

INVENTORY CONTROL MANAGEMENT FOR CONSTRUCTION INDUSTRIES USING SPSS SOFTWARE

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ABSTRACT

Inventory means maintaining stock of a company. The concept of 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 production down time, but a very high inventory on the other hand may lead to an increased production costs, due to high cost of an inventory transportation. Improper handling and storage of inventories in construction site lead to the project delay. Construction materials account 60% of the total expenditure of a project. So only proper handling and storage may be required is compulsory. Efficient material management plays a key role in the successful completion of the project within estimated cost and time. In this paper current practice of construction material management to construction project and inventory control techniques such as ABC classification and EOQ analysis are performed to maintain the inventory an optimum level. S curve analysis is perform to measure the fluctuation between the estimated material cost and market material cost. Total expenditure of inventory is less after the adoption of inventory control techniques. The principle target of the investigation is to dissect the stock administration control at the construction site with the assistance of SPSS program.

Keywords: Inventory Management, Construction, ABC Analysis, EOQ Analysis

I. INTRODUCTION

The term inventory refers to the goods or materials used by firm for production or sale. Inventories are the physical stocks of items that a manufacturing or service organisation keeps in hand for efficient running of its office or manufacturing activities. Inventory consists of raw materials, work in progress and finished goods. Inventory control is the course along activities with the purpose of getting to the right inventory in the right place at the right time and in the right quantity and it is directly connection to the production function of any organisation. The need for the project is to present the problems ,facing by the companies in material requirements and to provide proper material management. Nearly 60% money is allotted for the inventory in a project. Inventory constitutes one of the important items of current assets, which permits smooth operation of production and sale process of a firm. For data analysis inventory model like ABC analysis and EOQ analysis will be applied on acquired data Also qualitative analysis which include S – curve analysis will be used to differentiate between planned and actual consumption of materials. Material management is an essential tool which will be improving the productivity of a construction industry. Construction management is the overall planning b, sourcing, purchasing , moving , storing, coordinating and controlling the project from starting to the end. The objective is to produce a functionally and financially feasible project. The construction industry is consistent with five major sector, such as residential, environment , heavy civil, Industrial and commercial.

II. CONSTRUCTION INVENTORY MANAGEMENT

Construction inventory management is a means by which construction companies and suppliers can keep track of materials, work force, equipment and plant. This is particularly important when a construction company has multiple projects to manage, as efficient scheduling can become very complicated.

A well managed inventory can be critical to profitability as delayed, misplaced or lost items can incur avoidable delays and unnecessary costs .A project time line, planned in advance, with the full of the required materials , labour, equipment and so on is a vital part of the project planning process.

This might also include,

- An inventory tools including manufacturer details, instructions, parts requirements and so on.
- A consumable inventory (i.e. nuts, bolts , screws, nails, drill bits, wire , batteries and so on) with a system that alerts when supplies are lower.
- Automatic scheduling of preventive maintenance for tools , plants and equipment helping to ensure that unnecessary down time for repairs is avoid.
- Radio frequency identification (RFID) and barcode solution.

III. SCOPE AND OBJECTIVE

The objective of this paper is to study the different literatures about inventory management and identify the importance of inventory management and also the factors affecting inventory management.

The scope of paper includes

- To study the Various inventory control systems, inventory models useful for day to day material management.
- To study the application of inventory management systems to control the cost of a construction project

