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Efficient Construction by Implementation of Lean Management Principles

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ABSTRACT

This dissertation work was carried out on implementation of lean management principles in the construction industry with the focus on reducing wastes generated during the construction process and to increase the efficiency of resource utilization. Construction industry is one of the most unorganized, and complicated sectors. Also, this sector is financially dominated by use of material resources and workforce which makes it a highly complex and expensive sector. After identifying the issues concerning with this industry, the new technique is applied for increasing the efficiency and reducing the time consumption associated with this field. So, to achieve this goal, a method has been researched until that concept came which was already implemented successfully in the manufacturing sector. Then after brainstorming, that concept had been applied in construction industry which showed the potential of streamlining and the work processes. This leads to increase the output with comprehensive resource usage in the least possible time. In order to implement lean in construction, use the methodology of Value Stream Mapping because while doing this research work, we realized that this method unlike others, Essential features of lean construction includes a clear set of objects at project level. Lean construction helped us to practically visualize current state of the project and identify the wastes, which made it aqua clear to prepare a future state map with the evaluated results. In general lean construction project are easier to manage, safer, completed sooner, &less cost with better quality

Keywords :- Lean , Construction, Management & Implementation

I. INTRODUCTION

The term 'Lean' is a culture of continuous improvement practiced at every level of the organization and by every team. Lean construction on the other hand is a 'way to design production system to minimize wastage of materials, time, and effort in order to produce the maximum possible amount of value [1].

'Lean' is a production technique that considers the disbursement of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination [2].

The conventional management techniques used to emphasize more on the results rather on the intermediate steps implemented in achieving the target. This ultimately leads to cost overrun, lack of efficiency, time overrun, poor quality of work, underperformance and/or excess inventory. However, the new concept of lean management implies breaking down the entire process into number of steps and accordingly planning a clear set of objectives at each level of work. As a result, lean construction methods are less time consuming, easily manageable with lesser cost and improved quality.

OBJECTIVE OF PRESENT WORK

The major objective of the present work is to implement Lean Management Principles to improve the performance of the construction industry which can be done by achieving the following sub-objectives.

- Identifying the causes of wastes and classifying under pre-determined categories.
- Identifying the impact of underlying causes with respect to Time & Cost.
- Identifying the value-added and non-value added activities under Value Stream Mapping (VSM).
- Increasing the efficiency of value adding activities and suppressing the non-value adding activities.

SCOPE

Application of lean principles in construction industries have been found to play a crucial role in the identification of wastage in construction industry and their minimization/elimination by application of developed methodologies and techniques which lead to completion of project before the deadline, therefore, the benefit of saving both money and time.

II. LITERATURE REVIEW

Understanding and action of Implementing Lean Construction:

This research carried out by Greg Howell and Glenn Ballard who aimed at understanding the implementation of lean construction [6]. Lean thinking is a new way to manage construction. The goal of lean thinking redefine performance against three dimensions of perfection: (1.) a uniquely custom product, (2.) delivered instantly, with (3.) nothing in stores. This idea maximizes value and minimizes waste. The methodology of the research was based on just-in-time approach using the Value stream mapping. Implementing lean means adopting a "project-as-production system" approach to construction, defining the objective in customer terms, and decentralizing management to maximize throughput and reduce inventories. The tenets of lean thinking implies to: (1.) Specify value by product, (2.) Identify the value stream, (3.) Make product flow, (4.) At the pull of the customer, (5.) While pursuing perfection (custom product, zero time delivery, nothing in stores). The paper was concluded with the thought that lean thinking can be applied to every aspect of company management but no step by step guide can be provided. Furthermore, it was observed that there is a need to bring the like minds towards lean thinking together for better coordination between the supplier, manufacturer and seller in order to achieve custom or tailor made output in construction which can save a lot of resources by identifying the need and eliminating the wastes.

