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# Lean Construction Technique

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***Abstract— Lean construction is as an effective management tool to enhance the productivity in construction field. Large research is being done in recent past and is an on-going process to adopt lean principles from manufacturing industry to the construction industry. In order to improve the efficiency, reduction of waste, the lean construction has been introduced as new management tool. There are many challenges in implementing the lean concept in construction industry in India. Due to lack of attention and illiteracy towards the lean management principle, stake holders associated to this like builder, contractor, and engineering and project management firms etc. are still in process of adopting this principle for construction project. In this project report efforts are made to find out main barriers towards the implementation of lean techniques in Indian construction industry with the help of questionnaire survey and actual site implementations are made to develop a process map for on-going projects. Results of the survey showed that some of the lean techniques should be given more focus to enhance the process. The framework results show that the NVA (Non Value Added) and ENVA (Essential Non Value Added) activities have the highest impact on the project duration. Therefore with implementation of the proposed lean techniques, the NVA and ENVA activities have found to be improved and their durations can be reduced considerably.***

***Keywords— lean construction, lean techniques, visual management, non-value added activities, essential non value added activities.***

## I. INTRODUCTION

Lean is a technology or tools mainly found out for manufacturing industry in order to reduce waste and improve productivity based on value. Lean in one of such tool which is highly effective and efficient in reducing waste and improving growth when followed appropriately with effort. On the other side the construction sector lacks growth but the need for infrastructure and other building facilities are high. Construction industry encounter problems like delayed project delivery, less quality, excessive wastage of materials and improper resource utilization. The main prospect of lean management *principle* is –Drive more value by using less of everything.

## II. LEAN CONSTRUCTION PRINCIPLES

Lean construction is a "Way to design production systems to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value". (Koskela et al., 2002) Value in construction is like value in any business: it is a return on your investment. Adopting lean principles is an investment in the future of the project, which will reap benefits and give a solid return on investment.

Improve communication planning with owner, work force, contractors, and suppliers with visualization and open display of schedule, design, and workflow.

Eliminate waste of materials, poor communication, duplication of efforts, and design errors.

Improve work planning by early planning, with a focus on improved workflow, achievable tasks, distribution of workload, and a clearly defined work scope.

Look-ahead scheduling with just-in-time deliveries, engagement of all parties, availability of resources, access to site, and coordination of other dependencies.

Plan and coordinate off-site fabrication and modular construction activities to reduce site congestion, distribute workload, minimize field work force, and improve just-in-time delivery.

## III. NEED OF STUDY

Now days in India so many construction firms are coming up due to the need of infrastructure development in the country. Due to the huge requirement and to get well profit, the competitions among the companies are increasing day by day. In Indian construction industry, availability of skilled or literate labors is a major problem. Due to the unskilled labor and the lack of technology the quality of the project is reduced. To avoid such a problem, construction firms require new and innovative techniques. Such a technique name is called lean management. This is the principle is to be used in construction industry to avoid the above-mentioned problem. The lean management principles in the construction industry will increase the profit and quality of project in reasonable time. The main theme of lean management principle is "Drive more value by using less of everything."

## IV. PROBLEM STATEMENT

The problem statement was formulated after conducting an initial research in the literature and in the Indian construction industry. The literature and the study showed that there is lack of awareness of lean thinking in the construction industry. Most of the scholarly studies were based on data collected outside India and very few of them were conducted in India regarding lean thinking in Construction. Knowing everything about the lean concept , why Indian construction industry not use the lean construction technique for improve the performance of industry.

## V. OBJECTIVES

A. To study aspects of lean construction techniques in detail.
B. To study the challenges faced by Indian construction industry in implementing LEAN TECHNIQUES by conducting a questionnaire survey as well as site inspection and recommend the possible solution for overcoming the same.
C. To observe the effect of implementation of the lean tools on project duration.
D. To provide the recommendations based on the study carried out.

