A Literature Review on Improvising Labour Productivity on Construction Site by using Lean Principles

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Abstract— Construction Industry is a second largest and most challenging industry in India after agriculture. Construction industry contribute to GDP with about 11% in India.[1] Nevertheless, poor performance of the construction industry in India has been a cause of great concern among practitioners and academics. In India Construction projects have been experiencing significant cost and time overruns, with low labour productivity identified as a major reason for project delays and cost overruns. Improvising labour productivity in construction is therefore critical. Lean philosophy is concepts of manufacturing. Now a day's lean philosophy is widely use in the construction industry. Lean philosophy is use for the improvising construction labour productivity. This paper includes a review on various literature papers related to improvising labour productivity on construction site by using lean principles.

Keywords: Construction Industry, Labour Productivity, Lean Philosophy

I. INTRODUCTION

Construction Industry is a second largest and most challenging industry in India after agriculture. Construction industry contribute to GDP with about 11% in India.[1] In India the construction sector is a major employment driver, being the second largest employer, next only to agriculture. Construction industry is a labour oriented industry. The labour force in India is 520.2 million (2017).[6] In India all the large and small construction work depend upon the labours instead of using latest technology and machinery. Labours play most important role in construction industry because of the 30% to 55% total cost of project is spent on the labours. The total time used by labours on daily basis on productive work averages about 30% of the total time available for construction work.[2] Labours play major roles to increase the production efficiency in construction industry. Labours effects all the planning principles Time, Cost and Quality in construction so, we can say that labour productivity is most important in construction industry. By using lean principles, we can increase the productivity in construction from maximize customer value while minimizing wastage and creating more value for customers within limited resources.

A. Labour Productivity

Productivity can be defined in many ways. In construction, productivity is usually taken to mean labour productivity, that is, units of work placed or produced per man-hour. The inverse of labour productivity, man- hours per unit (unit rate), is also commonly used. Productivity is the ratio of output to all or some of the resources used to produce that output. Output can be homogenous or heterogeneous. Resources comprise: labour, capital, energy, raw materials, etc. Construction labour productivity is a measure of work process efficiency. It can be defined as the ratio of the value labour produces to the value invested in labour. Productivity increases as needed labour resources are minimized and wasted efforts eliminated from the work process.[3]

Productivity = Output ⁄ Labour cost or Work Hours

Horner and Talhouni [4] stated "A popular concept in the USA, and increasingly in the UK, is the concept of earned hours. It relies on the establishment of a set of standard outputs or norms for each unit operation. Thus, a number of, earned hours are associated with each unit of work completed."

B. What is Lean?

Lean philosophy is concepts of manufacturing. Now a day's lean philosophy is widely use in the construction industry. There are various definitions of the lean which is describe below.

Lean is a production approach that preserves value with less waste.

Lean can be identified as one of the key approaches that could lead to great improvement in quality and efficiency.

Lean is also defined as maximize customer value while minimizing wastage and creating more value for customers within limited resources.

C. Lean Principles

Lean methodology has five principles according to "Womack and Jones [5]" and they are defined as:

1) Identify value from customer point of view
2) Value stream mapping (process map)
3) Create flow – Redesigning processes to minimize waste and optimize customer service
4) Establish Pull – Produce when it is needed to fulfil customer demand
5) Pursue perfection – Zero Defects

D. Aim

Aim of the study is to review various literature paper and find out the impact on labour productivity after implementation of Lean principles on construction sites and also find out factors affecting to the labour productivity on construction sites.

E. Objectives

- Find out factors affecting to the labour productivity on construction sites.
- To study and find out the labour productivity of construction sites.
- To identify the impact on labour productivity after implementation of Lean principles.

F. Need for study

Labours play most important role in construction industry because of the 30% to 55% total cost of project is spent on the labours. The total time used by labours on daily basis on productive work averages about 30% of the total time

available for construction work [2]. To increase the production efficiency the labours, play major role in construction. Labours effects all the planning principles Time, Cost and Quality in construction. By using lean principles, we can increase the productivity in construction from maximize customer value while minimizing wastage and creating more value for customers within limited resources.

