

A Literature Review On Analysis Of Lean Concept In Construction Industry

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Abstract: one of the major obstacles faced by construction industry is inventory management. In every construction project inventory cost contributes around 50% to 60% of the total project cost. The profit of construction industries mainly depends on managing the inventories to avoid cost overruns and delay in projects. A proper material management system has to be implemented for effective utilization of resources. By applying lean concepts in a project, we will be able to find the lead time of procuring each raw material and also ways to identify and eliminate non value added activities. Based on consumption of each raw materials reorder level & EOQ will be arrived. Value stream mapping (VSM) is a lean tool used to map the process flow of a project along with cycle time of each process which helps to identify the total processing time. Through VSM we quantify the value added and non-value-added activities in a project and steps will be taken to reduce the non-value-added activities. By eliminating non value added activities, the total lead time to complete a project will be reduced and the resources will be optimally used.

Index Terms: ABC analysis, EOQ, Value stream mapping, Lean.

1 INTRODUCTION

In any industries, cost of inventory directly influences the profit of the organization. Managing all forms of inventory in industries is one of the tough tasks where the uncertainty is more in holding the inventory. Since the demand is unknown in most of the industries, the organization struggle to maintain inventories. So, Inventory management plays the pivotal role to meet the demand of customers. Inventory management refers to procuring raw materials from suppliers at the right quantity in the right time at right cost at right place to deliver the product to customers. Unlike other industries, inventory management in construction industry of raw materials depends on various factors like climatic conditions, environmental and cost factors. Inventories can be classified as perishable inventory and non-perishable inventory. In construction industries all the raw materials were non-perishable and can be stored for a long time. But the cost of holding inventory will increase which makes an impact in the profit of the organization. An optimal inventory quantity should be defined for all the raw materials to maintain a balance between continuous flow of production and cost of holding inventory. The most common tool used for inventory management is ABC analysis. ABC analysis classifies the product based on the value of the products, demand, lead time, variability, scarcity, number of suppliers etc. A items will get more attention whereas B items will get less attention compared to A items and C items will get least attention. 65% of the value of inventory will come under A category and 30% of the value of inventory will come under B category and 5% of the value of inventory will come under C category. ABC analysis gives a clear understanding of what are the raw materials need to be given more priority and some of the materials to be less priority.

Similar to ABC analysis, another tool to classify products is Pareto principle. Pareto principle is also known as 80/20 rule. The purpose of the Pareto principle is to separate vital few items from the trivial items. In other words, 20% of the work done can generate 80% of the benefit of doing the entire job. After classifying the product using ABC analysis or Pareto principle the next constraint industries face is how much to order in every cycle. EOQ (Economic order quantity) is the tool used to determine order quantity for every cycle based on the demand so that the holding cost and carrying cost can be reduced. EOQ gives the right quantity of materials at right time and also reduces the wastage of raw materials which ultimately save the cost of the project.

2 OVERVIEW

S.no	Paper title	Author	year	ABC analysis	SPSS	EOQ	Operations Research	Factor analysis	Frequency analysis	Reliability analysis	Regression analysis	SWOT analysis	VEDICE analysis	Pareto analysis	LCA
1	Performance Analysis of Inventory Management System in Construction Industries in India	S. Sindhu, Dr.K.Nirmalakumar, V.Krishnamoorthy	2014	✓	✓										
2	Analysis of Improper Material Management Affecting Cost in Construction Projects	P.Lenam ¹ , L. Kirishanaraj ² , D.Narendra Prasad ³ , V.R.Prasath Kumar	2014	✓		✓									
3	Analysis of factor affecting material management & inventory management : Survey of construction firms using RII method	Hemishkumar Patel Dr. Jayeshkumar Prasad Jaydev jagmohandas Bhasvar	2015				✓								
4	Inventory management technique in construction	Miss Monika R. Nanaware & Prof. U. R. Saharkar	2017	✓	✓			✓							
5	Inventory analysis of construction project	Almad Zehi ¹ , Daud Khan ¹ , Muhammad Sajid ¹ and Sikandar Bilal Khattak ¹	2017	✓	✓										
6	Analyzing Inventory Material Management Control Techniques on Residential Construction Project Using SPSS	T.Subramani ^{1*} , T.Suresh Kumar ²	2018						✓	✓	✓				
7	Inventory Control Techniques in Material Management	Rohan J. Madgi ¹ , Prof. Shashank U. Varakudkar ²	2018		✓								✓		
8	Use of Various Techniques of Material Management for Construction of Industrial Building	Sayali Shet ¹ , Raju Narwade ²	2017	✓										✓	
9	Inventory Management in Fertiliser Industry of India: An Empirical Analysis	Sanjiv Mittal,R.K. Mittal,Gagandeep Singh,Sunil Gupta	2014								✓				
10	Computational method for the profit bounds of inventory model with interval demand and unit cost	Shang-Tai Liu	2006			✓									
11	ABC Classification for Inventory Optimization	Dinesh Dhokai ¹ , Dr.Y.Lokeswara Choudary ²	2013	✓											✓
12	ABC Analysis for Inventory Management: Bridging the Gap between Research and Classroom	Handanihal Ravinder ¹ , Ram B misra	2014	✓											
13	Inventory analysis of LCA on steel- and concrete- construction office buildings	Su Xing, Zhang Xu [*] , Gao Jun	2008												✓