## VI. LEAN CONSTRUCTION TOOLS

*A.Last Planner System*

Ballard (2000) indicates that Last Planner System (LPS) is a technique that shapes workflow and addresses project variability in construction. The Last Planner is the person or group accountable for operational planning, that is, the structuring of product design to facilitate improved work flow, and production unit control, that is, the completion of individual assignments at the operational level. In the last planner system, the sequences of implementation (master schedule, reverse phase schedules (RPS), six-week look ahead, weekly work plan (WWP), percent plan complete (PPC), Constraint analysis and Variances analysis) sets up an efficient schedule planning framework through a pull technique, which shapes work flow, sequence, and rate; matches work flow and capacity; develops methods for executing work; and improves communication between trades. It will achieve "Should Can Will" which is the key term in WWP (Ballard 2000). "Should" indicates the work that is required to be done according to schedule requirements. "Can" indicates the work with can actually be accomplished on account of various constraints on the field. "Will" reflects the work commitment which will be made after all the constraints are taken into account.

*1) Master Schedule:* The master schedule is an overall project schedule, with milestones, that is usually generated for use in the bid package. Reverse phase scheduling (RPS) is produced based on this master schedule.

*2) Reverse Phase Scheduling (RPS):* Ballard and Howell (2003) indicated that a pull technique is used to develop a schedule that works backwards from the completion date by team planning; it is also called Reverse Phase Scheduling (RPS). They also state that phase scheduling is the link between work structuring and production control, and the purpose of the phase schedule is to produce a plan for the integration and coordination of various specialists' operations. The reverse phase schedule is developed by a team consisting of all the last planners. It is closer to reality than the preliminary optimal schedule which is the master schedule. However, without considering actual field factors in the RPS, the RPS is less accurate than the WWP.

*3) Six-Week Look ahead (SWLA):* Ballard (2000) indicated that the tool for work flow control is look ahead schedules. SWLA shows what kinds of work a supposed to be done in the future. In the look ahead window, week 1 is next week, the week after the WWP meeting. The number of weeks of look ahead varies. For the design process, the look ahead window could be 3 to 12 weeks (Ballard 2000). All six-week- look ahead durations and schedules were estimated based on the results of the RPS, and constraints are indicated in order to solve the problems before the actual production takes place. SWLA is distributed to all last planners at WWP meetings. Lean look ahead planning is the process to reduce uncertainty to achieve possible constraint free assignments (Koskela et al. 2000).

*4) Weekly Work Plan (WWP):* Should, Can, and Will are the key terms in WWP (Ballard 2000). Weekly Work Plan (WWP) is produced based on SWLA, the actual schedule, and the field condition before the weekly meeting. Along with this plan, manpower from each trade will be adjusted to the need. The WWP meeting covers the weekly schedule, safety issues, quality issues, material needs, manpower, construction methods, backlog of ready work, and any problems that can occur in the field. It promotes two-way communication and team planning to share information on a project in an efficient and accurate way. It can improve safety, quality, the work flow, material flow, and productivity among team members. Ballard and Howell (2003) indicates that WWP should emphasize the learning process more by investigating the causes of delays on the WWP instead of assigning blames and only focusing on PPC values. Variance analysis is conducted based on the work performance plan from the previous week. The causes of variance should be documented.

*5) Percent Plan Complete (PPC):* The measurement metric of last planner is the percent plan complete (PPC) values. It is calculated as the number of activities that are completed as planned divided by the total number of planned activities (Ballard 2000). The positive (upward) slope between two PPC values means that production planning was reliable and vice versa.

According to Ballard (1999), PPC values are highly variable and usually range from 30% to 70% without lean implementation. To achieve higher values, additional lean construction tools such as first run studies should be implemented.

*B. Increased Visualization*

The increased visualization lean tool is about communicating key information effectively to the workforce through posting various signs and labels around the construction site. Workers can remember elements such as workflow, performance targets, and specific required actions if they visualize them (Moser and Dos Santos 2003). This includes signs related to safety, schedule, and quality. This tool is similar to the lean manufacturing tool, visual controls, which is a continuous improvement activity that relates to the process control for smooth processing and management.

