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SOCIAL INTERACTIONS AND TEAM DYNAMICS IN A LAST PLANNER MEETING: AN OBSERVATIONAL METHOD

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ABSTRACT

The Last Planner System ™ (LPS) is one of the most widely recognized lean techniques in construction to improve production planning reliability. Previous studies have suggested there is still room to maximize the benefits of LPS by identifying the missing parts in the implementation process or identifying the barriers to the effective adoption of this strategy. As one of these shortcomings, LPS has had limited study concerning its human aspect and participants' social interactions to inform the technique's effectiveness.

This study seeks to understand the relationships among the LPS technical procedure, social interactions and team dynamics, and the actual planning outcomes in construction projects. An observational methodology is proposed to investigate the hypothesis that if construction teams more closely adhere to LPS procedures, the technical processes would be aligned with positive social interactions among team members leading to improved team dynamics. To support this hypothesis, the procedures and norms from literature were extracted to define the observable characteristics for capturing and comparing the implementation. This methodology can be used as a resource for construction companies to investigate the quality of the current operating procedures of LPS and develop corresponding implementation and improvement standards to secure the full benefits of LPS.

KEYWORDS

Last Planner System, process, observable traits, team, collaboration.

INTRODUCTION

Production control has always been considered a challenging area under traditional construction practices, where the ad-hoc control methods foster uncertainty and variability, limiting smooth production flow (Dave et al., 2015). In Ballard's (2000) view, the root cause is that traditional production management practices are dominated by the conversion model, which conceptualizes production as a process of converting inputs into outputs, ignoring the value generation model and flow management techniques. To tackle this issue, the Last Planner System ™ (LPS) has been introduced as a production planning and control tool, contributing to increased planning reliability and improved workflow through the collaboration of the entire project team and greater involvement of the *"last*

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planners" (Ballard, 2000; Hamzeh & Bergstrom, 2010). In this environment, by promoting effective communication among the project team at appropriate levels of detail and before issues become critical, LPS significantly improves program predictability, reliability, and feelings of well-being among project staff (Mossman, 2012).

Previous studies recognized that the LPS effectiveness in projects is not achieved due to partial, short-term implementations and without continuous feedback. The variation in LPS execution suggested developing a tool to measure the level of LPS implementation to help organizations achieve improvement actions (Perez-Apaza et al., 2021). From one perspective, LPS can be viewed as a social system comprised of project participants who come together to collaboratively plan and control project production. Therefore, social interactions among the project participants play a critical role in improving the project coordination and, thus, the workflow (Ghosh et al., 2019). Hence, studying and analyzing the participants' social interactions and their impact on creating positive team dynamics, along with how those behaviors match the technical processes of LPS, can bring insight into realizing the full benefits of LPS. In this context, research studies have investigated social aspects of LPS implementation, such as applying the Linguistic Action Perspective (LAP) to understand the effectiveness of LPS by measuring and controlling the management of commitments (Retamal et al., 2021, Salazar et al., 2018, 2019), or using Social Network Analysis (SNA) to analyze information flow (Retamal et al., 2020). However, how the technical procedures occurring during Last Planner meetings can be interpreted into social interactions by using behavioral metrics is missing from the current literature. To fill this gap, the authors suggest that the key aspects of technical procedures of implementing LPS, such as making a release of work between specialists reliable, can be measured by observable traits between project team members.

Therefore, this paper presents an observational method to investigate social interactions and team dynamics within the LPS meetings as a means to examine their impacts on the successfulness and effectiveness of LPS. Studying how last planners interact can provide valuable insights into the way they collaborate and make decisions in creating/controlling production planning. By defining proper measurement metrics to track these interactions as observable traits, constructive trends may be identified to help in creating successful LPS. For this purpose, a literature review was undertaken, followed by developing an observational study's procedure, including a coding scheme for studying and evaluating the impact of social interactions on team dynamics and the LPS implementation. A key objective of this study is to present a methodology for measuring and analyzing the team's adherence to technical procedures through observational social interactions and behavioral metrics within LPS. This paper does not describe the outcomes of using this framework in a real case study, which will be the authors' future direction.

