

Implementing the Last Planner System: Perceptions about Subcontractors

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The management of construction projects has been advanced by the introduction of the Last Planner System® (LPS). This system is an application Lean Management, and has been successfully applied to all stages of project development. Although the processes required for its implementation have been covered in detail by studies from the point of view of a project's general contractor, relatively few have addressed the perceptions about LPS held by a project's subcontractors. This exploratory study presents the perceptions of three practitioners experienced in Lean Management in general and particularly in LPS about subcontractors' views about this management system. Three main areas relevant to LPS are explored: shared planning, people expectations and dynamics in the implementation. Each of these areas are, in turn, subdivided into specific topics. The experts' opinions show that main concerns are the tension between the current role in planning expected from subcontractors and the higher level of participation demanded by LPS, a lack of knowledge about the system by subcontractors, and the delegation of leadership roles to subcontractors that should be taken by the general contractor.

Key Words: Last Planner System, Lean Construction, subcontracting, qualitative research

Introduction

Construction projects involve a large number of subcontractors. According to the NAHB, a typical residence involves 22 subcontractors and take over 75% of the total dwelling cost (Emrath, 2015), and large projects can require even more. Coordinating these distinctly different entities requires of considerable effort, which may not be successful. According to a report published by McKinsey and Company (Agarwal, Chandrasekaran, and Sridhar, 2016), large projects take an average of 20% more time than scheduled to complete and go 80% over budget. The Last Planner System of production control (LPS®) (Ballard, 2000) improves project performance in these areas by first stabilizing the flow of construction work processes and then raising their speed of production. For LPS, planning and control are inextricable from each other and are performed continuously over the project's life. Several plan levels are concurrently developed and maintained, namely the master, phase, lookahead and weekly work plans. Each level has different purposes and protocols; For instance, the lookahead plan is mainly directed to middle management, since a crucial objective of this planning level is ensuring that the resources required for upcoming work are made available. In turn, the weekly work plan must reflect the availability of labor, space, material and other resources resulting from the lookahead plan. LPS uses the Percent Plan Complete (PPC) as a metric for plan performance effectiveness and for locating reasons for non-compliance. To accomplish these goals, LPS relies on collaboration and commitment to the plan by the project's direct participants. This collaboration, beyond the benefits resulting from an improved working environment, is essential to the success of this system. Achieving this collaboration is particularly difficult due to the traditional performance and business style differences between general contractors (GCs) and subcontractors. Construction stakeholders have been said to "pursue their self-interests to such an extent that collaborative working has been impossible to achieve." (Akintan and Morledge, 2013).

Issues concerning the implementation of LPS from the GC's viewpoint have been well documented (e.g., Fernandez-Solis et al. 2012, Macomber, Howell and Reed, 2005). However, a review of published literature reveals that the subcontractor's perspective has not been addressed at the same scale. This disparity is present despite the substantial differences in context between typical GCs and subcontractors. A typical subcontractor has a limited role in the construction of a project, is involved in the construction of multiple projects, has managerial maturity and risk management strategies less sophisticated than those of a GC (Schaufelberger, 2003), and its volume of revenue is

smaller than a GC's (the contractor threshold to be considered a small business by the Small Business Administration in 2014 was $36 million, while the threshold for subcontractors was $15 million) (Small business Size Standards by NAICS Industry, FR 79-113).

Research Approach

This paper presents the results of three in-depth interviews to construction professionals with experience in the management of projects using lean management in general and LPS in particular. The objective of the present study is identifying issues concerning the implementation of LPS perceived as of high value or high concern by subcontractors. This study is qualitative in nature, and the small number of interviews performed limits the power of its analysis. Results, therefore, should be viewed as exploratory. Single-case experimental design is an emerging research approach, which "is largely in accordance with contemporary criteria for experimental quality" (Smith, 2012) as long as it can be understood as a complementary methodology for larger research studies.

The research included a review of current literature to provide a basis for the interviews. Additionally, the interview with Expert 1, whose background is discussed below, was used to fine-tune the scope of the questions for the other two interviewees. The factors and topics addressed in this paper are shown in Figure 1.
Expert 1 (E1) is a BIM manager at a local GC firm. He has taken a leadership role in helping the company as a whole to implement lean construction. He leads Study Action Team planning sessions with various project subcontractor teams, acting as the local Lean champion for the introduction to LPS to the subcontractors most frequently used by the company. Expert 2 (E2) works as Quality Manager for a GC, and acted as the safety coordinator of a minority-owned subcontractor for several years. Additionally, he has served as executive of the Lean Construction Institute's local Community of Practice. Expert 3 (E3) is the Director of Education and Loss Prevention for a large specialty contractor, and has a long experience in the implementation of a Lean culture in the organization. The company still has a large proportion of its business as a subcontractor.