*C. Daily Huddle Meetings*

Two-way communication is the key of the daily huddle meeting process in order to achieve employee involvement. With awareness of the project and problem solving involvement along with some training that is provided by other tools, employee satisfaction (job meaningfulness, self-esteem, sense of growth) will increase. As part of the improvement cycle, a brief daily start- up meeting was conducted where team members quickly give the status of what they had been working on since the previous day's meeting, especially if an issue might prevent the completion of an assignment (Schwaber 1995). This tool is similar to the lean manufacturing concept of employee involvement, which ensures rapid response to problems through empowerment of workers, and continuous open communication through the tool box meetings.

*D. First Run Studies*

First Run Studies are used to redesign critical assignments (Ballard and Howell 1977), part of continuous improvement effort; and include productivity studies and review work methods by redesigning and streamlining the different functions involved. The studies commonly use video files, photos, or graphics to show the process or illustrate the work instruction. The first run of a selected craft operation should be examined in detail, bringing ideas and suggestions to explore alternative ways of doing the work. A PDCA cycle (plan, do, check, act) is suggested to develop the study: Plan refers to select work process to study, assemble people, analyze process steps, brainstorm how to eliminate steps, check for safety, quality and productivity. Do means to try out ideas on the first run. Check is to describe and measure what actually happens. Act refers to reconvene the team, and communicate the improved method and performance as the standard to meet. This tool is similar to the combination of the lean production tool, graphic work instructions, and the traditional manufacturing technique, time and motion study.

*E. The 5s Process*

Lean construction visualizes the project as a flow of activities that must generate value to the customer (Dos Santos et al. 1998). The 5s process (sometimes referred to as the Visual Work Place) is about “a place for everything and everything in its place”. It has five levels of housekeeping that can help in eliminating wasteful resources (Kobayashi 1995; Hirano 1996): Seiri (sort) refers to separate needed tools / parts and remove unneeded materials (trash). Seiton (Straighten or set in order) is to neatly arrange tools and materials for ease of use (stacks/bundles). Seiso (shine) means to clean up. Seiketsu (standardize) is to maintain the first 3Ss. Develop a standard 5S’s work process with expectation for the system improvement. Shitsuke (sustain) refers to create the habit of conforming to the rules. This tool is similar to the 5S housekeeping system from lean manufacturing. The material layout is commonly used for acceleration of 5S implementation on the construction site. Spoore (2003) indicates that 5S is an area-based system of control and improvement. The benefits from implementation of 5S include improved safety, productivity, quality, and set-up-times improvement, creation of space, reduced lead times, cycle times, increased machine uptime, improved morale, teamwork, and continuous improvement.

*F. Fail Safe for Quality and Safety*

Shingo (1986) introduced Poka-yoke devices as new elements that prevent defective parts from flowing through the process. Fail safe for quality relies on the generation of ideas that alert for potential defects. This approach is opposed to the traditional concept of quality control, in which only a sample size is inspected and decisions are taken after defective parts have already been processed. This is similar to visual inspection (Poka-Yoke devices) from lean manufacturing. Fail safe can be extended to safety but there are potential hazards instead of potential defects, and it is related to the safety risk assessment tool from traditional manufacturing practice. Both elements require action plans that prevent bad outcome.

## VII. METHODOLOGY

The research method used to achieve the objectives of this project is based on the following steps:

*A.* Literature review to show the realized benefits from applying lean concepts to construction in different projects from different countries. Studying the literature review we know that the lean construction technique how much important for Indian construction industry. Knowing everything about the lean concept , why Indian construction industry not use this technique for that purpose we decide that , taking survey which is simple questionnaire survey , which is help us to know what is the main problem.