Application of Lean Manufacturing Principles to Construction

This Research was reviewed by O. Salem and E. Zimmer [7] with an aim to apply the lean manufacturing principles in construction. The main objective was to develop a comprehensive set of lean principles and their validation by field observations of lean behavior, value stream mapping and interview with early lean adopters. Under the methodology employed i.e. value Stream Mapping, the works were divided into three categories, namely: value-adding (VA), non-value adding (NVA) and non-value adding but required (NVAR). The authors found out five major lean principles that are applicable in construction industry i.e. customer focus, culture/people, workplace standardization, waste elimination and continuous improvement/ built-in-quality [8]. Further, the researchers concluded that even though construction is different in many ways from traditional manufacturing but the report suggests possibility of application of lean principles and improvement of construction industry. Another interesting aspect of this report was how worker movement studies were incorporated to figure out the

activities which lead to waste of time, consequently affecting the project.

III. METHODS AND MATERIAL

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

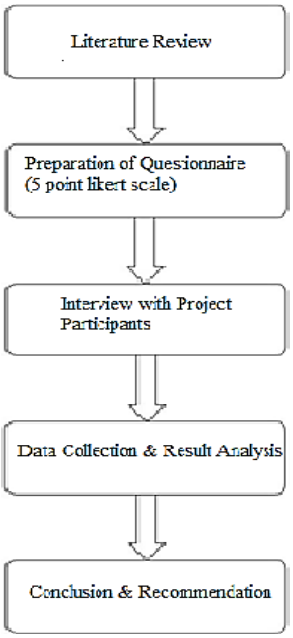

Fig 1.

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 weight ages. 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

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.

IV. 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 lab ours.

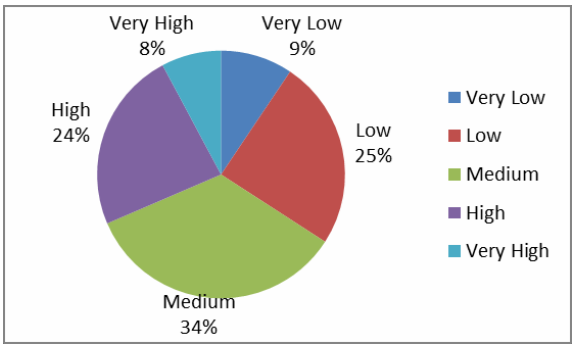

Fig 2. Waste due to Material

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.

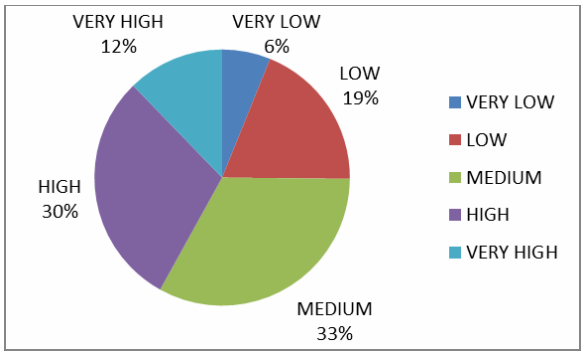

Fig 3. Wastes due to labour

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.

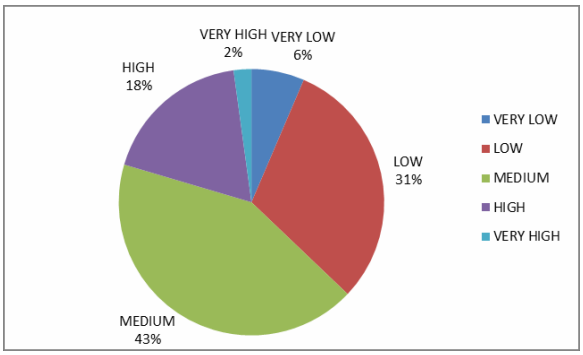

Fig. 4 : Waste due to plant and machinery

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

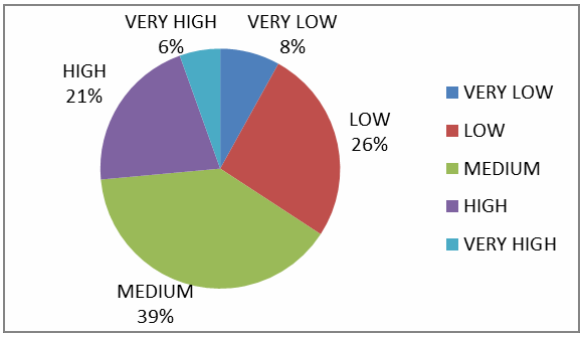

Fig 5. Waste due to design and specification

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.

