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APPLICATION OF INVENTORY CONTROL TECHNIQUE IN CONSTRUCTION

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ABSTRACT— Paper provides details of basic elements of construction material management, role of inventory management in material management including inventory terminologies & classification, Inventory process, inventory control systems, key performance indicators of inventory management systems, inventory models and optimization of inventory with importance of material resources planning to keep just in time inventory. This paper deals with ABC and EOQ Analysis of Construction Company and finally concluding section, project provides detail of financial analysis of effective utilization of inventory models in material management for cost reduction. The concept of inventory management has been one of the many analytical aspects of management. It involves optimization of resources available for holding stock of various materials. Lack of inventory can lead to stock-outs, causing stoppage of production, but a very high inventory on the other hand can result in increased cost of production due to high cost of carrying inventory. Thus optimization of inventory should ensure that stocks are neither too low nor too high. Inventories like finished products, work-in-progress, components, raw materials, stores, spares, etc. account for 80 per cent or more of working capital in some of the representative industries studied in the past. It would appear that any effort put in towards rationalization of inventories can bring about an appreciable saving.

KEYWORDS— Inventory Management, Inventory Process, Inventory Control Systems, ABC and EOQ Analysis, optimization of inventory.

INTRODUCTION

One of the most important aspects of any business is inventory management. Those who have never worked in the business sector may not understand the importance of efficient inventory management. But, the reality of it is if we don't have control of our inventory, we will be unable to ascertain you will have enough inventories on hand to handle the needs of our customers. Even worse than that, we will not have enough supplies on hand to produce the products we need to meet the needs of our customers. This requires the inventory.

Without inventory management it would be difficult for any company to maintain control and be able to handle the needs of their customers. Whether you use a fulfilment company or ship products yourself you need to know where your inventory is and where it's going. Unless you can meet the needs of your customers you will soon lose all of them to competitors who are able to meet their requirements, no matter how stringent. While inventory management has always been important, it has become more important over the past several decades. As the needs of companies increase, they must in turn increase demands on their suppliers. In order for suppliers to have the goods their customers need, it is necessary for them 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.

NEED OF THE PROJECT WORK

Importance of materials management in construction can be accessed through the fact that about 50% to 60% of the total project cost goes the materials and its management. Survey shows that average material cost is 64% (50% to 65%) of the sales value and only 36% cost goes towards wages & salaries, overheads and profit etc.

Thus the importance of materials management lies in the fact that any significant contribution made by the materials manager in reducing materials cost will go a long way in improving the profitability and the rate of return on investment.

OBJECTIVE OF THE WORK

i) Study and analysis various inventory control systems, inventory models useful for day to day material management.
ii) Application of inventory management systems for case study to control the cost of a construction project.

LITERATURE REVIEW

The author suggested that the total cost of material may be 50% of total cost; so that it is important for contractor to consider that timely availability of material. Material Manager should maintain reports such as material to order between two dates, material assignments, waste control, when to purchase construction material, when material must be on site, and purchase order between two dates."Material management is defined as the process to provide right material at right place at right time in right quantity so as to minimize the cost of project". They had mention that the efficient procurement of material represents a key role in the successful completion of the work. Poor planning and control of material, lack of material when needed, poor identification of material, remanding and inadequate storage cause losses in labour productivity and overall delays that can indirectly increase total project cost. Construction delay is considered to be one of the recurring problems in the construction industry and it has an adverse effect on project success in terms of time, cost and quality. The time and cost for performance of a project are usually important to the employer and contractor. The authors highlight the types of construction delays due to which project suffer time and cost overrun. Also give external and internal factors that influence the construction process and outline the effect of delay in large construction projects. [1]

As per author, Inventory Classification is very important to manage inventory efficiently. For inventory optimization and Inventory Forecasting, products need to be classified appropriately. There are several methods used for categorization of products and items in inventory. In any industry today inventory optimization is such a vital function. Excess and Shortage of inventory in all levels of the supply chain can affect the availability of products and/or services to consumers. Several monitoring systems and processes can be employed to check inventory imbalances to minimize the supply and demand dynamics. Most common classification used is the Pareto Analysis. ABC Analysis is based on Pareto Analysis which says 20% of the items contribute to 80% of sales. It implies that a small portion of items in Inventory contribute to maximum sales. Typically less than 20% of items classified as A, contribute as much as 80% of the revenue. The next 15% (80% - 95%) contribution to revenue is done by B class Items. The last 5 % revenue is generated by items classified as C'. As the classification is done according to the importance of their relative value, this approach is also known as Proportional Value Analysis. [8]

As per author, if the material management is not properly managed it will create a project cost variance. Project cost can be controlled by taking corrective actions towards the cost variance. Material management deals with principles and practices which effectively optimizes cost of materials used in the project. Material management is the line of responsibility which begins with the selection of suppliers and ends when the material is delivered to its point.ABC analysis helps in rationalizing the number of orders and reduces the overall inventory even though overall purchase orders are the same, the average inventory can be reduced substantially. The Cost Variance values for the Class A materials is a tool to measure the profit and it has a positive value. It indicates the project has a cost

under run i.e. the cost incurred is less than the planned or budgeted cost. This S Curve analysis recognizes that there is too much increase in material cost during actual execution. [10]

METHODOLOGY

1. Study evolves importance of inventory cost & its relation with project cost. Further it provides detail study of inventory control systems, inventory models & effective utilization of it for reduction of inventory cost.
2. After going through all reference document and literature project lead ahead with typical case study of construction project inventory management.
3. Analysis is carried analyzing planned and actual material consumption through techniques.