LITERATURE REVIEW

Construction is a project-based industry, which means for almost every new project, the construction team is organized and formed around specific trades and functions. For every project, different people are needed, many of whom must work with others from new and different companies (Levitt, 2011). In this context, understanding team member interactions and improving working relationships can influence project performance and success (Lin, 2015). Additionally, construction projects bring together multiple parties from various disciplines with diverse expertise and specialties. In organizational terms, each of these specialist firms has its own objective, resulting in a lack of shared goals and

objectives. According to Ju et al. (2017), the lack of common objectives among team members usually limits understanding of how one team member's behavior affects the others. Koskela and Howell (2002) remarked that organizations could build on their capacity with other project members through collaboration, helping reduce fragmentation and mistrust among the team. This implies that collaborative planning keeps the project team focused on the project's goal and creates a sense of ownership (Daniel et al., 2014). Successful collaboration does not occur naturally; rather, it is fraught with challenges. Collaborative conversations in the LPS have been noted to bring the team together, resulting in learning, innovation and creativity as team members benefit from each other's know-how (Daniel et al., 2014; Mossman and Ramalingam, 2021). According to Perez and Ghosh (2018), many researchers affirmed that LPS encourages teamwork, enables proactive involvement, promotes participation, transparency and improves communication and coordination.

Previous studies have tried to shed light on the social aspect of LPS through understanding the effect of this technique on the participants' social interactions. Murguia (2019) emphasized the critical role of having a social approach to planning rather than a technical approach, resulting in collaboration among project stakeholders. Likewise, Daniel et al. (2014) demonstrated that integration and communication were important to successfully implement the LPS. In one of the recent studies on the LPS social aspects, Ghosh et al. (2019) adopted a critical case study method to analyze the interactions among the participants of two projects, one following LPS and another following traditional project planning. Observing weekly subcontractor coordination meetings revealed that LPS increased the participants' understanding and control of the work assignments, creating a social system with higher trust. More cooperation was also reported among participants using the LPS than traditional project planning (Ghosh et al., 2019).

Previous studies have also examined the behaviors that emerge from LPS implementation. For instance, Pavez and González (2012) highlighted the importance of studying the social dynamic of improvement driven by LPS. Their analysis showed how the LPS implementation could change team dynamics in the construction field, transforming the work environment by changing the perceived level of trust and trustworthiness, the team's attribution process, and the quality of goal setting. They have noted that during the LPS implementation, a tipping point occurs in the dynamic of the weekly plan meeting when the project manager starts to listen more, and the last planners are allowed to share their viewpoints. They witnessed that when this happens, the dynamic of the conversation starts to change, and the project manager's behavior during the meeting turns from advocacy to inquiry. In this environment, the project manager's comments start to be perceived as a way to understand others' perspectives to improve project productivity and performance rather than orders. Similarly, Fauchier and Alves (2013) stated that LPS teaches the participants foundational behaviors such as collaboration, transparency, making clear commitments and reliable promises, accountability, and metrics. They identified three main sets of behaviors related to or promoted by the LPS: building social networks, treating construction projects as production systems, and addressing multiple needs in a dynamic environment, which are closely related to the challenging attributes of construction teams previously noted.

All of these studies suggest that in a project using LPS, social interactions occurring during the LPS implementation are important aspects that need to be considered in the execution. In this respect, previous studies tried to investigate how these social indicators influence the effectiveness of LPS. For example, Retamal et al. (2020) explored the

relationship between planning reliability by analyzing percentage plan completed (PPC) measures, Linguistic Action Perspective (LAP) indicators and Social Network Analysis (SNA) metrics in four construction projects using the LPS. This study revealed that better SNA metrics and better PPC are generally observed when better LAP indicators exist. Likewise, Castillo et al. (2016) conducted a study to analyze the relations between LPS implementation, social networks metrics and performance in construction projects. The correlation analysis demonstrated that the implementation level of LPS is related to social network average degree and density; however, it does not always mean better project performance. They claimed that further research is still required to identify social networks' optimum metrics related to project performance (Castillo et al., 2016). In other attempts by Salazar et al. (Salazar et al., 2018, 2019), researchers developed indicators of commitments based on the Linguistic Action Perspective (LAP) to measure, control and improve the management of commitments in planning meetings to enrich the implementation of the LPS. The authors proposed a series of Key Performance Indicators (KPIs) based on LAP to measure and control fundamental aspects of the commitments, requests, promises and foundations of trust.

Despite all these studies, detailed observational data points for the way the LPS procedures should be implemented have not been studied. As a contribution to this discussion, the present study investigates the human behaviors and social interactions in a LPS meeting and tries to link them to the LPS technical procedure, e.g., how the meeting is conducted and adherence to LPS best practices, and their impact on planning performance by defining observational traits between team members. The paper aims to be sufficiently descriptive of the observational processes so that team's behaviors can be understood and linked to the effectiveness of LPS implementation. This helps construction companies better take in strategies to realize the full benefits of LPS by considering human aspects of the method, in addition to the technical considerations.