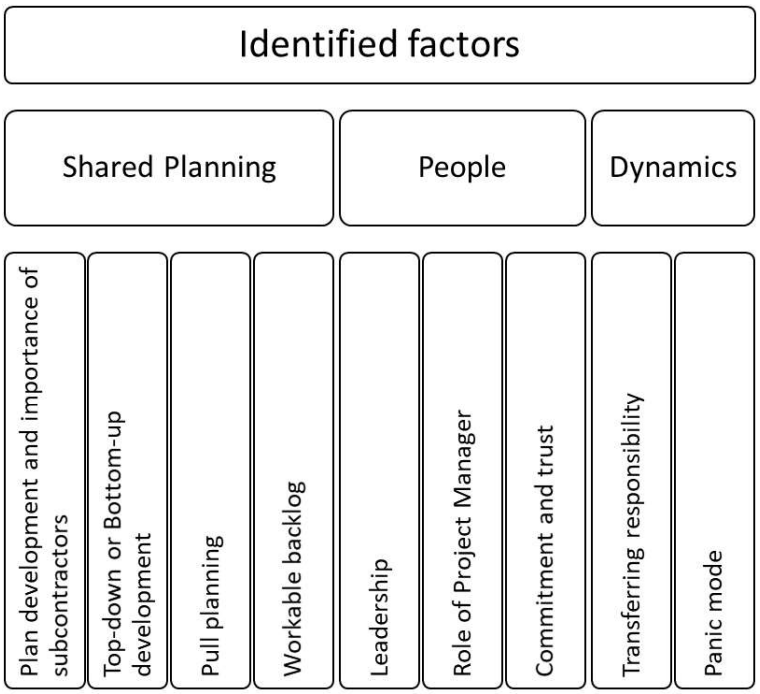

Figure 1: Identified factors and topics

Results

Interviews were recorded, transcribed and analyzed following a content analysis research approach. The results of this study are intended to establish the shape of the issues it addressed, as opposed to arriving to quantitative conclusions. It did not attempt to establish a relative importance ranking of the covered factors and topics. Table 1 shows the main perceptions and risks derived from the interviewees' response to each topic, subjectively included by the researchers. This section discusses and expands the summarized results shown in Table 1.

Table 1: Relevant perceptions and risks

Factors and topics	Perceptions	Risks
Shared planning		
Plan development, importance of subs	Hands-on role of subcontractors improve possibilities to implement LPS	Solutions offered by subcontractors tend to lack a total-project scope
Top-down or Bottom-up development	Bottom-up planning is more appropriate for LPS than top-down	Alternating bottom-up and top-down planning can be detrimental to the plan quality
Pull planning	Pull planning can be an easy catch phrase instead of reflecting a work strategy	Authenticity and reliability of promises can become questionable
Workable backlog	Workable backlog may not be as helpful for subcontractors as for GCs	Workable backlog might lead to confusion from the subcontractor
People		
Leadership	Strong team leaders are as necessary for success as the work plan	Reliability of the plan can becomes an attribute of the leader and not of the team
Role of Project Manager	The GC's project manager is the translator between the plans and the limited knowledge of many subcontractors	The project manager needs to be knowledgeable about LPS for a successful implementation
Commitment and trust	Non-compliance with LPS is usually due to an erosion of trust among participants.	Subcontractor commitment to LPS can be superficial. LPS tools can be misunderstood
Dynamics		
Transferring responsibility	Subcontractors are the weakest link in the command chain, and GCs transfer to them the responsibility for LPS	Subcontractors may lack the capacity for implementing LPS, leading to poor results.
Panic mode	The rushed mode that can overcome the final stages of a project execution is more common than usually perceived	Panic mode is made worse by the lack of trust among project participants, making difficult the sustained implementation of LPS.

Shared Planning

Plan development and importance of subcontractors

The interviewed experts agreed in considering subcontractors a crucial factor for the development of a work plan. E1 expanded this notion by observing that subcontractors are especially well positioned for understanding the project, as they are the ones who carry out most tasks in a jobsite, and often offered the most valuable ideas and suggestions. However, he also stated that the solutions offered by each subcontractor tend to be limited to their tasks and not necessarily are developed considering the entire project as target. E2 added that subcontractors gave more importance than the GC to the practical issues of manpower and the cost of manpower.
According to E1 and E2, lean techniques have been well received and viewed with interest by most construction project teams. Nevertheless, published literature notes that some subcontractors begin their work in the project late

in the construction, leading to a limited understanding of the details of the overall plan (Ballard and Tommelein, 2016).

