IMPLEMENTING LEAN CONCEPTS ON INDIAN CONSTRUCTION SITES: ORGANISATIONAL ASPECTS AND LESSONS LEARNED

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ABSTRACT

Construction sector in India has been on a high growth path lately and maximizing efficiency and profitability has been a key concern. Lean Construction offers a potential solution for system level efficiency improvement. Given the weak planning processes, diverse cultures and ill-trained labour in the industry, Lean implementation has been a challenge.

IIT Madras, an educational institution, had recently taken up a carefully-structured programme for training and implementation of Lean construction practices in nine trial projects with varying characteristics through classroom and webinar-based trainings, reporting in predefined formats, monitoring by site visits and periodic reviews. Sites were encouraged to adopt the LPS as the core and use various other Lean tools with close assistance from the Faculty.

Overall many of the standard benefits of Lean implementation were realised. However, the extent of gains was seen to be influenced by many soft aspects, such as the culture of the site and the organisation, planning and engineering expertise available, commitment and support from top management and site management.

The paper presents an overview of the programme and an analysis of the results obtained/lessons learned across the different sites based on the organisational and cultural aspects of the sites.

KEYWORDS

Lean construction, Indian Construction, Lean Implementation, Organisational Culture.

BACKGROUND

The Indian economy is at present on a growth trajectory and infrastructure which is commonly a major driver of the economy is also being rapidly developed. This has

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lead to pressure on the Indian construction industry to build more projects and deliver them faster. However, the industry is beset with a number of problems, such as too many small-sized contractors, poor planning strengths, diverse cultures, ill-trained labour, dependence on low technology processes, hierarchical controls, etc.

Lean construction practices have developed quite well over the last few decades and have lived up to their potential in many different countries, bringing in continuous improvement, inclusive culture and improved levels of certainty in project delivery. Many Lean tools have been developed over the years, such as Last Planner™ (Ballard and Howell 1998), work sampling, value stream mapping (Arbulu and Tommelein2002) and so on, to meet various objectives in the course of implementation of Lean practices. Many benefits such as completion within the stipulated time and cost with appropriate quality and safety have been attained in the last two decades. Emerging countries, such as Brazil, have also adapted to Lean practices reasonably well with Last Planner™ having been adopted by a large number of practitioners (Bortolozza and Formoso 2006, Formoso and Moura 2009).

Accordingly, for the management of the various challenges being faced by the Indian construction industry today in terms of rapid growth and project complexity, Lean would be a very useful tool to solve them. Lean's quest for continuous improvement could enable the introduction of new and effective technologies and work methods and the many Lean tools would optimise the use of equipment and labour and bring down costs. The inclusive culture could ensure the collaborative involvement of all the staff involved with generation of many innovative ideas.

PRESENT STATUS OF LEAN CONSTRUCTION IN INDIA

Earlier there have been only a few sporadic attempts to implement Lean concepts, and there is a general lack of awareness of Lean concepts in the Indian construction industry. To create awareness and get the Indian construction industry to start implementing Lean concepts, a group of industry leaders initiated the setting up of an organisation, Institute for Lean Construction Excellence (ILCE), in 2009 (Raghavan and Satyanarayana 2011). IIT Madras (IITM), a leading educational and research institution in the country, was chosen as the academic partner by ILCE. During the last five years, ILCE has conducted a number of seminars and workshops across the country to familiarise the Indian construction Industry with Lean concepts. International experts such as Dr. Lauri Koskela, Mr. Greg Howell and Dr. Carlos Formoso were invited to conduct seminars.

LEAN IMPLEMENTATION AND IMPEDIMENTS – INDIAN PERSPECTIVE

While the efforts of last five years improved the awareness of Lean to some extent, the actual implementation of Lean concepts in projects had not taken place in any significant manner. Anecdotal evidence from discussions with industry experts suggested the following reasons for non-adoption of Lean practices in Indian Construction:

- Lack of established and successful examples of implementation of the new Lean process within the country and belief that Lean is more applicable to manufacturing process.

- Cultural problems such as general reluctance to shed old, inefficient methods and adopt new methods; hierarchical tendencies and non-consultative processes restricting planning processes to a few in the planning office.
- General tendency to avoid formal planning processes and systems and using ad-hoc working methods, which is not aligned with the Lean philosophy
- Lack of a committed, trained and reliable labour force coming in the way of systematic planning and training.