PROPOSED METHODOLOGY

USE OF OBSERVATIONAL METHODS FOR LAST PLANNER MEETINGS

This section presents a method to employ direct observation using video recording of LPS meetings to analyze team members' interactions when planning and controlling a construction project. The goal is to assess the proposed correlation between LPS technical routines, social interactions that occur during a LPS meeting, and resulting team dynamics. We hypothesize (Figure 1) that if construction teams adhere more consistently to the LPS principles and procedures, those processes will reinforce the positive social interactions among team members. Subsequently, positive social interactions affect how people treat each other in the process. The resulting team dynamics promote open conversation among project teams that enhances the planning and scheduling performance, which cycles back to support the technical procedure of LPS. Figure 1 depicts a proposed framework to demonstrate the process between technical procedures, social interactions, and team dynamics.

As the first step, a review of the technical procedure of performing a LPS will be presented. This is an important step for the study's purpose since without understanding how the LPS should be implemented, the team interactions to bring effective outcomes cannot be studied. Moreover, as Perez & Ghosh (2018) discussed, without clear processes set out by management, personnel are unable to confidently take the steps necessary to implement the technique and see its benefits. Therefore, a review of technical procedures

for implementing LPS serves as the starting point. A literature review on the previous studies on the LPS was conducted to extract the implementation procedures. Ballard's (2000) study was the primary reference for this step; however, other studies were also considered to depict an appropriate implementation process.

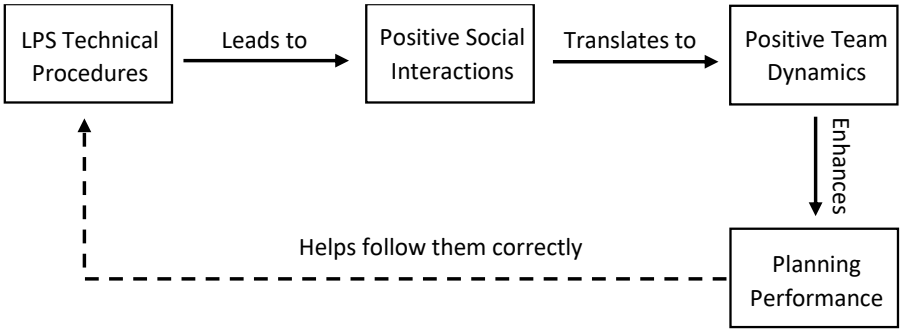

Figure 1: Hypothetical framework of the correlation between LPS technical routines, social interactions, and planning outcomes across the LPS teams.

LPS TECHNICAL PROCEDURE

A complete implementation of LPS consists of four scheduling and planning levels, including Master Schedule, Phase Schedule, Lookahead Schedule, and Weekly Work Plan (WWP) (Ballard, 2000). The first level, the Master Schedule, is the output of front-end planning describing work to be carried out over the entire project's duration, providing the basis for delivering the project and meeting milestones (Ballard & Tommelein, 2016). Phase scheduling aims at dividing the master plan into various phases to develop more detailed work plans and provide the project team with goals for each phase by using the *"pull planning"* technique and involving representatives of all organizations working on that phase (AlSehaimi et al., 2014). The third level, Lookahead Planning, contains major work items that must be completed to meet the milestone dates in the master pull schedule. To do so, a list of all activities planned to be carried out in the next 2-6 weeks needs to be prepared, and all the constraints preventing the execution of these activities need to be identified and removed (Ballard & Tommelein, 2016). At the last level, Weekly Work Plan (WWP) represents the most detailed plan in the system showing interdependence between the work of various specialist organizations containing the actual commitments to what is carried out on-site (Ballard, 2000).

Regardless of the planning level, an effective LPS meeting should include certain technical procedures to ensure the successful implementation of LPS. As explained before, the main objective of this study is to present a methodology for measuring the team's adherence to technical procedures through observational behavioral metrics. To propose these metrics, following the literature review, the authors observed six planning meetings in three different projects to understand behavioral traits within the implementation procedures. These projects were selected from construction organizations that actively used the LPS to schedule, plan, and coordinate their activities. Four observed meetings were Weekly Work Planning sessions, one was Phase Scheduling, and the last was Lookahead Scheduling. In addition to the direct observations, some data were obtained through unstructured interviews with team members, such as project managers or lean champions, about how they implement the Last Planner System and how they expect team members to interact with each other during these meetings.