ANALYSIS OF CASE STUDY

Based on the methodology above the case study is carried out and outputs are drawn. Case study is of construction of building in in Maharashtra state.

MECHANICS 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:

i) 5 per cent to 10 per cent of the top number of items account for about 70 per cent of the total consumption value. These items are called 'A' items.
ii) 15 per cent to 20 per cent of the number of items account for 20 per cent of the total consumption value. These items are called 'B' items.
iii) The remaining number of items account for the balance 15 per cent of the total issue value. These items are called 'C' items.

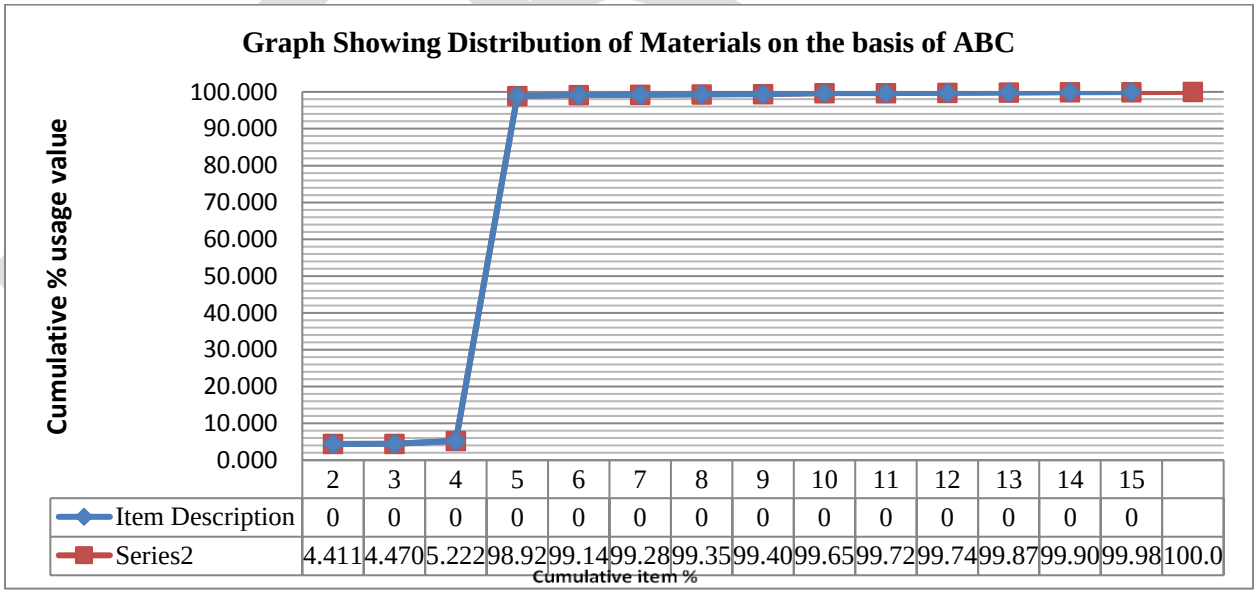
ABC Analysis for a Building

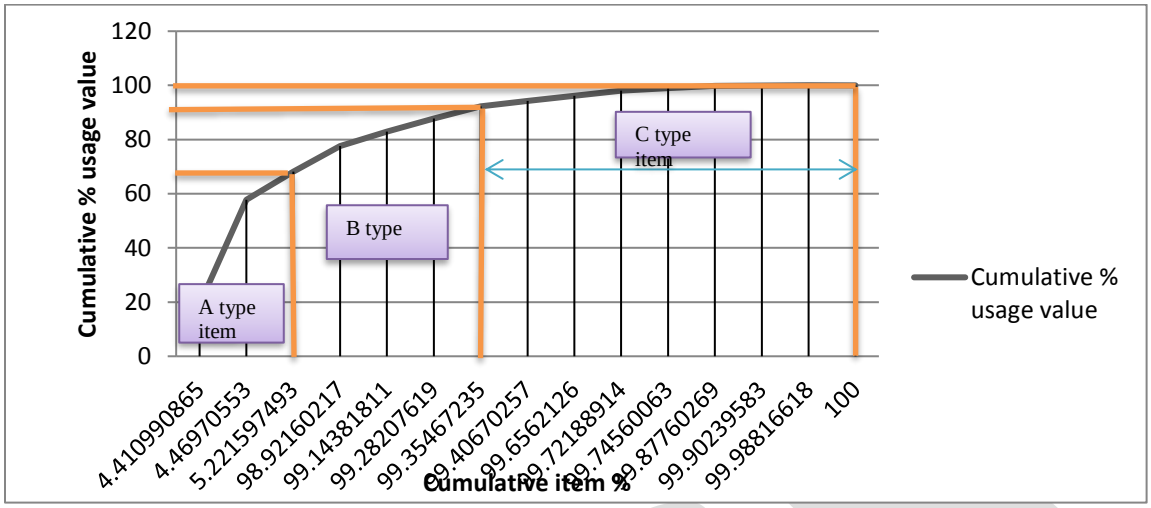
Table 1. Showing Distribution of materials on the basis of ABC