As a result of the above, even major construction companies have been avoiding the wide-spread usage of Lean, preferring to stick to traditional methods and practices.

A LEAN TRAINING & IMPLEMENTATION PROGRAMME

EVOLVING THE PROGRAMME

In order to change this scenario and encourage the use of Lean practices at Construction project sites, IITM felt that only a hands-on training programme would change the current status quo. Accordingly a Training-cum-Implementation programme was chalked out by IITM along with ILCE, after carefully examining the existing scenarios and identifying the problematic factors. IITM has also been running a postgraduate level course on Lean construction and many postgraduate and doctoral research scholars in IITM have been working on various Lean construction related assignments. IITM had also been engaged in a few consultancy projects which had some Lean construction aspects. All these had helped the IITM faculty to develop some insights into why Lean implementation had not progressed well in the country.

While designing this programme, IITM kept in mind the following factors:

- The programme has to be practical and site-oriented and not merely continued dissemination of theories. However, some amount of instructions on the theoretical aspects of Lean would still be required.
- Since this would be the first time the sites would be practising any Lean concepts, regular review, monitoring and guidance by IITM experts would be required.
- It is essential to earmark special Lean champions whose task would only be to understand the various Lean concepts thoroughly and drive the implementation at the site on full time basis, without getting diverted by routine tasks.
- There has to be a strong directive from the top management of the organisation for implementing Lean at the sites, monitored through a Mentor affiliated to the top management. The involvement and full backing of the Project Manager at the site is also essential.
- The participating organisations should have some modicum of planning expertise and implementation record, culture of improvement, etc. so that Lean implementation can start on an already developed platform of certain standards.

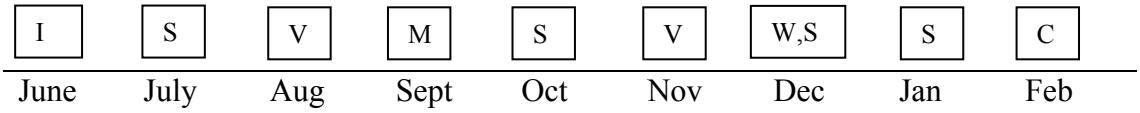
THE PROJECT SITES SELECTED

Based on the above, a training-cum-implementation programme was designed based on a site-based rollout of Lean practices under the close guidance of IITM at specific project sites, which were limited to nine to have better control. Four sites were located in Chennai (the base of IITM), two sites in Mumbai, two sites in Dahej (Gujarat State) and one in Erode (Tamil Nadu State). Four projects were for residential buildings, three for commercial buildings, one for a Marine jetty and one for an underground station building for Metro Railway. Three organisations were large-size contractors, one was a Developer and the fifth was a medium-size contractor. Thus the projects covered a wide spectrum of geographical spread as well as functional and organisational background. Two Lean champions were identified in each project site to coordinate with IITM and steer the implementation of Lean at the specific site. A Mentor was nominated from the head office of each concerned organisation to assist the site and oversee the implementation of Lean.

THE DETAILS OF THE PROGRAMME

TIMELINE HISTORY OF THE PROGRAMME

The programme kicked off with a three-day initial training session at IITM in June, 2013. Apart from the Lean champions from each project site, the Project Manager and the concerned Mentor as well as senior representatives of the managements participated. Thereafter, reviews and contact programmes were held at regular monthly intervals, with a closure programme after eight months. Figure 1 shows the timeline history of the various events.



I -Initial Training Programme at IITM for 3 days (6^{th} -8^{th} June 2013)
S - Review Meetings through Skype
V - Site Visits and reviews
M - Mid Term Meet at IITM for 2 days (6^{th} and 7^{th} September 2013)
W - Webinars
C -Closure Session at IITM for 2 days (10^{th} and 11^{th} February 2014)

Figure 1. Timeline History of the various events

The objectives and agenda for the various above-mentioned events were as follows:

-Initial orientation programme at IITM:

- The participants had been mailed general literature on Lean to study before the Orientation Programme. Detailed presentations were made by IITM faculty on various Lean concepts, tools and implementation strategies (Figure 2).
- Based on the initial studies done by the sites before coming to the programme and the presentations made by them on the nature of work at their site, some

initial areas of work where Lean concepts could be implemented and appropriate Lean tools were identified. Discussions were held by the Faculty with each site team to formulate the basic implementation plans, customized for each site (Figure 3).

