

Original Research Article

A Case Study of Spare Parts Inventory of Printing Industry using ABC and VED analysis

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Abstract

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Spare parts inventory is required in industries for maintenance and repairing of machines, equipment, and vehicles. Managing spare parts inventory is a complex task due to huge number of variety and its lower demand. In this study, inventory control techniques i.e. ABC (Always Better Control), VED (Vital, Essential, Desirable) analysis and ABC-VED matrix analysis have been applied to spare parts inventory of a printing industry to identify the items requiring strict management control. Data was collected mainly from the log book of the company and through interviews of middle and lower staff of technical store, production, purchasing, and maintenance departments. The expenditures of the items of each category for the year 2016-17 were analyzed using inventory control techniques. ABC analysis showed that 15% items were from category A and category B each, remaining 70% items were from category C accounting for around 66%, 15% and 19% of total annual expenditure of technical store respectively. VED analysis identified 34.91% items as Vital, 54.58% items as Essential and 10.57% items as Desirable accounting for 48.74%, 46.26% and 4.98% of total annual expenditure of the technical store respectively. On ABC-VED matrix analysis, 39.93%, 51.82% and 8.23% items were placed in category I, category II and category III, respectively, amounting for 79.81%, 19.16% and 10.01% of total annual expenditure. Based on these analysis, practical suggestions have given for industries about optimal stock, order quantity and reorder points. The benefits of the current study were reduction in dead stocks and rationalizing the number of items of each category of inventory, which leads to reduce capital investment and avoid disruption in process due to unavailability of spare parts inventory.

Key words: Inventory control, ABC analysis, VED analysis, Technical store, Spare parts

INTRODUCTION

Industries hold spare parts inventory for equipment repairs and support purpose only. It is different from other types of inventory that is used in production for conversion raw material to finished goods. This distinction keeps spare parts inventory apart from other types of inventory. It suggests a separate inventory system for spare parts inventory to control critical and valuable items stringently. Spare parts inventory is important for carrying out timely maintenance and

bringing broken parts in order. Out of stock situation of spare parts can disrupt the production process and may cause financial loss for the industry.

In this study, we are presenting a case study of inventory management of technical store of a printing industry comprising total of 331 items, located in the city of Karachi, Pakistan. The studied company is a private sector industry and had some serious issues in inventory of spare parts. The company had a number of dead stock

items and had a high number of some desirable spare parts. At the same time, they face shortage of vital and critical items in certain occasions, which cause wastage of both time and money.

This study intends to discuss the inventory techniques for the spare parts inventory to manage it in better way. The inventory control techniques commonly used to categorize items on the basis of its annual values and criticalities have been used in this study. The purpose was to minimize the dead stock, make sure the availability of vital and essential parts and other desirable items in optimal amount.

ABC analysis is a commonly used inventory technique, classifying inventory items in groups according to their values and rate of consumption. The limitation of the ABC analysis is that it compromises on the criticality of inventory. The analysis only bases on the values and rate of consumption of items. An item of relatively lower monetary value can be very vital for the maintenance and repairing of the machine (Silver et al., 1998; Fuerst, 1981). The importance of such vital parts cannot be ignored because of its monetary value. Therefore, another technique of inventory management to consider the criticality of the inventory is used i.e. VED analysis.

VED analysis is another inventory categorizing technique in three classes: vital, essential and desirable. It based on critical values, stock out cost, nature of item and source of supply, and lead time for procurement of item (Gajpal et al., 1994).

The combination of ABC and VED analysis group inventory in three categories. An item must be in any of these three categories namely category I, II, and III. Category I have only valuable and critical items (AV, AE, AD, BV, CV). Item of category must be either of group A in ABC analysis or group V in VED analysis or both at same time. Category II includes essential items of average values (BE, CE, BD), and category III includes only desirable items of VED analysis and cheaper items of group C in ABC analysis (CD) (NIHFW Module, 2009).

We divided this study in different sections to organize and explain each parts properly. After introduction to the study, we have presented a thorough review of the related literature. In the next section, we discussed research methodology to explain the methods of data collection, data analysis and give a direction to our research work. The prime section of the study was then put, in which we presented our results and discussed the findings in details. In the last sections, we concluded our study and added reference to the literature.

