INTRODUCING LEAN CONSTRUCTION PHILOSOPHY IN E-P-C PHASES OF A LARGE INDUSTRIAL PROJECT

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ABSTRACT

A manufacturing organisation in India contemplated augmenting their capacity and took up a green-field expansion project in a new location. The internal construction division of the organisation decided to introduce Lean construction philosophy. A study was taken up to understand the impact of Lean on the engineering, procurement and construction phases where multiple stakeholders who are entrenched in traditional approaches are involved.

A detailed case study and action- based approach was adopted. The data included both primary observation data collected by the researchers present in meetings and other data from various reports. . There were some interesting insights into the dynamics involved when groups with diverse approaches are brought together on a Lean construction journey. There was also a challenge of implementing Lean with multiple project teams all working in the same organisation and therefore with little or tacit contracts involved in the project. The initial attitudes of the people which ranged from enthusiasm to outright scepticism and engagement with reservations evolved progressively over time to embracing Lean in varying degrees and formats.

The complexities present in the organisational structure contributed to the formation of institutional voids which were leveraged by the Lean group to promote Lean practices.

KEYWORDS

Big Room, Transformation, Change Management, Culture, Institutional voids

INTRODUCTION

Lean Construction management has become popular in countries around the world. In India, though the concepts of Lean are practised widely in the manufacturing sector, the philosophy is only gradually gaining popularity in the construction sector. Several initiatives, including seminars by international faculty, under the auspices of Institute for Lean Construction Excellence (ILCE) have generated interest among the construction agencies to adopt and practice Lean (Ballard 2015; Raghavan 2015; Raghavan et al. 2014).

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Having experienced some of the benefits of Lean in an earlier Lean construction training-cum-implementation programme, the top management of the construction division of a reputed manufacturing organisation desired to implement Lean in all their sites progressively.

The present project is a Greenfield industrial expansion project of this organisation which presented an excellent opportunity to introduce Lean from the beginning. Though some members of the construction team of the Group had some exposure to Lean, the other teams had no Lean background. The various team members had come from different backgrounds, were staunch practitioners of traditional project management paradigms and had considerable reservations against Lean practices. The time-honoured organisational structures and practices of the parent organisation and the complex web of independent roles and aspirations of the various divisions of the parent organisation involved, created dual reporting structures and autonomous pockets, posing problems for integrated working. However, the pressure from the top as well as certain developing group dynamics induced them to adopt the Lean way over time. This paper presents a case study approach on how people who are well entrenched in conventional project management learn to open out into an inclusive Lean culture and provides interesting insights into the Lean cultural transformation and the group dynamics involved.

Another interesting aspect of this study is that the complexities present in the organisational structure contributed to the formation of institutional voids which were leveraged by the Lean group to promote Lean practices.

OBJECTIVES OF THE STUDY

The Study aims to explore the evolving group dynamics between the various teams as they progressively migrate from a conventional project management paradigm into a Lean management paradigm. In the particular project under study the various circumstances are rather unique and present a good opportunity for exploring the possibility of leveraging any institutional voids to promote the implementation of Lean concepts.

THEORETICAL LENS

Implementing Lean Construction practices is essentially an exercise in organisational and cultural change where established practices of planning and monitoring are replaced by newer practices that emphasize minimisation of waste. Institutional theory offers a theoretical lens through which these dynamics may be used.

Simply put, institutions are the 'Rules of the Game' (North 1991) that define the interaction between players. Scott (2008) unpacks these 'rules' and suggests that they consist of three varieties – regulative institutions enforced by legal rules, normative institutions enforced by social pressures and cognitive institutions that are deep seated guidelines enforced often on a personal basis. While early institutionalists considered institutions to be somewhat immutable, scholars have subsequently drawn upon theoretical formulations such as Structuration that describe the interplay and consequent change between structure and practice to show that institutional change is indeed possible (Giddens 1979).

