

Efficient construction by Lean Management

Ankur Dev Jain¹ Praveen Tomar²

^{1,2}M. Tech Student

^{1,2}Department of Construction Technology & Management

^{1,2}Patel Institute of Technology Ratibad, Bhopal, Madhya Pradesh

Abstract— In sense to develop the performance and reduction of waste, the lean techniques has been introduced as a new construction principle for better functioning. There are many challenges to implement the lean concept in construction industry. In India, the execution of lean management in construction field is a big task. Due to lack of awareness and illiterate towards the lean management principle. The main focus of this study is to implement lean thinking concept in order to manage, improve & develop the product faster while improving or at least maintain the level of performance & quality in construction industry. In order to find out the wastages prepare the questionnaire and finding out the major factors for waste generation and less productivity. The responses are taken from both, freshers as well as experienced people from the industry. Fresher's are selected because they are aware of the lean principle and experienced knows well about the kind of wastage and its reasons. The questionnaires were evaluated to adopt the techniques through statistical methods. This paper presents the possibilities of efficient implementation of lean management principle in construction industry, which will definitely increase the worth of work and profit rate by eliminating the wastage.

Key words: Lean, Construction, Management and Implementation

I. INTRODUCTION

In the present scenario India is most developing country so that many construction companies are coming out due to the need of development of infrastructure in the country. For achieving the goal of good infrastructure development along the profit in various manner, the competitions among the firms are increasing day by day. In Indian construction firms, availability of skilled or educated labours is a major concern. By lack of skilful labours and the lack of technology the quality of the project is not satisfied as per the actual senses. To overcome such a problem, Construction Company are required to develop new innovative technology. Such a technique name is called lean management. The term 'Lean' is a traditions of practice in continuity manner at all level of the organization and by every team. Lean is about obtaining a balanced or optimum use of people, materials and resources. Lean construction is a new approach toward construction sector. It sets productive flows in motion in order to develop control systems with the aim of reducing losses during the process. It was engaged from lean manufacture that can be traced to Toyota Production System (TPS), with its focus on the reduction and elimination of waste [1]. The Lean construction is also defined as a construction management approach for obtain a significant sustainable improvement, in the performance of the industry process of a contractor through elimination of all wastes of money, time and other resources that do not add value in the process or delivered Service to the customer [2].

Lean production or Toyota production system principles have evolved and were successfully implemented by manufacturing industry. Many researches is going on towards the lean principles and to get results of the successful adaption of lean principal ideas from car manufacturing industry to the construction industry. The construction companies struggling to change their current forms of project management into the lean management approach. To implement the lean management in construction industry, questionnaire approach is proposed in this paper, data are collected from fresher's as well as experts to find out the wastages in construction industry.

A. Objective of the study

The following are the objective of this paper:

- 1) Identify the source of wastes classified under lean construction industry to improve the quality of the project
- 2) Examine usual perceptions of the construction industry with the lean construction principles of practices.
- 3) Identify the profits and loss linked with lean implementation.
- 4) Evaluate the relationship between lean techniques and performance improvement programs in construction industry.

II. BACKGROUND OF LEAN MANAGEMENT

A. Origin of Lean Principal

The term Lean Production was popularized by Womack et al.[2] to name Japanese production system that had been developed by the automaker Toyota Motor Company for several year after the Second World War[1]. The Toyota production System(TPS), was inspired in Fords mass production system, but deeply deviated from it suit the financial reality in Japan after Second World War. Lean production is lean because it requires less of everything when compared with mass production, allowing the production of a wide variety of quality products at lower costs.

Despite the differences between the manufacturing industry and the construction industry, in the past decade, the use of Lean manufacturing concepts, principles, and tools applied to construction processes (e.g., activities developed on site) has proven to be possible and result in notable progress in the performance of construction project [3].

B. Overview of Lean Management

The lean management principle was first developed by the Industry - Japanese production industries (Toyota Car Company). It was executed by a discoverer named John Krafcik in the year 1988.

C. Lean Construction

According to Koskela and Thomas et al. [4], Lean construction includes practice of just-in-time, use of pull-

driven arrangement, reduction of variability in labour productivity, improvement of flow dependability, removal of waste, overview of the operation, and implementation of benchmarking.

