USE AND APPLICATION OF SELECTIVE INVENTORY CONTROL MODEL IN A TRACTOR TRAILER MANUFACTURING PLANT

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Dr. K. N. Agrawal

Abstract
This paper describes an Application of Selective Inventory Control Model in a Tractor Trailer Manufacturing Plant. Incorporation of the appropriate inventory management system plays an important role in determining the financial health of a manufacturing company. In most of the cases, unjustified inventory of raw materials is kept causing certain loss to the company. Keeping the above in mind, in the present work, a task is undertaken to find out relevant items that need stringent inventory management in one manufacturing company. Based on the demand pattern of spare parts different inventory control models are proposed. Since it is difficult to apply a proper inventory control model for each item separately because of its huge variety, it is necessary to find out few significant items using 'Selective Control' method. ABC and VED analyses are performed. The major thrust of the work is on inventory control of A and B class Vital and Essential items. The model used for the different categories are Periodic Review Model and Continuous review model. The analysis of the effectiveness of the proposed inventory control model against the present inventory control system is done.

Key words: Tractor Trailer Manufacturing Plant, Selective Inventory Control, ABC and VED analyses.

1. INTRODUCTION
The present study is conducted in a “Awachat Industries Ltd.” incorporated in the year 2004, at Wardha (Maharashtra, India), is a renowned ISO 9001:2008 certified company engaged in manufacturing and Marketing of “Raj” Brand Agricultural Tractor Trailers, Tankers and “Raj” Brand Agricultural Implements. In this plant large numbers of spare parts required for manufacturing of various types of trailers are stored. In the existing system for inventory control a predetermined maximum stock level is fixed for each item, based on rough estimates of the demand of items. For controlling the inventory in a scientific way, VED analysis is also important as in manufacturing industry where the plant may stop functioning for want of some spare part. In industrial situation, however ABCxVED analysis will help in setting proper strategies for inventory control.

For the A & B Class , Vital and Essential, Periodic review of inventory is advisable as number of items are less. If this approach is applied to all items, system may buckle. For C class , (vital , essential) & all desirable items continuous review system is proposed.

Amongst all these models most critical is continuous review model, where in quantity equal to EOQ is to be ordered when the stock falls below ROP due to any selling. EOQ and ROP are not static quantities in our model but they keep on changing based on history, trends, and fluctuations in demand. For this a tool to assess and present effectiveness of proposed inventory control model is to be developed.

The aim towards the study was to develop a system for the control of spare parts In order to fulfill the objective a systematic procedure has been taken up.

2. LITERATURE REVIEW
A huge variety of research in the field of inventory is being Carried out. In this a brief literature survey is shown which tells on various types of reports on inventory control practice in various industries which are published in research journals. In the last few years, a variety of case studies on inventory control have appeared in research journals, having an application in cutting tools, chemical, automotive and steel industries.

Kumar Pramod, Anas Mohd [1], has carried out the case study in Scooter India Limited on the ABC Analysis for the multiple product inventory. The main objective of this study is to find whether multiple-products in the Manufacturing Company can be evaluated and understood using inventory management techniques or not. It was also seen that there is no relation between annual demand and total costs of the products. An inventory model is based on projected sales, stock holding costs and lead times.

Mitra Shibamay, Kumar Sujit & Bhowmik Papiya [2], have applied the inventory analysis techniques on an electric multiple unit (EMU) manufacturing industry. Here the ABC and HML analysis are performed to maintain and control the optimum level of inventory. For this study, they found that the priorities of the items change according to different inventory analysis techniques.

Pratap Mahendra, Singh Harwinder [3], has studied the raw material inventory control problem in Bentex Engineering Pvt Ltd. This manufactures the ferrous, non ferrous components and assemblies for automotive. In this ABC, FSN and XYZ classification of raw material has been carried out. As determined by this proposed model, the total inventory cost has been less than the existing inventory cost. The result of this study shows that companies can save considerable amount of money per annum by adopting this model.

