



International Journal of Intellectual Advancements and Research in Engineering Computations

Applying lean thinking and analyse the performance in construction industry

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ABSTRACT

The productivity of the construction industry worldwide has been declining over the past 40 years. Lean manufacturing is the tool widely used now a day which involves mainly in waste minimization. As construction industry struggle with project delays and difficulties in resource utilization the lean concept will help to overcome these difficulties. Lean construction is now only evolving in foreign countries and it is in the research and development stage. However there is a lot of studies regarding lean implementation in construction it is not is practically applicable to all the projects in construction. The effectiveness and method of lean implementation varies with company and project. This paper describes the lean concepts in detail, its necessities in construction sector, studies various tools and techniques of lean and how it could be implemented along the various phases of construction like design phase, planning phase, construction phase and lean project delivery. The lean project delivery is possible only when there is full involvement from top management, stakeholder to the end customer. This study clearly defines the method for application of lean construction and its effectiveness using various statistics. Finally the result will show the advantages of lean in construction management and the obstacles in implementing lean in construction projects.

Index terms: Lean construction, delay factors, Planning, statistics

INTRODUCTION

Lean is an innovation or devices basically discovered for assembling industry so as to decrease squander and improve profitability dependent on esteem. With increment in globalization, need and headway in innovation the weight on ventures is expanding. Assembling enterprises are demonstrating colossal and consistent development over years with the assistance of innovation like 3D printing, robotics, internet facilities, computers, etc. Different devices like Just-In-Time, Value Stream Mapping; Poka Yoke helps in improving the efficiency and decreases squander. Lean in one of such device which is exceptionally viable and productive in lessening waste and improving development when

followed properly with exertion. On the opposite side the development part needs development however the requirement for framework and other structure offices are high. Development industry experience issues like postponed venture conveyance, less quality, inordinate wastage of materials and ill-advised asset use. The fundamental possibility of lean administration guideline is - Drive more an incentive by utilizing less of everything.

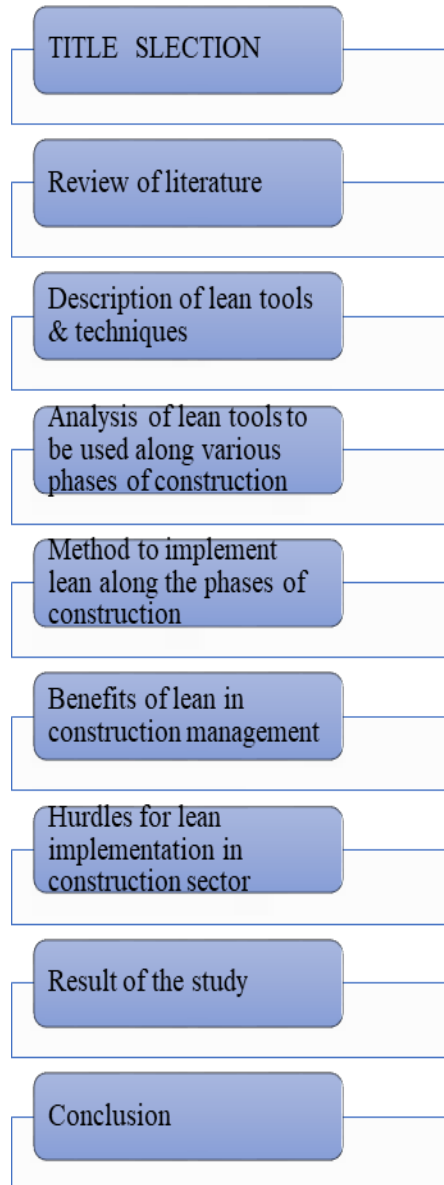
AIMS AND OBJECTIVES

Lean manufacturing technology is being successful in the industries but the concept of lean construction is still in theoretical status. Due to the massiveness, complexity and uniqueness of

projects in construction sector it is not an easy job to implement a new technology [1-5]. The main objective of the study is to define various tools and techniques of lean technology and how the methods of lean construction can be practically applied along various phases of the construction project.

METHODOLOGY

The methodology of the entire project involves definition about lean concepts and principles of lean and the lean construction at the initial phase, and then the literature review of various studies on lean construction, various tools of lean and case studies on lean implementation in construction industry has been made.