Table 1: Procedures expected to occur during a successful LPS meeting

Expectations	Observable Activities	Data Points and Metrics
Attendance: All key players are invited in advance. **Preparation:** Participants come to the meeting prepared with their specific inputs. **Participation:** Everyone participates in the actual pull planning session.	• All trade partners and the owner are present in the meeting. • Attendees join the meeting ready, bringing notes for their activities and tasks. • Participants all actively provide inputs for the conversations. • Requests or questions are posed to the team (other trades) with direct responses.	• Duration of time each team member talks. • % of the time superintendent (or facilitator) talks. • % of trades participating (of those working on-site). • % of stickies created ahead of time vs. created "upon request." • % of trade responses provided directly to GC. • % of responses provided to other trade questions/requests.
Training: Effective coaching before and during planning sessions is provided for all participants.	• The facilitator provides the set-up (board, stickies) for trade partners, explaining how to fill in their activities. • The project master schedule has already been provided for the last planners.	• Duration/ frequency of time re-visiting steps or procedures (e.g., how to fill out a sticky correctly). • Who provides procedural information. • References to or questions about other 'levels' of LPS planning (6-weeks, major milestones)
Collaboration: The team collaboratively plans in alignment with the trades' production systems and the project milestones.	• Facilitator helps team members collaboratively build the plan by considering the trades' resources and capacities and pulling from milestones. • The facilitator does not force trade partners to commit to completing a task. Trades are asked their opinion on how they can better align their production performance with project milestones.	• Number of questions vs. statements by a facilitator/superintendent. • Number of instances where team members say 'no.' • % of 'no' instances where a team works out an agreeable solution to meet teams' needs. • Number of times where an issue is not resolved during the meeting. • Number of instances in which another team member volunteers a solution that involves them compromising their plan.
Being Committed: Last Planners make promises that they can reliably keep.	• Last Planners do not blindly agree to requests. • The inputs come from the Last Planners themselves, rather than forced by the facilitator. • Team members show agreement and commitment to reliably delivering assignments they are responsible for.	• % of commitments made based upon the request of others. • % of commitments where last planners identify constraints that need to be addressed first. • % of topics for which "What, where, when, and who" are discussed for activities. • % of stickies placed directly by trades.

Using Visual Management of the Project Information: BIM Model, design drawings and layout of work area(s) are made available for the team to reference during the session.	• Trade partners use drawings to communicate clearly about the sequence or locations of their construction activities. • The facilitator uses drawings or model images to raise questions or support discussions about segmentations of work to ensure all parties are on the same page.	• Number of times model is explicitly referenced. • Number of references (specific pointing) to design drawings or model images. • Number of drawings or model images to be brought up on a screen to support discussion.
Identify Constraints: Constraint analysis of all activities is applied as a proactive approach to problem-solving as a team.	• Constraint analysis of all activities in the Lookahead schedule (e.g., funding, design, materials, prerequisite work, direct and indirect labor resource availability, and all other potential constraints considered).	• Number of times team members volunteer information about their work disruptions (e.g., design, materials, prerequisite work). • Number of items added to constraint log during a meeting. • Number of times existing constraints are discussed.
Analyzing the trends: The team measures the extent to which the Last Planners and team leaders' commitments were realized.	• They perform the weekly analysis of PPC. • The team works together to identify reasons for disruption and failure to complete planned work. • The facilitator tries to investigate noncompliance reasons, providing solutions to prevent their recurrence. • The facilitator focuses on process improvement by asking for team members' suggestions and opinions. • Visual illustration of the PPC and trends are provided.	• Duration that team determines what assignments were completed or not based on the plan (PPC). • Duration that is devoted to reviewing the task reasons for non-completion (root cause) • Duration of time devoted to discussing (changes in root cause) across multiple weeks of data. • Number of references that the facilitator uses diagrams and illustrations to discuss their performance with the team. • Tracking / visual(s) of root cause reasons are created and shared.
Continuous Improvement: Systematic learning is shared at the point of work.	• Team members actively participate in the discussion session and propose suggestions for their encountered situations. • The GC record the lesson learned from their failures and how they handle those situations.	• Number of suggestions made by trade partners. • Number of suggestions made by GC. • % of suggestions or options suggested by (each) trade?