Top-down or Bottom-up development

LPS work plans can be developed top-down, that is, by the upper management of a company or project to be propagated to the lower levels of the organization chart. Alternatively, the work plan can be developed bottom-up. In the latter scenario, the tasks in the work plan are defined in detail and incorporated into the plan with an active participation of lower management levels (Howell and Ballard, 1994). More general tasks are successively developed based on this detailed plan for the use of upper management.
The three experts coincided in that following exclusively a top-down approach was a hindrance for implementing LPS, although the practice is found in most construction projects. The rationale for a bottom-up approach offered by the experts was that it allowed for a deeper understanding of practices and the process of production systems. E2 expressed that a subcontractor's work plan would need to combine the two approaches (top-down and bottom-up). At the same time, this interviewee recognized that such development requires of "changing directions" in the lead in the development of the work plan several times, an uncomfortable situation for many subcontractor managers.

Pull planning

LPS, as well as Lean management in general, state that a work plan should be pulled instead of pushed. A task in a pulled work plan is executed because the conditions to begin it have been met and, in turn, its completion is a condition to start following tasks. In contrast, in a pushed plan a task is expected to be executed for compliance with the plan, with no regards to field conditions (Howell and Ballard, 1994). The differences between these two types of plans are subtle but considerable in consequences. In a pushed plan, a drywall subcontractor would be expected to mobilize and begin work at the contracted date. In a pulled plan, the subcontractor is expected to mobilize and work when it can be done and it makes sense to do so. A pushed plan could result in frustration, higher costs and insincere statements by the subcontractor. However, this type of plan is the most common in the industry (Senior, 2007). Introducing the motivation, discipline and protocol required to develop a pulled plan is probably one of the biggest reasons for the use of LPS. However, E3 mentioned that terms like “pull planning” have become easy catch phrases and are not given the appropriate amount of importance. He also expressed that "planned meetings turned into coordination meetings making void the goals of a pull-planning session".
Lookahead plans are closely related to the pulling plan session, the former having a limited timeframe and having more details than the output of a pull planning session. Macomber, Howell and Reed (2005) state that the routine of LPS-pull planning, look-ahead planning, weekly work planning and managing promises daily creates and provides a platform for developing the organization. An issue to keep in check according to E3, is that the authenticity and reliability of the look-ahead meetings can be easily compromised by unrealistic promises made by subcontractors and other project participants.

Workable backlog

Workable backlogs provide a work buffer to stabilize the work flow of a project. They contain a set of pending tasks not chosen to be immediately executed, but which could be readily scheduled to keep a crew meaningfully working towards the completion of the job. The backlog system according to Howell and Ballard (1994) "gives management a significant degree of forward control." Despite the strong rationale supporting the creation of a workable backlog by any subcontractor, E1 stated that "workable backlogs and planned buffers might not be a helpful solution and might cause more negative effects than positive", and E2 asserted that "including workable backlogs in each trade by various subs might lead to confusion and loss of actual schedule."
The reasons given by these two experts for these opinions relate to achieving clarity of objectives. They perceive that the GC and subcontractors may not grasp the rationale for not doing the task most immediately at hand. For example, the physically nearest task may be delayed in favor of another one requiring moving to a farther location if it ensures a continuous crew flow for the project at large. For many subcontractors, according to the interviewees, the logic for creating a workable backlog is not well understood.

People

Leadership

Leadership is generally considered fundamental for the success of a construction project. The results of a survey by Fernandez-Solis et al., (2012), for example, placed "lack of leadership or failure of management commitment or organizational climate" as one of the most important factors for failure in implementing LPS. The three experts interviewed here also considered effective leadership as a primary requisite to implement LPS. E2 stated that "a team and a leader for the team are equally important". Additionally, the leader must be knowledgeable about LPS. E2 reflected this common opinion by stating that "when a leader is not well learned on various lean concepts, especially the ins and outs of Last planner implementation, it is harder for the team to follow him." For E1, "the role of a project manager should be to play a strong leadership role in aiding the subcontractors to overcome the deficits of high scale planning by providing support", a view that once more reflected the sentiment that subcontractors are not proficient in the details of LPS. All levels of planning and implementation were considered as linked to leadership. For example, E3 stated that "the reliability of the weekly look-ahead schedule depends on the attributes of the team leader."