D. Waste Elimination

Waste elimination is a highly significant process in the construction field to improve the quality of the project and efficiency of the project. Whatever the Waste may be generated directly or indirectly during the construction in the construction industry.

III. LITERATURE REVIEW

This research carried out by Greg Howell and Glenn Ballard was aimed at understanding the functioning of lean construction techniques. Lean intended the new way to manage the construction. The goal of lean thinking redefine performance against three dimensions of perfection: (1.) A individually custom product, (2.) delivered immediately, with (3.) nothing in stores. Daeyoung Kim, Hee-Sung Park had analysed the lean construction principles, techniques and concepts for better performance and to get a result of successful adoption of lean ideas from car manufacturing application to the construction industries [5]. Eric Johnansen, Lorenz Walter had done questionnaire survey among the German construction companies to find out the current situation of lean principles and realization of lean and trends in lean development [6]. The application of lean principles is applied to one of construction operations using discrete-event simulation. To achieve this goal, lean construction concept can be applied through five principles: 1. Accurately specify value by exact product; 2. Recognize the value stream for each product; 3. Make value flow without interrupt 4. Let the customer pull value from the producer and 5. Pursue perfection.

IV. RESEARCH METHODOLOGY

The following methodology shows in figure (a) was proposed one to analyse and implement the lean management principles in construction industry.

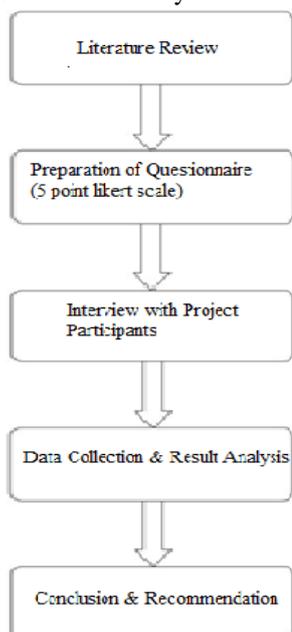


Fig. 1: Mythology adopted

A. Questionnaire Survey

The structure of this questionnaire is consists of 25 questions and its categorized under five criteria according to its type of waste. Totally 60 responses are taken from both, fresher’s as well as experienced people from the industry. Fresher’s are selected because they are aware of the lean principle and experienced knows well about the kind of wastage and its reasons. The design of questionnaire was prepared by using 5-point likert scale. In order to find out the criteria, decide its weightages. Finally the percentages of wastes were accepted by the project personals according to their impact given in Table 1.

Grading	Effect %	Rank Scale
Very High	80-100	R1
High	60-80	R2
Medium	40-60	R3
Low	20-40	R4
Very Low	0-20	R5

Table 1: Likert Scale

The prepared questionnaires were distributed to the different project starter from management level to labour level (Project Manager, Design Engineers, Executive Engineers, and Labours).

B. Recognition of waste:

In this progression, the wastages which produced throughout the project are identified and examined, causes are analysed. Based on the questionnaire survey data collected fresher’s as well as experienced people from the industry they are set together and formulated related to their usage and divided in to different categories are as follows,

- 1) Wastes of material
- 2) Productivity of labour
- 3) Plants and machinery wastes
- 4) Waste due to faulty design and specification
- 5) Waste due to activities at construction site.

The bar and pie chart prepared by using quantitative method. The bar and pie chart shows the percentage of waste occurred in construction industry. The above result are obtained based on the questionnaire survey is shown in figure for each wastes.

V. ANALYSIS OF COLLECTED DATA

A. Wastes of Material:

The material waste (steel, cement, formwork, brick, etc) is the major problems in the construction sites. It’s calculated that on the average construction resource waste consist 15-20% of the entire construction sites. It happens regularly in all sites because of carelessness of unskilled labours.