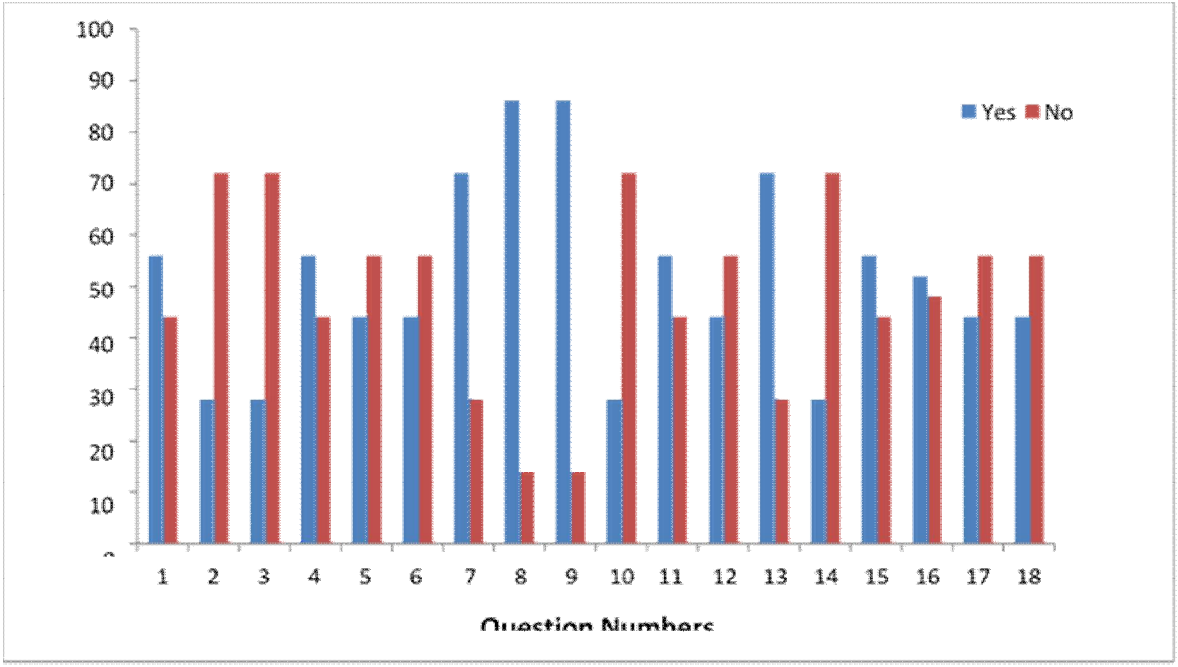
*B.* To identify the current appreciation and awareness of lean construction within construction industry with the help of questionnaire survey.

The questionnaire was prepared after through the study of literature and by understanding the lean construction technique with its advantages and challenges. All questions were framed in Yes/No type format, so they can easily answered.

The questions was mailed to 50 civil engineering professionals including contractors, site engineers, government employees, project managers etc. total 18 questions we asked as__

*1)* Have you heard about Lean before?
*2)* Have you thought about implementing Lean into your practices?
*3)* Do u think Indian construction industry is ready for an organizational change like implementing Lean?
*4)* Do you feel the need to adopt new techniques for the improvement of organization?
*5)* Are there obstacles when implementing a change? Like that.

*C.* Study and analysis of questionnaire survey.




As the graph shows the how much people aware about the lean. Then we study that questionnaire survey, after studying and analyzing that survey we find out some problems and all construction industry having this problems in India for implementing lean construction technique and these problems created barriers for the industry.

## VIII. CONCLUSIONS

The various studies shows that there are many obstacles when changing from traditional management to new management tools and the main concerns are top management commitment , labor problems etc. It can be also observed that many of the consultants have known about lean tools but could not implement the same as there is a constant resistance in the form of illiterate labors, financial issues, ignorance towards quality. The survey concludes that following are the major barriers for implementing the lean in Indian construction industry which needs to deal with.