Literature Review

Spare parts inventories have a vital role in industries to carry out the production process in time. It is different from other inventories i.e. raw materials, semi-finished product and finish product inventory. Spare parts have

intermittent demand. However, some items of great wear and tear have higher demand and some parts have extremely lower demand. This difference adds more uncertainty to the demand of spare parts inventory. As a result, some items available in higher quantity more than its demand and lying in the stores for years as dead stock. However, the items that have higher demand may face out of stock situation. This out of stock situation leads to delay in repairing machine parts. The delay increases the production time, which may worsen the negative perception of the client (Cohen and Lee, 1990; Cohen et al., 1997; Kumar, 2005).

Spare parts inventory is highly varied in term of nature, values and cost, service requirement and demand patterns (Boylan et al., 2008). Since manufacturing industries hold large number of spare parts inventory, a categorization of the inventory shall be carried out to determine optimal quantity, adequate managerial attention, demand forecasting and different service level between categories (Boylan et al., 2008; Huiskonen, 2001). These techniques identify the items requiring stringent supervision and management control.

The manufacturing organizations, which hold spare parts inventory, usually classify it using different criteria and service levels for each category of items (Syntetos et al., 2009). The commonly used technique of inventory classification is ABC analysis, which divides items on the basis of its values and rate of consumption into A, B and C categories. ABC analysis measures the importance of items on the basis of its values and annual consumption. ABC analysis suggests different level of control for the items of different categories. It placed strict control on the items having highest value and rate of consumption. The management focuses on parts that account for the highest annual expenditure of inventory (Onwubolu and Dube, 2006). In ABC analysis, generally but not mandatorily, items of category A include approximately 5 to 20 percent of all items of inventory, accounting for approximately 50-80 percent of annual expenditure. While B items, include roughly 20 to 40 percent of the items with 20 to 40 percent of the total expenditure. The remaining items, the C items, include approximately 50 to 70 percent of the items account for only 5 to 25 percent of the total expenditure (Fitzsimmons and Fitzsimmons, 2004; Winston, 1994). ABC analysis has certain limitations as it categorizes items on the basis of its annual expenditure rather than its criticality. Therefore another technique, VED analysis is recommended for classification of spare parts inventory. VED analysis classify inventory in three categories according to the criticality of items i.e. Vital, Essential and Desirable (Gajpal et al., 1994).

The absence of Vita items would halt the production. These items must be available in the store all the time. "Essential" group includes items whose stock-outs cost is very high. Moderate management control system is suggested for essential items. Where "Desirable" items

Table 1. Categorization of VED analysis

S. No.	Factors	First Degree		Second Degree		Third Degree	
		Criteria	Weightage	Criteria	Weightage	Criteria	Weightage
	Stock out cost	80	30	81-150	60	Above 150	90
	Procurement lead time	01 day	30	2-3 days	60	4-7 days	90
	Nature of item	Commercial standard	20	Supplier design	40	Buyer design	60
	Sources of Supply	Local	20	Out station	40	Imported	60

do not bring any immediate loss and delay to production process. Stocks out cost of desirable items are also nominal. VED analysis suggests lower management control for desirable items (NIHFW Module, 2009; Ramanathan, 2006).

ABC-VED analysis matrix which is the combination of two inventory control techniques i.e. ABC analysis and VED analysis. It classifies inventory items in Category I, II and III. As a result these items can be supervised and controlled in an appropriate way. Category I includes expensive and vital items (AV, AE, AD, BV, CV), category II have essential items of average values (BE, CE, BD), and category III includes only one sub-category (CD). This sub-category includes desirable items of VED analysis and cheaper items of ABC analysis (C) (NIHFW Module, 2009; Vaz et al., 2008).

In this study inventory control techniques were applied to the technical store of a printing industry to identify the categories of spare parts inventory requiring strict management control. The study has the following objectives:

1. To analyze and evaluate total annual expenditure of spare parts inventory
2. To implement inventory management techniques for better control of spare parts inventory
3. Identify and minimize dead stock
4. Identify the items needing strict supervisory and management control i.e. expensive and critical items
5. Identify adequate and optimal quantity level of each item

RESEARCH METHODOLOGY

Research methodology represents the methods and strategies used for collecting and analyzing the data. This section also explains tools and techniques of inventory management and gives a direction to the research work.

