Inventory Management of Automobile Shop Using ABC Analysis & EOQ Model

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Abstract— In the day-to-day management of the firm, it's essential to manage the inventory so on maintain the proper supply of products at the proper time. Too much and too low inventories bring down the extent of profitability of a corporation. Therefore, it is necessary to maintain a proper level of inventory. In this paper, we focus on the inventory management of an automobile spare part shop. This study aims to reduce inventory variable costs, spot the key factors that influence finished inventory management practices, investigate efficient and effective inventory management approaches. The methodology uses various Operations Research (OR) tools like ABC Analysis, EOQ models, safety stock & replenishment policies.

Keywords: Inventory management, retail inventory, ABC analysis, EOQ, spare parts inventory, Operations Research

I. INTRODUCTION

Inventory is the stock of resources or items used in the industry. Inventory management is the backbone of any manufacturing & retail industry. "Inventory analytics is the cornerstone of supply chain analytics. A company in trade industries may have 30-50% of its assets tied up in inventory. Effective inventory management can improve revenue by increasing product variety and availability, and reduce cost and speed up the cash cycle by reducing excessive inventory and waste [1]."

The inventory has to be managed efficiently because of various reasons, some of them are:

- For the smooth running of a business
- To fulfill an expected demand
- To avoid overstock or stock-out situations
- To seek protection from price increases in the near future

II. INVENTORY MANAGEMENT TECHNIQUES

A. ABC Analysis

ABC analysis categorizes given parts according to their value (i.e., item cost * no. of units sold)

- Category A serves as your most valuable products. These need very tight inventory control & buffer stock levels should be kept as low as possible.
- Category B is the products that fall somewhere in between the most and least valuable.
- Category C serves as your least valuable products. Loose inventory control & higher buffer stock levels can be considered for these items.

	Number of items	Annual sales revenues
Class A	About 20%	About 80%
Class B	About 30%	About 15%
Class C	About 50%	About 5%

Table 1: ABC analysis

B. Economic Order Quantity

Economic order quantity or EOQ is used to derive optimum no. of quantities to be reordered with the lowest possible inventory variable costs. As shown in fig. below at Q* procurement (ordering) cost & carrying (holding) costs become equal giving the lowest possible total variable cost. This order qty. (Q*) is known as EOQ.

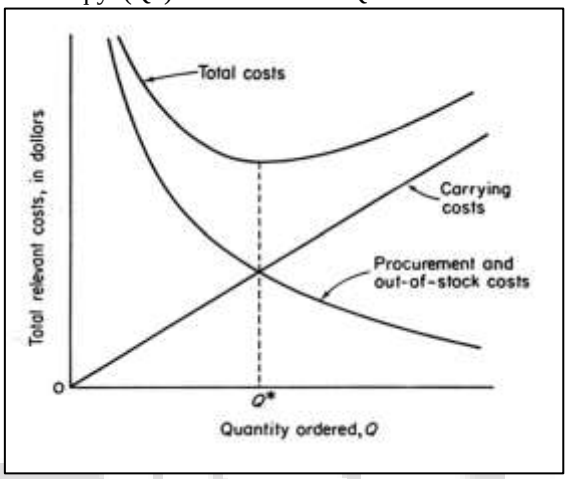


Fig. 1: EOQ model

III. LITERATURE REVIEW

1) GünerGören H, Dağdeviren O., (2017) used ABC-VED Matrix Analyses to categories the inventory items. Based on the results, order quantities were determined using the EOQ model [2].
2) Darya Plinere, Arkady Borisov (2015) presented a case study for the assembling company on inventory management. He used ABC analysis, demand forecasting & the EOQ model to build an inventory management model for given cases [3].
3) TRIMP (2009) presented a storage decision rule for spare parts where at least one unit should be kept in inventory if its unit annual holding cost is greater than the expected annual shortage cost i.e., cost of emergency purchase and penalties for downtime [4].
4) According to Huiskonen (2001), the classification of inventory is crucial, to i) determine the adequate level of managerial attention; ii) allow the choice of demand forecasting and inventory control methods [5].

IV. DATA COLLECTION & ANALYSIS

A. Data Collection

Data collection is an important task in this study. Inventory-related data was noted by frequent visits to the shop by interviewing the employee and owner, and also from their past 2-3 years sales data. Also, some of the data was noted by

unscheduled discussions in the shop and on phone calls. After collecting sufficient data of inventory, the data is systematically inputted into an Excel sheet for further detailed study.