Subsequent literature addresses responses to institutional conflicts (Oliver 1991) and pathways to institutional change. Attempts have been made to integrate social movements perspectives into mainstream institutional theory to describe the dynamics of how new institutional forms take root by overpowering the old (McAdam and Scott 2005). More recently, institutional change has been formulated as a process by which institutional entrepreneurs work institutional voids to achieve change (Mair et al. 2012). Institutional entrepreneurs are skilled actors who can leverage resources to transform exiting institutions to suit certain objectives. Institutional voids arise when existing institutional arrangements are in flux due to endogenous or exogenous change forces. These voids represent the inability of the present institutional arrangements to deal with particular new and unique situations. Such voids afford opportunities for institutional entrepreneurs with skills to create new 'rules' that can be followed. We argue that in the case that we are about to describe, a series of top-level announcements and changes in project organisational structure led to the creation of institutional voids, and a group of change-agents were able to leverage this by slowly reinforcing the use of a set of Lean practices that then became 'taken for granted' practices on the project. By describing our narrative and enfolding the working of institutional voids as an explanatory theoretical lens, we attempt to both extend the theory and answer a primary research question – 'What are some mechanisms that institutional entrepreneurs can use to implement new practices in the context of Lean Construction'?

CASE STUDY – INDUSTRIAL PROJECT

The study project involves the development of a Greenfield expansion of the manufacturing activities of the parent company. The parent company has a strong and unique traditional culture developed over a century, governing its working procedures and written and unwritten rules. This governs the way procurement is done, contracts are awarded, the working together of different divisions without encroaching upon each other's domains, etc. Being a Greenfield project the scope of work covers the entire gamut from synthesizing user/ client requirements through obtaining various approvals and land acquisition as well as Engineering, Procurement and Construction to commissioning of the project. Except the architectural and detailed engineering to be done by an external party, all activities including the main project management are managed by internal teams from the various divisions of the parent company.

The expansion is for the products of two divisions of the company, which are virtual clients for the project and the construction division is executing the overall project construction. The engineering and coordination for procurement and construction for the electro-mechanical (M&E) works are taken care of by another Division, which has traditional competency in this area, in cooperation with the Construction division. The site management acts as an overall coordinator for the multiple agencies involved, with loosely defined responsibilities and unwritten contracts. The overall corporate advancement is the common goal for all the divisions and the driving force cementing the various roles. Responding to the requirements of the Construction division for total Lean construction implementation, the research team, which was appointed as consultants for this purpose,

devised a three-phase programme. This envisaged a transition from a heavy-training initial phase to a mentoring-for-execution third phase, with progressively lesser presence of the team. We first describe the organisational structure that was adopted and how this created a series of institutional voids. In order to avoid diluting the purity of the subject group's interaction dynamics and encouraging the development of self-motivation and spontaneous learning, the research team has taken up a stance of minimal interventions and guidance.

ORGANIZATIONAL STRUCTURE AND LEAN IMPLEMENTATION

The project witnessed an interesting interaction between the nature of the organisation structure and effectiveness of Lean implementation. This dynamic was exposed as the project progressed through its Lean journey.

The reporting structure

The various components of the project were implemented by different divisions of the same organisation. The construction division was responsible for the overall planning and implementation. Some specific components like M&E were implemented by a separate division of the organisation and a central procurement team/ division of the overall organisation was in charge of the bigger procurement items. Though the departments are directly engaged on the construction of this project, division they report to the top management of the organisation and not to the Construction division, on account of legacy organisation protocols. A Project Manager of the construction division was responsible for the entire project, but the peculiar reporting structure meant that the other teams working on the project did not directly report to him. Also, the planning, procurement and all other divisions were independent and had their respective heads. Such historically evolved reporting structure, which could not be changed just for a single project, created challenges for the project as often the team members had two or more supervisors. This also meant that the Project Manager was responsible for the project without adequate authority for the same.

The issue of the complex contract structures

The project also presented some peculiar contractual structures. The clients were internal to the organisation and the construction division became the general contractor for the project. The M&E works were then contracted to the electrical works division of the organisation (owing to their expertise in M&E equipment). This division thus became a contractor for the M&E works, but they would also be part of the client's team for maintenance of the same. Thus electrical division became a contractor and the ultimate client to itself. Similarly, while the procurement was handled by a separate division, some of the items were procured by the electrical division and some by the corporate procurement division owing to organisational policies. Such kind of complex structures precluded clarity on who would take decision on what matters till Lean was implemented on the project. When Lean was introduced, the periodic meetings and review of progress and causes for delay created situations where some decision should be taken on various items to move on with the project. Such situations enabled the project team to closely look at such contractual structures and make the right persons/divisions responsible for the decisions, with collective responsibility resorted to in some cases.

