

# General overview of Lean Management in Construction Industry

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**Abstract** – In rapid, construction projects, it is not possible to manage the project through the conventional ways. It has been observed many times that the productivity of the construction depleting and leads to rework and produces many wastages such as over production, inventory, unnecessary transportation, workers displacements, over-processing, defect, waiting of materials, unused employee creativity, work accident, etc. Therefore practical ideas and techniques need to be used in construction that will help projects teams to deal with wastages in construction with the use of optimum resources and this can be achieved by using lean construction principles and techniques. So this paper aims to overview and discuss the applicability of lean principles and its techniques used in construction project which helps to reduce wastages in construction and brings the quality of work in product developing process with raising the profit level and also which factors affects to adopt lean management in construction has discussed with the current construction practices and past studies.

corresponds to waste due to the inefficiency of the traditional management system. According to (LCI) Lean Construction Institute, The construction industry is characterized by a ratio production/waste higher than that of the manufacturing industry.[1] nevertheless, lean manufacturing principles and techniques provide the foundations for minimization or total elimination of the waste faced by the industry. Lean construction has change the traditional view of labor flow and work flow reliability and gives the value added construction.

## 1.1 Objective of Study:

This paper review on the principles and techniques of lean management currently used in civil industry to reduce various types of waste and discuss the obstacle of lean management in construction in construction.

## 1.2 Present scenario of construction:

Infrastructure is the second largest sector after agriculture in India and is the integral part of country's development. It includes hospitals, townships, schools, offices, houses and other buildings and urban infrastructure. Construction is the basic input for socio economic development. In the past years many researchers stated there are number of waste can occur at any stage of the construction project. Since construction has directly or indirectly impact on many other industries so reducing the waste in the construction industry and saves the great cost of employer. Waste can be classified as natural waste which is unavoidable and avoidable waste. And the main root cause of waste comes from construction processes such as Planning, Design, Material procurement, Material handling, Material supply and Material manufacturing as well as construction stages, lack of work knowledge in labours, casual approach towards work, improper concrete mix design, faulty shuttering. Accidents due to negligence, choice of wrong construction process, cement/ mortar, timber, blocks, steel as the major material wasted on construction projects. It has become crucial to seek innovative and creative solutions/alternatives that ensure better and more optimized management techniques that could minimize the sources of wastes and increase the performance of the construction process. The construction industry facing various problems as a result of the uncertainties of the global economic climate, environmental hazards, including labor delayed projects and zero margin contract bids, greenhouse gas emissions etc. So there is need for waste minimization and enhancement of productivity in

## 1. INTRODUCTION

Projects have been considered as temporary based production systems which need to be designed, planned, produced and delivered within a specified time. Fast track projects with long, complicated supply chains involving many players and subject to multiple, extensive process design changes have complex flow management that has failed miserably. As a result, the industry is characterized by delays and often has suffered cost and time overruns. In general, a very high level of wastes/non-value added activities is confirmed to exist in the construction industry. Several studies from various countries have confirmed that, wastes in construction industry represent a relatively large percentage of production cost[2] The existences of significant number of wastes in the construction have depleted overall performance and productivity of the industry, and certain serious measures have to be taken to rectify the current situation. It has been contended by the Lean Construction Institute (2014) that about 57% of productive time waste can be found in the construction industry [2]

The conventional project management approaches have inadequacies in resolving the problems in the industry. In the United States, meticulous studies have been carried out by CII (Construction Industry Institute), which estimate that between 25% and 50% of the cost of construction

construction activity. Productivity is critical determinant of cost efficiency. The conventional system of construction is not sustainable. In one of the research it is estimated that current system of construction had around 50% of non-value added efforts or waste [4] Most of The present construction practices run with traditional work flow methods and uses conceptual models of construction management because there are some barriers to adopt lean management in present construction practices those are mentioned further.

## 2. Overview of Past Studies:

The Lean philosophy begins to integrate into the construction industry as a new method of construction projects management aiming at eliminating waste and creating value to the customer. Here within this work we have enlisted past work for better enhancement and to represent gap between past and future work.

