

A Significant Review on Lean Technology/ Practices in Construction Industry

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Abstract

Development in construction industry is a need of this developing era. New and advance technologies are introduced, which ease the construction sector load by lending a helping hand to skill work force of the industry. Lean technique/ procedure are found to be effective in many industrial sector including construction but deal with soft interventions. These interventions take into account planning and allocation of resources, strategic planning on managerial level with less focus on reducing the waste on construction site thereby earning profit in a particular project. The paper focus on various dimensions of lean technology / practises observed in construction industry and the need of cohabiting use of recycled/ reusability of smart sustainable construction material on regular basis. This review paper explores various possibilities and opportunities of incorporation sustainable materials along with lean construction practices.

Keywords: - Lean technology, smart sustainable material, recycled materials

INTRODUCTION

Lean construction technology/ practices in construction industry consists of gratify the requirement of clients somewhere instantly or in long terms. Lean thinking in general has a long history of generating

radical improvements in fields like manufacturing, health care and construction (Poppendieck et al., 2003). As the lean principles are being adapted and tested in other sectors, the concept evolves and changes. Nevertheless, comparing the

lean manufacturing and the lean construction literature the manufacturing field is more developed than the latter (Jørgensen et al., 2008). Currently, the construction industry is at a stage where some efforts have been made to define the theory of lean construction. However, we see that the actual implementation of Lean Construction practices is still lagging the theoretical development. Lean construction theory offers examples of concrete tools which may apply; converting into construction industry practice can be difficult. Changing the way an element of structure or building is constructed is often the case in the construction industry/ technology is more empirical/ orthodox, a number of construction companies/ consultancy firms perform their work with a regular methodology driven by various codal provisions showing very less scope to customization.

Lean construction practices that we have observed in any case studies and the effects that can be achieved by implementing these practices are theoretical that need to be validated from time to time. In this paper we present a review on lean construction techniques/ practices which are found to be useful in construction industry but are not adopted

in absence of known standard procedures and outcomes after applying them on field, along with other existing/ prevailing lean measures. Lean construction techniques / practices is all about reducing the cost of construction by waste minimization, efficient use or reuse of waste construction material (construction & demolition waste) and introduction novel/ innovative cost saving practices for work force. It also improves the growth of productivity level in construction sector. It is the collection of standard practices to follow on site and design the structure by using processed material by saving the natural virgin material in the construction industry. Lean construction techniques / practices is the best supportive sustainability through reducing the waste and by using recycle material. The construction industries transform their forms from conventional approach to lean management approach. It increases the quality of the work and reduces the wastes in the industry.

Need of the Use of Lean Construction Techniques:

In developing country like India new infrastructural development is coming out with new construction industry. Construction industries are increasing now days and to achieve success and high profit competitions between them also increased.

To avoid competitions and loss most of companies introduces a new and innovative technology of construction management called as lean management or a lean construction technology. Lean construction will increases the value of construction industry and minimizes the wastages in construction material by using different smart sustainable materials such as recycled aggregate, use of discarded tyre in construction, reusing plastic by making it adaptable to construction materials, reducing the exploitation of fresh water for construction by replacing the fresh water by recycled waste water and many more. All these are effective and have been used on many occasions owing to the critical situation arise on different sites conditions. Reducing the use of fresh virgin construction material and recycling the waste construction material have been some times discouraged due to its high recycling cost, but considering the benefits on environmental impacts by reducing carbon footprints have sufficiently steered the score to even giving a way to encourage a lean construction technology in construction sector.

Lean Construction Techniques:

Lean construction is a way of designing production systems to minimize waste of materials, time and effort in order to

generate the maximum possible amount of value for the client (Abubakar M. Bashir et al 2011). The concept was also defined as the continuous process of eliminating waste to meet or exceed customer requirements, while focusing on the value stream and continuously pursuing perfection in the project execution. Lean construction principles on the construction industry have been investigated by the researchers for past two decades. Lean construction is the project management theory based on set of approaches in the production management. Lean Production was possessed by Toyota Production system. It was assigned to eliminate waste (Howell, 1999). Lean principles state that conversion activities add values and non-add value are flowing activity should be on eliminated or reduced (Koskale, 1992). Ballard and Howell (2003) says that the lean construction is targeted to minimize waste (i.e.) materials, money and time and to maximize the value. According to Senaratne and Wijesiri (2008) Lean construction is a new concept to the construction industry. All activities in the construction can be divided into two: tangible and flow activities which can be produced by conversion activities. The wastes which are considerable lie on the flow processes of construction. The elimination of waste from such processes

can become “less” (Womack and Jones, 2003). Moreover, Salem and Zimmer (2005) stated that lean construction is the process of eliminating waste in continuous and meeting all the requirements of customers. Then focusing on the value stream and chasing perfection in the execution. Lean construction techniques are not only applied for the construction but also applied in all service and other environment. Construction industry may have some levels of waste. To reduce this construction waste and cost, the lean construction will have the same principles which will lead to maximum profit and reduce waste.