Tacit Contracts

A related issue was that there were no formal contracts between divisions. e.g., there was just tacit understanding that the construction division was responsible for construction and that the M&E work would be done by the electrical division. No formal contract was written between various divisions and the construction division. The relational contracting schemes here did not have any incentive criteria outlined. But as Lean was introduced and the teams started pulling work from the upstream, the divisions were forced to re-look at their work behaviour. This led to some turbulence in the team where some team members felt the pressure of such complexities for the first time. The peer pressure and imperatives created by the missed promises and low PPC counts acted as incentives for the other divisions to drive up their performance. Thus, it was possible to point out the need for better performance based on real data from not only other divisions but also from the vendors where formal contracts were present. The construction division started contemplating the inclusion of a "Lean Clause" in their future contracts where all the vendors would have to agree to work on Lean philosophy. As this section shows, the coordination and contractual practices adopted for this project were somewhat unique and non-standard. Coupled with top management commitment towards implementing Lean, there was a pressing need to customize project planning and monitoring practices for this project, thus giving rise to an institutional void in this space. The next section describes the dynamics surrounding the introduction of Lean philosophy on to this institutional void. This is done by discussing how Lean was introduced to the team members, the dynamics of team behaviour and the team morale across the phases of the project.

DYNAMICS OF LEAN PHILOSOPHY INTRODUCTION

THE INITIAL PHASE

Initial Deliberations

The senior management of the construction division of the organisation had extensive deliberations with the research team on ways to improve project performance by the introduction of Lean construction philosophy into the project. Fortunately, the core management team of the present project were also involved in the implementation of a previous project for Lean implementation along with the research team and hence had some expertise in Lean implementation.

Formation of "Lean Core Team"

After the initial deliberations, it was decided to have a "Lean Core Team" consisting of the head of construction, the project head, head of planning, the Project Manager and a Lean initiative champion. The core team was chaired by the head of the construction division

Initial Introduction of Lean philosophy to the project team

The Lean implementation for the project was initiated through a meeting with the various stakeholders covering procurement, engineering and construction functional people, the M&E division and the consultants for design. In this meeting the head of the construction division made it clear to the project team that Lean philosophy should be adopted in spirit

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and letter on the project. He asserted the absolute faith of the organisation in the Lean initiative and the importance of the current project to the organisation. The project would then form a template for Lean construction practices across different future projects by the organisation.

Introduction to Lean Construction

The research team then had a training session with all the team members, introducing Lean construction philosophy and the methodologies for implementation. The fundamental intuitions behind the implementation were discussed and some examples of Lean implementation and results from projects in India were shared with the team. Persons who were associated with the earlier flag-ship project implementing Lean talked about their Lean experience and benefits of the change.

CHANGE IN BEHAVIOUR

During the initial meetings the team was divided on the usefulness of this implementation. While some members saw merit in the implementation, others felt that this could become an additional overhead to their work. Some members expressed concerns on the rationale behind experimenting on a large and strategically important project as this. However, the team was given a clear mandate on Lean for this project. Further, the team wanted the project to move on and see some activity after the initial slump. Hence, the team agreed to embrace the change.

"Big Room" meetings

As an initial phase, "Big Room" meetings were agreed to be conducted each week. The engineering team, procurement team and the construction team were part of these meetings. The project concepts were still evolving at this phase and the master schedule was at a very macro level and lacked details on the project scope and the work methodology for various tasks involved, across the engineering, procurement and construction phases. During these meetings it was decided to evolve the look-ahead schedule for four to six weeks from the macro level "Master Schedule" and the task list for the next week in a collaborative way. The team would list out constraints from the look-ahead schedule and agree on the tasks promised for the week ahead. It was decided to calculate PPC every week and have root cause analysis performed on the promises not kept during the week.