Fig 1. Overview

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Based on the summary of literature review the most common used tool is ABC analysis to classify the inventory and some other tools like EOQ, SPSS, Regression analysis, and LCA, factor and frequency analysis to enhance their work to achieve their objective. Sindhu et al.[1]used ABC analysis as a base tool to classify and finalized the A type, B type and C type raw

materials. After classifying, re-order level for each raw material is determined and factors affecting the inventory management is identified using Statistical package for social science (SPSS). Lenin et al. [2] analyzed the variables affecting the inventory management and reason for cost overruns through questionnaire. Based on the response received through questionnaire, SPSS software is used to calculate the mean value of all variables and rank the variables based on the mean values. Patel et al. [3] prepared a questionnaire related to factors affecting material management and inventory management and received response from 80 respondents. Based on the response all factors were ranked by using RII methodology. Results indicate that the most important factors are misunderstanding of owner's requirements by design engineer, inadequate details in drawings, poor documentation, mistakes and delays in project design, insufficient raw materials. Nanaware et al. [4] classified the raw materials using ABC analysis based on annual usage of all raw materials. EOQ is calculated for all raw materials based on annual used so that right quantity of materials was delivered at right time. Inventory control system minimizes the wastage of material which ultimately saves the cost around 8.5 lacs. Zeb et al. [5] used ABC analysis in a construction project and identified cement and steel are the most significant inventory items and should be procured properly. The author made S curve analysis for cement to identify the gap between the planned cost and actual cost. Subraman et al. [6] prepared a questionnaire related to lean implementation for inventory management. Based on the response received frequency analysis and factor analysis were performed. Through analysis the major factor affecting inventory management is lack of communication. Madgiet al. [7] made an HML analysis which is more likely similar to ABC analysis where he classified the inventory items and EOQ analysis is performed for H-class items. Based on HML analysis, the total number of times placing the orders will be reduced such that documentation and processing time can be reduced. Shet et al. [8] made a comparison between ABC analysis, VED analysis and SDE analysis. The ABC analysis gives the idea about the inventory value whereas VED analysis gives the importance of material for each activity and SDE analysis tells the availability of material in the market based on season. Based on the analysis following factors need to be considered while ordering materials like scheduling of materials, quantity of materials required, transportation capacity, time required to reach the location and supplier previous record. Mittal et al. [9] made an empirical analysis in fertilizer industry for a better inventory management. Descriptive analysis like regression analysis and correlation analysis is performed based on certain hypothesis and the analysis shows the models very well confirm the hypothesis framed. Liu [10] developed a method to derive the imprecise profit of the inventory model when the demand quantity and unit cost is imprecise. A two-level mathematical programming technique is used to formulate the upper bound and lower bound of the imprecise profit. This paper discusses the range of optimal profits produced from the interval demand and unit cost in a priori manner. Dhoka et al. [11] has made ABC analysis for the finished good to forecast sales and planning for the upcoming months. The author has used ABC analysis for all 12 months individually since the requirements vary each month. If ABC analysis is done for one month a smaller number of critical items would have been identified which leads to loss in revenue. Similarly, if a 12-

month data is used the number of critical items will be optimal. Ravinder et al. [12] performed a comparison study between traditional ABC analysis and multicriteria ABC analysis. Traditional ABC analysis has been based on the criterion of dollar volume. Today's business and supply chains operate in a world where the ability to deliver the right products at the right time in the right place. In multi criteria ABC analysis the author proposed various factors like demand, cost, criticality, scarcity, replenishment cost, lead time, serviceability, number of suppliers etc. As a result, companies will be able to manage the inventories better and be more competitive in the marketplace. Xing et al. [13] analyzed life cycle inventory for office buildings in china. The author compared steel framed building with the concrete framed building and the results shows that steel framed building is better than concrete framed building on two aspects i.e. life cycle energy consumption and environmental emission of building materials. The energy consumption of steel framed building in use phase is larger than that of concrete framed building.

