AN EXAMINATION OF THE BARRIERS TO LAST PLANNER IMPLEMENTATION

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ABSTRACT

This paper presents results that contribute to an ongoing PhD work, looking at the implementation of Lean Production in manufacturing and what findings can be derived for the implementation of Lean in construction. This paper focuses on Last Planner as one approach to implementing Lean in construction. The aim of the paper is to identify implementation barriers and to determine whether or not factors contributing to the success of Lean projects in manufacturing were present in last planner implementation projects. The paper concludes with suggestions for further research aiming at reducing the barriers experienced when implementing Last Planner and highlighting important points to be considered when using any lean method on construction sites in the future. These findings will be developed further as part of the PhD work.

KEYWORDS

Lean manufacturing, lean construction, critical success factors, last planner

INTRODUCTION

The general thinking behind Lean is based on a desire to deliver a product which an individual customer needs while keeping waste in all processes to an absolute minimum. The origins of Lean can be traced back to the Toyota Motor Company, who developed a set of concepts known as the Toyota Production System, to reduce waste in all processes. The Toyota Production System incorporates tools to help managers and employees to introduce Lean into their organisation. However, experience in the implementation of Lean by using these tools has shown that much more is needed than just a tool to ensure success (Ahrens, 2006). The Lean approach needs to be adapted to work in a project-based industry (Lillrank, 1995).

It has been recognised for some time that it is necessary to improve the process of Lean implementation. This paper recommends some improvements to the Lean implementation process in construction, by looking at selected examples of Last Planner implementation. This system is used as an example since it represents a primary method of Lean implementation in Construction.

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METHOD

This literature review based investigation draws on information gathered from previous research containing relevant information on the achievements, barriers and challenges of Last Planner implementation since the early 90's. It is important to highlight that not all papers describing last planner implementation efforts have been included here, but only those describing barriers to the implementation of Last Planner.

CHANGE MODELS AND CRITICAL SUCCESS FACTORS FOR LEAN IMPLEMENTATION

The implementation of Lean is a change process. Many change models have been described in the literature, providing guidelines on what steps to take when implementing change. One influential change model has been that of Lewin (1947). This three-step planned change model has played an important part in understanding the change process. The essence of the three-step model is the "freeze, move, unfreeze" concept where organisational members are disengaged from their conventional practices (unfreeze) in order to develop new values, attitudes and behaviour (move) so that these new values can be the new norm (refreeze). Other examples of planned change models are: the human resource models of change (Kolb, 1991), the political and cultural models of change (Pettigrew and Whipp, 1991) and Eclectic models of change (Kotter, 1996), which apply different elements from a range of "purist" change models together.

Kolb 1991, highlights that the relationship between managers and those affected by the change, as well as their satisfactory participation in the change, is of utmost importance. Pettigrew and Whipp, 1991 on the other hand point out five interrelated aspects of managing change i.e. Coherence, environmental assessment, leading change, human resources in assets and liabilities and linking strategic and operational change and Kotter (1996) focuses strongly on changing peoples behaviour. There are also Business Process Re-engineering approaches to organisational change which focus on the design and implementation of new or redesigned processes. Some examples of these models are Peppard and Rowland (1995), which focuses on processes, people and technology and Vakola et al. (2000), focusing on BPR and IT implementation within the construction industry.

More recently it has been suggested that managerial action is "crucial" at the level of operation and improvement and tends to be overlooked in the structure oriented BPR approach (Koskela 2010). This thinking reflects some ideas considered important by Kolb (1991) which are based on management relationships with operational level and participation in change.

Change models are also described in practical guides written for the industry (Hamlin et al., 2001). One example is Tempel (2001), who emphasises the importance of the presence of critical success factors when implementing Lean. This is an important source for the wider reseach work, as the practical projects looked at, follow the approach outlined by this author. According to Tempel (2001), the critical success factors that should be present when implementing Lean project are: Standardisation, Leadership, Speed, Measurement and Team Harmony.

