ISSN: 2455 – 4200
International Journal of Engineering Research and Modern Education
Impact Factor 6.525, Special Issue, April - 2017
6th National Conference on Innovative Practices in Construction and Waste Management
On 25th April 2017 Organized By
Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu

THE REVIEW ON LEAN CONSTRUCTION AN EFFECTIVE APPROACH IN CONSTRUCTION INDUSTRY

S. Dinesh*, R. Sethuraman ** & Shruthi Sivaprakasam***
* Assistant Professor, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu
** Assistant Professor, Sri Ramakrishna Engineering College, Coimbatore, Tamilnadu
*** PG Student, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu

Cite This Article: S. Dinesh, R. Sethuraman & Shruthi Sivaprakasam, "The Review on Lean Construction an Effective Approach in Construction Industry", Special Issue, April, Page Number 119-123, 2017.

Abstract*:*
Lean construction is a new management involved in making a theory which has the capacity to develop advanced and original changes in the construction industry. The principle of lean construction focuses on material and waste minimization which is contributing to sustainable construction. Lean construction enhances the productivity. The main objective of this paper is to draw a special attention to review on literature. Researchers have used pertaining methods for examining reimbursement of lean construction by analyzing and describing the obtainable literature. This study assumes the existence for understanding the lean concept in desirable manner, proper implementation and sustainability concepts that contribute to lean construction.

Key Words: Lean Construction, Project Management Method & Sustainability

1. Introduction:

Projects are considered as effective for a specified time based on production system which needs to designed, planned, produced and delivered. For this type of approach cannot be managed by conventional methods (Traditional Construction Methods i.e. critical path and earned value method etc..,). This kind of uncertain projects can lead to cost and time overruns. In this paper is to make an effort to understand the concept, implementation of lean methods in construction industry. The concept of Lean construction is adapted from Toyota production system. Lean construction is all about reducing the cost by waste minimization and efficient work place and engaging people in innovations. It also improves the growth of productivity level in construction sector. It is the collection of data to change the delivery and design processes in the construction industry. Lean construction is the best supportive sustainability through "reducing the waste and increasing the cost". The construction industries transform their forms from conventional approach to lean management approach. It increases the quality of the work and eliminating the wastes in the industry.

2. Objective:

The main objective of this study is to identify the benefits of implementation of lean management. The following are the considerations to carry the lean management implementation.

- ✓ Lean construction should be carried according to the customer point of view.
- ✓ Benefits and barriers of the lean implementation should be identified.
- ✓ Improvement changes of lean implementation requirements are analyzed.
- ✓ To minimize the waste and increase the quality of the work.

3. Need of the Study:

The construction industry is coming out with new infrastructure development. The companies are increasing now-a-days, competitions between them also increased and to get high profit. To avoid that kind of problems companies introduce the new and innovative technology, this technique is called lead management. Lean management in the construction industry will increases the value and minimizes the wastages.

4. Lean Construction:

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 (LP) 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). Ballarad 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 (2008) 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 manufacturing techniques is not only applied for the manufacturing and also applied in all service acclimatized and other environment. This is because each system has some levels of waste. The lean construction will lays on the five principles which will lead to maximum profit and reduce waste. These principles are

Specify Value: It is defined by the customer's needs through management of tools and simulation. These are characterized under client's satisfaction on delivery.

Mapping the Value Stream: Identifies the stream required to make a product. Mapping raises the performance possibilities during construction.

Flows: It is a basic unit of analysis in LC. It ensures the activities in continuous flow in the stream.

Pull: It delivers the product according to the needs of the customer's just in time.

ISSN: 2455 – 4200
International Journal of Engineering Research and Modern Education
Impact Factor 6.525, Special Issue, April - 2017
6th National Conference on Innovative Practices in Construction and Waste Management
On 25th April 2017 Organized By
Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu

Perfection: Always obtain the customer's need in the perfection and expect continuous removal of waste in the flow process.

Lean construction can be examined through the essential elements and it is achieved by the holistic approach. It undergoes continuous process by identifying

- ✓ Understanding the waste
- ✓ Lean thinking
- ✓ Lean techniques
- ✓ Lean Implementation

All these elements can be explained as follows.

5. Wastes in Construction:

Lean construction is a process used to minimize waste and 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 client's 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: Wastes are 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.

The seven types of waste are discussed below:

- ✓ Over production is identified by producing earlier than expected time and producing more than required. This may lead to quality and quantity issues. It causes misuse materials, handling the equipment and working hours.
- ✓ Waiting is identified by indolence which is mostly caused by poor reconciliation and material flow leveling and pace of work by diacritic equipment and groups. The products are not being processed waiting is occurred.
- ✓ Transportation is done for materials and equipment when working in the poor environment. The working environment in the site is very important criteria, because it causes major reason for unnecessary transportation. Work process flow cessation can significantly add cost to the transportation.
- ✓ Unbecoming process occur when the conversion activity does not add value to the customer's frame of reference. This mainly created by the quality issues of work done. Tools used to identify and to remove the waste from this process are statistical process, 5 why and mistake proofing. This waste can be avoided by changing the technology used for construction.
- ✓ Movement is also referred as motion. It is identified with workplace efficiency and all seen in lifting, bending, strolling, stretching and reaching. The waste provoked by motion is entangled with the unnecessary movements made by employees. Unproductive movements may increase the level of accidents, injuries and their related costs. The unproductive motion of workers can be minimized by preparing proper layout for work area.
- ✓ Inventory or stock or storage waste is identified with haphazard or excessive inventories which expeditious material waste (i.e.) losses Because of insufficient storage conditions at site, deterioration, robbery, sacking. Pecuniary losses because of the initial investment being cinched up. Inventory incurs costs, more space to store and unsympathetically affects capital cost. The problems correlated with inventory may be due to quality problems with the production processes.
- ✓ Making imperfect products (reprobate/ unacceptable/ unnecessary works) happens when the finished or half processed products are not up to the quality requirements. In construction industry this waste are commonly produced. Defects should expeditious rework or use of poor material to the building.