- Panel discussions were held by IITM faculty with senior management representatives to identify potential road blocks, as well as possible solutions to remedy the same.

Figure 2: Initial kick-off session, IIT Madras

Figure 3: Break-out discussions – Initial session at IIT Madras

-Monthly Reviews by IITM with Sites: In these reviews conducted online (through Skype) or during site visits, IITM faculty reviewed the performance of each site and offered suggestions on ways to improve Lean Implementation. The Lean Champions and Project Managers attended these meetings.

-Site Visits: IITM faculty visited the sites twice to study the implementation at close quarters and offer suggestions for improvement as well as for direct interactions with a wider segment of people (Figure. 4).

-Mid-term Meet: A workshop was conducted where the basic Lean concepts were reinforced and advanced Lean topics were presented. The project participants presented their experiences and issues faced during Lean implementation. This provided a knowledge sharing platform.

Figure 4: Site Visits

-Webinars: Apart from the initial instructions, additional notes were sent to the sites on some of the Lean tools and a series of four webinars was conducted at the end of the sixth month by the IITM faculty.

-Closure Event: This event covered identifying and sharing best practices from various sites and recounting the enablers and road blocks encountered for Lean implementation as well as the solutions adopted to solve them. Feedback was also given by the various sites on what had gone well and what was needed to be improved as well as on recommendations for improvement for similar future training and implementation programmes.

The classical Last Planner system is not amenable for direct implementation in many Indian sites as planning concepts have not spread widely outside the main planning office, which is often located centrally. Hence, a modified approach called Collaborative Planning System (CPS), which ensured close involvement of the Project Manager and the planning manager in the weekly planning sessions, and also in the daily sessions many times, was evolved and implemented successfully. Various Lean tools such as work sampling, wastage minimisation, value stream mapping were taken up by most sites for implementation. Location-Based Management System was tried out in a couple of sites. Cycle time optimisation was a major gain in a few sites. BIM was also a useful enabler for visualisation and progress comparison between planned and actual scenarios, but the requirement for higher end hardware, expensive software and skilled operators at the various sites came in the way of its common use.

OUTCOME OF THE PROGRAMME

The feedback and the discussions in the closure session clearly showed that the programme was quite successful and that all the project sites had indeed made gains ranging from highly significant to moderately successful. However, all the sites had realised that Lean practice and implementation can have very beneficial impact at the site and agreed to continue to implement the Lean practices. Some of the positive results reported by a majority of the sites were:

- The morale of the site staff had significantly improved as a result of inclusive working culture (Figure 5).


Figure 5: Daily Huddle

- The CPS process helped frontline staff to develop planning skills and gave them a sense of participation as well as achievement. In some other sites where even the labour were involved in the Lean process, many innovative suggestions came out for improving the productivity and reducing the wastages.
- Innovations resulted in better work procedures, construction methodologies, utilisation of tools and equipment, procurement strategies, etc.
- The involvement of the subcontractors in the work sampling process revealed the inefficiencies in their working and they were successfully persuaded to switch over from a labour headcount based remuneration system to a piecework based remuneration system, which is more efficient.
- The work sampling processes backed up by photographs and videos as evidences persuaded labour and supervisors to drop wasteful and inefficient processes and adopt more efficient practices.
- Based on many suggestions from the site staff, value stream mapping exercises were used to identify inefficient work streams and optimising them.

Many other specific and tangible results were also reported by the various sites: improvement of Percent Plan Completed (PPC) for CPS practices, reduction in project duration even within the short programme duration of eight months, reduction in percentage of Non-Value Adding activities, improvement in labour productivity, reduction in cycle time for floors for multi-storey buildings, etc.

A DISCUSSION ON THE OUTCOMES & WAY FORWARD

The performance of the various sites that participated in this programme has been rated on a 4-point scale and shown in Table 1. On this scale:

- Level 1 indicates that there was no visible implementation of Lean practices.
- Level 2 represents ‘Light Lean’ status. Here the site was expected to come up with some Lean process templates but was not expected to have a fully integrated system.
- Level 3 represents ‘Heavy Lean’ status. In this stage, the site was expected to have implemented robust and integrated Lean tools that visibly drove project

planning on site. Further, at this point Lean approach was expected to be an accepted mechanism, visible in all project meetings and reviews.

- Level 4 represents 'Lean as Culture' status. In this stage, all personnel at site purposively think about Lean as they carry out their tasks.