II. LITERATURE REVIEW

A. Improvising Construction Crew Productivity on Construction site by Lean Method

Study: In this research paper author discuss about various methods used to evaluate 'Construction Crew Productivity' for various activities like masonry work, plastering work and flooring work and find reasons affecting the productivity of labour and reduce them. The main objective of this research paper is to identify and rank factors influencing productivity that are applicable to the Indian construction industry. To achieve the objective, a questionnaire survey of project managers, site engineers, supervisors and craftsmen working on construction sites was conducted. From the observations it is seen that continuous focus must be made in increasing value-added activities and reduce non-value-added. So, the wastage will be reduced and productivity will be increased.

B. Analysis of Labour Productivity

Study: In this research paper author discuss about analysis of productivity of labours for construction of basic elements of a building which are casting of slab, beams, columns and construction of burnt brick masonry. This research paper is about the case study of South Gujarat Region of India. The study was done for the duration of 15 weeks within which all the elements regarding the productivity of labours were studied. After studied the author concluded that there were many factors other than the skill and quality of labours affect the productivity of Labour. Improper workmanship of labours also affects the productivity of project. The more the Labour force would be productive, less time would be required for completion of the project and the more would be the profit of the company.

C. A Study of Labour Productivity and Work Hour Loss - Case Study for Brick Masonry

Study: This research paper elaborates the methodology used for controlling labour productivity which can be improved by cutting down un productivity time of the labour. In this research paper author find out actual productivity of labours, comparing and analyzing the causes for finding the remedial measures to improve productivity. Author take brick masonry for the study. In case study author compare the Burn Brick Masonry work, constructed at two similar, medium sized commercial construction projects located in at Walwadi area of Dhule city. The objectives of this case study are to qualify the potential benefits. After studied the author concluded that the more effective and proper material management required for speedy construction. Use of proper methodology like Lean is also beneficial for speedy construction and increase in labour productivity. There were also other ways to increasing in labour productivity like improve method of executing work, replace an inefficient working tool by appropriate efficient tool, improve working condition, employ competent supervisor and reduce unproductive time by constantly reviewing and minimizing causes responsible to unproductive time.

D. Studies on Improvement of Labour Productivity in Construction Sites Using Lean Technique

Study: This research paper gives the details about productivity improved with the same resources as planed but without any waste. Labour productivity depends upon how labours are utilized. In this study the time taken by a worker involved in a task, is recorded and variation between cycle are evaluated to determine whether alternative processes would improve production rate or not. Work measurement also helps to identify non-productive work that are done by the labour and to eliminate the non-value-added activities that are performed by the labour. Author used Crew balance chart to evaluate the work done by the worker correctly. The crew balance chart for the case study is done for brick work for a residential building in Chennai region. A crew balance study chart was performed for that brick work activity for the crew of four members in this research paper. The data collected through video recording. After data collection author analyzed crew balance chart. After analyzing the chart, the author concluded that how the crew members are effectively worked and also gives a remedial action to improve the productivity. If the crew chart has more of non-value-added activities which results in low productivity of the labour. Analysis of crew chart gives more idea about how to improve labour productivity.

E. Construction Crew Design Guidelines: A Lean Approach

Study: In this research paper author discuss about an interdisciplinary approach was adopted to provide crew flow and work design characteristics and develop lean-based crew design guidelines. This framework is derived from well-developed theoretical and empirical studies in lean production, lean construction, and socio-technical system theory, social and organizational psychology. It provides important crew, task, social and waste characteristics along with several performance outcomes that should be considered in the design of crews. Further, the causal relationships between the primary design characteristics, intermediate performance outcomes and final performance outcomes provided in this research paper guide the crew design process leading to the joint optimization of both the crew and the work performed, resulting in better overall crew performance. Lean-based crew design guidelines is expected to lead to better overall performance of crews achieving lean construction ideals of minimizing waste and maximizing value for construction operations and projects at large.

