

Role of Lean Techniques in Improving the Construction Processes of Materials Supply & Storage Area Management - Review

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Abstract— Construction projects suffer some issues concerned with material supply and inadequate space for storing materials. In order to tackle such problems, construction management is studied from global point of view, reviewing the various practices of lean techniques and applied to the construction project. This article is based on reviewing the various issues relating with material supply and storage area management and to provide suitable solution which will influence on reduction of time and cost of analysed works. In construction projects huge part of cost and time is being spent in materials supply and storing the materials. The proposed solutions using lean techniques can be adopted to achieve the improvement in material supply and storage area management. This paper can help to understand how lean techniques play a role in improving the economic aspects of introduced changes into the process of material supply and storage area management.

Key words: Lean Technique; Construction Project; Materials Supply; Storage Area Management

I. INTRODUCTION

The construction project involves various tasks from the design to completion phase. Among them material supply and storage area management are the two key elements in the construction processes. Traditional methods of managing, material supply leads to lots of loss like delay in delivery of materials, quantity, quality errors, transportation, and in storage area leads to losses like various places for same materials, inappropriate plan and organization, inadequate health, safety and cost constraints. Thanks to the methodology of lean technique, where production is understood as the network of processes and operations [1]. It sets up productive flows in motion in order to develop control systems with the aim of reducing losses throughout the process. It was taken from lean production that can be traced to Toyota production system (TPS), with its focus on the reduction and the elimination of waste [2]. The types of waste that are addressed in TPS are wastes of time, transportation, more stock at hand, movement, inventory, money waste etc.

The goal of paper is to assess time, cost savings while introducing lean technique into the management of material supply and storage area. The lean techniques involved in the construction project mainly comprised of kanban system, technique opposed to muri, pursue perfection and 5S management.

II. LEAN TECHNIQUES APPLICATION IN CONSTRUCTION PROJECTS

Lean technique is simply an attempt to apply lean principles that originate from Toyota Production Systems (TPS) to construction aiming at managing and improving the construction processes with minimum cost and maximum

value by considering customer needs [3]. Waste reduction and value creation for the customers are the main goals of this philosophy [4]. In addition attempts have been made to apply lean principles and techniques to all project management processes, including the project delivery system, production control, work structuring, design, supply chain, project controls, and overall construction project management [2]. Among lean principles, “value” is the most important point which can be only defined by the customers. Lean tools and techniques come into being to help identify and eliminate the waste that adds no value [3]. Lean construction promises outstanding results in managing the construction processes and achieving the project’s objective by eliminating waste [5].

The lean technique is carried out by the various methods introduced at stage of planning and production of product. Kanban system is a visual method for controlling the products as a part of Just in Time (JIT) and Lean Manufacturing. Technique opposed to muri is to prevent the occurrence of overburden of resources involved any processes. However; with the help and support of all of your employees you need to strive towards perfection; delivering exactly what the customer wants, when they want it at an acceptable price with zero waste. Below there is a brief overview of 5S method for storage area management, which may be successfully used in many building processes due to low financial outlay needed for its implementation [1].

- Seiri (Organization, sorting) – the removal of unnecessary tools and parts, putting in order;
- Seiton (the flow improvement) – the deployment of work, workers, equipments, parts and instructions in such a way that flow of work is free from inefficient tasks;
- Seiso (cleaning) – cleaning workplace and all of the devices used;
- Seiketsu (standardization) – making sure procedures are standardized and reproducible;
- Shitsuke (discipline, habits, self-discipline) – helps maintain introduced procedures and rules.

The phases should be effective and implemented in order

III. PREPARATION OF QUESTIONNAIRE SURVEY

The residential building project in Bangalore was taken for analyzing the material supply process in construction. The construction began in September 2015 and the planned date of completion is in September 2020. This project involves construction of 6945 apartments which consist of five phases and consist of typical houses of area 650 sq. ft., 1000 sq. ft. and 1200 sq. ft. The project area was 81 acres and the total budget of the project is 1500 crore.

A questionnaire was prepared to collect the material supply details in the construction site. The following are some

problems in material supply. These problems were in the form of statement manner that were included in the questionnaire. The following questionnaire survey was sent to 20 construction engineers who were with 2 – 5 years' experience in order to confirm the problems that we had visited in the site.

- 1) Delay in material supply affects the construction project.
 - Agree
 - Disagree
 - Neutral
- 2) Quantity of materials in Delivery Chelan (DC) is not being the same as quantity of materials received from the vehicle which affects the construction project.
 - Agree
 - Disagree
 - Neutral
- 3) The truck skidding during rainy season affects the material supply in construction Project.
 - Agree
 - Disagree
 - Neutral
- 4) Overloading of materials in the truck affects the material supply in construction Project.
 - Agree
 - Disagree
 - Neutral

- 5) Quality check was not properly done from suppliers which will cause resenting of Materials thereby it affects construction project.
 - Agree
 - Disagree
 - Neutral
- 6) Lack of identifications like marking or stickers with material leads to difficulty in Material supply.
 - Agree
 - Disagree
 - Neutral
- 7) Poor Infra facilities affect material supply in construction project.
 - Agree
 - Disagree
 - Neutral
- 8) Inadequate maintenance of truck affects the material supply in the construction Project.
 - Agree
 - Disagree
 - Neutral

From the responses, the most important factors which are considered to be the main problems in the material supply are categorized in the table 1 also the improvement method in the form of lean technique is also mentioned.