Sanjeevy C, Ciby Thomas [4], designs the inventory models for the spares inventory in a chemical processing plant. Selective treatment is done based on ABC and VED analysis, which were then combined. The simulation techniques are applied to obtain probable lead time and demand optimum reorder quantity.

Fu Kuo-En, Chen Wei-Zhen, Hung Lon-Chen & Peng ShihSen [5], had studied a raw material inventory control model for the most important multiple products production in the company X. The ABC analysis technique for the inventory control system is first used to distinguish the most important
multiple products and then the economic order quantity (EOQ) of each product is set up to find their inventory model equation individually.

Madan A K, Ranganath M S [6], shows the inventory control need in industries. The ABC and VED selective inventory techniques are used for monitoring inventory of cutting tool. It shows the need and importance of a JIT system in the industries.

3. DISCUSSION ON EXISTING SYSTEM AND PROBLEM IDENTIFICATION:
As far as inventory control of spare parts is concerned. The first problem which reflects from existing system for inventory control is that the maximum level of stock, safety stock, review period, reorder quantities, etc., are based on experience. And the criteria for setting those parameters are that “with this much they will never go out of stock”.

There are too many items in store to set these parameters for controlling inventory, even based on experience of thumb rules. The company is interested in letting those setting be done by the system automatically. However, to rely on those decisions company wants to assess the effectiveness of inventory control system over the existing.

The root of all the problems discussed above is, no use of scientific technique in inventory control of spare parts is made. Right now, there is no way to know whether inventory they are keeping is optimum or not, but with the application of scientific technique, there is scope for reduction in inventory while providing a required service level. Application of scientific techniques will reduce the internal lead time by providing a confident base in taking decisions like order or not to order, how much and when to order. This in turn will reduce present safety stock levels.

4. OBJECTIVE
The objective of the present work is formulated for reducing the total inventory cost in the industry.

1. To provide a scientific basis for control of inventory of spare part, according to classification of item it belongs.
2. To provide a decision support module to help stores people to control inventory that can be plugged in the present system for inventory control.
3. To assess the effectiveness of the proposed inventory control model over the existing inventory control system.

5. METHODOLOGY
Present paper deals with reduction of total inventory cost by using selective inventory control model. The methodology for achieving this purpose is as follows.

1) Data Collection.
2) Preliminary Analysis of collected Data using ABC and VED Classification.
3) ABC/VED Joint Analysis
4) Development of Inventory control model.
5) Comparison Of Present System With Proposed Model

6. PRELIMINARY ANALYSIS
(A) ABC Classification of Raw material

<table>
<thead>
<tr>
<th>Category</th>
<th>No. Of Item</th>
<th>Percent age of items</th>
<th>Percen tage Total</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A</td>
<td>11</td>
<td>11%</td>
<td>80%</td>
<td>Close control</td>
</tr>
<tr>
<td>Class B</td>
<td>19</td>
<td>19%</td>
<td>15%</td>
<td>Regular review</td>
</tr>
<tr>
<td>Class C</td>
<td>70</td>
<td>70%</td>
<td>5%</td>
<td>Infrequent review</td>
</tr>
</tbody>
</table>

(B) VED Classification of raw material

<table>
<thead>
<tr>
<th>Categories</th>
<th>Total No. items in Classes</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>69</td>
<td>69.00%</td>
</tr>
<tr>
<td>E</td>
<td>21</td>
<td>21.00%</td>
</tr>
<tr>
<td>D</td>
<td>10</td>
<td>10.00%</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Table 1: Table for ABC Analysis

Table 2: Table for VED Analysis

Figure 1: ABC Analysis Graphical Representation

From the ABC analysis of the under frame items we have found that about 11% of the items are classified as 'A' class items which contribute towards 80% of the total annual consumption. About 19% of the items are classified as 'B' class items which contribute towards 15% of the total annual consumption. The remaining 70% items are classified as 'C' class items which contribute towards 5% of the total annual consumption.

