Author(s): Dave, Bhargav & Hämäläinen, Juho-Pekka & Koskela, Lauri

Title: Exploring the Recurrent Problems in the Last Planner Implementation on Construction Projects

Year: 2015

Version: Final published version

Please cite the original version:

Dave, Bhargav & Hämäläinen, Juho-Pekka & Koskela, Lauri. 2015. Exploring the Recurrent Problems in the Last Planner Implementation on Construction Projects. Proceedings of the Indian Lean Construction Conference (ILCC 2015). P. 9.

EXPLORING THE RECURRENT PROBLEMS IN THE LAST PLANNER IMPLEMENTATION ON CONSTRUCTION PROJECTS

Bhargav Dave[1], Juho-Pekka Hämäläinen[2], Lauri Koskela[3]

ABSTRACT:

Traditionally, production control on construction sites has been a challenging area, where the ad-hoc production control methods foster uncertainty - one of the biggest enemies of efficiency and smooth production flow. The Last Planner System® has been one of the most popular lean construction tools that offers a solution to tackle the problems of production management on construction sites. Since its inception almost 20 years ago, construction companies across the world have implemented Last Planner with reported success. However, there have also been reports of challenges in a number of areas whilst implementing the Last Planner. These challenge areas limit the effectiveness of Last Planner if not tackled properly. Some of the biggest challenges appear to be partial implementation of Last Planner; lack of standardised flow of reporting between shorter planning functions such as weekly and daily planning to long range plans (i.e. Phase and Master plans); lack of attention to long range plans; inability to deploy the collaborative aspects and lack of recognition of information systems. In this paper some of these challenges are explored through review of past literature and also through direct observation of Last Planner implementations. The challenges are categorised in two major areas and potential solution candidates are presented.

KEY WORDS:

Lean Construction, Last Planner, Lean Implementation

INTRODUCTION

The Last Planner® system of production planning has emerged as one of the most important lean construction tools since its inception. For many construction organisations embarking on their lean journey, Last Planner is one of the first steps taken. The benefits of the Last Planner approach are well documented, some notable ones are:

- Tackling variability, ensuring task availability and compressing duration

[1] Senior Researcher, Civil and Structural Engineering Dept, Aalto University; Finland. +358 50 4364717; bhargav.dave@aalto.fi

[2] Commercial Manager, Skanska (Finland), Helsinki, Finland.

[3] Professor, Civil and Structural Engineering, Aalto University; Finland; lauri.koskela@aalto.fi

- Smooth production flow
- Improving flow, making waste visible and continuous improvement
- Building collaboration and trust amongst project participants
- Supply chain integration

There are numerous examples of a successful Last Planner implementation internationally (Alarcón et al., 2005; Bortolazza and Formoso, 2006; Friblick et al., 2009, Ballard and Howell, 2003). However, there are a number of challenges that have emerged that somewhat minimise the impact the Last Planner could have on a project, which need to be tackled in order to improve the penetration of the Last Planner as the standardised production planning, scheduling and control method on a construction project.

This paper outlines observations from five major construction firms from Europe (four from UK and one from Finland) and one detailed case example from the UK in order to highlight the main challenge areas. The paper begins with reviewing literature pertaining to Last Planner implementation challenges, followed by the observations from the field and the case study. Subsequently, the problems are discussed along with potential root causes, solutions and concluding remarks.

LITERATURE REVIEW

A wide range of literature already exists on the performance of the Last Planner system in various countries. While most studies indicate an overall success story where the Last Planner system improves the overall performance of the project, some also highlight the barriers to implementations and challenges. The majority of the barriers indicated tend to be related to the softer aspects of implementation, such as people and organisational processes, however this in this study the focus is mainly on the functional aspects, i.e. components of the Last Planner system.

A study carried out in Brazil (Bortolazza and Formoso, 2006), which collected data from 133 projects where Last Planner System (LPS) was implemented highlighted that the main emphasis of the implementation had been on short-term planning. The study pointed out that the effective implementation of the lookahead planning function remained a major problem. In a similar study of over 100 projects in Chile (Alarcón et al., 2005), the authors concluded that only a selected elements of the LPS were effectively deployed, in particular, the make-ready (lookahead planning), workable backlog and corrective actions aspects were not in wide-spread implementation. The study also highlighted the lack of supply chain integration as one of the major problems.