Although each of them had their organizational planning processes, their responses were beneficial to understanding how each pursues LPS in their projects. Using the triangular method, which means gathering the information in different ways (in this paper, literature review, observation, interview), helped consider different perspectives, providing insights into the technical routines of utilizing the LPS and suggesting data points and metrics for measuring them. A list of these technical procedures, along with observable

activities, are outlined in Table 1 to help define what observable data points to look for during a LPS meeting. To capture and code those observable traits, a set of data points and metrics is also provided with each expectation.

OBSERVATIONAL METHOD STEPS

This section proposes observational activities with supporting data points to investigate how social interaction and team dynamics in construction teams impact the successful implementation of a lean method, the Last Planner System (LPS). To this end, the paper puts forward a process to study the relationship between team interaction and the LPS technical procedures by observing the attributes or traits of project participants during LPS meetings to identify what meaningful correlation between them may exist.

STEP ONE: DATA CAPTURE THROUGH DIRECT OBSERVATION OR VIDEO-RECORDING THE MEETING

We posit a possible correlation exists between social interactions and team dynamics with the successful implementation of LPS technical procedures. The observation method is proposed to investigate this hypothesis and collect data to indicate how construction teams interact during the LPS meeting. For this purpose, a list of technical procedures expected to occur during the successful LPS meeting was presented in Table 1. The data points and metrics provided in this table offer an initial set of data to investigate how closely the project team adheres to LPS best practices concerning the technical expectations of the method.

Knowing these technical procedures, a researcher takes the role of a third-party observer, attending a meeting and concentrating on team members' social interactions. The observation process should not be particularly disruptive for conducting the planning and coordination session. While observing, listening, and taking notes on teams' interactions seems to be a more natural procedure, video recording can add value to the observational study. Visual recording devices allow for capturing an activity under study, letting the observer return to the document for further analysis. Hence, the content analysis can achieve greater rigor or exactness (Leicht et al., 2010). Despite all these benefits, recording is not an absolute necessity; rather, it is highly desirable as a sort of *"insurance"* against accidental loss, and it is beneficial for examining the study's reliability (Bales, 1950). Yet, it is possible that the project team would feel uncomfortable being recorded. Moreover, the process of video-recording the team interactions carries the risk of unintentionally changing participants' behavior (Paoletti et al., 2021). Therefore, the benefits and potential impacts of video-recording need to be weighed carefully against the benefits in each project context.

STEP TWO: ANALYZE THE SOCIAL INTERACTIONS USING THE IPA METHOD

A common form of interaction analysis is Bales' (1950) *"Interaction Process Analysis"* (IPA). He proposed a method to observe social interactions in a small face-to-face group, including teams and workgroups. For this technique, he classified group ranges in the number of involved persons from 2 to 20 as *"small groups,"* which appears to be applicable for most construction project teams applying LPS. The heart of this method is a way of classifying direct, face-to-face interaction as it takes place, act by act, and a series of ways of summarizing and analyzing the resulting data to yield useful information. IPA is a 12-code taxonomy of team communication consisting of four groups and three codes under each category. These groups are (1) positive social-emotional reaction (e.g.,

shows solidarity/seems friendly), (2) negative social-emotional reaction (e.g., shows tension or anxiety), (3) task-related questions (e.g., asks for information), and (4) task-related attempted answers (e.g., gives suggestions) (Paoletti et al., 2021). By reviewing the meeting, the observer codes how often an action takes place and how much time is spent performing a given activity. As people in the meeting talk to each other, the observer breaks their behavior down into the smallest meaningful units that can be distinguished.

We posit that if team members properly follow the technical procedures of LPS (Table 1), we will witness higher positive social reactions, as well as task-related interactions. In contrast, the negative reactions would be decreased. This argument is based on the fact that the fundamental principles for implementing LPS, such as *"produce plans collaboratively with those who will do the work planned," "make and secure reliable promises,"* and *"reveal and remove the constraints on planned tasks as a team,"* (Ballard & Tommelein, 2016) are closely related to these social reactions, leading to positive interactions among team members. It should be kept in mind that LPS technical routines encourage effective and useful communication, transparency, and cooperation, bringing constructive social interactions, such as showing agreement and asking for suggestions.

Moreover, fewer negative reactions would occur if the project team adhered to the LPS procedures. For instance, the shared leadership style, a preferred type of leadership for collaborative planning, results in less antagonism or deflating of others' status. The autocratic control of traditional planning is no longer welcome under the lean mindset. Therefore, the observer probably sees fewer indicators of someone attempting to control or supervise in an autocratic manner, in which freedom of choice or consent for members is either greatly limited or non-existent. In contrast, in a true LPS, trade partners can freely talk about constraints they might encounter and request/suggest measures to solve them rather than follow the General Contractor (GC)'s directive immediately without argument.