In the above table shows the classification of various components as VED items using VED analysis techniques based on criticality to production. From the classification V items are vital items and their analysis requires more attention since stock out situation would result in stoppage of production and constitutes 69% of total components. E items are those which are necessary for efficient running of the system, but without which the system will not fail and constitute 21% of total components and D items are those which don't effect immediately on production but they help to increase efficiency and decrease fatigue and constitute 10% of total components. The percentage of vital components are more so there should be sufficient stock of vital components for smooth running of the production.
(c) ABC/VED Joint Analysis
Sample results of joint ABC and VED analysis is shown in following format.

<table>
<thead>
<tr>
<th></th>
<th>V</th>
<th>E</th>
<th>D</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>B</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>C</td>
<td>40</td>
<td>20</td>
<td>10</td>
<td>70</td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>21</td>
<td>10</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 3: Table for ABC/VED Joint Analysis

7. INVENTORY CONTROL MODEL:

<table>
<thead>
<tr>
<th></th>
<th>V</th>
<th>E</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>(AV)</td>
<td>(AE)</td>
<td>(AD)</td>
</tr>
<tr>
<td>B</td>
<td>(BV)</td>
<td>(BE)</td>
<td>(BD)</td>
</tr>
<tr>
<td>C</td>
<td>(CV)</td>
<td>(CE)</td>
<td>(CD)</td>
</tr>
</tbody>
</table>

Figure 2: ABC/VED Joint Analysis

Category 1 : AV+AE+BV+BE
Category 2 : AD+BD+CV+CE+CD

Category I is high priority group, requires greatest attention. It contain the vital & Essential items which are costly one, whose shortage may adversely affect the functioning of the industry or whose over stocking /pilferage may lead to financial loss to the industry. Q System of inventory control is used.

Category II is under moderate management and moderate attention is devoted. Here items are vital , essential & Desirable but are least costly and can have lesser stringent controls. P system of inventory control is used.

Inventory Control System:
1. Continuous Review System(Q System)
2. Periodic Review System(P System)

8. COMPARISON OF PRESENT SYSTEM WITH PROPOSED MODEL:
In the present scenario, the annual cost of maintaining the inventory of the raw material has been calculated in this organisation.

For Category I:
For the raw material Leaf Spring Assy -42", the calculation of Annual total inventory cost has been explained as follows:
Annual Demand (units) = 198
- Ordering Cost = 500
- Annual Holding Cost = 20%
- Unit cost = 4066
- Annual holding cost/unit = Rs 813.2/-

Total Inventory Cost by the Present Inventory System:
- For Leaf Spring Assy -42", Pre determined Ordering Quantity= 50 units
- So according to annual demand the No. of orders per year = 4 orders
- Annual ordering cost= Rs 2000/-
- Annual holding cost = Rs 20330/-
- Total cost= Annual ordering cost + Annual holding cost
  T.C = Rs 3,76,307/-

 Likewise the total annual saving is calculated for category-I Items

<table>
<thead>
<tr>
<th>Description</th>
<th>Present Inventory System</th>
<th>Proposed Inventory System</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Of Orders/Year</td>
<td>144</td>
<td>273</td>
</tr>
<tr>
<td>Annual ordering costs</td>
<td>Rs 72,000</td>
<td>Rs 1,36,500</td>
</tr>
<tr>
<td>Annual holding costs</td>
<td>Rs 7,97,210</td>
<td>Rs 3,56,403</td>
</tr>
<tr>
<td>Total Cost</td>
<td>Rs 8,69,210</td>
<td>Rs 4,92,903</td>
</tr>
</tbody>
</table>