Brand	Items	Annual purchase Quantity	Annual Purchase Cost
Hero	128	9,743	₹ 17,44,254.00
Honda	133	7,928	₹ 19,54,725.00
Bajaj	128	5,799	₹ 12,60,404.00
TVS	128	3,772	₹ 8,32,360.00
Suzuki	128	3,729	₹ 6,95,266.00
Misc.	29	5,787	₹ 5,10,455.00
Total	674	₹36,758	₹69,97,464.00

Table 2: Overview of data collection

B. ABC Analysis-:

	Items	Annual purchase Quantity	Annual Purchase Cost (₹)
Class A	215	13,323 (36.25%)	52,55,800 (75.11%)
Class B	254	12,539 (34.11%)	14,17,958 (20.26%)
Class C	205	10.896 (29.64%)	3,23,706 (4.63%)

Table 3: ABC analysis result

C. EOQ Sample Calculation-:

Sample calculation for Front and rear mag wheel of hero bike (Part no. H043)

Notations used are:

R= Demand rate (Annual Usage)

C_1= Carrying cost per unit per year in Rupees

C_3= Order cost per unit per order in Rupees

q = Economic order quantity (EOQ)

N_{old} = no. of orders per year as per current model

N_{q^*}= no. of orders per year as per the proposed EOQ model

T_{old}= cycle time as per current model

T_{q^*}= cycle time as per proposed EOQ model

Available data-:

Purchase cost = ₹8500 per unit

Present. Order quantity = 4

R =12 per year

C_1 = 13% of purchase cost

C_1 = 0.13*8500 = 1105₹ per unit per year

C_3 = 20₹ per unit per order

1) EOQ calculation

$$q^* = \sqrt{\frac{2*C3*R}{C1}}$$

$$q^* = \sqrt{\frac{2*20*12}{1105}}$$

$$q^* = 0.66$$

$$q^* = 1 \text{ (rounded off)}$$

2) No. of orders per year as per proposed EOQ model

$$N_{q^*} = \frac{R}{q}$$

$$N_{q^*} = \frac{12}{1}$$

$$N_{q^*} = 12$$

a) Cycle time as per proposed EOQ model

$$T_{q^*} = \frac{12}{Nth}$$

$$T_{q^*} = \frac{12}{12}$$

$$T_{q^*} = 1 \text{ month}$$

3) No. of orders per year as per current model

$$N_{old} = \frac{12}{4}$$

$$N_{old} = 3$$

a) Cycle time as per current model

$$T_{old} = \frac{12}{Nold}$$

$$T_{old} = \frac{12}{3}$$

T_{old}=4 months

4) Variable cost as per proposed EOQ model

$= (0.5* C_1 *q) +(N_{q^*} *20)$

= ₹ 792.5

5) Variable cost as per current model

$= (0.5*C_1*$ present order quantity) $+(N_{old} *20)$

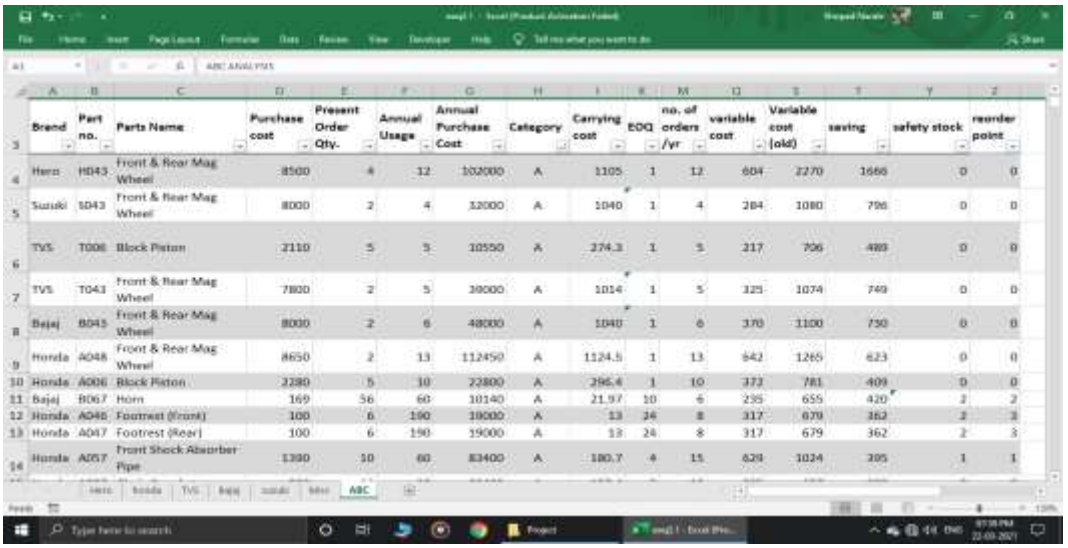
= 2270₹

6) Savings per year for given item

= (Theoretical variable cost as per proposed EOQ model) – (Variable cost as per current model)