STEP THREE: INVESTIGATE THE TEAM DYNAMICS THROUGH OBSERVATION AND INTERVIEWS

Having identified the technical procedures and social interaction among team members, the researcher seeks to answer the question of *"how these reactions can lead to positive team dynamics."* As Asadian & Leicht (2021) explained, team dynamics describe how unconscious psychological forces affect the behavior of groups of people working together. Understanding and identifying these dynamics within the project team helps align team outputs with project goals and ultimately increases the likelihood of project success. In this study, they used the A-B-C framework developed by Salas et al. (2008) to establish a meaningful correlation between team dynamics and lean principles. The proposed framework depicts three essential aspects of teamwork: Attitudes, shared Behaviors, and Cognition of the individuals that make up the team (Delice et al., 2019).

We believe there is a direct relationship between technical procedures of LPS, positive social interactions and team dynamics. Based on this assumption, if team members follow LPS procedures (Table 1) correctly, the emerging positive social interactions lead to constructive team dynamics. For example, Bales (1950) highlighted a permissive attitude, where the other is led to understand that a team member is accepted "as he/she is," as an indication of showing agreement, acceptance and understanding. When this positive social interaction occurs, team members believe that the incorrectness of their proposed solution to a problem does not adversely affect their status in a LPS meeting. They can *"make mistakes without blame,"* thus, they do not feel anxious when someone asks their opinion. These kinds of social reactions by their teammates encourage team dynamics,

namely openness, trust and psychological safety, which are critical to the collaboration of multiple stakeholders and effective communication. This is the exact environment where the LPS processes can be implemented properly.

STEP FOUR: STUDY THE PLANNING PERFORMANCE USING PPC

One of the main processes of LPS is that the construction team learns together about the production procedures from their weekly performance. For this purpose, construction teams use metrics, such as Percent Plan Complete (PPC), Percent Constraints Removed (PCR), Tasks Anticipated (TA), and Tasks Made ready (TMR) (Perez-Apaza et al., 2021) to help update the next WWP accordingly by identifying and removing the reasons for the non-completion of tasks. As one of the most widely used metrics, Percent Plan Complete is calculated by the number of planned completions divided into the number of actual completions. This metric is used to track the performance of reliable promising at the weekly work plan level, helping initiate preparations to perform work as planned (Hamzeh & Bergstrom, 2010).

We postulate that since Last Planner System supports effective relationships by enabling open conversations and resulting commitments for action at the right level at the right time, leading to better planning. Therefore, we set forth that measuring the PPC of different LPS meetings, along with the data gathered by the observer on the team's adherence to the technical procedures and social interactions and team dynamics, will provide effective data to properly evaluate this hypothesis. In this regard, the observer needs to study the PPC as an indicator of how well the team conducted its planning production and compare this metric across different work teams. We predict that a higher percentage of tasks completed will be observed among the teams with a higher level of procedural adherence, corresponding with positive social interactions and team dynamics.

CONCLUSIONS

Most of the prior research studies in the lean construction domain have concentrated on lean instruments and applying new technologies. These studies have contributed to the development and advancement of lean adoption by pointing out principles, practices, methods, and techniques. However, understanding how project participants use the methods with a specific concentration on their social interactions and team dynamics can also bring valuable insight into how to enhance the effectiveness of these methods. Therefore, to achieve the best possible result from adopting a powerful planning production technique, namely the Last Planner System, in addition to focusing on the technical procedures of implementation, the question of *"how human dynamics influence the method's adoption"* is required to be answered.

In this article, we presented an observation-based mixed-method (including observation, interview, and analyze the data collected) that is advantageous and suited to study the relationship between social interactions and team dynamics and the technical procedure of LPS implementation. By explaining the four steps for this method, along with details of the needed LPS data collection, we demonstrate a potential method for systematically capturing ongoing processes of team dynamics for construction projects that use LPS. This study contributes to academic and practitioner knowledge by helping document what teams experience and hypothesizes how their experiences translate to performance. Our proposed method is not the only option. Still, it may illuminate a path forward for team-level research in the lean construction domain in hopes it will facilitate the investigation of human- and team-related aspects of lean techniques implementation.

The authors plan to test and validate the proposed methodology in case studies to improve data points and metrics for future research.

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