Table 4: comparison of present system with proposed Q System

- Total Inventory Cost by the Proposed Inventory System:
  As the Leaf Spring Assy -42 comes in category I the Q-System of inventory control is used.
  - Standard Deviation=0.595
  - Order size=16 units
  - Average no. of order per year=12.3 orders
  - Stock required to meet average demand=2x3.81 =8
  - Std. Deviation for 5 weeks lead time= 0.595 2
  - Reserve stock for 98% service level = 2.05x0.84= 2 units
  - Total unit units for reserve=8+2 =10 units
  - Ordering Cost = 500 x 12 =Rs6000
  - Annual holding cost=Rs 7569.02/-
  - Total Cost = 6000+ 8132 = Rs 14132

Total Cost Saving by using the proposed inventory system for the Leaf Spring Assy -42

= Total cost by Present inventory System - Total cost by Proposed inventory System
= Rs 22330- Rs 14132
= Rs 8198/-

So annual cost saving on Leaf Spring Assy 4 = s 8198/-

For Category II Items:
For the raw material 7/8 Cut Washer, the calculation of Annual total inventory cost has been explained as follows:

- Standard Deviation=37.23
- Periodic Interval Between order (P)=2 weeks
- Safety Stock at 99.5% of service level = 12 units
- Targeted Inventory (T) = 5814 units.
- Order quantity. (Q ) = T – IP

The quantity to order is found by taking the target value and subtracting the current inventory level or inventory position, IP.
Annual ordering cost = Rs 13000/-
Annual holding cost = Rs 46586.15/-
Total cost= Annual ordering cost + Annual holding cost.
\[ T.C = 1000 + 1830 \]
\[ T.C = Rs 2830/- \]

Total Inventory Cost by the Present inventory System:
For 7/8 Cut Washer, Pre determined Ordering Quantity = 2000 units
So according to annual demand the No. of orders per year= 7 orders
Annual ordering cost= Rs 3500/-
Annual holding cost = Rs 600/-
Total cost= Annual ordering cost + Annual holding cost
\[ T.C = 3500 + 600 \]
\[ T.C = Rs 4100/- \]

Total Cost Saving by using the proposed inventory system for the 7/8 Cut Washer
\[ \text{Annual Cost Saving} = \text{Total cost by Present inventory System} - \text{Total cost by Proposed inventory System} \]
\[ = Rs 4100 - Rs 2830 \]
\[ = Rs 1270/- \]

Likewise the total annual saving is calculated for category-II Items

<table>
<thead>
<tr>
<th>Description</th>
<th>Present Inventory System</th>
<th>Proposed Inventory System</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Of Orders/Year</td>
<td>190</td>
<td>16</td>
</tr>
<tr>
<td>Annual ordering costs</td>
<td>Rs 95,000</td>
<td>Rs 58,000</td>
</tr>
<tr>
<td>Annual holding costs</td>
<td>Rs 1.01,811</td>
<td>Rs 98,910</td>
</tr>
<tr>
<td>TOTAL</td>
<td>Rs 1,96,811</td>
<td>Rs 1,56,910</td>
</tr>
</tbody>
</table>

Table 5: comparison of present system with proposed P System

Annual Cost Saving for Category-II Items:
\[ = Rs 1,96,811 - Rs 1,56,910 \]
\[ = Rs 39,901 \]

Total Annual cost saving on all raw material
\[ = Rs 3,76,307 + Rs 39,901 \]
\[ = Rs 4,16,208/- \]

9. CONCLUSION
The purpose of this work has been to set the rules for inventory control of the Spare parts according to the Category it belongs. The Inventory carrying and the ordering cost were calculated from the collected data.

For the selective control of spare parts the preliminary classification of spare parts has been done. The preliminary analysis consists of ABC, VED classification. Based on this joint classification have been done. Considering the group of items Periodic review system and continuous review system is proposed to estimate order point and order quantity. To calculate the total inventory cost for the present and the proposed system the software is developed and proposed. If the proposed inventory control system is used, then the annual saving on the total inventory cost will be Rs 4,16,208/- However it will be more suitable for implement the system.

REFERENCES


BOOK:


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