IV. METHODOLOGY

GRAPHICAL REPRESENTATION OF METHODOLOGY

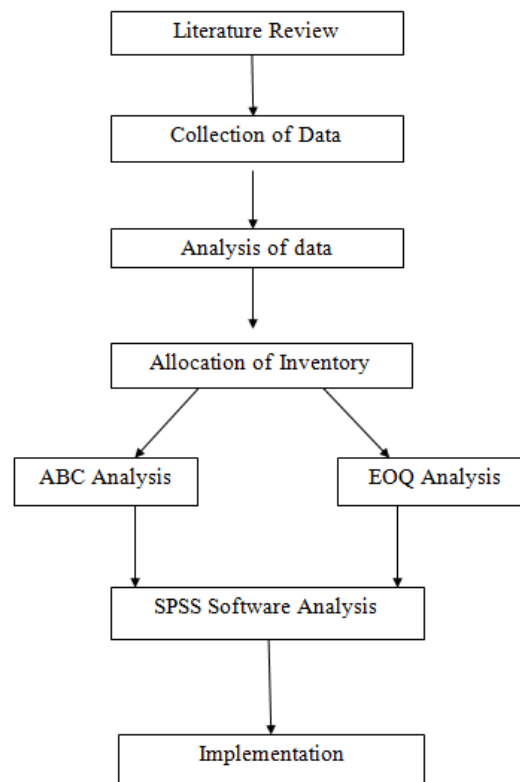


Fig 1: Flow chart for Methodology

Data collection for ABC, EOQ and S- Curve analysis area profile

The data collection which is selected for this project is Residential Project under Anand Constructions, Tisayanvilai, Tirunelveli District. Company have successfully executed en- number of Construction Projects and achieved recognition in the Construction field. Company has various residential and commercial projects going on. Residential Project which has been selected for my work.

ABC Analysis

The ABC analysis classified the material item based on the Annual Usage Value of items in order to determine its priority. The ABC analysis is used to identifying material items that has the highest impact on overall inventory cost. In this method materials divided into three groups they are A,B and C group. The grouping of all materials used in Construction into materials (A Class) which require the highest attention , materials (B Class) which require medium attention and materials (C Class) which require the least attention such that the control mechanism be focused on selective class of materials.

Methodology Adopted for ABC analysis:

List all the materials items used in the project along with unit price and quantity consumed annually.

1. Compute the Annual Usage Value (AUV) of each material item.
2. Arrange the items in the descending order of AUV and compute the cumulative percentage units consumed and cumulative percentage of AUV for each item.(Appendix C)
3. Graph is plotted between cumulative percentages of unit's vs. cumulative percentages of items.

S curve Analysis

S curve analysis is an important project management tool. This analysis is carried for comparison of planned and actual cost for material items. S-curve provides at a glance view of project performance in terms of cost and time. Analysis of S-curves allows project management team to quickly identify project growth, slippage, and potential problems that could adversely impact the project if no remedial action is taken. The deviations of the quantities is produced by the cumulative expenditure of certain parameters (Material cost) against time and it is the representation of project path. Using s curve analysis Cost variance is calculated as difference between Budget costs for work performed (BCWP) and Actual cost for work performed (ACWP). Cost performance Index is calculated as ratio of Budget cost for work performed to Actual cost for work performed.

EOQ analysis

Economic order quantity (EOQ) is the order quantity of inventory that minimizes the total cost of inventory management. Two most important categories of inventory costs 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 represent the costs incurred on holding inventory in hand. They include the 1. Space, Electricity and other facilities 2. People for safety 3. Absolute items etc. At our site ordering cost includes transportation cost. Inventory cost includes Electricity and Cost of store keeper.

1. Find out the Q (Economic Order Quantity)

$$Q = \sqrt{\frac{(2 * Co * D)}{Cc}}$$

- Co= Ordering Cost
- D= Total Consumption
- Cc =Inventory carrying Cost

2. Find out the number of orders per year.

$$\text{No of orders} = (\text{ordering cost}) / (\text{Cost per order})$$

3. Find out the total cost.

About SPSS Software

SPSS is a widely used program for statistical analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, data miners, and others. The original SPSS manual has been described as one of "sociology's most influential books" for allowing ordinary researchers to do their own statistical analysis.^[4] In addition to statistical analysis, data management (case selection, file reshaping, creating derived data) and data documentation (a metadata dictionary was stored in the data file) are features of the base software.