Role of Project Manager

A project manager, as representative of the prime contractor, wields considerable contractual power in the field, and is the person presumed to be in charge of the work plan (Salem, Solomon, Genaidy and Minkarah, 2006). His willingness to implement LPS is a vital component of the effort in many aspects. E2 pointed out that "the primary role that a Project Manager can play early in the project implementation phase is the translation of the master schedule into the subcontractor's schedule." This insight, in turn, points to the back and forth between bottom-up and top-down previously discussed. Following one of these two possibilities too rigidly can "doom the implementation effort very early on."

The other interviewees provided additional perspectives about the project manager's role in implementing LPS. E2 stated that "a project manager is to be in relationship with superintendents and subcontractors to truly practice last planner pull type schedule." For E3, "the responsibility to implement Last Planner System during its operation should trickle down and be transferred to the hands of the subcontractor, while the upper management focuses on resources and logistics." The issue of the GC's responsibility as team leader arose several times. The overall opinion can be summarized in the statement by E3 that "the project management team is responsible for finding methods of meeting the control budgets and schedule rather than justifications for not meeting them."

Commitment and trust

It has been found that a strong commitment is required from the owner, top management and the project team for a successful implementation of LPS (Hamzeh, 2011). A risk about continued commitment, as stated by E3, is that "lean is viewed as a fairly new concept, and human nature leads us to fall back into pre-established comfortable ways". A distinct condition for promises in LPS is that they need to be achievable. "[A]llowing for specific, challenging and achievable promises to be defined by the project team based on production needs, resources and workflow is an important factor in LPS." (McConaughy and Shirkey, 2013). In LPS, commitment implies trust among subcontractors and the reliability of the promises they make toward the performance of the plan. Pull planning is a powerful tool for the shared development of a work plan. However, the experts warned of the problems intrinsic to this process. E3 stated that in most instances, the commitment of subcontractors toward Lean implementation can be superficial. Although unforeseeable conditions make impossible a perfect compliance to stated promises, according to E2, "nine out of ten times [non-compliance] is because someone's trust has been eroded". In an environment of distrust, "each subcontractor does not answer to the other peer and there is isolated or minimal implementation of lean techniques".

E1 believes in the effectiveness of a Study Action Plan "with the purpose of establishing a collaborative environment." This indirect approach to regain trust is well-suited Lean Construction. Games and simulations are frequent tools for LC education and establishing rapport among the project participants (Alarcon and Ashley, 1999, Pellicer and Ponz-Tienda, 2014). Macomber et al. (2005) also propose measures for increasing the reliability of promises and managing their implementation

Level of knowledge

The learning of any new method is intrinsically difficult. "People seem to be happy staying in a comfort zone where people generally don't need to learn new things and therefore don't change." (Koskenvesa & Koskela, 2012).The interviewees had largely negative opinions about the current level of knowledge of subcontractors for implementing LPS. A representative statement by E1 was that "there exists a lack of capacity for the subcontractors to do high level intrinsic planning that the Last Planner System requires and would thus require some extra work in order to implement lean from the team." The reasoning is that if a subcontractor is not familiar with the principles of lean management and LPS in particular, she cannot be expected to accommodate the required changes in style and essence such as collaborative management. The negative perception of the low level of knowledge about LPS was extended by the interviewees to the GC. According to E2 and E3, project engineers and PMs inexperienced or untrained in lean issues tend to transfer responsibility to the subcontractors and their foremen, which in turn find themselves with a responsibility that they cannot undertake. Moreover, a partial understanding of LPS was viewed as very negative. E1 mentioned that when untrained project engineers and project managers partially grasp the ideas of Lean construction implementation, their interpretation can result in a flawed or one-sided implementation of Lean processes and concepts.

Dynamics

Transferring responsibility

E1, E2 and E3 agreed in that the risk of keeping to schedule and practicing lean "gets transferred very quickly to the subcontractors." They pointed out that this shifting of responsibility happens because subcontractors are perceived to be the lowest in the contract chain. This shift is considered by E3 as a risk allocation strategy. The expert coincided in that this shift generally takes place when there is lack of commitment from the GC and other team members supporting the subcontractors to carry out the LPS. The added responsibility frequently happens without much support from the GC or commitment from the subcontractor's upper management. E3 also pointed out that this common situation happens when the GC does not feel confident about implementing LPS, and uses subcontractors as scapegoats for an effort which has a high probability of failing.
E2 stated that subcontractors and their foremen have tangible and immediate means of control over the schedule inside each one's trade, which he saw as an advantage for implementing LPS. This advantage is diluted by subcontractors' perceived limited knowledge and experience with LPS, and because the actual responsibility for implementing LPS is seen as trickling down to the foremen in the jobsite. This affects the project at crucial points such as the 'panic mode' discussed below. E3 added that it would be challenging to be a foreman working on a construction project in a specific trade since he is the head to only one trade, his impact on other tasks that need to be done is limited.