A Swedish study (Friblick et al., 2009) in implementation of LPS based on a survey of 270 participants concluded that even though the importance of involving physical workers (i.e. the Last Planners) in the planning process is recognised, it still remains a problem area. Hence, the effectiveness of the collaborative planning aspects remains limited in practice.

In a review of the LPS implementations carried out over 10 years in Finland (Koskenvesa and Koskela, 2012), the authors studied four major construction organisations following initial pilot implementations. The study showed that only one of the four contractors actually started to implement LPS systematically. One of the organisations studied had difficulties in continuing with collaborative planning sessions once the external consultant had stopped facilitating them, even though the

perception of these sessions was positive in the beginning. Another organisation reported that only weekly planning, reverse phase scheduling and 5 whys were being implemented.

It emerges from the study of past literature that one of the most widely implemented aspects of LPS is weekly planning, while lookahead planning, continuous improvement, root cause analysis and collaborative aspects remain a major challenge.

OBSERVATIONS FROM LAST PLANNER IMPLEMENTATIONS

Five companies were observed from a LPS implementation perspective, four from the UK and one from Finland. All five were large size main contractors that were familiar with Lean Construction principles and had prior experience in implementing LPS on their projects.

Table 1 summarises the main components of LPs implemented by each company. Phase scheduling, Lookahead planning and Weekly or commitment planning are the commonly known aspects of the LPS and need no further explanation. Collaborative planning here refers to the act of bringing all subcontractors to the same meeting and planning in a true collaborative fashion at each stage, i.e. phase, lookahead and weekly aspects. The reason to separate this from the planning functions is that while some organisations implement LPS functions in the same collaborative way that they were intended to, many organisations implement the functions without the collaborative aspect. Also, analysis here refers to systematic discussion on the PPC, reasons for non-completion and root cause analysis, while continuous improvement refers to acting on those root causes.

Company A had been implementing lean processes under the guidance of a process improvement manager who had around 20 years of experience in the construction industry. Company A had received LPS training on client's initiative, and had been developing their own methods based on LPS workflow for two years. A planning manager was in charge of preparing the master plan, while site engineers would manage the LPS process. The planning manager (a graduate civil engineer with around 3 years of experience) had received LPS training from a lean consultant, while the site managers had been coached by the process improvement manager and the planning manager. Lookahead plans were prepared directly from the Master Plan without implementing the Phase scheduling function. In company A, lookahead planning was carried out by listing major concerns and countermeasures (including roadblocks) for the whole plan, rather than carrying out a systematic constraints analysis for individual tasks. Weekly plans were carried out by the main contractor's site managers along with the foreman, which were then discussed with the site team on each Friday. However, it was observed that the collaborative meetings (where all subcontractors would be present) were not consistently carried out. While asked about this, the project manager explained that the availability of subcontractors, and the needed training on LPS were the major factor behind the inconsistent meetings. Each week, a report outlining PPC, reasons for non-completion and task progress would be circulated (however, no 5 whys or root cause analysis were performed).

Similar to Company A, Company B also had received coaching on Last Planner by an external consultant on client's initiative. A different external consultant had been helping Company B implement LPS and lean techniques on this project.

Internally, the LPS implementation was coordinated by the System and Performance Manager, who was a graduate civil engineer with around 1.5 years of experience. The external consultant had around 10 years of LPS implementation experience and had previously overseen LPS on large infrastructure projects. They had implemented Lookahead and weekly planning functions, and also a "daily huddle" where the project team would discuss the planned tasks for the day and any adjustments needed each morning. The lookahead and weekly planning aspects were recorded in Excel spreadsheets and a lean software to produce PPC charts and other reports. The team would monitor the PPC and reasons for non-completion, and had also implemented root cause analysis for continuous improvement.