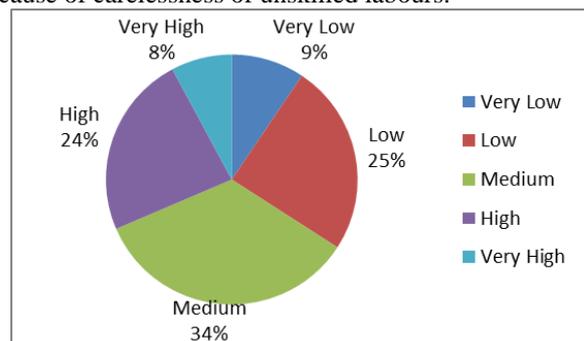


Fig. 2: Waste due to Material

From the fig 2 it is seen that most respondents feels that material is one of major cause of waste. From analysing the data we have found out that respondent feels that steel wastage impact on Cost and Time overrun is in medium category and its relative index is 59.39%.

B. Productivity of Labour:

Construction sector faces many problems correlated with its output and the problems are usually related with performance of labour. The efficiency of labour is affected by many factors and it is generally linked to the performance of time, cost, and quality. Labour productivity is influenced by many constraints that include age, skill, experience of workforce, leadership and motivation of workforce.

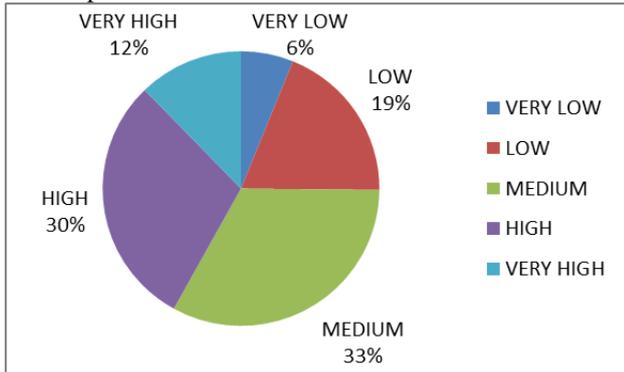


Fig. 3: Wastes due to labour

From fig 3 it can be said that loss due to different factor like proper training, unskillness etc of the labours has medium to high impact on time overrun as well as cost overrun. Relative index 64.30%.

C. Wastage due to Plants and Machinery:

Wastage through Construction Equipment's plays a considerable role in cost of construction as they lead to the wastage to all kinds of material. If we can reduce the wastage causing due to these equipment's we can surely make a huge difference on construction cost. Waste mainly happens due to error by equipment malfunction, Equipment frequently break down, Unreliable equipment, inclement climate, accidents.

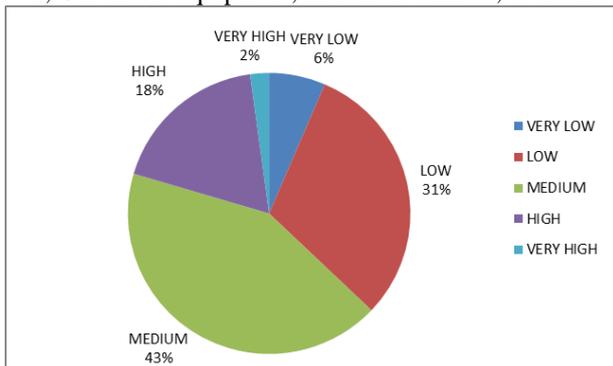


Fig. 4: Waste due to plant and machinery

From fig4 it can be said that wastage through construction equipment's has medium impact on time overrun as well as cost overrun. Relative index 55.79%.

D. Waste due to Faulty Design and Specification:

Mostly it happens due to error in contract documents, incomplete at the starting of the project, change in design after beginning of project. Sometimes, ordered material cannot attain its location on exact time, forcing them to use substitute material which is available in very short time. With

a restricted time, designer change their design according to the available material.

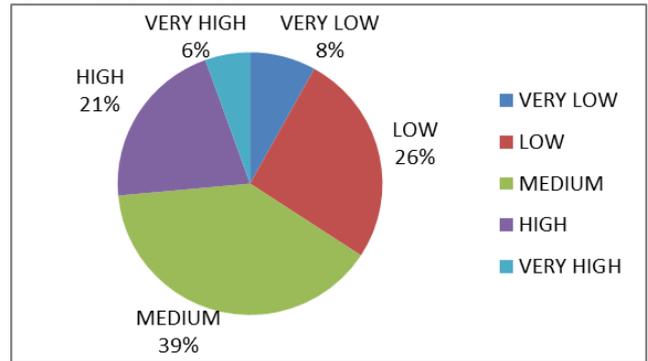


Fig. 5: Waste due to design and specification

From fig 4 it can be said that wastage through Steel Design has low to medium impact on time overrun as well as cost overrun. Relative index 57.94%.