Key processes for improvement	Major factors affecting construction project	Improvement methods using lean technique	Description
Material Supply	Delay in material supply	The kanban system	Pull system used in the procurement to deliver the right materials at right time
	Overloading of materials in the truck	A technique opposed to muri	Optimum use of truck by eliminating some materials which are loaded more than 100%
	Quantity of materials in the delivery Chelan not being the same as the quantity of materials delivered from the truck	Pursue perfection	Every supplier should strive towards perfection while delivering products based on the customer needs

Table 1: Major Factors Causing Problems and Improvement Methods in the form of lean Technique is given for the Process of Material Supply

A. Cost & Savings Discussions

Analysis of the cost of introduced changes is difficult, as it is very hard to measure. List of necessary operations that can influence on the higher cost of the introduction of lean techniques are:

- Vehicle shifts have been optimized to avoid material delivery delay in site,
- Optimum utilization of trucks in order to eliminate overloading and
- Maintaining the valid document in order to ensure that quantity of material in the delivery Chelan is same as on truck.

By implementing the actions like delivering the right amount of materials at right time, optimum utilization of trucks by loading the appropriate amount of materials and achieving perfection in quantity of materials in delivery, there is huge reduction in total time of the construction project.

Hence the reduction in total time of the construction projects reduces the indirect costs involved in the project.

IV. CASE STUDY

From the literature survey, a case study on execution of office building “Baltic” in Poland was taken under consideration for storage area management. The construction began in November 2014; the planned date of completion of the work is in February 2017. It will have 16 floors above the ground and 3 underground. It will have 15000m² of space and height of this building will be about 65m. The building has very interesting shape referring to local modernism. In this case study storage area management was taken under consideration for cost savings and other benefits.

Storage area management on the analyzed construction site is carried out by 5S method of lean technique while using finished floors for storing materials with proper visual signs for designation of place for each and

every material in the construction site rather than Using back up storage yard connected with avoiding additional costs. During the delivery of reinforcement, the storage yard ran out of space for unloading transport. It was decided to transport the materials to reserve place, 20 km away from the construction site which was the storage place of subcontractor. Before introducing the lean techniques regarding construction site storage place, 3 times happened the situation when the site management was forced to unload the materials on backup storage yard. This involved additional, previously unforeseen costs incurred by the general contractor, the detailed extra cost calculations are presented in Table 2.

S. No	Type of cost	Extra cost [PLN]	In Indian currency [rupees]
1	People [loading and unloading]	1062.50	19,836.875
2	Crane [loading and unloading]	1020.00	19,043.4
3	Longer unloading	500	9,335
4	Transportation	1200	22,404
SUM		3782.50	70,619.275

Table 2: Extra Cost Calculations Connected With Using Back Up Storage Yard/ 1 Occurrence

Cost of one normal unloading on main construction site is estimated 412.50 PLN (7,701.375 Rs) involving crane and people. Extra cost of 3782.50 PLN (70,619.275 Rs) that is 9.16 times higher than standard unloading on construction site was charged while storing materials on back up storage yard. As previously said, the situation before introducing lean technique happened 3 times between September 2015 and December 2015 where the amount of 11,347.5 PLN (2, 11,857.825 Rs) was already spent on storing materials in back up storage yard, when construction above ground started, which is 1 situation/ month. Concrete works are planned to be finished in October 2016. It can be assumed that such problem could happened once a month for the whole concreting period, which could give the total amount of 45, 390 PLN (8,47,431.3 Rs). After introduction of proposed solution using 5S method of lean technique by using finished floors for storage, such situation never happened, so it can be assumed that from December 2015, which was the month of introduction of lean technique, 3782.50 PLN (70,619.275 Rs) was saved every month i.e., the total cost saved after the introduction of lean technique is 34,042.5 PLN [6, 35,573.475 Rs] for around nine months.

By introducing 5S method of lean technique in construction project apart from achieving cost savings around 3782.50 PLN/ month (70,619.275 Rs/ month), other benefits like quicker access for materials, improvement of health and safety and in-site transportation savings can be achieved.

V. CONCLUSIONS

This paper presents and discusses the results of applying lean techniques in improving the construction processes of material supply and storage area management. The problems associated with the material supply are identified and various solutions like lean technique of kanban system, technique opposed to muri and pursue perfection were introduced. Also

problems associated with storage area management are identified and the 5S method of lean technique was adopted. Based on the study the following conclusions can be drawn.

- Lean technique has the potential to improve the existing processes of material supply and storage area management.
- By introducing the kanban system, vehicle shifts have been optimized which avoids material delivery delay in construction site.
- Adoption of technique opposed to muri, the problem of overloading materials in the trucks can be avoided, there by the truck performance is increased.
- By implementing the technique of pursue perfection, valid documents are maintained and perfection was achieved that the quantity of materials in the delivery Chelan being the same quantity of materials delivered from truck.
- Through implementation of lean techniques in the process of material supply there is a
- Huge reduction in total time of construction project thereby the indirect cost involved in
- The project gets reduced.
- 5S method of lean technique in storage area management can achieve results like money saving around 3782.50 PLN/ month (70,619.275 Rs/ month), quicker access of materials, improvement of health and safety, and in-site transportation savings.

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