Company C had been implementing LPS only in their infrastructure division under the guidance of their Lean Development Manager. The Lean Development Manager (a civil engineer with around 10 years of experience in construction management) had received training on LPS implementation on the client initiative. The project team was implementing lean under the guidance of their commercial manager who was a quantity surveyor with around 20 years of experience, and the project manager with around 30 years of construction management experience. Company C had developed the Master Plan in a collaborative manner at the beginning of the project, in a similar way of a LPS phase plan. Subsequently, the project team had implemented a four-week lookahead planning cycle with the weekly collaborative planning function and would track their weekly PPC. A constraints analysis exercise was carried out by the Section engineer in an independent way, which was then shared with the team during the weekly briefing. Similarly, the weekly planning sheets were developed by the section engineers under the guidance of commercial manager, and then shared with the subcontractors.

Company D, which is a residential and commercial contractor, had been implementing LPS along with some other lean tools with the help of an external consultant. The company originally started implementing lean in a joint initiative with a client, but did not succeed at first due to the perception that the consultant had been trying to fit "manufacturing lean" in a construction process. However, the company persisted and hired a consultant with lean construction background and began to re-implement lean processes. Since 2007, they had implemented lean practices on two previous projects. The company had implemented just-in-time, waste walks (Gemba), offsite manufacturing and parts of the LPS on their projects. In LPS, Company D was not implementing phase or lookahead planning but had implemented a 4-week planning function that would serve to identify major roadblocks and constraints similarly to a lookahead plan (however with no collaborative meeting). The plan would then be displayed on the site cabin for the whole project team to review and any issues were then discussed on an individual basis. The company had implemented the weekly planning function where the foreman would prepare the plan and then discuss it with each subcontractor individually to ensure commitment. A PPC was then prepared at the end of each week and displayed on the site cabin.

Company E, a major contractor undertaking residential, commercial and infrastructure work, had several years of experience of implementing lean practices and LPS. They had taken part in early LPS implementation pilots and had gone through several pilot projects and developed their own way of implementing LPS

functions. All aspects of LPS were implemented along with analysis and continuous improvement functions (PPC, root cause analysis and 5 why). The company was implementing lean practices under the guidance of their commercial manager, who had more than 10 years of production management experience on construction projects. The company would develop detailed phase plans using Line of Balance approach and would then prepare look-ahead and weekly plans in an integrated way each week. However, the major omission was the collaborative function at each level, i.e. the phase and weekly plans were prepared in a collaborative way, but the lookahead plan was developed by each foreman and then discussed with subcontractors.

Table 1 - Last Planner Implementation Summary

LPS Component	Company A	Company B	Company C	Company D	Company E
Phase Scheduling	Not implemented	Not implemented.	Not implemented	Not implemented	Implemented
Lookahead Planning	Partial implementation.	Implemented.	Implemented	Not implemented	Implemented
Weekly Planning	Implemented	Implemented.	Implemented	Implemented	Implemented
Collaborative Planning	Partial implementation	Implemented.	Not implemented	Implemented	Partially implemented
Analysis and Continuous Improvement	Not Implemented.	Implemented.	Not Implemented	Not implemented	Implemented

It can be seen that the findings are consistent with what was found in the literature review. All companies implemented the Weekly planning component of the LPS, while only one company fully implemented Lookahead planning module while one other company partially implemented it. Similarly, Phase planning was only implemented by one company showing the difficulties of implementing the concept in general. In addition to the observations, some additional insights were gained in the implementation of LPS functions:

Lack of detailed long range planning. As observed from literature and case organisations, only a small number of organisations succeeded in implementing phase planning and lookahead planning functions. This led to a situation where, in scheduling, a transition from the master plan level (i.e. high level milestones) directly occurred to the monthly or weekly task level. This resulted in suboptimal plan performance, as detailed constraints analysis was not carried out, and tasks were not analysed for appropriate sequencing logic.

Ambiguity in planning responsibility. In some cases, the project manager and the site supervisor who would normally take responsibility for the overall planning and scheduling, felt that they were no longer responsible as the site team or that the "last planners" were in charge. However, without all the planning functions being deployed, and the collaborative planning function not being deployed properly, the plans did not function well either, resulting in overall confusion.