E. Waste due to Activities at Construction Site:

The waste are generated due to construction activity in site are like Slow in making decisions, poor coordinating among project participants, Poor planning and scheduling, poor communication between providing to participants etc. Ordering error, under ordering, supplier's error, damage during transportation to site, inappropriate storage etc causing the wastage while procurement.

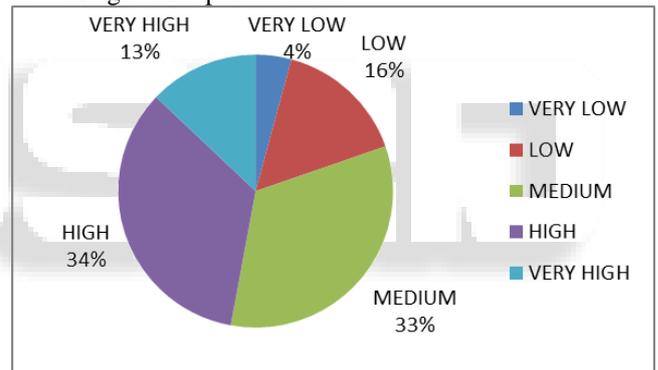


Fig. 6: Waste due to construction activity at site

From fig 6 it can be said that waste due to site management has medium impact on time overrun as well as cost overrun. Relative index 67.22%.

VI. RESULTS

The obtained data from all the places were analyzed by using Statistical Methods and each waste parameter were given grading depending upon their impact, In this study, an ordinal measurement scale 1 to 5 was used to determine the effect level. Respondents were asked to rank the factors affecting quality performance according to the degree of importance (1 =affects with Very Low; 2 = Low; 3 = affects with Medium; 4 = affects with High; 5 = affects with very High). For analyzing data by ordinal scale, a relative index (RI)

$$\text{Relative Index(R. I)} = \frac{\sum 1X1 + 2X2 + 3X3 + 4X4 + 5X5}{\sum X1 + X2 + X3 + X4 + X5}$$

Where,

X1=Number of respondent for very low

X2=Number of respondent for low

X3=Number of respondent for Medium

X4=Number of respondent for High

X5=Number of respondent for very High

In general, the groups of factors that give high effect are: material, labour, equipment, design & site management. While other groups of factors only give a normal affect even a small effect.

Group	Relative index(RI)	Effect	Rank
Construction Activity(Inventory, Housekeeping)	67.22%	High	R1
Labour Productivity	64.03%	High	R2
Material	59.39%	Medium	R3
Design & Specification	57.94%	Medium	R4
Equipment & machinery	55.79%	Medium	R5

After finding out the Relative Index select top cause for further analysis. Above table shows that inventory, labour productivity & material waste are the major cause with respect to time and cost.

VII. CONCLUSION AND RECOMMENDATION

By the entire analysis of various factors and responses coming from company participants work carried out it is found that 70% of companies accepted the criteria that wastes are generated in the construction industry which is accepted by the companies.

Based on this entire analyses, the recommendations are offered to support the effort of implementation of lean management techniques in construction field,

- Orientation programs need to be developed for subcontractors. Because lean concepts and principles may be complex for the contractors to understand.
- The companies may provide adequate training for management level employees.
- Appointment of highly qualified and quality supervisors, and making their objective known to them, i.e. to increase productivity
- Weekly meeting may held to the skilled and unskilled labours to discuss about the ongoing project at site.
- Developing a performance improvement plan, to let the workers know what is expected from them.
- Conducting regular inspection and interaction to make sure the works are in order
- Consider a maximum use of local available materials
- To ensure every project participants involved in the construction process in full-fledged manner.
- Establish good relationship between manufacturers and management.

If we effectively implement the lean principal fully in construction industry means it will be possible to reduce the wastes in construction industry as well as increase the productivity and profit.

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