3 DISCUSSIONS

This considerable amount of literature review discusses about the raw material classification using tools like ABC analysis, Pareto analysis. After classification the economic order quantity (EOQ) of each raw material were defined. Some analysis explains intangible factors like poor communication, poor quality of materials, site issues, store issues, labour issues, client and design issues which leads to delay in project and cost overruns. The intangible factors can be eliminated through the concept of concurrent engineering. Concurrent engineering is a concept of forming a cross functional team where one member from each department form a team which led by project managers. As a first step work break down structures (WBS) for all activities need to be created and after creating WBS the cross functional team should conduct a brainstorming session to predefine their roles and responsibilities to the project and fix the lead time of all activities from procurement of raw materials to delivering the product. With reference to the meeting, the total duration of the project will be finalized. After finalizing the total duration, a Gantt chart need to be prepared to define the sequence of operation so that if any deviations is found the root cause analysis for the deviation can be found easily so that the remaining activities can be planned according to finish the project on time. Another way of reducing the project lead time by using lean tool called value stream mapping (VSM) which is reference in the fig :3. VSM is a lean management tool helps to visualize the total process flow both information and material in a pictorial manner. First step is to design the current state VSM where we can identify the bottleneck process in a project. After identifying the bottleneck process, the cross functional team should conduct a brainstorming session and identify the solution to reduce the lead time of the bottleneck process. After the solution is implemented future state VSM has to be drawn so that the amount of time reduced in a project can be identified. The main advantage of drawing VSM is the percentage of value added and non-value-added activities can be identified. By identifying the non-value-added activities the steps can be taken to reduce the non value added activities which also will reflect in lead time of the project. Each activity in a value stream mapping should be represented by symbols as shown in fig: 2.

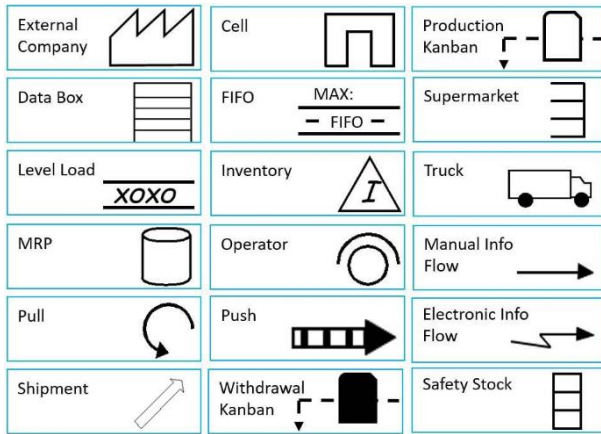


Fig 2 VSM Symbols[14]

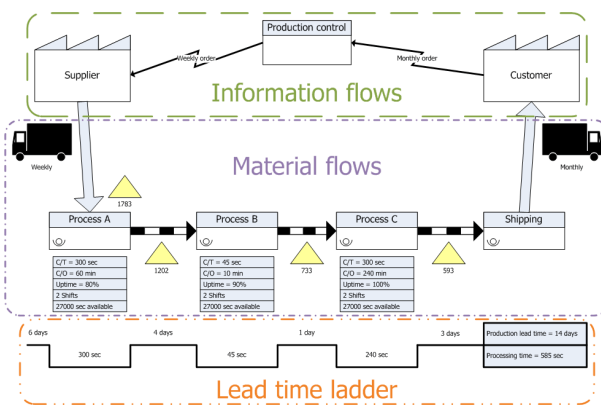


Fig 3 VSM template[14]

4 CONCLUSION

In the current globalized hyper-sensitive business environment, the moment when the project lead time starts the industries receives the order from the customer end and also expectations will vary from one customer to another customer. In order to achieve profit, the industries need to manage not only the inventories but also effective communication needs to followed to deliver the quality product in a right time at the right place and right cost. Application of VSM tool helps to reduce the lead time of a project and also manage the inventories in a better manner.

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