Table 1: Lean Performance of Sites

S.No.	Type of Project	Lean Score	Salient Features
1	Residential building-1	3	• Strong top management commitment • Lean champion with a willingness to learn
2	Residential building-2	2	• Client and Contractor both keen on Lean • Weak systems
3	Residential building-3	2	• Weak top management commitment • Lack of strong systems
4	Residential building-4	3	• Committed & enthusiastic Lean champion • Strong systems
5	Commercial building -1	2	• Committed site management • Project in end stage without much scope for Lean
6	Commercial building-2	2	• Strong management and systems • Weak commitment for Lean systems
7	Commercial building-3	2	• Strong top management but weak site management • Lack of strong systems
8	Special project-1	3	• Strong top management commitment • High all round enthusiasm
9	Special project-2	3	• Strong top management commitment • Push to share learnings with neighbouring sites

Note: The higher scores were given for demonstrated reduction in project duration, significant improvements in productivity and wider involvement at the sites as well as implemented Lean processes.

CHANGES IN PERCEPTIONS

The feedback received from the various participants as well as the observations from Table 1 showed that the programme essentially went off quite well and that it is possible to implement Lean practices in Indian construction sites satisfactorily. It was also seen that the site staff were generally quite amenable to adopt more advanced practices such as Lean given appropriate orientation, and welcomed the inclusive culture of Lean. The culture of analysing the various processes to understand the root causes for what was not going well and correcting the same had spread in most sites. Though some planning managers were initially reluctant to yield control of the

planning process, they also realised the advantages of a more participative and inclusive practice of the planning process and the innovative improvements which could be made for the work through wider involvement at the site level. Though some project managers were initially inclined to make light of the Lean practices, they came around to accepting the advantages and the good potential for improving time and cost bottom lines as well as for improving certainty levels. Though some of the senior managers did not show that much interest in the beginning and relied more on optimising the conventional practices rather than successfully implementing the Lean practices, later on came around to appreciating and supporting the Lean practices. At least three organisations wanted to spread Lean implementation to other sites. It was also clear that the close support and involvement of the Project Manager at the site level as well as clear directives and support from the top management for wider and deeper involvement at the site were vital for successful implementation.

VARIATIONS IN RESPONSES FROM THE VARIOUS SITES

Apart from the standard benefits of Lean as described above, what was interesting to note was the manner in which the various sites responded to the Programme, depending on their backgrounds and cultures and the impact the nature of the Projects had on the implementations.

At the higher end, for the organisations which had standard, time-tested and strong planning and control systems, their own standard processes were given a Lean slant, without really going the full mile with formal Lean processes. At the lower end, for the organisations which did not have well established planning and control systems, understanding, interpreting and spreading Lean concepts in the site were a challenge and the implementation consisted of a set of sporadic exercises with some Lean tools, rather than a coherent holistic implementation. The best implementation came from a site where the top management had given strong backing and the site management drove the process inclusively with total faith and commitment. The site management acted well to generate good enthusiasm among the site staff and come up with innovative implementations. The inhibiting factors also came out clearly, to cite a few: weak site management; diverse pulls between various segments of the site, head office and intermediate regional office; lack of focus between the client and the site.

There was not much of an influence due to the nature of the Project. A highly specialised marine jetty project or an underground structure or a somewhat routine implementation for a building were all implemented well but some other simpler building projects lagged behind. The emphasis was clearly on people factors rather than on project complexities. Buildings where many trades have to work in various sequences in repetitive manner appeared to offer good scope for implementation of a variety of Lean tools with tangible results.

CONCLUSIONS

This Lean Training and Implementation Programme has demonstrated that Lean concepts and practices can be successfully adopted in Indian construction projects and has evoked keen interest from many organised players in the industry. It was clearly seen that the enabling factors included commitment of top management and site management, as well as the culture and systems of the organisation. The

inhibiting factors were seen to be lack of well-established planning and control systems, poor inclusive culture or strong existing systems coming in the way of formal Lean implementation.

WAY FORWARD

Requests have come from a few organisations for extending the programme to more project sites. The previous practitioners have also sent in requests for a more advanced, continuing programme. Possibly the higher level programmes will include deeper practice of the Lean concepts and tools previously identified as well as involve the use of Integrated Project Delivery, BIM and other relevant tools. Repeat programmes, similar to the one conducted, would generally be with the same format, except for getting more support from the top management and closer guidance to the sites from IITM.

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