Statistics included in the base software:

- Descriptive statistics: Cross tabulation, Frequencies, Descriptive, Explore, Descriptive Ratio Statistics
- Bivariate statistics: Means, t-test, ANOVA, Correlation (bivariate, partial, distances), Nonparametric tests
- Prediction for numerical outcomes: Linear regression

Prediction for identifying groups: Factor analysis, cluster analysis (twostep, K-means, hierarchical), Discriminate. There are 35 questionnaire prepared and circulated to various companies. About 30 respondents answered based on five point liker scale. These data's are entered in SPSS Software. Reliability analysis and the cronbach alpha value allows to study the properties of measurement scales and items that compose the scale. Mean value also find to rank the rank the factors. Table value gives the general acceptable value of cronbach's alpha

Table 1 Cronbach alpha table

ALPHA	REMARKS
$\alpha \geq 0.9$	Excellent
$\alpha \geq 0.8$	Good
$\alpha \geq 0.7$	Acceptable
$\alpha \geq 0.6$	Questionable
$\alpha \geq 0.5$	Poor
$\alpha \geq 0.5$	Unacceptable

V. ANALYSIS AND RESULTS

ABC Analysis

Table 2 ABC Analysis

S.No	Item name	Unit of measurement	Annual usage	Cost per unit	% of item used	Cumm per item used	Annual Usage vaue(Rs)	% of annual usage	Cumm annual usage %	Rank
1	Cement	Bag	676	410	2	2	277160	24.6	25	A
2	Bricks	Nos	29500	6.2	88	90	182900	16.2	41	A
3	M Sand	Load of truck	15	10000	0	90	150000	13.3	55	A
4	Tiles (350mmx450mm)	Boxes	320	250	1	91	800000	7.1	62	A
5	Windows	Sq.m	10	8000	0	91	80000	7.1	62	A
6	Gravel	Load of truck	10	65000	0	91	65000	5.8	75	A
7	Doors	Sq.m	5	8000	0	91	40000	3.6	78	A
8	Lime	Kg	40	1020	0	91	40800	3.6	82	B
9	P sand	Load of truck	3	13000	0	91	39000	3.5	85	B
10	Steel	Kg	875	42	3	94	36750	3.3	89	B
11	Aggregate (20mm)	Load of truck	7	5000	0	94	35000	3.1	92	C
12	Hollow bricks	Nos	1200	18	4	98	21600	1.9	94	C
13	Stone	Load of truck	5	4000	0	98	2000	1.8	95	C
14	Wiring	m	900	14	2	100	12600	1.1	96	C
15	Water tank	Nos	1	12218	0	100	12218	1.1	98	C
16	Half brick	Load of truck	2	4000	0	100	8000	0.7	98	C
17	Ceiling fan	Nos	5	1500	0	100	7500	0.7	98	C
18	Aggregate (40mm)	Unit	2	3000	0	100	6000	0.5	99	C
19	Painting	litre	38	175	0	100	6650	0.5	99	C
20	Switch board	Nos	13	280	0	100	3640	0.3	100	C