Data collection

This is a case study of spare parts inventory of a Karachi based printing Industry. The data were collected for one year from April 2016 to April 2017. The collection

processes comprised of two phases. In initial phase, interviews of workers and supervisors of technical stores, maintenance, purchasing and production departments were carried out to collect the required information related to stock out cost, procurement lead time, sources of supply and nature of item. These interviews helped in identifying critical and essential inventory. In the second phase, log book of the company was reviewed thoroughly. All the information related to unit price, rate of consumption and inventory in hands were recorded from the book. During reviewing the log book, store in-charge was consulted to resolve if there is any confusion. The technical store comprises total of 331 items.

Data Analysis

Before analyzing the data, factors and criteria for ABC and VED analysis were described and assigned weightage to each factor according to their importance to the company as given in Table 1. There is no fixed threshold for assigning weightage to each factor, different proportion may be applied based on the criteria and objectives of the company. All the data were put in MS Excel spreadsheet to refine and arrange for analysis. The data were transcribed then into Minitab17 for statistical analysis.

There are a number of approaches of performing VED analysis. We used a quantitative method as described in Table 1 for carrying out VED analysis. An item will be considered as vital if it scores 230 to 300, if any item scores 161 to 230 will be categorized as essential and the items which score 160 or below 160 will be kept in desirable category.

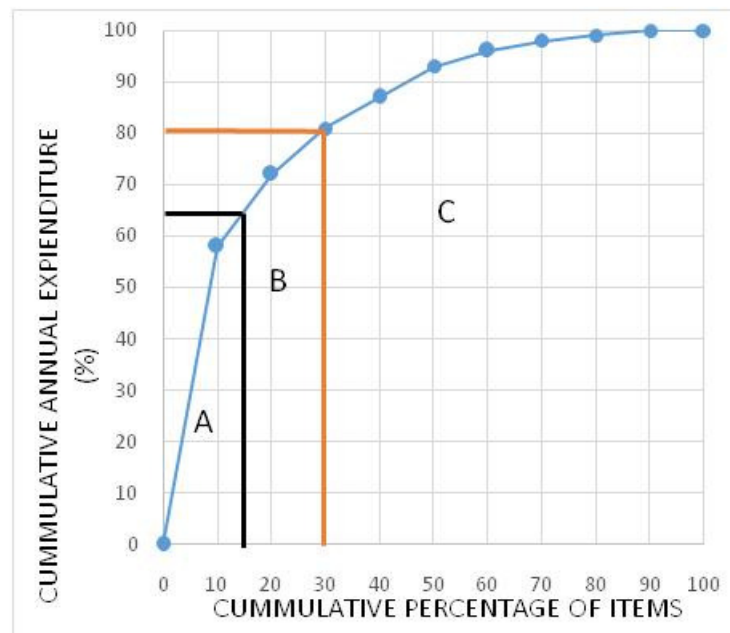
Tools and Techniques

ABC Analysis

ABC analysis is a commonly used inventory technique classifying inventory items in groups according to their monetary values and rate of consumption. In ABC analysis items of highest values and rate of consumption are put in category A. Items of average cumulative

Table 2. ABC analysis, VED analysis and ABC-VED matrix

Category	No. of Items	% of items	Annual expenditure (Rs)	% of Annual Expenditure
A	51	15.40	743,944	65.67
B	51	15.40	176,192	15.537
C	229	69.18	217,872	18.86
V	114	34.75	541308	41.01
E	180	54.87	513752	53.24
D	34	10.36	55396	5.74
I	131	39.93	740252	76.72
II	170	51.82	213324	22.10
III	27	8.23	11280	1.16

**Figure 1.** ABC Analysis Cumulative Curve

annual values are put in B and the remaining items of lowest annual cumulative values are placed in category C.

VED Analysis

VED analysis is an inventory technique classifying inventory into three categories i.e. Vital, Essential and Desirable. It categorizes items on the basis of stock out cost, nature of product, source of supply and lead time for procurement of items. The criteria and scale for categorization of items in VED analysis have been presented in Table 1.

ABC-VED Matrix analysis

It is framed by putting ABC analysis and VED analysis in

cross-tabulating form. This combination of two techniques, divided item in three different categories: category I, category II, and category III as discuss in the early section.