Standardisation may involve the tools used in implementation, benchmarks for quality and cost etc or standard processes in manufacturing (in construction this might

refer to the stability of processes since standard processes are hard to define due to the one-of-a-kind nature of a construction project). Leadership is considered important as managers must be involved in and support the change process as should other organisational members. Speed is essential, as people tend to lose interest in initiatives happening over long periods of time and are slow to show results. Measurement refers to being able to clearly monitor progress. The introduction of Key Performance Indicators is important to track progress and prove results. Finally Team Harmony refers to the involvement of the organisational members in the change process.

A further source of knowledge on Lean success factors, drawn from empirical data, comes from a survey carried out by Ahrens (2006). The aim of the survey was to analyse the critical success factors for sustainable Lean implementation and the results of the survey in general show that cultural and leadership aspects seem to play a very important role. This is also an important part of the human resource change model from Kolb (1991), where significant importance is placed on the participation of managers and people in the change process, focusing on beliefs, attitudes and values. This is also reflected in the critical success factors as identified by Tempel (2001) above, where the origins of at least two of these factors (Leadership and Team Harmony) are concerned with good manager and worker relationships, getting people involved and gaining acceptance.

Although further research is needed in this area, so far there are common themes to be found in the literature on change models and the critical success factors for Lean implementation. The common factors that are important for the success of Lean initiatives appear to be:

- Training and standards (Tempel 2001, Lewin 1947)
- The human factor: Team work and worker involvement (Tempel 2001, Kolb 1991, Ahrens 2006)
- Leadership (Tempel 2001, Ahrens 2006)
- Speed (Tempel 2001, Ahrens 2006)
- Measurement (Tempel 2001, Ahrens 2006)

THE LAST PLANNER SYSTEM

The implementation of the Last Planner System is analysed here as an example of Lean implementation in Construction, to determine the type of barriers experienced and to investigate whether the above critical success factors are present in any of the past implementations analysed. The Last Planner planning and control System is a method developed by Ballard and Howell to introduce better planning and reduce excess waste in construction projects. The Last Planner is the person or group accountable for production unit control, that is, the completion of individual assignments at the operational level (Ballard, 2000).

The Last Planner System works to enhance reliability in three main ways: the ‘look ahead planning’ and ‘make-ready’ process, in which construction managers make work ready by ensuring that materials, information and equipment are available; filtering planned activities through the weekly work planning procedure to ensure that the preceding activities have been completed; and lastly, by seeking conscious and

reliable commitment of labour resources by the leaders of the work teams involved. Ballard and Howell (1998) have presented also the idea of "shielding production" where the idea of quality assignments help to increase the reliability of commitment plans. According to Ballard and Howell, 1994, Last Planner focuses on quality characteristics of weekly work plans:

- Work is selected in the right sequence
- The right amount of work is selected
- The selected work can be done

Last Planner is a system for creating predictable and reliable workflow. This is achieved through "Pull Planning" which is at the core of LPS. This technique is based on working from a target completion date backwards which causes tasks to be defined and sequenced so that their completion releases work. This maximizes value generation and eliminates waste of over production, one of Ohnos seven areas of waste (Ballard, 2000).

OVERVIEW OF BARRIERS IN LAST PLANNER IMPLEMENTATIONS

Table 1 shows of some of the implementations of Last Planner since the early 90's, which have been documented in the IGLC conferences over the years. Only papers that contain relevant information on the barriers experienced during Last Planner implementation are shown. In the literature, it was possible to identify more than 83 construction projects where the Last Planner was implemented (A survey of 77 projects on one hand and a series of in depth studies on a further 6 projects: Aslesen et al 2008; Alarcon et al 2005; Friblick et al 2009; AlSehaimi et al 2009**;** Kalsaas et al 2009; Kim et al 2005; Conte 1998). The projects cover a variety of different types of construction, from low and high rise buildings, heavy industrial projects, heavy civil construction projects, light industrial construction, educational facilities to shipbuilding. Information on the types of projects where LPS was used and what the main actions were, that contributed to improvement in PPC, is displayed in Table 1. In addition, information on what barriers were experienced and suggested improvements is also presented. The barriers experienced during implementation will be discussed along with possible future improvements.