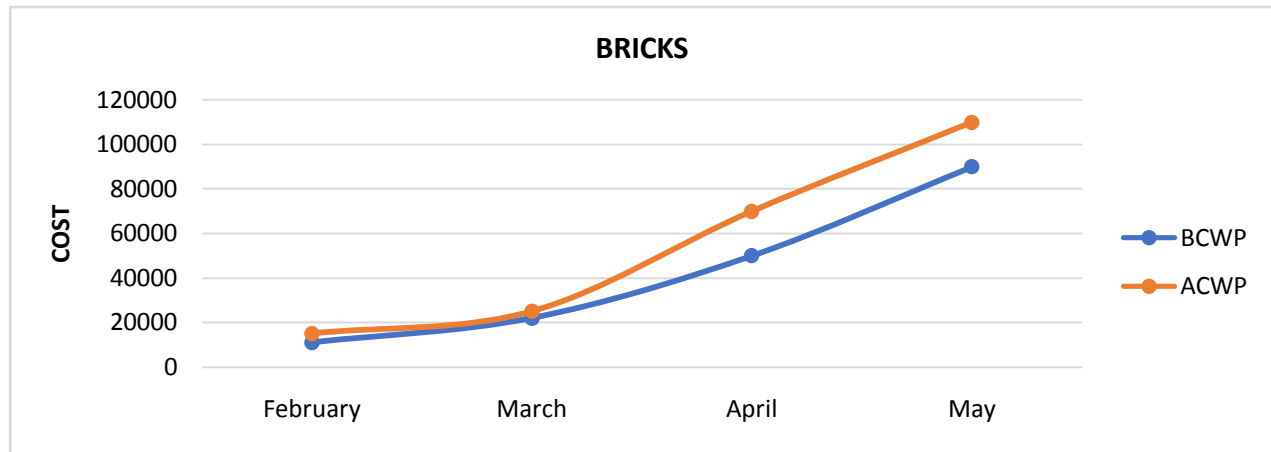


Fig 4: S Curve for Bricks

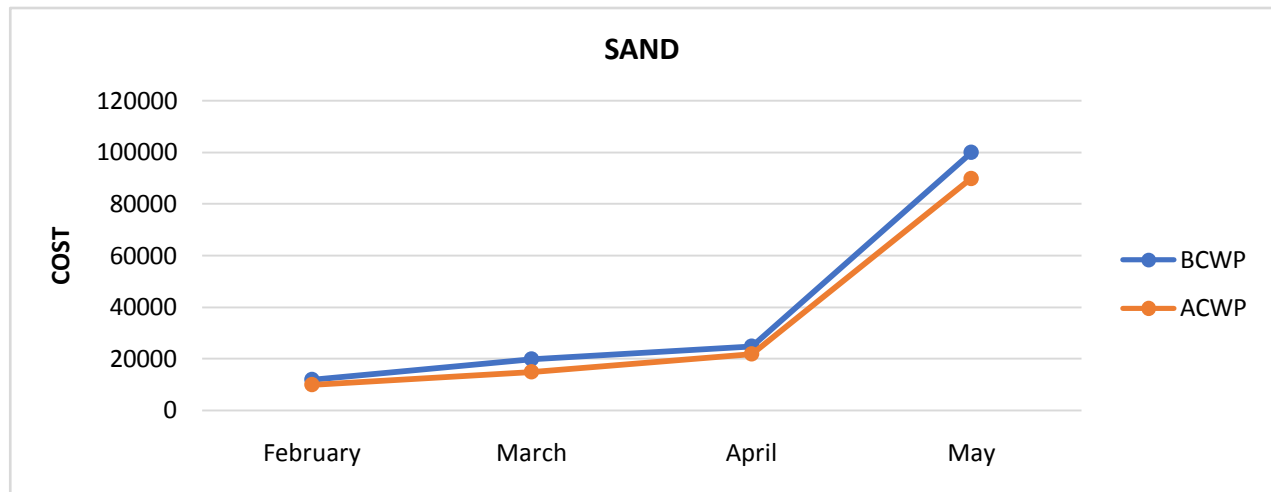


Fig 5: S Curve for sand

Table 3 Cost performance index and Cost variance of material

Name	ACWP(RS)	BCWP(RS)	CV(RS)	CPI
Cement	295200	277160	18040	1.01
Bricks	198400	182900	15500	1.08
Sand	200000	15000	50000	1.3