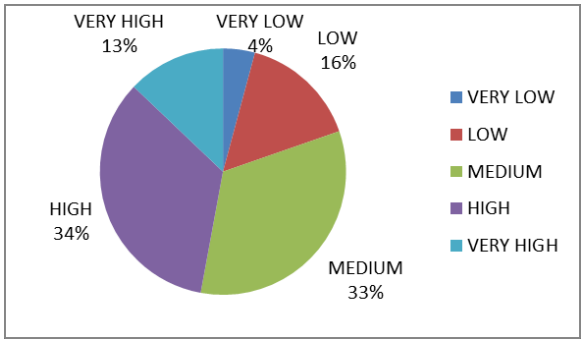

Fig 6. Waste due to construction activity at site

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%.

V. RESULTS AND DISCUSSION

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)

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.

VI.CONCLUSION

For a long time, it has been believed that the concept of lean is applicable only in the field of manufacturing, but this research confirmed that it is highly applicable in the construction industry as well. With the help of this work, the practical

strategies are described to improve product development performance by reducing the time overrun, cost overrun and material wastage to a great extent. It not only helps in increasing the efficiency of construction activities, but is also instrumental in organizing the work processes in the best possible way.

In order to prepare the questionnaire, first major areas of concern in terms of material wastage such as steel, cement, concrete, brick work, formwork, etc., which lead to aforesaid issues are identified by taking design and specifications into consideration for several times it has been observed that design constraints also lead to cost and time overrun in a construction project. Productivity of labour also paid attention, since it can cause delays in schedules which often lead to quality related problems. Material wastage in plant and machinery was one of the prime factors in determining the cost concerns of the project. Many a times, faulty construction activities such as improper housekeeping and inventory management, poor workmanship, inefficient monitoring and control carried out on site, which often lead to delays, increased expenses and confusion with reference to works to be carried out. After collecting the feedback of the questionnaire which was responded by the professionals in the industry, it is analyzed, evaluated and pointed out the significant factors which adversely affect the output of the construction industry.

For further implementation of Value Stream Mapping, first the Current Value Stream Map of the project, taking steel and concrete under consideration as they were the prime factors is created then the problem areas right from the extraction of iron to the reinforcement placement and fixation is identified. Similarly, the problem areas in concreting which covered the aspects ranging from preparation of concrete to compaction and hardening of concrete are identified. After identifying the problem areas, apply the methods by which these issues can be resolved are applied.

VII. REFERENCES

[1]. Fawaz A, Abdulmalek, Jayant Rajgopal, “Analyzing and benefits of Lean manufacturing and value stream mapping via simulation”,International Journal of Production Economics 107(1):223-236, 2007.

[2]. Frank and Lillan Gilbert,“Manufacturing & marketing of motion study” Business & Economic history 2nd series,vol 18th, 1989.

[3]. Bertelsen, S, “Lean construction: where are we and how to proceed Retrieved”,Lean construction journal, 2004.

[4]. Cullen, P.A., Butcher, B., Hickman, R., Keast, J., & Valadez, M, “The application of lean principles to in-service support comparison between construction and the aerospace and defence sectors” Lean construction journal, 2005.

[5]. T., Bozdogan, K., Cutcher, J. G., McManus, H., Nightingale, D., Rebentisch, E., Shields, T., Stahl, F., Walton, “Lean enterprise value: Insight from MIT’S lean aerospace initiative” ,the lean enterprise value foundation.INC, 2002.

[6]. Greg Howell and Glenn Ballard, “ Implementing Lean Construction: Understanding and Action”, the international group for lean construction, 1998.

[7]. O. Salem and E. Zimmer, “Application of Lean Manufacturing Principles to Construction” , Lean construction journal, 1555-1369,2005.

[8]. Yu, H., et al.,” Development of Lean Model for House Construction Using Value Stream Mapping” American Society of Civil Engineers, 1943-7862,2014.

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