RESULTS AND DISCUSSIONS

In this section we will discuss in detail the results and findings of each technique applied in this study.

Results

As ABC analysis categorizes items on the basis of its value and rate of consumption. The findings of the ABC analysis in this study have been shown in Table 2 and Figure 1. About 15.40 % items were put in category A and category B, each and 69.2 % items in category C

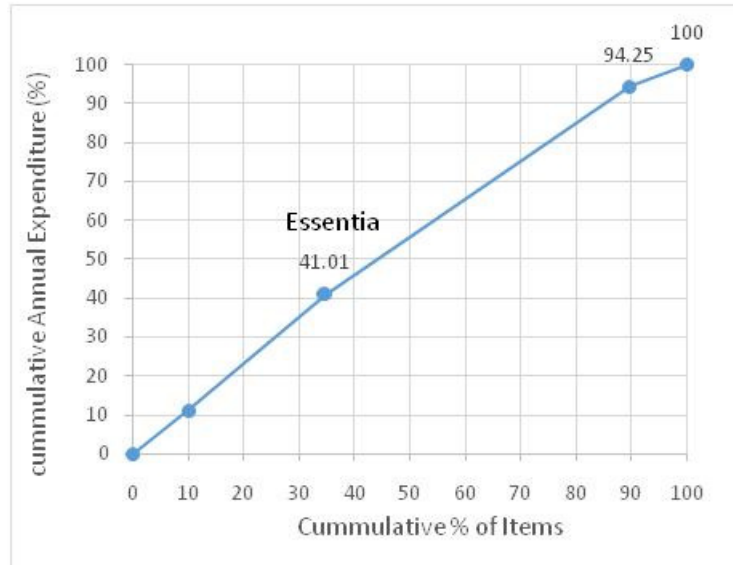


Figure 2. VED analysis Cumulative curve

Table 3. ABC-VED analysis

	V				E				D			
	No.	%	Annual Expenditure (Rs)	%	No.	%	Annual Expenditure (Rs)	%	No.	%	Annual Expenditure (Rs)	%
A	35	10.67	225400	23.36	15	4.57	318120	32.97	2	0.06	26424	2.37
B	33	10.06	122200		12	3.65	44700	4.63	5	1.52	17692	1.83
C	46	14.02	48108	4.98	153	46.64	150932	15.64	27	8.23	11280	1.16
Total	114	34.75	395708	41.01	180	54.87	513752	53.24	34	10.36	964856	5.74

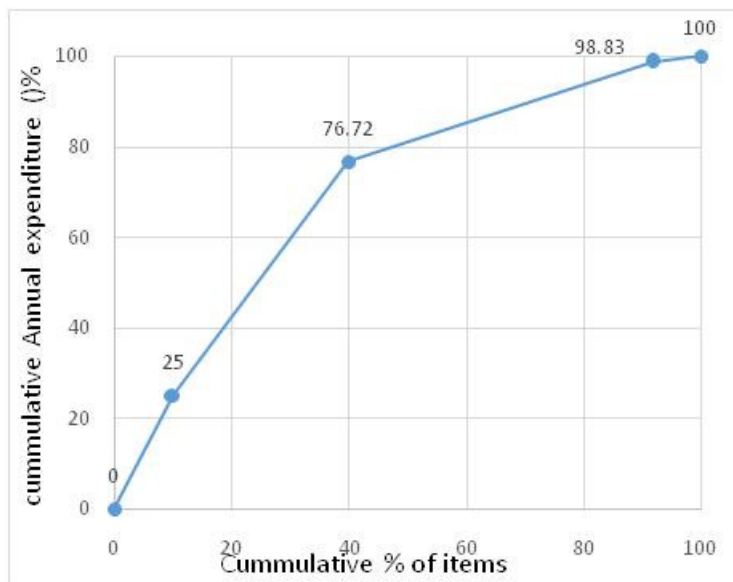


Figure 3. ABC-VED Matrix Cumulative Curve

accounting for 65.67 %, 15.53% and 18.86% of total annual expenditure of technical store respectively (Table 2 and Figure 1). In our study cut-offs of items and its values are marginally different from presented one i.e. 70/20/10 %, which is permissible (Ammer, 1982).

