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EMPIRICAL STUDY ON THE INFLUENCE OF PROCUREMENT METHODS ON LAST PLANNER® SYSTEM IMPLEMENTATION

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ABSTRACT

Previous studies have examined various factors that influence the implementation of the Last Planner System (LPS) in construction projects. However, there is limited documented evidence on the influence of procurement methods on the implementation of the LPS. The aim of this study, therefore; is to understand the influence of some selected procurement methods on the implementation of the LPS using case study approach. Three in-depth case studies were conducted on building and highways projects in the UK. The projects were managed with the LPS principles with dissimilar procurement methods. In addition to document analysis and physical observation, 28 in-depth-interviews were conducted.

The investigation shows that the prevailing traditional mindset exhibited by the designers in the traditional design bid build (DBB) influences the quality of promises and commitments that could be made during the lookahead planning. From the study, it seems no single procurement method is a sure way to the full application of the LPS process on a project. The study observes that irrespective of the procurement route used, a mindset change towards collaboration among the different stakeholders on the project is fundamental to successful LPS implementation. For instance, on projects where DBB was used and the subcontractors were in framework agreement, the LPS implementation worked well among the subcontractors. The study recommends that the procurement approach to be used on LPS projects should not be too firm, but lithe enough to integrate collaborative working among the different stakeholders on the project for a smooth workflow.

KEYWORDS

Lean construction, Last Planner System, procurement methods, collaboration, make ready

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INTRODUCTION

The wrong choice of procurement method has been identified among the factors that contribute to construction project failures (Love et al. 1998). Love et al. (1998) argued that procurement method not only drives the project in term of time, cost, and quality, but also, it contributes to the relationship that develops among the stakeholders on the project. This shows the vital position procurement method occupies in the delivery of a successful project. In this study, procurement is seen as the approached used in the delivery of the entire project right from design to handover. Also, in recent time the application of lean construction techniques, for example, the Last Planner System (LPS) to improve the prevailing approach to construction project management has been suggested by key stakeholders in the industry (Egan, 1998).

The LPS is an approach for managing project production in the construction industry (Ballard and Howell, 1998). Studies have shown that the LPS has been implemented on construction projects in different parts of the world; Middle East, North America, Europe, Asia, Africa, and South America, among others (Daniel et al, 2015; Fernandez-Solis et al. 2012). This shows there is an increase in the rate of implementation of the LPS in construction projects across the world. However, it has also been observed that contextual factors (such as procurement method, contract and culture) within the project environment could influence LPS implementation on a construction project (Daniel, 2017; Heidemann and Gehbauer 2010). On the contrary, there is limited documented evidence to support this assertion. In voicing their concern on this, Fuemana et al. (2013) pointed out that adequate attention has not been given to the influence of procurement methods on the implementation of the LPS. Additionally, Vilasini et al. (2014) argued that procurement process should be the starting point for the integration of lean techniques into the construction industry.

Procurement methods play a central role in the delivery of construction projects. In addition to the increasing use of the LPS in the delivery of construction projects, understanding the relationship between the former and later is essential. The goal of this investigation, therefore; is to explore the influence of some selected procurement methods on the application of the LPS in construction project. The key question is; *What is the influence of procurement methods on the implementation of the LPS in construction projects?* Providing an answer to this question would expose and offer a new insight into how procurement methods (traditional procurement system and design and build) influence the implementation of LPS in construction projects. This contributes to further implementation of the LPS principles in projects.

LITERATURE REVIEW

LAST PLANNER SYSTEM

The LPS is an approach developed for managing project-based production system for practitioners in the construction industry (Ballard and Howell, 1998). The "Last Planner" refers to the frontline supervisors (Ballard and Tommelein, 2016). The LPS is based on five key elements; (1) the master planning or milestone planning, (2) collaborative programming/phase planning, (3) the Make-ready planning, (4) Weekly work plan and (5)

Measurement and learning. These elements are described extensively in Ballard and Tommelein, 2016). Through the application of these elements, the LPS supports the development of a collaborative working relationship and on time delivery of construction projects. However, the LPS has been criticised because the programme used in developing the phase planning is taken from the traditional programme developed with a Gantt chart (Koskela and Stratton, 2010). Nevertheless, the LPS process empowers the stakeholders doing the work to contribute to the phase planning process so as to develop a reliable plan which makes it different from the traditional approach to project management.