BARRIERS EXPERIENCED IN PAST LPS IMPLEMENTATIONS

In the overview, it can be noted that over time, the LPS has continuously improved the PPC on projects where it has been implemented. In all projects, LPS was implemented in a somehow similar way. In the shipbuilding project (Aslesen et al 2008) it was felt that the LPS approach had to be adapted to suit the shipbuilding process. In summary, the following barriers to implementation were experienced.

WEAK COMMUNICATION AND TRANSPARENCY

While the Last Planner tool required regular meetings with the project team to plan work and although work packages were visualised on post-its, it tended to lack a more visual perspective at the actual area of work. Alarcón et al. (2005) describes weak communication and transparency as a barrier to progress. Since with the Last Planner system, information is exchanged and discussed in weekly meetings, it is often not

possible for all participants and construction workers to be aware of important details if they were not present at the meeting.

Table 1: Overview of Last Planner implementations

	Project type	Project description	What was achieved?	How was this achieved?	Barriers	Improvements to consider	IGLC Paper
1	**Chilean construction projects**	Database of 77 projects focusing on LPS implement-ation	PPC improved from 63% to an average of 71 % within a 3 year period.	1) Through the learning process 2) Experience accumulated by the GEPUC team 3) Adaption of support tools 4) Top management involvement	1) Poor use of info 2)Lack of time and training 3)Organisation 4) Lack of self criticism 5)inadequate administration 6) inadequate communication	Visualisation, leadership, training	ASSESSING THE IMPACTS OF IMPLEMENTING LEAN CONSTRUCTION, IGLC 13, 2005.
2	**Two construction projects in Saudi Arabia**	2 LPS projects carried out at educational facility in Saudi Arabia.	Increase of PPC in both projects from 69% and 56% in the first week to 86% and 82% in the last week.	Implementation in four phases - an evaluation being made after each. PPC monitored and reasons for non-completion gathered.	1) Management support 2) Committment 3) Administration 4) Communication	Visualisation, leadership, training	LAST PLANNER SYSTEM: EXPERIENCES FROM PILOT IMPLEMENTATION IN THE MIDDLE EAST, IGLC 17, 2009.
3	**Construction of a library in Sao Paulo State**	The construction of a library in Campinas.	Ontime completion. Reduced costs by 42%.	Weekly preparation of medium term schedule (lookahead). Elaboration of weekly work plan with exact details. New function for foreman.	1) Lack of integration of all areas	Visualisation, leadership, training	LAST PLANNER, LOOK AHEAD, PPC: A DRIVER TO THE SITE OPERATIONS, IGLC 6, 1998.
4	**Shipbuilding project**	LPS project in Norwegian shipyard.	Throughput improved.	Mapping of shipyards organisational challenges. Formation of "change group". Focused Weekly work plans and lookahead plans.	1) Standard not full suitable, interpretation unclear	Visualisation, leadership, training (especially to develop and communicate new standard)	LAST PLANNER IN A SOCIAL PERSPECTIVE – A SHIPBUILDING CASE,IGLC 16, 2008.
5	**Havlimyra case (Norway)**	LPS project by general contractor, Skanska.	A further improvement in PPC of 65% in 2009 is expected	Active involvement of technical sub-contractors. Measuring of PPC and a more focused approach to solving issues.	1) Difficult relationships 2) Inadequate information	Visualisation, leadership, training	IMPLEMENTATION OF LAST PLANNER IN A MEDIUM-SIZED CONSTRUCTION SITE, IGLC 17, 2009.
6	**Last planner projects in Sweden**	LPS survey on construction projects in Sweden.	Amount of time spent on non value adding activities decreased.	The survey didn't go into details about actual implementation.	1) Lack of involvement 2) Lack of training & communication	Visualisation, leadership, training	PROSPECTS FOR IMPLEMENTING LAST PLANNER IN THE CONSTRUCTION INDUSTRY, IGLC 17, 2009.