LEAN TECHNOLOGY IN CONSTRUCTION

Lean Design

The major three considerations for a lean design process are follows:

- Transformation (transformation of inputs into outputs)
- Flow (flow of material and information through time and space)
- Value (the generation of value for customers)

VALUE STREAM MAPPING (VSM)

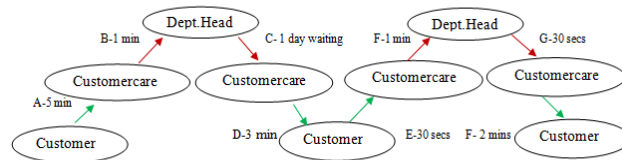


Figure 7.1.VSM in construction office previous map

Total time required = 1 day and 13 minutes

- Value added activity
- Non-value added activity

In order to neglect the excessive processing time the customer care personnel was provided

with a detailed catalogue with all the necessary information and a brochure for giving to the customer containing outline of the services provided. This helped in reducing the total time for addressing the customer enquiry.

Current map



Figure 7.2.VSM in construction office current map

Total time required = 7 minutes

Result

Total time has been reduced from 1 day 13 minutes to 7 minutes

POKA YOKE

Poka yoke in construction phase will help to prevent mistake before it occurs rather than finding it after completion of work. Some of the poka yoke are as follows:

- A worker has to sign in a log book kept at the inventory or material store whenever he borrows or returns a tool or equipment from the store. So that he will not be able to leave the site or allowed to get new tool & equipment unless he returned all the tools and equipment's borrowed from the inventory. This will help in proper inventory

management, prevent missing of tools, reduce wastage of time in searching of tool, etcetera [6-10].

- In construction, a contractor can colour-code inserts in metal decking to highlight which ones belong to which trade. This helps, among other things, in making it easy to assess whether or not all inserts are in place prior to casting the concrete slab on this decking.
- On site often the reinforcing bars are mistakenly chosen assuming its dimension resulting in wastage of time spent in bar bending. This can be prevented by using stickers mentioning dimension or color coding at end of bars can act as mistake proofing.
- Nails and screws can be bought in different colours to save time in searching for the correct tool while working.

5 S

It adds to the decrease and end of the 8 squanders (overproduction, stock, transportation, movement, pausing, abandons, over-handling, and non-used inventiveness); it builds individuals' inclusion, collaboration, spirit, wellbeing and security; it lessens costs, fluctuation and vulnerability; and it help in setting the premise to actualize Lean Construction in any organization or undertaking.

Sorting (Seiri)

Sorting out the necessary from the unnecessary

Simplifying (Seiton)

Putting everything which is necessary in a designated place and mark it so it can easily be

seen

Sweeping (Seiso)

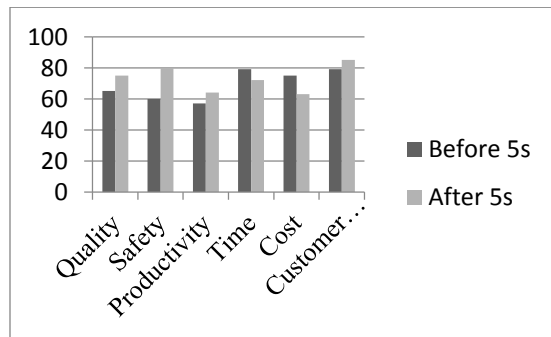
Physically cleaning up the work area; deliberately pick up all parts and materials that are out of place and return each to its assigned place

Standardizing (Seiketsu)

Creating standard ways to keep the work areas organized, clean and orderly, and standard ways to do the 5S's

Self-Discipline (Shitsuke)

Following through with the 5S's agreements and ensure it is maintained properly.



| 5S | PLACE | PROCESS |
|-------------|--------------------|---|
| SORT | In office | a) Keeping necessary documents and discards unwanted bills and papers. b) Reducing files by using computer |
| | In site | a) Keep the materials & equipments needed on site as per schedule. b) Discard unwanted materials, metals, scrap and wastage from previous work. |
| SIMPLIFY | In office | a) Arrange all the documents in appropriate places b) Everything is kept in its place and labeled in away such that anyone can find the required document easily without unwanted motion c) All the stakeholders, vendors, customer care numbers are displayed clearly. d) Each department is allocated with a definite space and a clear tag. |
| | In site | a) All the materials are arranged well in its place with clear indication of its specifications like dimension, supplier name, etc b) Color coding may be done for easy identification by labors. c) No unwanted material should allow to rest in unwanted place at any time. |
| SWEEP/SHINE | In office | a) Assigning people for sweeping. b) Every area should be kept clean |
| | In site | a) After completing a day's work the site should be made clean by respective workers b) Cleanliness should be followed by every person in site c) Site should be clean of scrap, metals, screws, broken glass, nails, etc d) Supervisor should check for cleanliness in site |
| STANDARDISE | In office and site | a) Deciding who is in charge of maintaining the needed conditions to maintain the first 3S. b) Avoid setbacks by means of integrating daily maintenance. c) Checking the level of maintenance periodically |
| | In site | a) Specifying certain location for tools, equipments and materials b) Clearly displaying the specific location for tools by pictures for easy understanding |
| SUSTAIN | In office and site | a) Training b) Periodical review and kaizen |