Sr. No.	Item Description	Unit of Material	Annual usage	Usage %	Cumulative Item %	Rate/ Unit	Value	% Usage Value	Cumulative % Usage Value	Material Type
1	Cement	Bags	30177.39	4.411	4.411	300.0	9053217	19.141	19.141	A Type Material
2	Steel	Ton	401.691	0.059	4.470	45500.0	18276940.5	38.642	57.783	
3	Flooring	Sq. Feet	5144	0.752	5.222	951.8	4895900	10.351	68.134	
4	6" fly ash bricks	Nos	641040	93.700	98.921	7.0	4487280	9.487	77.621	B Type Material
Sr. No.	**Item Description**	**Unit of Materi**	**Annual usage**	**Usage %**	**Cumulative Item %**	**Rate/ Unit**	**Value**	**% Usage**	**Cumulative % Usage**	

		al						Value	Value	
5	Paint	Liter	1520.27	0.222	99.144	1661.6	2526134	5.341	82.962	
6	Crush Sand	Brass	945.88	0.138	99.282	2400.0	2270112	4.800	87.762	
7	Window	Nos	497	0.073	99.355	4328.0	2151038.5	4.548	92.310	
8	River Sand	Brass	355.96	0.052	99.407	2600.0	925496	1.957	94.266	C Type Material
9	Sanitary Fittings & Plumbing	Nos	1707	0.250	99.656	534.9	913015	1.930	96.197	
10	Aggregate	Brass	449.32	0.066	99.722	2000.0	898640	1.900	98.097	
11	Door	Nos	163	0.024	99.746	2595.5	423059.55	0.894	98.991	
12	Murum	Brass	903.08	0.132	99.878	420.0	379293.6	0.802	99.793	
13	Plinth filling (with outside murum)	Brass	169.62	0.025	99.902	420.0	71240.4	0.151	99.944	
14	Anti-termite liquid	Liter	586.79	0.086	99.988	40.0	23471.6	0.050	99.993	
15	Box type waterproofing – lift	Sq. Feet	80.96	0.012	100.000	40.0	3238.4	0.007	100.000	
	Total in Rs. =		**684142**				**47298077**			

Graph 1. Showing Distribution of materials on the basis of ABC





EOQ analysis for a Building

Economic order quantity is the order quantity of inventory that minimizes the total cost of inventory management. Two most important categories of inventory cost are ordering costs and carrying costs. Ordering costs are costs that are incurred on obtaining, additional inventories. They include costs incurred on communicating the order, transportation cost, etc. Carrying costs incurred on holding inventory in hand. This includes Cost of Storage, Insurance taxes, Deterioration & obsolescence this calculates in %. Inventory Carrying Cost = 20%

Economic Ordering Quantity =$\sqrt{(2DS/H)}$

D= Annual Demand (units)

S=Cost per Order

H=Annual Carrying cost per unit.

Table 2. EOQ Analysis of cement bags at Construction SiteNasik.

Sr No	Item	Unit	Annual Demand (units) (D)	Cost per Order (S)	No of Order	Quantity/ Order	Annual Carrying cost per unit (H)	EOQ
1	Cement	Bags	30177	71500	110	275	5200	**911**

From the data collection of the construction site, gives the 275 cement Bags per order for construction. Due to this order carrying cost & inventory cost are increases. But when we applied EOQ analysis on cement bags. Then we got the optimal quantity of cement bags. After EOQ Analysis we got Optimal Order Quantity of cement bags are 911 units. At this order we minimise the ordering and carrying costs.

Annual demand of Cement bags are 30177 units so the construction site to place 33 orders (= annual demand of 30177 divided of order size 911)

No of order for cement bags = D/EOQ

=30177/911

No of order for cement bags = 33.

No of frequency for cement bags=1/33*425=13 days.

CONCLUSION

1. As per analysis it can be conclude that the inventory control very useful to control the cost of a any construction project.
2. Inventory management can be done effectively by using ABC analysis and EOQ.
3. The implementation of ABC analysis gives the distribution of A, B, C type materials. This distribution of materials gives the Economical importance of materials.
4. EOQ gives the results of right quantity of orders at right time. It avoids the delays in material supply and also avoids wastage of materials.
5. From analysis it can be conclude that if there is saving of materials by implementing ABCS analysis and EOQ methods to project then this will give huge money savings in large projects.
6. Inventory control system minimizes the wastage of materials which ultimately saves the cost of a project.

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