MINIMUM INVOLVEMENT OF CONSTRUCTION WORKERS

Minimum involvement of physical construction workers was perceived to have been a barrier on some projects, especially those carried out in Sweden (Friblick et al 2009) Also, the inadequate involvement of sub-contractors in the Last Planner process hindered its effectiveness.

INADEQUATE PREPARATION AND TRAINING OF PARTICIPANTS

In some cases, certain preparations were missing to support the successful implementation of Last Planner. For example, some projects experienced lack of knowledge of what this tool was and why it was needed. In the Chilean construction projects (Alarcón et al 2005), one barrier was the lack of training of those involved in the use of LPS and the lack of understanding of LPS concepts. There was a lack of good communication also on the Saudi Arabia projects (AlSehaimi et al 2009) which led to misunderstandings and non-compliance. In the Last Planner projects in Sweden (Friblick et al 2009), the lack of knowledge of what the system is and how it works on behalf of construction workers was a major obstacle. Better preparation would increase acceptance and lead with an example of good communication right from the very beginning.

LACK OF ROLE DEFINITION

Other barriers were experienced due to a lack of role definition. In some cases, important project participants did not feel obligated to work according to the terms of Last Planner. In the Seoul and Busnan Subway projects (Kim et al 2005), the foreman was not adequately involved in the planning and scheduling process!

One of the most important roles for the success of Last Planner is that of the foreman. He or she needs to be on board and this needs to be made clear right from the beginning. Other organisational issues also resulted due to a lack of role definition. For example, work was structured and scheduled not through engineers in a construction team but through those in a project control team. Problems arose since engineers in the project control team were not very aware of site constraints such as the progress of pre-requisite work. In addition, participants often found it difficult to "say no" when it was necessary – especially to superior levels. It is important for any method in use in Lean Construction that hierarchy does not come before process. This is something that needs to be made clear at the very beginning of the project when defining roles. Top management support and commitment to promises are also mentioned as critical success factors for implementation during the construction projects carried out in Saudi Arabia (AlSehaimi et al 2009).

INFORMATION NOT ADEQUATELY USED

Information was collected in meetings but it was found in the Chilean projects (Alarcón et al 2005) that this information was inadequately used and administered to create a learning cycle. In the Havlimyra case (Norway) (Kalsaas et al 2009) the information was not fully adequate as it was felt that there was a missing link between the production schedule and the phase schedule (in order to remove constraints and create a backlog of workable tasks). Clearly, we need to concentrate on ways to better use the information made available to us when implementing LP.

LACK OF TIME FOR IMPLEMENTING IMPROVEMENTS

This was also mentioned as a barrier during the Chilean projects (Alarcón et al 2005). There is never time for improvements unless we make time. During construction, we also need to focus on improvements that are possible. Long complicated and expensive solutions should be avoided.

LACK OF INTEGRATION OF PRODUCTION CHAIN (CLIENT, SUPPLIERS, SUB-CONTRACTORS)

At the construction of a library in Sao Paulo state (Conte 1998) the most difficult part of implementation of LPS was linking the areas of supply, execution and integrated financial control. In the Havlimyra case (Norway) (Kalsaas et al 2009), a difficult challenge was the dysfunctional relationship between the architect, general contractor and the owner which made co-operation difficult. There was also insufficient support from general project manager for the lookahead process.

Some of the above barriers will be subject to cultural variation. This means that they will not necessarily be encountered in the context of the research project reported here, which is based in Germany. This is particularly true of the seniority issues, which are most prominent in high power-distance cultures (Hofstede 2002). However, all are significant in considering the generic issue of implementation.

