12	Whiteboard Markers (Pack of 10)	Pack	30	200	6000	821480	95.52	C
13	Envelop A3	No.s	1000	6	6000	827480	96.22	C
14	Office Register (200 pgs)	No.s	40	110	4400	831880	96.73	C
15	Stapler	Dozen	4	960	3840	835720	97.17	C
16	Sticky note	Packet	20	175	3500	839220	97.58	C
17	Office Register (100 pgs)	No.s	40	80	3200	842420	97.95	C
18	Sketch pen	Packet	60	50	3000	845420	98.3	C
19	Whiteboard Duster cloth	Dozen	24	120	2880	848300	98.64	C
20	Pencil cell (strip of 10)	Strip	24	110	2640	850940	98.94	C
21	1.5v AA battery	Strip	16	165	2640	853580	99.25	C

22	Paper A3	Rim	4	550	2200	855780	99.51	C
23	small box file (Packet of 4)	Packet	8	160	1280	857060	99.6	C
24	Stamp pad ink	Bottle	2	540	1080	858140	99.78	C
25	Remote cell (strip of 10)	Strip	8	75	600	858740	99.85	C
26	Paper cutter	Dozen	4	120	480	859220	99.9	C
27	Highlighter	Packet	4	120	480	859700	99.96	C
28	Stamp pad	No.s	8	40	320	860020	100	C

We will now calculate an economic order quantity for each above item and compute inventory carrying cost, procurement cost for respective item after application of economic order quantity technique.

Table 4. Inventory costs calculation on application of EOQ

Class	Article	A/Unit	Annual Consumption	Cost/Unit	q*	ICC	Procurement Cost	ATC
A	Paper A4 (box of 10)	Box	200	2200	6	1188	1066.7	2254.7
A	Answer sheets (pack of 100)	No.s	190	1100	8	792	760	1552
B	Small envelop	No.s	12000	3	1193	322.1	321.8	644
B	Director letter head	No.s	16000	2	1686	303.5	303.7	607.2
B	Flat Cardboard file	No.s	1600	15	195	263.3	262.6	525.8
B	Big Box File (Packet of 4)	Packet	60	280	9	226.8	213.3	440.1
B	9 v Battery	Box	80	185	12	199.8	213.3	413.1
C	L folder (Packet of 50)	Packet	40	350	6	189	213.3	402.3
C	Whiteboard Duster	Dozen	24	420	4	151.2	192	343.2
C	Envelop A4	No.s	2000	5	377	169.7	169.8	339.4
C	C/2 type battery cell	No.s	40	220	8	158.4	160	318.4
C	Whiteboard Markers (Pack of 10)	Pack	30	200	7	126	137.2	263.1
C	Envelop A3	No.s	1000	6	243	131.2	131.7	262.9

C	Office Register (200 pgs)	No.s	40	110	11	108.9	116.4	225.3
C	Stapler	Dozen	4	960	1	86.4	128	214.4
C	Sticky note	Packet	20	175	6	94.5	106.7	201.2
C	Office Register (100 pgs)	No.s	40	80	13	93.6	98.5	192.1
C	Sketch pen	Packet	60	50	20	90	96	186
C	Whiteboard Duster cloth	Dozen	24	120	8	86.4	96	182.4
C	Pencil cell (strip of 10)	Strip	24	110	8	79.2	96	175.2
C	1.5v AA battery	Strip	16	165	6	89.1	85.3	174.4
C	Paper A3	Rim	4	550	2	99	64	163
C	small box file (Packet of 4)	Packet	8	160	4	57.6	64	121.6
C	Stamp pad ink	Bottle	2	540	1	48.6	64	112.6
C	Remote cell (strip of 10)	Strip	8	75	6	40.5	42.7	83.2
C	Paper cutter	Dozen	4	120	4	43.2	32	75.2
C	Highlighter	Packet	4	120	4	43.2	32	75.2
C	Stamp pad	No.s	8	40	8	28.8	32	60.8
Total						5310	5299	10609

Comparing the total annual inventory costs, before and after the application of material management techniques, we will be able to find the total cost savings.

Table 4. Annual Total Inventory Costs comparison

Description	Without Inventory Management	With Inventory Management
Cost of material	860020	860020
Procurement Cost	1916.8	5299
Inventory carrying Cost	31491.45	5310
Annual total inventory cost	33408.25	10609
Annual Inventory Cost savings	33408.25 - 10609 = 22799.25	
Percentage savings	68.24%	

6. Conclusions of the research study:

A. Selective control technique (ABC Analysis)

Any good stock control system should ensure that each item gets the right amount of attention at the right time. Below are the conclusions that can be drawn from ABC analysis:

- i. A class items, account for bulk of the annual usage value and hence must attract utmost attention. B items should be brought under normal control and periodic stocktaking should be done. Little control is required for C items.
- ii. A class and B class items require careful and accurate determination of order quantities and order points based on exact requirements.
- iii. Safety stock should be less for 'A' class items. The possibility of stock out can be cut down by frequent reviewing and forecasting. A moderate safety stock required for 'B' class items whereas 'C' class items should have sufficient safety stock to eliminate progressing and to reduce the possibility of stock outs.

B. Annual total inventory costs saving by application of EOQ

- i. EOQ gives the right quantity of orders at right time. It avoids the excessive stock of items and losses due to stockouts.
- ii. Procuring 'A' and 'B' class items at economic order quantity considering all possible constraints can reduce substantial amount of inventory cost.
- iii. In this case, we saved 68.24% of total annual inventory cost with application of material management techniques and economic order quantity.

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7.2. Book

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