From *"I will come back on this point"* to *"We will discuss this right here"*

Though the initial meetings had representatives from all the divisions of the project, the persons attending the meetings were not the ones who were actually executing the projects but the ones who were managing those persons. As the initial meetings kicked off and the look-ahead schedule was being evolved, the phrase which was quite often heard by the researchers in the initial meetings was, *"I will have to talk to my team and come back to you on this".* Initially, the team was agreeing to wait, but the various players found it increasingly difficult to go ahead with the planning in the absence of timely commitments and information. Thereafter the phrase "*We have to discuss this item here itself and close this"* became quite common. The team representatives then brought along the members who could actually answer other team members' queries. In other cases, where the team

members were not located in the meeting place, the representatives called them on phone to discuss the particular issues and understand the dependencies with other team members. One quote which signifies this change was by the team manager to one of the representatives. *"If she is not here, call her right now and ask how this will affect her work. Ask all your team members to have their phones with them switched on during this meeting time. We want such answers in the meeting itself".*

From *"This item will be done next week"* to *"I cannot do this item by this time"*
In the initial meetings, when some work was not done as promised, the bland reply used to be: *"Do not worry; this will be done next week."* People were not in the habit of coming out with the real root causes and were over-confident of their capabilities for achievement. But as the meetings progressed, the members started realizing that they were losing their credibility if they reneged on their promises. There was an invisible peer pressure to be transparent and honest and soon, the team members were proactively telling the team management – *"Look! I cannot perform those tasks in the next week or week after, these constraints we identified earlier were not removed."* and *"We should look deeper into this issue. I cannot figure out how to handle this constraint".* The root cause analysis was naturally taken up after some weeks of implementation by the team.

From *"What were my PPC items"* to *"Can you send these PPC items as quickly as possible to me"*
In the initial few meetings, people waited for the week's list of work items to be sent to them by email after the meeting and would inform details of action taken only in the next meeting. As the project progressed, the management started displaying PPC count for the whole project as well as for the individual teams (like engineering, design, procurement, vendors) separately. Then people started taking notes of their work items and proactively working on them. This led the management to use a workflow management software which would automatically send emails to the team members immediately after the meeting and also display the PPC count for the previous week. Further, the team members started sending details of their promises kept and promises not kept in advance to the team management with reasons why some tasks were not performed.

EMBRACING THE "PULL" PHILOSOPHY

The team was initially working only on those items listed from the master schedule which was still at a macro level. The initial look ahead plans and tasks for week ahead were also very macro in nature and had a lot of uncertainties and dependencies tied to them. The team members were over-optimistic in their estimates of productivity and often presented the best-case scenario to the other team members. But soon the "down-stream" team members started realizing that their work was getting affected severely due to this behaviour. A natural moderation occurred during the meetings where the down-stream members started correcting the team members about such promises. The unintended result of such interactions was that the entire processes of procurement and design in the organisation were examined in detail and also led to the evolution of time-bound *"Standard Operating Procedure"* for procurement and design for the organisation. Interestingly, the team started putting pressure on the planning team to come up with a good base-line and "realistic"

master schedule on pull basis. The planning team then started co-ordinating with the Civil and M&E construction teams to prepare a schedule for construction and worked backwards through procurement to engineering. The procurement team and design team including the vendors and consultants were asked to draw up their plans realistically to be included in the master schedule. Thus, the master plan was prepared in a truly "collaborative-pull" based manner for the project.

TEAM MORALE

From *"This project was always like this"* to *"We are progressing well"*
The project had some initial doldrums on account of some preliminary issues and the team was used to slippages of deadlines and blockages in the earlier days. When the management conveyed their initial decision that the project was to be completed in a challenging time frame, many of the team members did not believe that could be achieved. During the initial weeks of Lean implementation, when the PPC numbers were low people thought that the project may get delayed and some actually put this project on a low-priority. However, with steady practice of Lean, the team slowly started realizing the significance of the new philosophy and the project climbed high on their priority lists. The team members started taking the responsibility collectively and when they saw some good initial progress in design and procurement which were out cold for a long time, enthusiasm started picking up. With the unfolding of pull-based planning, the team felt naturally responsible for the schedule and started working towards making it work. The team gradually started believing that they were progressing on the project.