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 seven types of wastes various researchers have presented the eighth and 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.

6. Lean Thinking:

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 client's 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

- ✓ Specify the value stream to meet the client's perspective.
- ✓ Identify the value in the process of delivery.
- ✓ Non value adding steps can be eliminated.
- ✓ Without interruption add the remaining value.
- ✓ Managing different steps.
- ✓ Suggesting the decision to make.
- ✓ Quick production.
- ✓ Perfection by continuous improvement.
- ✓ Projects cannot be pushed to customer.

7. Lean Techniques:

Manufacturing industry were developed the several lean techniques. They are;

- ✓ Last planner
- ✓ Just In Time
- ✓ 3D models
- ✓ Increased visualization
- ✓ Value stream mapping
- ✓ Stopping the line
- ✓ Reverse phase scheduling
- ✓ Huddle meeting
- ✓ Kaizen
- ✓ Five S
- ✓ Fail safe quality
- ✓ Off-site manufacturing
- ✓ Target value design

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.

8. Lean Construction Implementation:

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:

- ✓ Reducing share of non-value adding activities.
- ✓ Increasing the output value to meet the customer's requirements.
- ✓ To reduce cycle times
- ✓ Minimizing the steps to simplify
- ✓ To reduce process variability
- ✓ To increase the output flexibility
- ✓ Focusing in the completion of process
- ✓ To increase transparency
- ✓ Continuous flow process
- ✓ Balance flow improvement
- ✓ Benchmarking

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 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.

9. Application of LC in Indian Industry:

In India, the awareness of lean concept is very low. The implementation of lean concept had not taken place in significant manner. Anecdotal evidence were discussed by the experts, they suggested the following reason for the non-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 labor force.

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 is used any construction industry and we can minimize the cost, complete the projects in required time.

10. Conclusion:

This paper was to explore the literature how the lean construction is implemented in different construction industries. Lean construction system is the good for what ails you in industry as it minimizes the waste 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 we 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. 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 application of lean tools and techniques by projects, and then 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.

11. References:

1. Abdul, Rahman, H., Wang, C., and Yen, W., L., I. 2012. “Waste Processing Framework for Non-Value Adding Activities Using Lean Construction”. Journal of Frontiers in Construction Engineering, 1(1), pp. 8-13.
2. Ballard, G., and Howell, G., A. 1994. “Implementing Lean Construction: Stabilizing Work Flow”. Published in 2nd Annual Meeting of the International Group for Lean Construction, Santiago, Chile.
3. Ballard, G., Howell, G., A. 2003. “Competing Construction Management Paradigms”. Published in 2003 ASCE Construction Research Congress, Honolulu, Hawaii.
4. Ballard, G., Howell, G., A. 2004. “Competing Construction Management Paradigms”. Lean Construction Journal, 1(1), pp. 38-45.
5. Koskela, L., and Howell, G. 2001. “Reforming project management: the role of planning execution and control”. In: Proceedings 9th Annual Conference of the International Group for Lean Construction (IGLC-9), 6-8 August, Singapore.
6. Koskela, L., Bølviken, T., and Rooke, J. 2013. “Which are the wastes of construction?” Proceedings IGLC-21, Theory, Fortaleza, Brazil, pp. 3-11, http://core.ac.uk/download/pdf/18410348.pdf (Retrieved on 25 March, 2015).
7. Richard Hannis Ansah, Shahryar Sorooshian and Shariman Bin Mustafa, 2016. “Lean construction: an effective approach for project management”. ARPN Journal of Engineering and Applied Sciences, vol. 11, no. 3, pp. 1608-1612.
8. Aakanksha Ingle, Prof Ashish P Waghmare, 2015. “Advances in construction – Lean construction for productivity enhancement and waste minimization”. International Journal of Engineering and Applied Sciences (IJEAS), Volume-2, Issue-11, pp. 19-23.
9. Oyedolapo Ekundayo Ogunbiyi, Adebayo Akanbioladapo and Jack Steven Goulding, 2013. “A Review on Lean concept and its application sustainable construction in the UK”. International Journal of Sustainable Construction Engineering & Technology, Vol 4, No 2, pp. 82-92.
10. Nilmini Thilakarathna and Sepani Senaratne, 2012. “A preliminary literature review into lean construction implementation”. World construction conference, Colombo, Sri Lanka, pp. 345-354.

11. Ohno, T. 1988. Toyota production system: "Beyond large- scale production". Cambridge, MA: Productivity Press.
12. Salem, O., and Zimmer E. (2005). "Application of lean manufacturing principles to construction". Lean Construction Journal, 2005, pp. 51-55.
13. Formoso, C.T., Isatto, E.L., and Hirota, E.H. (1999). "Method for waste control in the building industry". In Proceedings of the IGLC-7.