VED analysis is another inventory control technique which categorizes items on the basis of its criticality. The VED analysis show that around 34.75% items were found Vital, 54.87% Items as Essential and 10.36% items as Desirable amounting for 41.01%, 53.24% and 5.74% of the total annual expenditure respectively (Table 2, Figure 2).

ABC-VED matrix analysis as given in Table 3 and Figure 3, suggests a multilevel control system. In ABC-VED matrix, the inventory was analyzed and grouped in nine different sub-categories on the basis of classification of ABC and VED analysis i.e. AV, AE, AD, BV, BE, BD, CV, CE, and CD. These nine sub-categories were further grouped in three categories, category I, II and III. The analysis shows that around 39.93 % items were found in category I, 51.82 % in category II and 8.23% in category III accounting for 76.72%, 22.10% and 1.16% of total annual expenditure of the technical store respectively.

Discussion

Spare parts inventory is important for proper running of any industry and have great impact on customer satisfaction. It must be controlled carefully to make sure timely availability of spare parts and avoid delays in the production process. Besides criticality of spare parts, cost factor should also be considered. As shown in ABC analysis, 15% of items are responsible for around 70% of total annual expenses. This category needs strict controlling as few items are consuming most of the money. In ABC analysis, these items were put in category A. Further, it was cleared from VED analysis that all items of Category A were not vital and essential but also had items of desirable category. If ABC analysis considered alone, then only 15% items in category A amounting for 66% of total expenditure will be effectively controlled. It will ignore the availability of vital items from category B and category C.

If VED analysis is considered alone, then only the vital and essential items categories (89.62%) with almost 94.25% of total expenditure will get stringent control. It will ignore the desirable valuable items of category A. ABC-VED matrix analysis helps to cover the limitations of the two analysis i.e. ABC analysis and VED analysis. The ABC-VED matrix identify more precisely the items need stringent control. The ABC-VED matrix identified 39.93 % of items accounting for 76.72% of total annual expenditure in category I for stringent control. Items of category I are either expensive or vital. Subgroups AV, AE and BV of category I have items, which are vital or expensive or both at the same time. These subgroups

comprised of 25.3 % of total items accounting for 68.9% of total annual expenditure. As these items are either vital or expensive, so, their out of stock for an industry is unacceptable for any industry. To prevent locking up of capital on these items, a lower safety stock level needs to be maintained with a strict checking and control on consumption level and inventory in hand. CV items (14.02 % of total items accounting for 4.23% expenditure) are items of lower cost and vital in nature. These items should be purchased once in a year as their cost is lower. It will avoid ordering cost. As these are spare items of normally small size, so their stocking shouldn't be problem.

AD (0.06% of total items accounting for 2.37 % of total annual expenditure) items are expensive items of desirable category. These items should be monitored for economic order quantity. These are expensive items and their non-availability doesn't make much difference to the processes.

Category II items (51.82%) consumes 22.10% of total annual expenditure. These items should be purchased once or twice in a year to save ordering cost without locking substantial capital. Category III items 8.23 % are consuming 1.16% of total annual expenditure. These items as having lower cost should also be purchased once or twice in a year to save ordering cost without blocking substantial capital. ABC-VED matrix analysis recommends strict control for category I and proposes different control techniques for category II and category III. ABC-VED matrix shall be used as routine practices to avoid out of stock situation and use the available resources optimally.

CONCLUSION

It was found that there were around 31 items as dead stock in the store. Additionally, other items were available in a disproportionate amount. The items had lower frequency of utilization, may had high number in store and vice versa. This disproportionate amount, despite of locking a substantial capital may not avoid delay because of having lower number of some critical items and high number of some desirable items.

This study recommends the application of inventory management techniques to properly manage spare parts inventory, efficient decision making in purchase and distribution of specific items and close supervision on items belonging to important categories. These scientific tools help the management to avoid out of stock situation as well as eliminate dead stock without blocking substantial capital. These scientific tools also identifies the categories of items need stringent management control. These techniques reduce the amount of locked capital on spare parts inventory as well as reduce the disruption period.

Though we analyzed the spare parts inventory of a

smaller company, it can benefit other companies having huge spare parts inventory. This study can also help for scholars or academicians in future research in the field of spare parts inventory management.

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