Difficulty in tracking and monitoring. One of the most important aspects in LPS is the "make ready" process, often called look-ahead planning. However, it was observed that in most cases there was no mechanism to track or anticipate the impact of identified constraints on workflow reliability before the execution week or even until the Performance Plan Complete (PPC) is measured. This has also been identified as a problem area in prior lean literature (Abdelhamid et al, 2010). Additionally, the tracking of task input availability is quite hard as the information related to their current status is not aggregated or synchronised by any function or a system (Dave et al., 2014; Hamzeh et al., 2015). Another major shortcoming of the current workflow that emerged is that the information does not naturally flow back to the high level plans (such as Master plans and Phase plans). Hence the production control aspects remain generally weak, ad-hoc and manually implemented. It was observed on at least four major projects, that the main contractor's foreman had to spend 2-3 hours each week, first to collate individual weekly plans for subcontractors and then to insert the progress information back into the plan.

Case Study of Lean Implementation in a House Building Construction Company

Company D had started implementing Lean Construction principles in 2005 under the guidance of consultants. Initially this was met with mixed results due to a number of reasons, but the team persisted, and in 2007/8 a second set of consultants were appointed. While there were still some issues left to be addressed, there was an agreement to more fully drive lean principles in the company.

During this study, 13 semi-structured interviews were carried out with the contractor, designer and the client. The study found the main drivers and barriers for lean implementation at Company D. the main drivers identified were i) push from the client, ii) high level champions in top management; iii) partnering contract; iv) culture of innovation. The main barriers were identified as, i) Education and training; ii) industry's resistance to change; iii) manufacturing principles being applied without adapting to construction; iv) focus on cost rather than value.

At company D, the main lean tools being implemented were i) waste walks; ii) short term planning; iii) Just-in-time deliveries; iv) first run studies and v) offsite manufacturing. Due to scope limitations and the theme of the paper, only the first two tools are described in detail in this paper.

Waste Walks: Waste walks refer to the regular site observation walks carried out by various members of site team including the project manager, site manager, foreman and the Quantity Surveyor. Although the primary purpose of the waste walks was to identify waste within various construction processes around the site, it also served many secondary purposes.

Members regularly supervised key activities on site and at the same time engaged with the supply chain (trade foreman or the person carrying out the work) to identify any problems or opportunities for improvements. Here the main members of the project team brought their experience and knowledge about the construction process and transferred that to improve the efficiency of key activities such as plumbing, HVAC, etc. On many occasions, the team identified opportunities for off-site manufacturing through waste walks.

One of the other key supply chain purposes that waste walks helped achieve was standardisation. By engaging with the supply chain and discussing the best way to carry out a task right in the beginning the project, the site team ensured that the

process was standardised and carried out in the same way across the site making sure mistakes were not made subsequently.

As such "waste walks" is not the terminology used by lean literature, equivalent lean tool here is "***Gemba***" which means, "go see for yourself". In traditional manufacturing lean, it means going to the production floor to observe the process. In lean construction, it means observing the construction process first hand. It is a powerful problem solving tool, which also helps transfer knowledge.

Short term planning: At Company D, the typical Last Planner process was not followed, however, the team implemented the company's own version of short term planning. The team kept an updated schedule on the wall every month, which was prepared to match the current situation on the ground. This, although not same as look-ahead planning, served a similar purpose. Also, the project and site manager carried out a weekly round of site each week to talk to each subcontractor to understand what was the actual status of work and what they "COULD" realistically perform the following week. This was beneficial in providing realistic targets that could be achieved rather than following something from the master plan.

Summary

Despite the lean implementation started in 2005, the company only effectively implemented three main tools from the Last Planner toolset. From the planning perspective, only the short term (weekly) planning function was deployed and that too without the collaborative meeting. The company also implemented first run studies on some occasions. The main reasons put forward for not being able to implement Last Planner fully were lack of training and constant change in personnel on the subcontractors' side. Also, among other problems highlighted were the lack of information management tools to support the Last Planner process. The company mostly used Excel spreadsheets and traditional CPM (Critical Path Method) software to manage the scheduling processes.

DISCUSSION ON RECURRENT PROBLEMS IN THE LAST PLANNER IMPLEMENTATIONS

It emerges from the literature and also from direct observation from organisations practicing LPS that there are several recurrent problems, which can be categorised, in the following themes:

- Inability to effectively deploy collaborative aspects
- Partial deployment of LPS
- Reduced importance of robust phase and master plans
- Missing continuous improvement
- Missing the links between detailed and high level plans

The problems can be analysed/understood/tackled from two different perspectives, first from people and process perspective, i.e. the need for training and change management, and secondly that LPS itself may need updating to reflect the practical needs of the industry.