- Waste in Construction site
- Use of innovative smart sustainable materials on construction site
- Lean thinking on construction site
- Lean techniques used in construction site
- Lean Implementation in construction site

Wastes in Construction Site:

Lean construction is processes which minimize waste material in construction site. When waste material reduces and by using recycled materials or smart materials which maximize profit. It is operated in the flow process continuously. Wastes do not add value to the consumed resources.

It is one of the flourishing concerns in traditional construction industry. Wastes in the construction industry are in different ways. According to new production theory, wastes are from the equipment, material, labor or initial investment in large quantities. The waste in the companies increases the loss and execution of unnecessary work, which gives additional costs to the project (Polat and Ballat, 2004). Waste is produced by any activities and it generates direct and indirect cost. It does not add any value from the construction sites point of view (Formoso, 1999). Wastes are discriminated in seven types of waste: Overproduction, Waiting, Transportation, Unbecoming process, Movement, Inventory and Making imperfect products. Manufacturing and construction waste involves the excess cost of quality, time overruns, far distance, rework, lack of safety, unnecessary transportation, handling the materials & equipment, inspection, poor decision making and management strategies and requirements. Wastes are classified into process and operational waste (Koskela, 2013)

- **Process Waste:** Process wastes are those waste which produced through the over production, inventory, unbecoming process, transportation and making imperfect products.

- Operational Waste: Wastes are from unnecessary moving of equipment and people (i.e.) movement and waiting. Following are some types of waste are discussed below:

1. Production process is always carried out by proper planning to reduce quality and quantity issues. Proper planning and execution reduces waste of material.
2. Flow of execution of construction is prior decided to reduce waste of time and labor cost.
3. Unnecessary transportation of material and equipments are reduces.
4. The idea of waste can be significantly effort to the separate activities which are connected with the use of resources that add no value for the finished products. The activities in construction can be separated by value adding and non-value adding activities (Abdul Rahman, 2012). In addition to types of wastes various researchers have presented other waste. For exemplify, identified several waste can be classified as: utilize individual abilities, capacities and skills; information waste; behavioral waste and waste of good ideas. Waste of human potential is determined with the failure using the skills of individuals.

Use of innovative smart sustainable materials on construction site: The idea behind using smart innovative sustainable material has been practised from way long back without specific guidelines to monitor or specific policy to implement. Reusing/ recycling gained an impetus when the shortage of virgin materials captured the market and a need to search an alternative source came in to existence. Fly ash one of the waste/ by product of thermal power plant is been absorbed by cement industry for manufacturing of PPC cement on a very large scale. By adopting lean construction procedures / technology on construction site fused with smart sustainable materials have opened a new way to tackle the problem arising out of depleting natural construction resources and creating specific guidelines on use of the recycled material with lean construction practices. To quote some lean technology / practices which are practised but not cultured properly is inclusion of BBS (Bar binding schedule) while making structural reinforcement. In many sites, particularly where structural bars are cut at random without proper planning crate lot of small bars which adds in to the wastage of bar. Many a times contractor/ site in-charge refrain from using these small pieces dispersed on site due to extra burden on labour cost. Hence, a small part

of planning and proper detailing can reduce the waste of steel on site and reducing the project cost in longer stretch.

Lean thinking on construction site:

Lean is a traditional thinking of construction. It focuses on the conversion of activities and flow and value considerations. Lean construction is the utilization of lean thinking to the construction and design process conceiving improved project delivery to meet construction need. It improves the profitability to the constructors. The goal of lean thinking is to minimize the cost and optimizing the total value. Within lean cost cutting has to be seen in relative importance of eliminating non adding value activities. The aspects of lean construction can be grouped into six essential elements: reduction of waste, production planning and controlling process, focus on end customer, continuous improvements, cooperative relationships and perspective of systems.

The lean principles are:

- Elimination of waste in construction
- Specify the value flow to meet the construction perspective.
- Identify the value in the process of delivery in construction
- Non value adding steps can be eliminated.

- Without interruption add the remaining value.
- Managing different steps.
- Suggestion on the decision making.
- Quick Decision.
- Perfection by continuous improvement.

Lean Techniques used in construction site:

Construction industries developed the several lean techniques, which reduces effort and maximize work efficiency.

