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Barriers to Implementation of Lean Principles in the Indian Construction Industry

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Abstract— **Lean construction emerged from attempts of transferring and applying the Japanese Lean production philosophy to the construction industry. Lean construction is a confluence of ideas including continuous improvement, flattened organization structure, efficient usage of resources, elimination of waste, and cooperative supply chain. Based on the success of Lean Production in manufacturing and the development of Lean Construction in countries such as Brazil, Denmark and the USA, the application of Lean Construction is currently debated in India.**

The aim of the study is identification of barriers to successful implementation of lean construction in the Indian construction sector.

The data was collected by questionnaire survey of project managers of building construction organizations and senior consultants of architectural and project management firms.The data collected was then analyzed to rank the main barriers and lean principles are suggested to overcome these barriers

Keywords—Lean construction; waste; barriers; management; project

I. INTRODUCTION

Toyota was the first to bring the Lean principles into limelight. Toyota created a focus on eliminating waste and grew to be the worlds largest automotive industry by adopting seven principles of reducing waste. It believed in preserving value with less work and also improvement in efficiency by improving the workflow. Today Lean manufacturing is practiced by many leading auto makers.

Lean principles have slowly made inroads into the construction industry because of its approach to waste elimination and providing value with less effort and time. Construction management is defined as the judicious allocation of resources to finish a project on time , at budget and at desired quality [1]. The biggest cost impact of the construction today is the way the whole process is managed and not the cost of labour and materials. Construction process consist of countless activities that add no value to the product. According to Hines and Rich, these non value adding activities (e.g. waiting time ,double handling, searching for material etc) are pure waste and should be eliminated completely [2]. In a study conducted by Josephson and Saukkorippi, a group of workers were followed around for 22 working days and it was noted that 33.4% of their time was waste [3].

II. NEED FOR STUDY

India's rapid economic growth over the past few decades has placed a tremendous stress on its limited infrastructure. Construction industry is one of the largest industries which support the economy of a country. Since construction has a major and direct influence on many other industries reducing waste in construction can go a long way in helping the economy of the world.

III. LITERATURE REVIEW

Existing data and literature on lean principles and its applications in construction industry around the world was collected. This formed the reference for framing the questionnaire for survey.

A. Lean construction

According to Chick G. et al, waste is more than the physical wastes that are the focus of construction site activity [4]. In fact waste is any activity (or inactivity) that does not add value to the product or service.

Waste can be

- Value-adding (VA): is the work that the customer is willing to pay for.
- Essential non-value adding: these are the tasks that must be completed to enable the value-adding activity to be completed, but do not add value. For example, inspection is not that the customer pays for but is necessary.
- Waste: Waste can be of two types. Waste in the work itself (e.g. excessive walking, looking for tools and materials, poor quality). Introduced or 'enforced' waste (eg waiting for information, materials not supplied), which has prevented work activity from being carried out.

According to Koskela and Howell, Lean Construction is a way to design to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value [5].

According to Dulaimi and Tanamas, managing construction under lean construction is different from typical contemporary practice [6] because it:

- Has a clear set of objectives for the delivery process
- Is aimed at maximizing performance for the customer at the project level
- Designs concurrently product and process
- Applies production control throughout the life of the project

B. Lean principles

Womack and Jones describe Lean thinking as a cycle of five guiding principles where the implementation of the first four lead to achieving the fifth [7]. The ultimate goal is the elimination of waste. The principles are described below:

- **Specify value**
  Only what the customer considers as value should be taken into consideration, "*nothing more, and nothing less".* In construction activities can be classified as 3 types:
  1. Value Adding (VA)
  2. Non-value Adding (NVA)
  3. Necessary Waste (NW)
- **Identify the value stream**
  This is about identifying all the steps in the value stream in order to determine activities that do not add value and seek for their elimination.
- **Make value flow without interruption**
  This is done by minimizing delays, inventories, defects and downtime.
- **Use pull logistics**
  All components and information are made and supplied at the necessary time to deliver the product or service to the customer at exactly the time the customer wants it.
- **Pursue perfection**
  Lean consists of continuously improving through collaboratively identifying and removing wastes to provide the desired results.

C. Lean Project Delivery System (LPDS)

According to Ballard, the Lean Project Delivery System (LPDS) [8] consists of the following phases:

- project definition
- lean design
- lean supply
- lean assembly
- Use

Essential features of LPDS include:

- the project is structured and managed as a value generating process
- downstream stakeholders are involved in front end planning and design through cross functional teams
- project control has the job of execution as opposed to reliance on after-the-fact variance detection
- optimization efforts are focused on making work flow reliable as opposed to improving productivity
- pull techniques are used to govern the flow of materials and information through networks of cooperating specialists
- feedback loops are incorporated at every level, dedicated to rapid system adjustment; i.e., learning.