In tackling the first problem, it should be noted that there is generally a lack of standardised training material on the LPS implementation. The lean construction field is strewn with consultants from varying backgrounds that practice and preach

different forms of LPS. Some consultants emphasise the use of weekly planning while neglecting the (often difficult at first) aspects of lookahead and reverse phase scheduling. Also, it should be noted that LPS has not yet found a place in textbooks or standard academic curriculum. Hence fresh graduates entering the field (who would normally be more perceptible to new ideas) are not familiar with LPS concepts.

The second problem needs a much deeper exploration with theoretical underpinning. Much of this is beyond the scope of this paper, however some broad suggestions are outlined below.

1. The collaborative aspect of planning needs to be considered with a fresh perspective. It has been documented that much of the time during collaborative meetings is spent in collecting information about the past and future actions rather than planning (as it has been intended). The use of an information system that aids distributed planning may minimise this time and help the teams in focussing on planning and scheduling activities.
2. The information flow from high level plans to short term plans, and more importantly from short-term plans and the field to the Master level plans needs to be explicitly defined in the LPS.
3. More systematic continuous improvement, based on root cause analysis and tracking task status mechanism in addition to PPC and reasons for non-completion needs to be implemented.
4. The role of information systems and product modelling systems (such as BIM) should be integrated/considered in the new LPS model. The construction industry has made significant strides in embracing information systems in last 5-10 years and this needs to be brought into consideration in the LPS.

CONCLUSIONS

The Last Planner system of production management is one of the most popular lean tools being deployed in construction companies across the world. It was originally designed to address practical gaps in the production management process in construction, specifically those left by the Critical Path Method system. However, the full potential of the Last Planner System is rarely achieved, and the root causes for this are not entirely understood. However, the lack of an authoritative and in-detail exposition of this system, as well as the missing of an accessible theoretical explanation, figure among the reasons. Further, computer support for the Last Planner System has evolved slowly and it is still patchy. Moreover, further development of some sub-functions seems to have merit. While a wider and deeper analysis is warranted, the initial insights discussed provide directions for further amelioration of production control in construction.

REFERENCES

Ballard, G., & Howell, G. A. (2003). An update on last planner. In *Proc., 11th Annual Conf., International Group for Lean Construction, Blacksburg, VA*.

Ballard, H. G. (2000). *The last planner system of production control* (Doctoral dissertation, the University of Birmingham).

Alarcón, L.F., Diethelm, S., Rojo, O., Calderon, R., 2005. Assessing the Impacts of Implementing Lean Construction, in: 13th Annual Conference of the International Group for Lean Construction. Sydney, pp. 387–393.

Bortolazza, R.C., Formoso, C.T., 2006. A Quantitative Analysis of Data Collected From the Last Planner System in Brazil, in: 14th Annual Conference of the International Group for Lean Construction. Santiago, pp. 625–635.

Dave, B., Kubler, S., Främling, K., Koskela, L., 2014. Addressing Information Flow in Lean Production Management and Control in Construction, in: Kalsaas, B.T., Koskela, L., Saurin, T.A. (Eds.), 22nd Annual Conference of the International Group for Lean Construction. Oslo, pp. 581–592.

Friblick, F., Olsson, V., Reslow, J., 2009. Prospects for Implementing Last Planner in the Construction Industry, in: Cuperus, Y., Hirota, E.H. (Eds.), 17th Annual Conference of the International Group for Lean Construction. Taipei, pp. 197–206.

Hamzeh, F.R., Saab, I., Tommelein, I.D., Ballard, G., 2015. Understanding the role of "tasks anticipated" in lookahead planning through simulation. Autom. Constr. 49, 18–26. doi:10.1016/j.autcon.2014.09.005

Koskenvesa, A., Koskela, L., 2012. Ten Years of Last Planner in Finland - Where Are We?, in: Tommelein, I.D., Pasquire, C.L. (Eds.), 20th Annual Conference of the International Group for Lean Construction. San Diego.