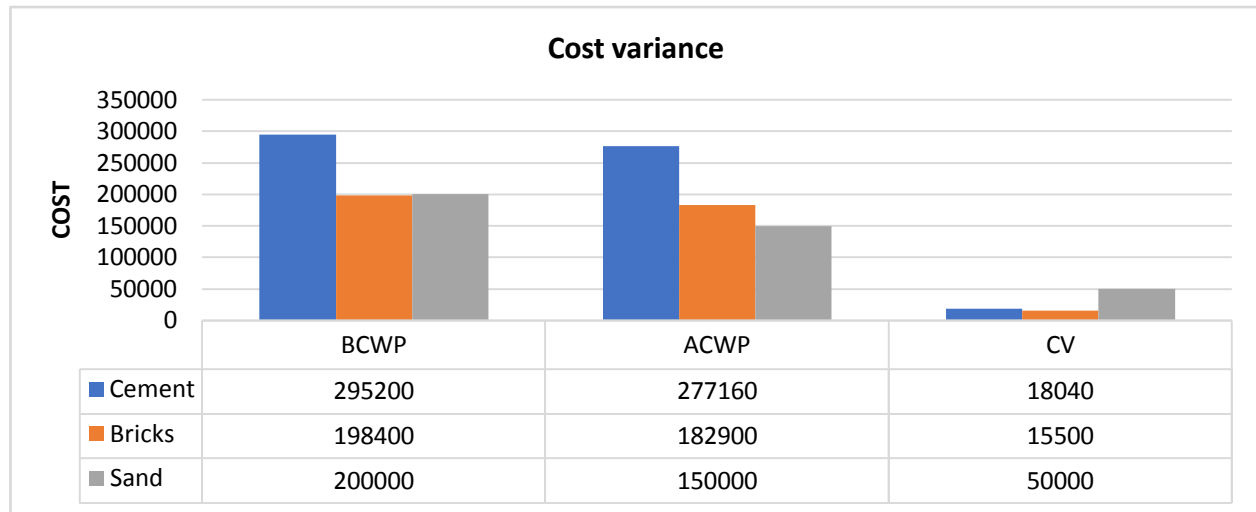


Fig 6 Cost variance graph of material

The above graph shows that cost variance of cement ,bricks and sand is positive that means Project run for cement , brick and sand under budgeted cost. Cost performance index for A class material is one or greater than one indicates the favourable performance.

EOQ Analysis

Table 4 EOQ Analysis

S.no	Item name	Demand	Ordering cost	Carrying cost	Cost per unit	EOQ	No of order
1	Cement (Bags)	676	600	61.5	410	115	6
2	Bricks	29500	500	0.87	6.2	5431	5
3	Sand (Load of truck)	15	700	1200	1000	4.2	4
4	Tiles (Boxes)	320	300	10	250	138	2
5	Steel (Kg)	875	500	2.94	42	546	2

SPSS SOFTWARE

The data are entered in SPSS Software and the Cronbach alpha for this research is 0.996. So the research is an excellent one.

Reliability statistics

Table 5 Reliability statistics

Cronbach's Alpha	N Of Items
0.996	35

Table 6 Factors mean value and ranking

FACTORS	MEAN VALUE	RANKING
Improper supervision	4.37	1
Selection of vendor	4.3	2
Poor communication	4.27	3
Frequent moving of material due to improper site layout	4.23	4
Availability of quantity	4.2	5
Labour strikes	4.17	6
Improper planning	4.13	7
Manual inventory stock	4.13	8
Distance from project site to storage yard	4.13	9
Lack of storage space	4.1	10
Inspection in goods arrival	4.07	11
Late delivers	4.03	12
Poor communication in inventory	4.00	13
Storing of stock	4.00	14
Get damaged goods on receipt	3.97	15
Need for material management system	3.97	16
Adequate safety stock level	3.9	17
Over inventory or under inventory	3.9	18

Lack of conformance to requirements	3.9	19
Seasonal problems	3.87	20
Damaging	3.87	21
Improper handling of material	3.77	22
Use of advance tool to maintain inventory	3.77	23
Transportation problems	3.73	24
Matching price to competitors price	3.63	25
Better relations with suppliers	3.6	26
A responsible official authorises purchase	3.57	27
Availability of material	3.53	28
Involvement of contractor	3.43	29
Experience under stock situations	3.33	30
Constant design changes	3.3	31
Re work	3.27	32
Limited skill professionals	3.2	33
All store staff are highly skilled	3.17	34
Goods are inspected on receipt	3.17	35

VI. CONCLUSION

In this paper inventory management can be effectively done by using ABC analysis and EOQ method. S curve analysis are also done to find the deviation ,the cost performance index for A class materials are equal to are greater than 1 indicating the favourable performance of the material in project .In ABC analysis 7 items are under A type and these materials need higher attention .In EOQ method the no of order per year were found and these helps avoid over stocks. From SPSS Software the Cronbach value found to be 0.996 and these result give excellent remarks also mean value were computed .Based on the analysis, the result shows that below points were focused mainly in Construction Industries.

- Improper Supervision
- Selection of vendor
- Poor communication
- Frequent moving of material due to improper site layout
- Availability of quantity
- Improper planning

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