LAST PLANNER SYSTEM IMPLEMENTATION AND PROCUREMENT METHODS

There is compelling evidence that the implementation of the LPS is growing (Daniel et al, 2015; Fernandez-Solis et al. 2012). But, at the same time, lean construction scholars have also identified barriers to its implementation in a construction project. Some of these barriers are; resistance to change and human attitude, short-term vision, use of incompatible procurement methods and focus on cost, culture and structural issues within organisations, among others (Fernandez-Solis, et al. 2012; Fuemana, et al.2013). The identification of incompatible procurement methods among the current challenges to LPS implementation cannot be discounted because of the central role procurement methods play in the delivery of construction projects. The procurement method is seen as a major factor that contributes to client satisfaction and the achievement of the overall project goal (CIOB, 2010; Love et al, 1998). However, the choice of procurement method to be used on a project could be tricky and complex as it is usually influenced by external factors, client characteristics and project characteristics (Love et al. 1998).

Lean construction researchers, on the other hand, have always maintained that lean construction principles and techniques are best implemented under a relational contractual framework (Vilasini et al. 2014; Mathews and Howell, 2005). However, in practice, most construction projects are procured using other methods and arrangements such as a traditional design, bid, build; design and build; management contracting; and construction management; among others (especially in the UK and other Commonwealth countries). While the design and build procurement method allows for some integration between design and construction the traditional design, bid, build procurement system (DBB) method does not (CIOB, 2010). Previous studies have speculated that procurement methods could influence implementation of lean techniques in construction projects (Fuemana, et al. 2013; Matthews and Howell, 2005). There is limited documented evidence to support this assertion with regard to specific procurement methods, such as DBB and design and build procurement methods. In the light of this, the current investigation seeks to understand the influence of DBB and design & build procurement methods on LPS implementation using a case study approach.

RESEARCH METHOD

A case study approach was adopted in the current investigation. Case study methodology is usually used when a study seek to examine a phenomenon in a real life environment (Yin, 2014). Additionally, lean construction scholars have also argued that the case study

approach is appropriate for investigating the LPS because of its practical nature (Daniel et al, 2015). Their review of over 50 IGLC published studies on LPS found that the case study approach is the most used research method in LPS related studies. In this study, the case study strategy was applied as it allows the investigation to understand how procurement methods influence the implementation of the LPS in real life situation (the project and the context of the physical environment where the LPS is being implemented).

Different techniques were used to collect data from multiple case studies. These techniques include semi-structured interviews, document analysis, and unstructured observation to support triangulation. Unstructured observation was used as it allows the study collect more relevant evidence. Contract documents, construction programme and charts displayed on boards were analysed. Yin, (2014) observes that triangulating data through the use of multiple techniques and methods make the findings of a study robust. However, Yin, (2014) cautions that the study should be designed to ensure all the required evidence is captured. In view of this, three case study projects managed with the LPS and procured with different procurement methods were selected. This was done to enable the study explore the influence of the procurement method on the implementation of the LPS. The case studies were conducted concurrently over a period of 12 months providing an opportunity to collect real world evidence. For the purpose of confidentiality, the case studies are described as CSP01, CSP02 and CSP03 (where C= case, S= study P=project).

Data collection started with observations, followed by document analysis and then semi-structured interview. This enabled further clarification on findings from observation and document analysis. Also, the first author attended monthly Look ahead production planning meetings as an observer. The following research participants were interviewed; senior managers (SM), middle managers (MM), operational managers (OP), and subcontractors (SC). Four of the SM and three of the MM interviewed are from the client organisation. The interview instrument consists of two sections; the background of the respondents and questions on the influence of procurement method on LPS implementation on the particular project. A total of 28 research participants were interviewed, which include; SM = 9, MM = 6, OP = 6, and SC = 7. The respondents were selected because of their extensive experience in the use of LPS. The transcribed interviews were substantiated with results from document analysis and physical observation. The result of the qualitative data gleaned are presented and discussed in the subsequent section. Specifically the impact of DBB and D&B procurement methods on the quality of promising and the level of commitments during the make ready and look ahead planning are discussed.

PROJECT ATTRIBUTES

Table 1 shows the attributes of the case study projects investigated. It can be seen that dissimilar procurement methods were used on the projects providing a comparison of the influence of the procurement method selected on LPS implementation. Additionally, the project durations are all long enough to capture the evidence required to address the research questions. Most of the subcontractors on all the projects are in a framework agreement with the main contractor. The case studies were done concurrently over a

period exceeding 12 months. Twenty-eight semi-structured interviews were conducted. The respondents interviewed have 5-20 years' experience in the construction industry and 3-10 years in the use of LPS. They all claim to have been involved in more than one project where the LPS was used.