Panic mode

Towards the end of the project, the timing for the execution of many activities tends to reach a critical level where the management of the project enters into 'panic mode'. In panic mode, subcontractor attention focuses on overcoming immediate struggles to project completion, even at the cost of introducing increased uncertainty and work variability to the project at large. Everyone feels the need to fend for themselves.
Johansen, Eric and Porter, Geoff (2003) narrate such a situation: "The trend towards the end was that this resource pressure [on labor availability] became the major problem. The subcontractors seemed to work on an inter job resourcing process based upon 'the loudest shouter gets the resource today' and little pressure could be produced even on preferred subcontractors to improve this."
Panic mode can be a challenging phase for the project teams to continue implementing LPS, and it is at this point that commitment to the developed work plan is truly tested. E2 expressed that this mode happens more often than rarely. He suggested that on the event of such an issue of panic mode, the PM could perform a pull planning session. Instead of abandoning LPS, the goal would be to make the system work by increasing the understanding of the causes of the situation and reacting to it. E3 suggested that the trust of the team members toward each other can be best regained by conducting a Study Action Plan, with the purpose of establishing a collaborative environment.

According to Macomber et al. (2005), some companies that initially begin applying lean concepts in a project tend to use their daily stand up meetings to address urgencies, give directions and transmit superintendent's orders for the day instead of using the meeting to bring resilience to the network of commitments. This short-sighted attitude can eventually hasten the perception of being in panic mode.

Discussion

Shared Planning

LPS' distinctive feature of collectively creating a work plan that makes sense to all participants has been found in previous research as an asset for implementing the system (Ribeiro, Costa, and Magalhães, 2017). The advantages for subcontractors of allowing an active participation in developing the work plan were clearly appreciated by the experts. Their main concern was that a pull planning session could be transformed into a traditional coordination session, with the danger of distorting the plan with unrealistic promises made under pressure by subcontractors. The perception that defining subcontractor work backlogs could be counterproductive for the work flow appeared to be less focused on the pressure that subcontractors may receive during the shared planning phase and more on the ability of a subcontractor to misunderstand the use of the work backlog as a reservoir of feasible but not chosen tasks. This insight, shared by two of the three experts, demands more attention in further research, since it touches on an important component of LPS.

People

Given the intense, person-centered nature of LPS, leadership was considered essential to the implementation of LPS at the subcontractor level. The GC, and particularly the PM, was viewed as largely responsible for carrying out the role of leader for implementing LPS. Given the vertical contractual relation between contractor and subcontractor, this perception implies that subcontractors depend on the PM's drive for implementing LPS, and therefore, the subcontractor's role is intrinsically passive. This statement contradicts the experience of one of this paper's authors, who has seen the planning of projects being led by one or two subcontractors, with the PM participating at roughly the level of other stakeholders.

The experts had largely negative opinions about the knowledge level of subcontractors about LPS and the effect that this unfamiliarity can have in the effort to implement LPS. The conundrum of level of knowledge versus willingness to participate in implementing LPS seems difficult to overcome, but needs to be further addressed.

Dynamics

This area illustrated the many issues that need to be addressed when a transformational system like LPS is implemented. The transferring of responsibility for the implementation of LPS from the GC to the subcontractors seems to be inconsistent with the high expectations that subcontractors have towards the PM as the leader of this effort. The other aspect discussed under this area was the panic mode that can arise in a project. This issue was perceived to be essentially dependent on the level of trust among participants. Improving trust was viewed as a precondition for overcoming panic.

Conclusion

This study identified issues concerning the implementation of LPS that were perceived by the interviewed experts as of high value or high concern by construction subcontractors. Given its small, qualitative nature, it shows the shape of these issues instead of offering a detailed depiction. Despite its limited scope, the present study contributes to the understanding of LPS. As Priven and Sacks (2016) point out, despite empirical evidence of the effects of the Last Planner System, the mechanisms by which it works are less well understood. This statement is especially relevant in the case of construction subcontractors, whose views tend to be overwhelmed by the larger size and visibility of general contractors.

This exploratory research will be followed by a larger, quantitative-oriented study.

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