F. A Study of Various Factors Affecting Labour Productivity and Methods to Improve It

Study: This research paper focuses on labour productivity in the construction industry. This research paper reports on a survey made on project managers and experienced engineers of building projects in Sangli, Kolhapur & Pune districts, where an increase in productivity is being sought. The survey was carried out by a questionnaire and responses. The ten most significant factors affecting labour productivity for

small, medium and large companies are identified. The Author Concluded that the groups of factors which are highly effective are: supervision, material, execution plan, and design. Moreover, for large companies, equipment factors have also highly effective. While in small and medium companies, owner/consultant factors also need special attention because it has high effect too. Practically it is difficult task to all to improve labour productivity up to 100%. But if we have properly control on the factors, productivity can be improved up to large extent.

G. Waste Processing Framework for Non-Value Adding Activities Using Lean Construction

Study: In this research paper author discuss about various types of wastes in construction processes. Productivity improvements can be achieved by simply targeting at reducing or eliminating those wastes. Wastes that are mentioned are identified by Taiichi Ohno as the seven wastes that are part of the lean manufacturing. Lean construction results from the application of this new form of production management to construction, which has the goal of meeting the customers 'needs while using the least of everything. Author concluded that as a beginner, there is no necessity to start off a project with total implementation of lean management method. It is recommendable to embark with the basic principle, which is identifying and eliminating the wastes in construction process rather than just focusing on the reduction of construction material waste.

H. Labour Productivity in Construction

Study: This research paper focuses on labour productivity in the construction industry. It covers the construction labour productivity definitions, aspects, factors affecting it. The main outcome from the literature is that there is no standard definition of productivity. This research study provides a guideline for necessary steps required to improve construction labour productivity. This research paper reports on a survey made on project managers and experienced engineers of building projects in Sangli, Kolhapur & Pune districts, where an increase in productivity is being sought. The survey was carried out by a questionnaire and responses. The ten most significant factors affecting labour productivity for small, medium and large companies are identified. The Author Concluded that Project management skill is a major factor influence the labour productivity. So that, proper planning is really need to make sure that the project completed successfully. The project manager should train themselves to be more leadership, more innovative, and creative. Explorations of new technology or transfer technology will increase the productivity in construction industry. Project managers to consider of all these factors at an early stage.

I. Improving Productivity of the Construction Industry

Study: This research paper focuses on productivity improvement in the construction industry. The objective of this research paper is to identify the key factor affecting the productivity of the construction industry. In this research paper author Four type of analysis work is done for brick work and concrete work; they are process analysis, activity analysis, operation analysis, cost analysis. From this analysis quantity of material used, responsibilities of every individual involved in the work, cost associated with each work is identified. During the process some of the factors that affects on-site productivity is identified. Through process analysis scope of work, material and manpower involved are identified. Activity analysis aims to analyses sequence of work and complete method of work involved. Operation analysis helps in understanding responsibility of every individual involved in the process. Cost analysis helps to identify the total cost of brick work and concrete. And also, factors affecting on-site productivity are identified.

III. Conclusion

After these researches, we are able to identify the influencing factors which is affected to labour productivity and also find out the importance of labour productivity in construction industry. After labour productivity factors are identified, management can take actions to mitigate these issues. Using lean principles, we can improvise construction labour productivity by increasing value-added activities and reduce non-value-added activities. So, the wastage will be reduced and labour productivity will be increased. There were also other ways to increasing in construction labour productivity like improve method of executing work, replace an inefficient working tool by appropriate efficient tool, improve working condition, employ competent supervisor and reduce unproductive time by constantly reviewing and minimizing causes responsible to unproductive time. Proper planning and guideline are also required to improvising construction labour productivity.

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