Table 1: Project Attributes

Project Attributes	CSP01	CSP02	CSP03
Nature of project	Highways and Infrastructure	Highways and Infrastructure	Building construction project
Proposed project duration	30 months	24 months	30 months
Procurement Method	D&B	Traditional DBB	D&B

RESEARCH METHOD

INFLUENCE OF PROCUREMENT METHODS

Influence of DBB on Make-Ready and Look ahead Plan and the Quality of Promising

The investigation shows that build ability issues occurred more on CSP02 where the traditional DBB was used. A research participant stated: *“The barrier here is that the design is not been met. The drawing is not working as expected. Some of the information used in the design was wrong and also client changes his decision at some point[CSP02, Project Manager]”*. This was further echoed by the Construction Manager working for the main contractor: *“The biggest problem we have got is to have a client who does not know what he wants, the client keeps on introducing new things and also the original design is not working [CSP02 Construction Manager]”*. This reveals the impact of non-involvement of the site team in the design process enshrined in traditional DBB procurement. The consequence of this practice on LPS implementation became evident during the lookahead and make-ready planning. For instance, it was observed on CSP02 that during the lookahead and make-ready planning, identified constraints could not be fully removed or the strategies for removal could not be achieved especially when they were design related. This was because the design team members did not attend the LPS meetings held on the project due to the traditional DBB method used on the project effectively separating designers and constructors.

The programme manager for the main contractor expressed his frustration by saying: *“Some of the designers are based on site, but they will never come to LPS meeting because they were engaged by the client [CSP02 Programme manager]”*. It is important to note here that it was the main contractor that was leading the LPS implementation on the project. The impact of this was minimised to some extent on the project, as it was observed that the project manager later introduced an ad-hoc meeting with the design team for design-related constraints identified from the lookahead and make-ready planning. The ad-hoc meeting with the design team was made possible because of the

client's support for the use of LPS on the project. Again this shows that, although the project was procured with DBB, if the owner is committed to LPS, the design team could still be involved in a way. Nevertheless, the actions of the design team still limited real-time collaborative decision making and reliable promising framework advocated in the LPS. Last Planner System researchers and practitioners have argued that the success of LPS is hinged on having the right people with the required knowledge and capacity to make a decision in the planning room (Malcomber and Howell, 2003; Ballard and Howell, 1998). This means not having the right people in the room limits the quality of promise and commitment that could be made at the production planning meeting. The level of commitment of the design team in the LPS implementation was not full because it was not included in their original contract. According to Daniel (2017) including the use of the LPS in the contract clause encourages all the stakeholders on the project to be committed to the LPS implementation.

Influence of Nominated Subcontractor Traditional Mindset on Quality of Promising

It was observed on CSP02 that the nominated subcontractor appointed by the client was reluctant to participate in the LPS meetings. One of the construction manager interviewed on CSP02 stated that: *"There are some subcontractors employed directly by the client whom we do not pay but we manage them, they tend to be stuck in the old ways and not motivated to participate in the LPS meetings [Construction manager]"*. This attitude influenced the effectiveness of the production planning and control meetings held on CSP02. Most times, further arrangements had to be made with the nominated subcontractor (NSC) outside the production planning meetings to arrive at a reliable plan. Such arrangement is not without its own consequences especially with regard to the quality of promise that could be made in real time and double handling of information and communication across the team.

While it could be argued that the traditional DBB used on CSP02 could have created a platform for this behaviour flourish; the root cause could be traced to the traditional mindset exhibited by the NSC. Ballard and Howell, (2005) argued that even when a procurement method that could be said to be collaborative is used on a project and the traditional mindset still dominates, collaboration would not happen among the people on the project. This means the traditional DBB is not the only problem. Additionally, the behaviour exemplified by the NSC shows the challenge of integrating two organisations with different organisational cultures in LPS implementation. Liker and Morgan, (2006) observe that alignment of organisational culture is essential in the implementation of lean techniques across organisations.

Influence of traditional DBB on the Level of Collaboration and Communication among the Project Team

The investigation found that long response time from the designers influenced the LPS implementation on CSP02 where traditional DBB was used. Some of the respondents stated that: *"The designers are employed by the client and it does affect the Last Planner System, we only have liaison meetings with the designer rather than LPS meetings to try and focus on the priority, but it does not help. The best way to control somebody is when*

you are paying them. If you are paying somebody, they listen more than when someone else is paying them. It is not as it used to be initially, they try to listen to us a bit. The designers have little appreciation of the commercial implications of what they do and they don't do. It is very difficult but we have to manage it [CSP02SC01, PM]”.

This statement reveals the influence of the procurement method on LPS implementation. For instance, the view that designers seem to care less about the financial consequence of their action to the project implies that the design team were only working to achieve their individual goals and not the overall goals on the project. Pasquire et al, (2015) argued that key players in the construction industry are safeguarding their individualistic interest on the project. Similarly, it has been observed that vested commercial interest among professionals has taken away the energy required to drive construction projects to successful completion (Naoum, 2001). The impact of these on LPS implementation is that smooth workflow is hindered as a result of the poor communication and collaboration among them. Pasquire, (2012) asserts that for a smooth workflow in the production system, various stakeholders on the project need to develop a common understanding of the project goal and process.