DISCUSSION: ARE THE CRITICAL FACTORS TO SUCCESS ALWAYS PRESENT WHEN IMPLEMENTING LAST PLANNER?

So far we have considered what the critical success factors are when implementing Lean and what barriers have been experienced when implementing Last Planner. This section attempts to link these two aspects by determining whether these critical success factors were present on projects using this method of Lean implementation in construction. It looks towards the future of Lean implementations in construction and attempts to determine the areas where the main focus for improvement should be.

It is not easy to say that certain success factors do or do not exist when implementing Last Planner, since each project presents unique circumstances. There is however, always an element of measurement in the Last Planner system, particularly that of PPC (PPC was positively improved on all of the projects shown in table 1). While PPC is not always a predictor of project performance (a high PPC doesn't always mean that the project is on schedule), transparency of results helps the Lean implementation process.

Other areas however could be improved so that Lean in construction can progress in the future. Training and communication are two important areas. A lack of knowledge of the concepts of Last Planner and what the benefits were hindered progress on some projects (Chilean and Swedish). Good communication, team work and poor worker involvement were issues on others.

Satisfactory Leadership and management involvement were sometimes an issue since role definition and a sense of responsibility seemed to have been lacking on some projects.

CONCLUSION

Based on the ideas presented in this paper, the following section will suggest some points for future Lean implementations in construction .

FURTHER IMPROVEMENT OF COMMUNICATIONS AND INCREASED INVOLVEMENT OF CONSTRUCTION WORKERS

As experienced in many of the past implementations (e.g. Alarcón et al 2005, Friblick et al 2009) lack of involvement of construction workers and inadequate communication were common barriers. One way of improving the communication

and involvement of construction workers is by visualising all necessary information at the place of work. Construction workers will not be sitting at a computer so by visualising information at the place of work, the construction workers are more involved and communication is improved at all levels. The importance of the involvement of operational workers has also been pointed out more recently "the problems of construction require new initiatives at the level of operation and improvement" (Koskela, 2010, P. 85).

TRAINING OF LEAN CONSTRUCTION PARTICIPANTS IN ADVANCE

Before the implementation of any new method, those involved must be trained in its concepts and approach. As was highlighted in the shipbuilding project case (Aslesen et al 2008), there is an important "social element" to implementing Last Planner and by focusing on the training of participants and good communication from the beginning, it will make it easier to introduce any changes at a later date. Training information on Last Planner and any other method should be visualised where construction workers and all participants can see to always remind them of the reason why such methods are being used.

IMPROVED USE OF INFORMATION AVAILABLE – VISUAL MANAGEMENT

By displaying the work to be carried out on a daily basis at the site, everyone can see what the progress is and what work was planned for when. This information can be used to measure performance of work and reasons for non-compliance should also be gathered and visualised so everyone is aware of why actions have not been carried out. Corrective actions taken should also be displayed and this would generate a learning effect.

ADEQUATE PREPARATION

A clear definition of roles and responsibilities within the team before project start is essential. This includes making it clear that decisions will be made based on process and not on hierarchy. Once roles are defined, these can be also visualised at the area of work on an information notice board. Who is involved in the successful implementation of this tool? Who should be there at what meetings? What is the process for implementation?

Get everyone on board. To implement a new method for Lean Construction on a project is first of all a decision. Therefore time should always be made for improvements (this will save time later).

Necessary preparations should also be made in advance, in order to fully integrate the whole production chain (client, suppliers and sub-contractors). Get them involved in the process, perhaps already in the contract negotiations stage. Visual management can also be used here. Display who the sub contractors and suppliers are and what work they have to complete on site. Introduce Key Performance Indicators to measure their performance and display this information onsite. Finally, while we can see that Last Planner has proved itself as a successful method in Lean construction, there is room for improvement in the process of how it is implemented.

FUTURE RESEARCH

The possibility of using visual management to help reduce the barriers mentioned above will be an important topic for the future research. In addition, further research into change models and success factors will be carried out.

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