IV. METHODOLOGY

The main tool for the collection of data includes questionnaires. The target population for the data collection includes project managers of building construction organizations.

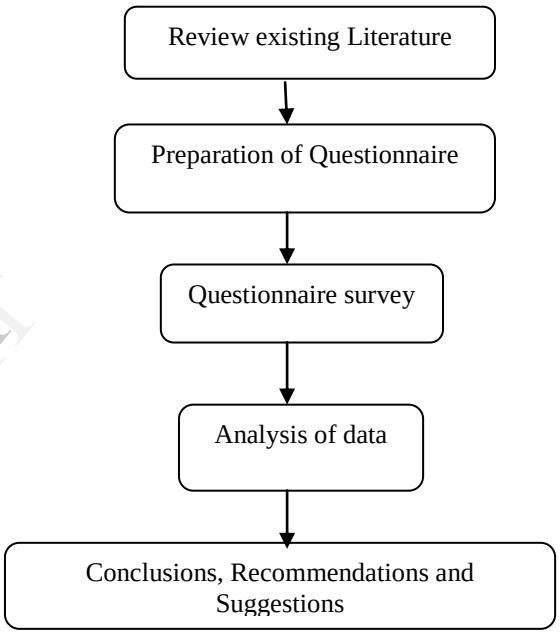

Fig. 1 Proposed methodology for the project

The questionnaire was uploaded to Google drive in the form of Google docs so that the survey details could be collected online. The questionnaire was circulated as a link to the architects, civil engineers and project managers of construction firms through emails. The questionnaire was circulated to about 50 companies. The representatives were to fill the questionnaire and submit the data online. The questionnaire when submitted collects the data in an excel sheet real- time in the Google drive database.

V. RESULTS AND DISCUSSIONS

To identify the barriers for successful implementation of lean construction, a questionnaire was prepared after thorough literature study of barriers faced in other countries. Table 1 lists out the mean score of various barriers to implementation of lean principles in India.

The main barriers to applying Lean principles in Construction industry in India have been identified as

- Lack of exposure on the need to adopt lean construction
- Uncertainty in the supply chain
- The tendency to apply traditional management
- Culture & human attitudinal issues (Mindset issues)
- Lack of commitment from top management
- Non-participative management style for workforce

Figure 2 highlights this analysis in the form of a bar-chart.

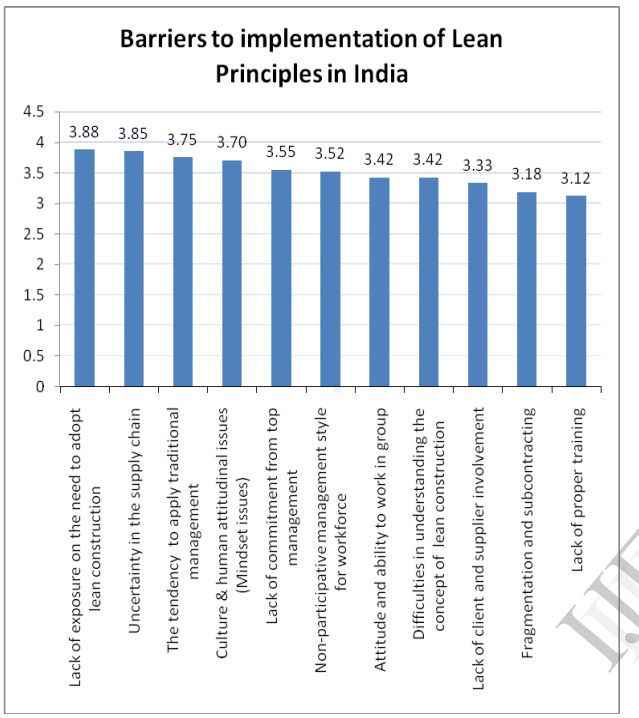

Fig. 2 Barriers To Implementation Of Lean Principles In India

Table 1. Mean Score of barriers to implementation of lean principles in India

Barriers to implementation of lean principles in India	Mean Score
Lack of exposure on the need for lean construction	3.88
Uncertainty in the supply chain	3.85
The tendency to apply traditional management	3.75
Culture & human attitudinal issues (Mindset issues)	3.70
Lack of commitment from top management	3.55
Non-participative management style for workforce	3.52
Attitude and ability to work in group	3.42
Difficulties in understanding the concept of lean construction	3.42
Lack of client and supplier involvement	3.33
Fragmentation and subcontracting	3.18
Lack of proper training	3.12

Lean construction principles are still a new concept in Indian construction sector. The benefits of lean construction has been recognized by some of the leading construction firms like Larsen and Toubro, Tata Realty & Infrastructure, Shapoorji Pallonji & Co., GMR Group and other such organizations, but it is yet to percolate down to the medium and smaller construction firms. "Lack of exposure on the benefits of adopting Lean construction" is one of the main barriers identified in the survey.