- Last planning
- Just In Time
- 3D models
- Increased visualization
- Value stream mapping
- Stopping the line
- Reverse phase scheduling
- Group meeting
- Kaizen
- Five S
- Fail safe quality

Last planner is the technique of lean that has four main processes: Phase schedule, Master schedule, Look ahead schedule and weekly plan. Reducing plan in the variability helps to increase productivity. Inventory of material is wasteful. Within the pull approach the just in time concept is included, this concept is utilized in the construction wherein the inventories are

kept maximum. New inventories are ordered based on the current demands. Improvements of the design and procurement process are the success key in order to facilitate the construction site. They used 3D models to provide better, fit coordination, faster information about isometric drawings of components, motivation of workers crew and planning of construction methods through visualization. Design, estimate and rework are the cycle is wasteful and reduce the value customer get for their money. Cost, time and location are the conditions stressed to meet the deliver value to customers and implementation of Target value design constantly resulted in the delivery of projects faster and under budget. The value development and product components would be in constant motion without stopping based on the lean principle make it flow. Then it maximizing the performance at the project level revealed by value stream mapping. Design decision adopted the lean principles for increasing productivity, reduction in space, time, human effort, and investment tools and improving quality and safety. The problems in this case of prefabrication production process can be solved by lean principles.

Every stage of construction process generally varied significantly. The Lean construction implementation is developed to deliver the lean project system in the manufacturing process to life in the construction industry. Success to any lean project is to creating a culture of collaboration, system integration and transparency. The implementation of lean construction in the work environment stabilized through modifying the panning system, it reduce variation in flow that improves the downstream operations. It is a new way of coordinating the production system rests on the new model and solved by lean in construction. Some researchers identified the general benefits while applying lean construction principles. There are many barriers for lean construction implementation. They are: time, training, organization, low understanding of concept, self-criticism, and lack of integration. Lean principles play an important role to integrated project delivery (IDP) such as maximizes the value in order to strategic planning and minimizes the waste. The top management committed to the implementation of lean in proper manner. The top management of the construction firms is sufficient to induce the changes in the production flow process. The guidelines for the lean

Lean Construction Implementation:

implementation in an effective approach are:

- A segmented and rigorous sequence of design activities is avoided.
- Designers should be involved in joint solutions.
- Introducing control on the flow activities.
- Adopt lean project delivery system.
- Do target costing.
- Pursuing lean idle development of methods.
- Set design alternatives
- Production control should be practiced.
- Build safety and quality.
- Just in time and multi organizational process should be implemented.
- Use 3D modeling for process design.
- The lean principle is used to exploring the lean implementation in the construction industry.

Application of Lean Construction in India:

In India, the awareness and use of lean construction concept is very low. The implementation of lean techniques had not taken place in significant manner. There are many things which were not used in Indian construction industry. If we used lean construction in India then it is very efficient technique to reduce waste material and use of proper equipment and

sources reduces construction cost. Undependable evidence were discussed by the experts, they suggested the following reason for the rare adoption of lean practices in Indian construction industry.

- Lean is mostly used in construction industry.
- Resistance for changing
- Formal planning is avoided.
- Issues related to HR
- Inadequate trained and skilled labour force.
- Lack of use for innovative ideas/materials

The hurdles, training and awareness are overcomes by improving the proper implementation of lean construction in Indian Construction Industry. The pioneer organization for proper consultancy and training required for implementation of lean construction technique in India are Indian Lean Construction of Excellence (ILCE) and Indian Institute of Technology, Madras (IITM). Lean concept used in construction industry can minimize the cost; complete the projects in required time.

CONCLUSION

This review paper of lean construction technology/ practices explores the various possibilities and avenues through which

the lean construction technology / procedure can be implemented in different construction industries. Lean construction system is very good to reduce waste in construction industry and increases the productivity. It gives maximum benefits for the construction industry. The literature review makes it tangible to understand the concept of lean construction. From the review paper it has been summarized that planning and control of production, improving the safety measure performance, risk level forecasting for time and new approach developing to construction safety and removal of waste in every stage are important and somehow practised but lack of adopting of smart sustainable materials fused with lean technology / practises has not been observed especially with reference to Indian construction industry context. Impact in the construction activities on our environment have to be minimized by green growth and sustainable and also by proper implementation. The application lean in construction is not only possible at operational; it should planned at strategic level. This paper establishes the need of application of lean tools and techniques in construction projects, and in turn it will minimize the waste, enhances the performance and lead to profit. It is expected that fundamental knowledge

about lean construction provided by this paper and practice from elimination of waste and also assist as a criterion for continuous improvements of performance in construction industry.

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