From *"You"* to *"We"*
A significant observation to be noted here was that during the initial meetings there were prolonged discussions on responsibilities for tasks and responsibilities for delays. The reluctance for transparency was more for external consultants who feared contractual problems in case they came out with the real reasons. The word *"You"* was heard a number of times during the initial meetings. However, as time progressed, this behaviour changed and all the team members felt part of the team and openly discussed their constraints. The team felt collectively responsible for each task and started helping out each other. This significantly improved the morale of the team.
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DISCUSSION

This study shows that where the top management is very focused and keen to implement Lean and where the project context is unique leading to the existence of institutional voids, it is indeed possible through regulative fiat (enforcing Lean implementation) and normative pressures (increasing transparency, broadcasting PPC metrics and instilling a sense of shame into non-performing participants) to implement the Lean philosophy over the course of a project. Progressively the team members start wanting to perform on their own, without the catalysis of peer pressure. This is also in line with the earlier experiments in the Indian context where the research team had been involved. The initial stages of the project covering the conceptualising, engineering and procurement phases are usually the

most difficult stages for Lean introduction. In this study this was also compounded by the problems of the diverse nature of the teams involved and their inexperience and inertial hesitations to embrace a new paradigm after having followed traditional and comfortable mechanisms for many decades earlier. Now that the project has entered the construction phase the implementation is becoming stronger and it has also been decided to bring in all the sub-contractors and vendors into the Lean fold. Even though the latter are traditionally much less inclined and capable than the main construction team to embrace a new field concept, the construction team is still quite confident that the experiment would be successful by deploying suitable training and motivation measures. The research team is closely watching the situation and providing guidance appropriately.

Organisational Issues and Involvement of Top Management

Since the project was highly strategic for the organisation and the top management of the organisation – to which the head of construction reported – was also keenly interested in the decisions relating to and the progress of the project. A few decisions regarding the design and scope of the project actually went high up to this level but because of other natural preoccupations of the top management decisions had to wait. However, by and by a mechanism was evolved in such a way that when a decision was put to the top management, the significance of the decision in terms its impact on the schedule of the project (and cost whenever it could be evaluated) would also be conveyed. This enabled the top management to prioritise and allocate time for key decisions. Earlier the team was not in a position to convey the impact, but after the set-in of pull- based planning based on Lean, they realized the significance of such decisions and were in a better position to convey the impact of various decisions. In the end analysis, we conclude that paradigm shifting innovations such as Lean may best be implemented on projects with unique technical, organisational and contractual characteristics since such projects are more likely to feature the presence of institutional voids, in comparison to more standardized projects. This can be a key insight to practitioners. In addition, the presence of a core team that can act as Lean entrepreneurs and can use specific mechanisms to bring about institutional change is critical. In this case, the core team used a combination of fiat as well as 'naming and shaming' techniques, coupled with more cognitive learning and evangelization sessions conducted by the research team at critical points to instil a new set of rules, norms and values surrounding Lean that then led to its adoption on the project.

CONCLUSIONS

For any new technology initial acceptance progressing to enthusiastic comprehensive adoption takes some time and all the more so in environments not permeated with organised systems. Though Lean construction concepts have been around for more than two decades now all over the world, their use is still not that widespread. Given the background of the Indian construction industry the permeation can only be progressive and slow. A few shining beacons such as the project cited as well as the enthusiasm of enlightened agencies such as the one covered in this paper are vital in the earlier stages for establishing the credibility of Lean construction as well as serving as path-breakers to be emulated by the rest of the construction industry. However, the initial learning process and

acceptance of Lean were fraught with many hurdles. Inducing the concerned teams to enthusiastically take part in Big Room meetings, leveraging peer pressure, bringing around the team members to accept joint and several responsibility even in the lack of clear definitions of authority, carful management of the institutional voids, etc were some of the steps taken to further the development of the Lean culture. The Research team is closely working with the project team to study the evolving dynamics in a multi-stakeholder environment and the enthusiasm with which the various teams embrace Lean. As a next step, field implementation in construction sites almost always has many surprises deviating from the theory and availability of such projects for study present a golden chance to understand the appropriate introduction and implementation mechanisms which are to be followed for future applications

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