**Mohammed Fadhil Dulaimi and Caroline Tanamas [2008]** had stated that, lean construction is a new way to design and build capital facilities. It advocates the simultaneous consideration of product and process development using simultaneous engineering. This study examines the pre-requisites and barriers for the possible implementation of lean construction in the local industry. Interviews are done with the managing directors and construction managers from selected Singapore ISO 9000 certified construction firms. From the research findings, it is found that only certain techniques of lean construction have been implemented locally. The biggest barrier is the cultural resistance to change.

**Raid Al-Aomar [2012]** showed from a research perspective, that the lean construction efforts have been focused on proposing and applying lean methods and tools in the various sectors of construction industry. Thus, this paper aims to investigate and categorize the different types of wastes in the construction industry and to develop a lean construction framework incorporating Six Sigma rating that can be used to quantify and assess the quality, cost, and schedule implication of lean construction practices. Empirical results obtained through a locally funded research project are used to analyze lean construction practices in Abu Dhabi (AD) construction industry, provide lean construction performance measures, and clarify the practical aspect of the proposed framework.

**Aakanksha Ingle, Prof Ashish P Waghmare [2015]** highlighted the cost and benefits of the potential contribution of lean construction to the achievement of productivity enhancement and waste minimization in construction industry. Researcher has used exploratory method for investigating the benefits of lean construction system by exploring, and understating the available literature and some case studies and stated, conventional system of construction is not sustainable. The construction

industry is seen as one of the worst performing industry as regards to the innovation. This calls for concern about the poor state of construction innovation. The emergence of lean construction is to bring significant reform to the construction industry to achieve the objectives of value addition and waste minimization within the built environment in the critical social, economic and environmental aspects.

**Richard Hannis Ansah, Shahryar Sorooshian and Shariman Bin Mustafa [2016]** considered that projects are temporary based production systems which need to be designed, produced and delivered within a specified time the conventional ways and that fast track projects with long, complicated supply chains involving many players and subject to multiple, extensive process, design changes have complicated flow management that have failed miserably. The conceptual models of construction management and the tools like work breakdown structure, critical path method, and earned value management have deficient in handling the present challenges of projects. As a result, the industry is characterized by a number of wastes, therefore the need for practical and robust models and techniques that will help projects teams deal with the issues of wastes in projects. This can be achieved through the adoption of lean production systems in the construction industry, in this paper, LC approach and the importance for its implementation has been discussed as the robust approach for project management.

**Mohamed Saad Bajjou, Anas Chafi, and Abdelali En-nadi [2017]** focuses mainly relate to the most relevant management techniques in the construction industry, and more specifically, on the lean construction concept. Initially, he was determining the main characteristics of the construction industry compared to the manufacturing industry according to three levels: on-site production, one of a kind projects, and complexity. Subsequently, he was focused on the main sources of waste in the construction industry. Finally, a rigorous comparative study was carried out to show the contribution of the lean construction tools in the promotion of traditional construction especially at the level of the following factors: Creating value and eliminating waste; Planning and mutual coordination; Site organization. (LPS), (VSM), Just-in-Time philosophy, (VM) and 5S have shown a great ability to improve the traditional production system through waste reduction, encouraging people involvement, ensuring a pull flow production, and promotion of a continuous improvement philosophy.

## 3. Lean construction:

Lean construction is a philosophy to design production systems to Minimize waste of materials, time, and effort in order to generate the maximum possible amount of value. Lean Construction is using the same principles as lean production to reduce waste and increase the productivity

and effectiveness in construction work. The most important determinants of construction are supposed to be workflow reliability and labor flow, but lean construction has changed the traditional view of the project as transformation, and the concept of flow and value generation.

Lean construction is composed of the following principles and techniques.

### 3.1 The Lean five principles:

- I. **Value specification:** Precisely specify what creates value from the client's perspective
- II. **Value stream identification:** Clearly identify all the steps in the processes (value stream) that deliver exactly what the customer values and remove everything that do not add value to the customer.
- III. **Flow:** Take actions that ensure continuous flow in the value stream,
- IV. **Pull:** This means to produce only what the customer wants just in time; and
- V. **Perfection:** Always strive for perfection by delivering what the customer wants and expects through a continuous removal of waste. Through process improvement to deal with the challenges in the construction.