BENEFITS OF 5 S IMPLEMENTATION

A 3 Thinking

A3 believing is a communitarian cycles the executives and improvement instrument created by Toyota. The uses of an A3 are expansive. It very well may be utilized for critical thinking, dynamic, arranging or revealing of a particular issue from the proposition stage to appointing. Regularly, it is important for a PDCA cycle or DMAIC cycle.

Steps involved in preparing an A3 Report

- Identify the problem or need
- Understand the current state

- Develop the goal statement or target statement
- Perform root cause analysis
- Brainstorm/determine countermeasures
- Create an implementation plan
- Check results – confirm the effect

CHOOSING BY ADVANTAGE (CBA)

CBA is often used when multiple variables need to be considered to make a decision. This tool can be used for making decision when there is number of alternative choices available but a team can't determine the best outcome.

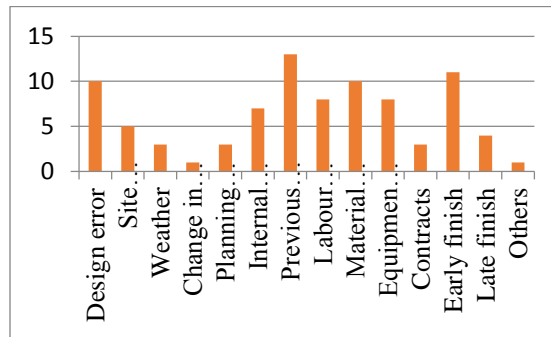
Weekly work plan

| WEEKLY WORK PLAN | | | | | | | | | | | | |
|-----------------------|--------------------------|----------------------|----|---|---|---|---|---|-----------------------------------|-------|---------------------|----------|
| Project Name : C17 | | WEEK 10-JUL 31-AUG 5 | | | | | | | | | | |
| Act ID | Description | Responsibility | M | T | W | T | F | S | Comments | PPC % | Reason for variance | category |
| | | | 31 | 1 | 2 | 3 | 4 | 5 | | | | |
| C022 | Foundation | | | | | | | | | | | |
| | Start of foundation | | | | | | | | Excavation work must be completed | 100 | | |
| 221 | Lean concrete | | | | | | | | | 100 | | |
| 222 | Shuttering | Labor - Saravanan | x | | | | | | | | | |
| 223 | Formwork | | x | | | | | | | | | |
| 224 | Concrete pouring | Material - Ravi | | x | | | | | | 25 | Equipment repair | 10 |
| 225 | Curing | | | | x | x | x | x | | | | |
| 226 | Brickwork | Equipment - Gopi | | | | | | | Curing must be completed | | | |
| 227 | DPC | Supervisor - Senthil | | | | | | | | | | |
| 228 | Backfilling & compaction | | | | | | | | | | | |
| | End of foundation work | | | | | | | | Foundation work must be completed | | | |

Looking over head plan

| 3 WEEK LOOK AHEAD PLAN | | | | | | | | | | | | | CONSTRAINTS | | | | |
|------------------------|------------------|----------|---|---|---|---|-----------|---|---|-----------|---|---|-------------|---|-------|---|--|
| Project Name: C17 | | | | | | | | | | | | | | | | | |
| ACTIVITY | CREW | OCT-9-14 | | | | | OCT-16-21 | | | OCT-23-28 | | | | | NEEDS | | |
| | | M | T | W | T | F | S | M | T | W | T | M | T | W | | T | F |
| Elevation Work | Mason crew | x | X | x | x | x | x | | | | | | | | | | Material on site |
| Door & Window Fixture | Carpenter crew | | | | | | | | | | | | x | x | x | x | Doors, Windows, Frames & other tools |
| Plumbing | Plumber crew | | | | | | | | | | | | x | x | x | x | Pipes, Valves, Taps, Sanitary wares, Fixtures & other tools Order sanitary ware |
| Electrical Wiring | Electrician crew | | | | | | | | | | | | x | x | | | Wires, Cables & other tools |