The next important barrier identified in the survey is the "Uncertainty in the supply chain". The Lean Construction principles stress on waste minimization. This can be achieved through maintaining the right inventory; there should be no over-ordering or under-ordering of materials. Lean principles also stress on just-in-time supply. This does minimize waste but the risk involved is also high. Therefore the uncertainties in the supply chain can prove to be a big risk and a barrier which can prevent the practitioners from adopting the Lean principles.

The third barrier identified is the "Human attitudinal issues and cultural mindset" and the tendency to apply the traditional concepts of project management. Human beings are people of habits and there is a general tendency to resist change. Construction industry is a huge and old industry. People are used to and are comfortable with the traditional style of management and so do not want to disturb what is already working. But with the construction sector on the boom and resources depleting at a fast pace, it is high time that the construction industry which has a big role in waste generation and environment pollution, changes and adopts principles which will result in waste minimization and prevention of environment pollution.

"Lack of commitment from the top management" and the "Non-participative style of management" is also a barrier in implementing Lean concepts in construction. Indian construction industry is used to working as a bureaucratic style of management, where orders are given by the managers and they are executed by the workers. Managers are resistant to change, as they feel that workers would not work properly if they are included in the decision making process. Previously workers in the construction sector were illiterate and learnt on the job, but with technological advances in construction, at present the workforce consists of engineers and other educated and experienced personnel, who if given responsibility, will be motivated and assume responsibility to provide better and faster results.

VI. CONCLUSION AND RECOMMENDATION

Most of the respondents who have not heard about lean management principles are from the public sector executing huge projects along with big firms. Though the big firms are using lean principles, people from the government sector should also be educated about the savings due to adopting lean principles, so that they can mandate it on all government sponsored projects.

Individual practitioners can also be made aware of lean concepts by workshops, conferences, journals, and business magazines.

Lack of exposure on the need to adopt lean construction can be overcome by communicating the benefits of Lean construction through seminars and conferences to the construction practitioners. Also the government should enact policies which appreciate the effort by firms which adopt Lean principles. Recommendation is to take companywide initiative to apply Lean principles and it is not enough to send a few managers or personnel for workshops and seminars. This way of working should eventually percolate to the lower levels. The sub contractors and suppliers should also be made to attend these workshops and take initiatives to implement Lean management principles.

Barriers in uncertainty in the supply chain can be overcome by choosing proper suppliers who not quote less price, but deliver good quality and who also have a proven track record. By working closely with suppliers and subcontractors, problematic issues can be minimized by participative style of managing projects and establishing strategic alliances with them. This can be done effectively if one works with the same supplier again and again

There is a tendency to apply traditional management principles. People generally do not want to disturb processes which have been going on since a long time, but now with so much construction boom, it is high time the construction industry gives cognizance to the fact that waste produced by industry is high and needs to be minimized. This can be achieved by training all managers and workers in the firm on the benefits of Lean construction. Workshops on the comparisons on Lean and traditional methods of construction, and how Lean is better should be conducted. Suitable metrics should be developed so that practitioners apply Lean management principles.

Managers should promote lean construction, as it can bring considerable revenue savings for the firm. Managers should change with times and new technology. This can be done by bringing about a change in organization culture by making the adoption of lean principles mandatory, by enacting new policies for waste minimization, and by partnering with suppliers and subcontractors to ensure that they follow Lean construction methods.

Participative style of management has many benefits. So it is recommended that the managers include the foremen, supervisors, and construction crew in day-to-day planning, as they are more involved with the ground realities. The lean concept of "Daily huddle meetings" where every day before work starts, everyone gathers to learn about work allocation and discusses various issues will be beneficial. Increased visualization adopted by lean construction will also increase participation, as the progress of the work can be visually represented on a board for all employees to see, so that they know when they are lagging behind. Using the "Last planner system" for scheduling of tasks which involves participative style can lead to huge benefits.

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