### 3.2 Various Lean Techniques:

The Lean techniques are used in manufacturing as well as in construction industry to eliminate waste, improve productivity and saves time and cost with adding values to the product. Identification and elimination of activities with no added-value are primordial in Lean Construction philosophy indeed, the removal of no value-added activities helps to get closer to customer expectations. like Lean design, setup time reduction, worksite layout design, Kaizen, and team work. The second class of lean techniques include work structuring, lean supply, lean assembly, labor cross-training, using work standards, visual aids, and Total Productive Maintenance (TPM). standard work procedures, quality-at-the-source, team work, lean supply, lean assembly, buffers, small work packages, look-ahead planning, and work scheduling. Some techniques are discussed below,

#### Value Stream Mapping:

"VSM" is considered among the most used Lean Construction tools for identification of the sources of wastes. VSM consists in creating a visual map of the flow of materials and information from suppliers to consumer. The main

objective is to identify the different tasks of the process analyzed and to distinguish between them into two categories: those that create value-added (VA) and those with no value added (NVA), which allows identifying the sources of wastes that must be eliminated for objective to transform the current process into a future process more optimized.

#### Pull System:

The concept of a pull system is a fundamental pillar in a lean approach. At a strategic level, pull identifies the real need to deliver the product to the customer as soon as he needs it. The traditional construction process pushes the client into an often-protracted development process where risk and uncertainties are prevalent. The principle of pull suggests a decision where the ability to define quickly what the client needs from a building in relation to his business and subsequently customizing and deliver them more predictably when the client requires them.

#### Just in Time:

"Just in Time" is classified between the most developed Lean Construction tools designed to eliminate non-value-added activities and to reduce process variability. Just-In- Time philosophy is based on the concepts that stocks which do not bring added value to the customer (internal or external) should be considered as sources of wastes. So, the materials or equipment must be available only when it is necessary.

#### Kanban Board / Card:

Supply management using "kanban" cards is a very effective technique to ensure the minimum amount of materials, depending on the real needs of the site construction. Proposes another solution to the storage problem by tracing the working areas so each one of them will have his own storage. In addition to that, we can use mobile storage blocks, equipped with wheels to facilitate the movement. Indeed, this solution will actually allow following physically the flow of production which helps to effectively reduce many sources of waste (operators' displacements, waiting, stocks).

#### Last planner system (LPS):

Used for Planning and mutual coordination. The Last Planner System (LPS), the main tool of Lean Construction, is a collaborative planning tool facilitating communication, participation and which take into consideration the constraints of each stakeholder. The scheme of planning with the LPS tool is given below:

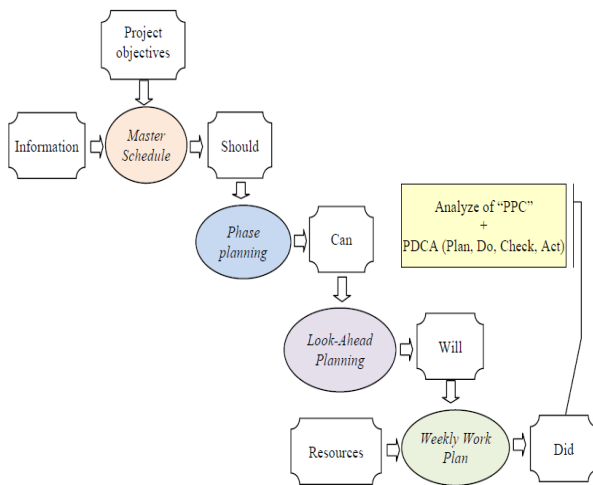


Fig1: Scheme of planning with the LPS integrated [1]

“Master Schedule” is used to determine crudely the main actors, the sequences of building as well as the milestones which should be accomplished during the step “Phase planning” each company, represented by a foreman, will try to regulate the schedule according to the activities for which it may engage. The objective is to identify possible constraints related to each task. At the end of this phase, the planning becomes not only more faithful to the reality of the work, but the most important are that it contains sequences and durations of tasks not imposed, which they have been planned in collaboration with all participants; those who are directly responsible for the supervision of the work on the site of construction.