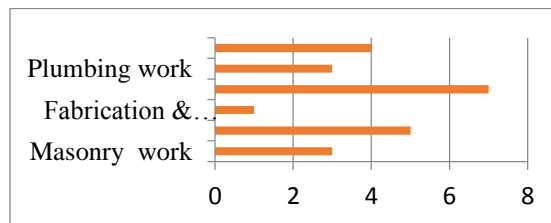
Reason for Variance



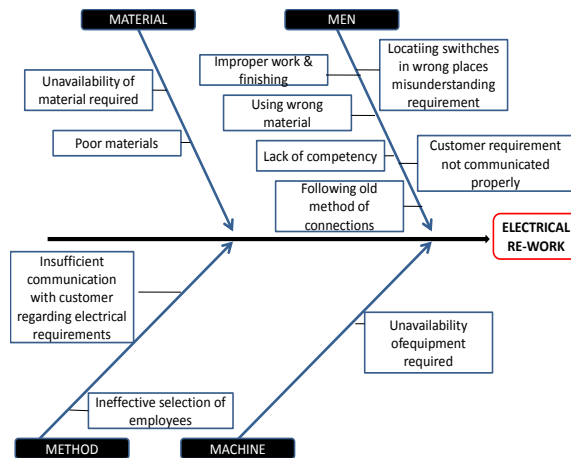
APPLYING LEAN THINKING

Plan

A person was assigned to collect data regarding the rework in different projects in the company. Result of the data was as follows:



Fish bone analysis for electrical rework



Do

The planning and designing department was ordered to make a separate plan indicating electrical and plumbing specifications and get confirmation with customer for the switch orientation and connections while showing the interior planning.

The supervisor was ordered to provide the electrician with the plan with detailed specification for electrical work and to communicate with him accordingly about the work.

The electrician was trained to do the work as per drawing and specification.

Check

The study was made after the implementation of above improvement activities and checked for its effectiveness.

The result was good revealing that the number of reworks due to electrical and plumbing work gets decreasing gradually.

Act

The improvement actions were implemented in full scale and the concerned person were given training.

KAIZEN

Thus through a Gemba walk, a kaizen event of neglecting waste associated with electrical work has been made with a PDCA analysis.

By continuous improvement lean construction can be achieved resulting in high advantages.

INTEGRATED PROJECT DELIVERY (IPD)

- Into a cycle that cooperatively saddles the abilities and experiences of all members to:
- Optimize venture results
- Increase qualities to the proprietor
- Reduce squander
- Maximize proficiency through all periods of plan, manufacture and development

HURDLES IN IMPLEMENTING LEAN TECHNOLOGY IN CONSTRUCTION

Although lean is an effective and efficient culture for management and the manufacturing sector shows a good and clearly visible result implementing lean technology, it is not widely applied in construction sector. The following are neither the various reasons for nor implementing lean in construction:

- Lack of exposure to Lean technology
- Nature of the construction sector involving wide variation in working site , type of people and project nature
- Tendency of the people to apply traditional construction practices
- Attitude of the labours
- Lack of client and stakeholder involvement
- Lack of training.

CONCLUSION AND RECOMMENDATIONS

Development part being perhaps the biggest segment adding to nation's 11% GDP much of the time experiences venture deferrals and spending overwhelms. The part essentially relies upon work, gear and material. The whole cycle from plan to conveyance of an undertaking includes a lot of waste. It represents arrangement of exercises out of which just 10 % is esteeming included exercises and 57 % is squander. Lean development system substantiates itself proficient in killing this waste. Lean development isn't an instrument yet a culture that must be executed bit by bit so as to get a productive outcome .it includes expulsion of waste in every single imaginable ways, improves the work process and expands the estimation of each cycle by methods for ceaseless improvement . A

few dynamic devices like A3 thinking, Choosing by Advantage, Value Stream Mapping assists with taking care of issues related with development. Last Planner helps in making dependable timetable and work plan for the undertaking as opposed to ordinary anticipating which at last prompts venture delays. Subsequently, numerous apparatuses in lean innovation have been considered and the strategy to apply them in venture has been recognized. The outcomes show the adequacy of each apparatus and practice. At long last the obstacles in executing lean in development have been examined. Generally lean innovation helps in accomplishing better development the board diminishing pointless waste, improving quality, forestall venture postponements and spending invades. It additionally helps in accomplishing consumer loyalty.

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