= ₹ 1666

The same methodology can be used for all remaining items to calculate EOQ. A screenshot of the same is given in fig.



Brand	Part no.	Parts Name	Purchase cost	Present Order Qty.	Annual Usage	Annual Purchase Cost	Category	Carrying cost	EOQ	no. of orders /yr	variable cost	Variable cost (old)	saving	safety stock	reorder point
Hero	H043	Front & Rear Mag Wheel	8500	4	12	102000	A	1105	1	12	604	2270	1666	0	0
Suzuki	S043	Front & Rear Mag Wheel	8000	2	4	32000	A	1040	1	4	284	1080	796	0	0
TVS	T008	Block Piston	2110	5	5	10550	A	274.3	1	5	217	706	489	0	0
TVS	T043	Front & Rear Mag Wheel	7800	2	5	39000	A	1014	1	5	325	1074	749	0	0
Bajaj	B043	Front & Rear Mag Wheel	8000	2	6	48000	A	1040	1	6	370	1100	730	0	0
Honda	A048	Front & Rear Mag Wheel	8650	2	13	112450	A	1124.5	1	13	642	1265	623	0	0
Honda	A006	Block Piston	2280	5	10	22800	A	296.4	1	10	373	781	409	0	0
Bajaj	B067	Horn	169	56	60	10140	A	21.97	10	6	235	655	420	2	2
Honda	A048	Footrest (Front)	100	6	190	19000	A	13	24	8	317	679	362	2	3
Honda	A047	Footrest (Rear)	100	6	190	19000	A	13	24	8	317	679	362	2	3
Honda	A057	Front Shock Absorber Pipe	1390	10	60	83400	A	180.7	4	15	628	1024	395	1	1

Fig. 2: Screenshot of excel file showing results for some parts according to proposed EOQ model

V. RESULTS & CONCLUSIONS

In this paper the existing inventory management system is analyzed and OR technics are applied to reduce holding costs of the inventory.

Brand	Variable cost	Variable cost%	saving	saving%
Honda	33097.30	24.01	8863	27.05
Bajaj	26341.15	19.11	5355	16.34
Hero	30137.55	21.86	9924	30.29
Misc.	7301.44	5.30	1001	3.05
Suzuki	19821.73	14.38	3612	11.02
TVS	21162.36	15.35	4014	12.25
Total	137861.53	100.00	32768	100.00

Table 4: Overview of Brand wise variable cost and savings

Class	variable cost (₹)	%
A	7456.11	53.94
B	44203.41	32.06
C	19302.01	14.00
Total costs	137861.53	100

Table 5: ABC category wise variable cost

First, we determined the savings of all 674 items then for further analysis we were considered only items which were providing 20₹ or more than 20₹ of saving per year. There were a total of 343 items that were providing 20 ₹ or more than 20₹ saving/per year. So instead of focusing on 674 items, we were only focusing on 343 items. By changing the present order quantity of 343 items which were just about 50% of the total items, we were able to save ₹31895.48 whereas savings for 674 items was ₹32768.48

By adopting the new inventory policy i.e., EOQ for about 50% of total items and older inventory policy for the remaining 50% of items we were able to save 31768.48

Class	Savings (₹)	%
A	15004.98	47.04
B	10175.41	31.90
C	6715.10	21.05
Total savings	31895.48	100

Table 6: ABC category-wise savings

VI. FUTURE WORK

From the last few years' sales data, overall annual demand was observed to be fairly constant, so that the proposed model can be continued in the future. Some managerial interference is required when sudden rise/fall in demand of products, or change in products (for ex. Due to transformation from BSIV to BSVI), to make required changes in the model for order quantity & reorder point.

Q (i.e., fixed order quantity) type replenishment system was observed to be most suitable. Any inventory software can be used to track in-stock inventory to review & make decisions of reordering whenever current stock drops below reorder point.

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