“Look-Ahead Planning”, schedule of two to eight weeks, which help to identify the constraints to be taken into account to avoid overruns of deadlines. Indeed, all companies and subcontractors must check the availability of all the necessary resources and conditions for the proper conduct of scheduled tasks. The seven points to check are prerequisites Work, Surface ready, Labors available, equipment available, materials available, Plans available, and favorable external Conditions.

“Weekly Work Plan” is a weekly schedule containing only the tasks without constraints so all stakeholders become responsible and engaged on the activities that will be executed the next week (promises).

PPC (percentage of Promises Completed) is an indicator that allows tracking the production by measuring the percentage of completed activities amongst those that have been scheduled (rate of implementation of the commitments). From this measurement, the difference between what was planned and what was achieved can be evaluated by conducting PDCA approach and using root cause analysis methods (Ishikawa Diagram, Five Why, Pareto Chart).

### 5 'S' Technique:

Recent research shows that construction companies with an efficient organizational level are those who have started the deployment of Lean Construction by the implementation of 5S management, it 5S approach allows keeping the construction site more organized than before, reducing damage to equipment/materials by improper storage, and increasing the safety of personnel.

- **“Sort”**: Separate the needed materials and tools, which are essential for production steps, from the superfluous (trash);
- **“Set in order or Straighten”**: Dispose each tool and material in his position for ease of use;
- **“Shine”**: Maintain clean and liberated zone from bulky items;
- **“Standardize”**: Standardize the rules and keep the first 3Ss;
- **“Sustain”**: Progress and ensure continuous improvement.

### Visual aids:

Visual management helps to make the construction process transparent, simple and secure for all stakeholders on site. Digital billboards, signs of security facilitate the construction process and increase the performance of communication between the coordinators of the project, which make the site of construction safer and more transparent.

### 3.4 The benefits of Lean Principles:

- Precisely specify value from the perspective of the ultimate customer.
- Clearly identify the process that delivers what the customer values.
- Delivering projects on time or in some cases ahead of schedule and eliminates all non-value adding steps.
- Crating a smooth workflow and eliminates the waste.
- Improving relations with vendors and improving customer satisfaction.
- Let the customer pull – don’t make anything until it is needed,
- Increases profit and market share.

- Pursue perfection by continuous improvement.
- Improving the project cost, quality and time

### 3.5 Obstacles of adopting lean techniques include:

- Lack of lean awareness amongst workers and management.
- No adequate training and high cost of lean training.
- Lack of lean specialist and expertise.
- The current financial crisis.
- Work pressure and fear of failing in the implementation.
- Lack of workers skills and workers are not easy to educate.
- Management considering lean initiative as an added cost.
- Workers' attitude and resistance to change.
- Multi-cultural workforce and language barrier.

### 3.6 Effective implementation of the lean construction following practices need in look ahead planning:

1. Split work packages to smaller tasks with reduced variability and less simultaneous work to reduce cycle time.
2. Set up the layout of the work site to achieve a seamless work-flow and clean up and organize the work site daily using 5S techniques.
3. Reduce changeover from one task to another and prevent machine and equipment failures.
4. Balance work resources (add/remove resources) based on work flow,
5. Arrange resources for all work packages, use less internal logistics implement multi-tasking and cross training.
6. Use buffers (cost, time, capacity, space, etc.) to absorb work flow variability.
7. Release tasks from one station/worker to another when required and all resources are ready, preceding tasks are completed, and simultaneous tasks are synchronized.
8. Proceed until the project is completed and delivered to the client. Check the overall Quality, Schedule, and Cost performance and document best practices and lessons learn.

## 4 CONCLUSIONS

- From the above study it is observed that the number of researchers used and applied Lean Construction method in their projects to improve the quality of their work but it is seen that the only few of the lean techniques are till utilized and applied more effectively in civil industries, Some of the researchers work on comparative study of conventional and lean management and found that lean construction saves cost and time, One of the other researcher from above study applied lean management to improve delivery time and to reduce wastage in construction. Therefore from the above study concludes that lean has better result than traditional construction,
- The study can be extended to find out various types of construction waste been produced in construction industries and to implement various types of lean techniques in order to minimize waste and decrease the impact of waste on Cost, Quality and Time.

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