- Lack of lean awareness and understanding

- Cultural and human attitude issues
- Commercial pressure
- Lack of proper training
- Long implementation time required
- Lack of top management commitment
- Educational issues
- Lack of proper communication between client and contractor
- Fragmentation and subcontracting
- Financial issues

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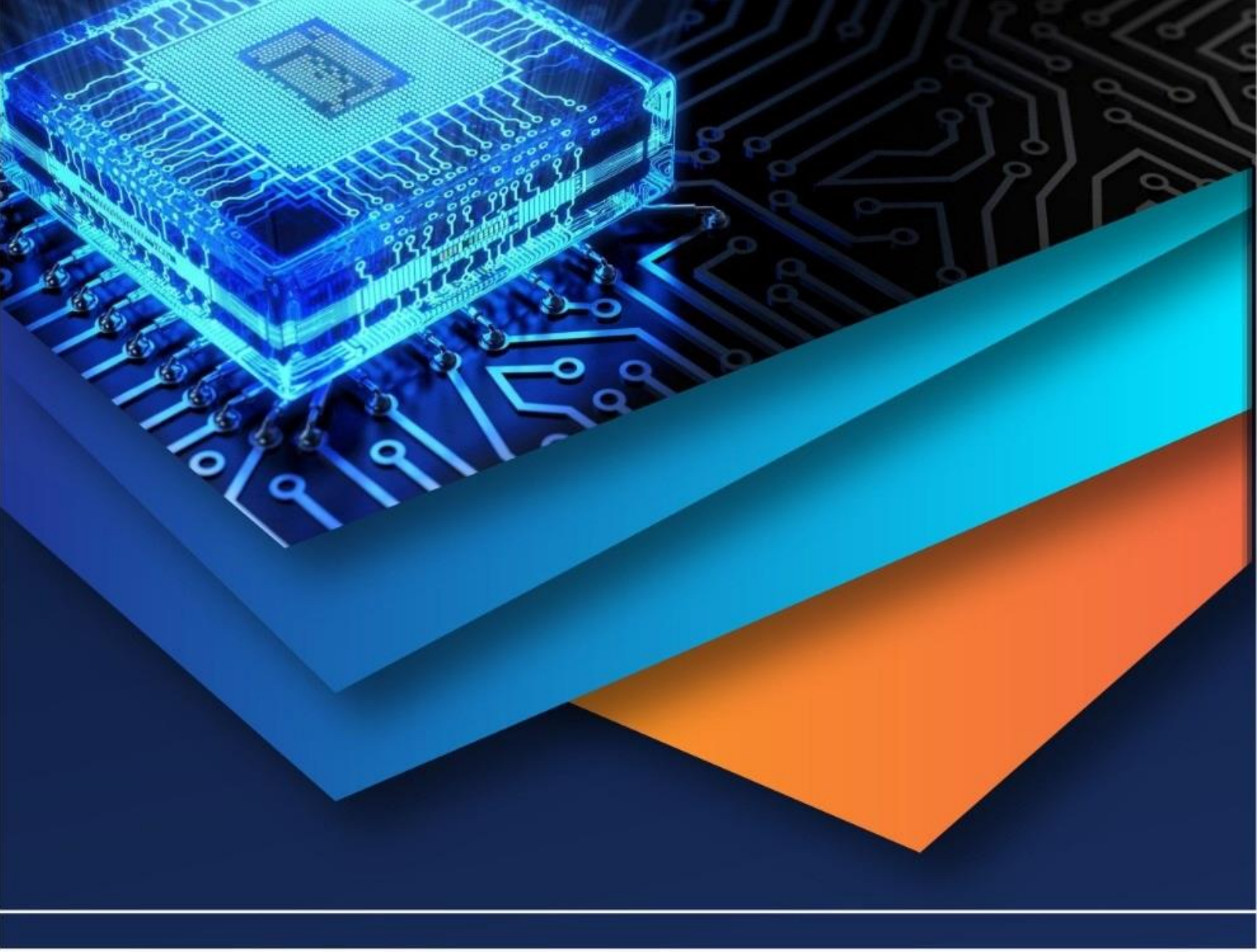

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