Furthermore, document analysis and observation on CSP02 revealed that the design team required nine days to respond to a request for information. However, to minimise the impact of this, the nine days waiting period was factored into the lookahead and the make-ready plan on CSP02 which was beneficial. Nevertheless, this still has some impact on the quality of promise and commitment that could be made by other stakeholders in real time in the LPS meetings as bad news early provides better opportunities for problem solving.

Influence of D&B Procurement System on Look ahead and Make-Ready Planning

On CSP01, the research participants interviewed believed that the use of design and build supported the implementation of the LPS on the project. On CSP01, members of the design team were present at the different Last Planner meetings where their input was required. For instance, during one of the lookahead and make-ready planning sessions, the design team made commitments on the delivery of design information for specific work sections in the 6-week lookahead window. The benefit observed in this practice was the clear visual view of the effect of the non-availability of such information on other people's work to the members of the design team. This presents a system view rather than a functional view where work is done in isolation which limits smooth workflow. The system view according to Koskela and Howell, (2002), supports the integration of both design and construction. Some of the respondents stated that: *“Using design and build with early contractor involvement, all the designs are reviewed by the construction team to get things out early. We get value out of the process since we make all the decisions together [CSP01SM03, Construction Manager]”*. It was also observed that during the lookahead and make-ready planning, the project team was able to identify constraints and make a commitment for their removal in real time. Thus, contributing to the quality of promises made at the production planning sessions.

This implies the use of the design and build on CSP01 supports LPS on the project. This finding aligns with a previous study in New Zealand that shows that collaborative

procurement such as design and build could support the implementation of the LPS on a construction project (Fuemana et al. 2013). Additionally, Vilasini et al, (2014) found that procurement methods with some collaborative undertone are the best to adopt in the implementation of lean construction techniques.

However, on CSP03 when a respondent was asked what could have happen if other procurement methods such as DBB were used on this project. The respondent argued that the implementation of the LPS on the project would still work irrespective of the procurement method used. Here are some of their comments:

"I am not sure if things could have worked differently if another procurement route is used. To me, irrespective of how the job is procured we can still involve the people in the LPS process and still have the same outcome. However, if the subcontractors are involved at the tender stage the construction programme will be better" [CSP03SM, Senior Planner] *"The procurement route helps in the implementation. On this project, we are using standard JCT and D&B contract which actively support collaboration between the subcontractors. It is opposed to NEC contract which is more programme focused and rigid, but with this contract, we rather pull together"*[Subcontractor's Project Manager].

It was also observed on CSP01 where D&B was used that the team on the north and central section collaborated more which support the implementation of the LPS. However, on the south section of the same project there was in fighting between the construction manager and other members of the team which affected the success of the LPS implementation on the south section. For instance, document analysis showed that while the average PPC for north and central section was between 80-90% while that of the south stood at 50-55%. It is worth to note that CSP01 was divided into three sections and each was independently managed by the LPS. The above statements and observations indicate that the success of the LPS implementation should not be hinged on the collaborative procurement only. This aligned with the position of Ballard and Howell, (2005) where they argued that collaborative procurement method with traditional mindset would not support genuine collaboration. However there are potentials for collaborative procurement to create the platform for collaboration to thrive.

Influence of Collaborative Procurement Strategies on LPS Implementation

The investigation shows that the use of a framework agreement supports the implementation of LPS on the projects. Some of the respondents stated that: *"We are in a framework agreement, we have been working with the M&E, the building envelops subcontractor. We have worked together on four different project which is a benefit to us all on this project. We passed on the lesson learned from the previous projects to this which makes us more successful"*[CSP03; Subcontractor's, Contract Manager]. *"Each subcontractor on this project has worked together previously, thus, we understand each other's capability and we know we are all working to achieve the same goal"*[CSP01, Subcontractor's Project Manager]

The long-term relationship between the team supports effective conversation during the LPS meetings on the project on CSP03. Further document analysis on CSP02 reveals that even though traditional DBB was the procurement method used, some of the

subcontractors were in a framework agreement and had worked together on a project where the LPS was used in the past. One of the respondents stated that: “*we have worked with some of these subcontractors in our previous project using LPS, it helps [CSP02 subcontractor]*”. Again, all these show that collaborative procurement practice supports the development of a good working relationship with the team which could enhance LPS implementation.

CONCLUSIONS

The aim of this study is to understand the influence of procurement methods (design and build and traditional design, bid, build procurement system) on LPS implementation. The study found that procurement methods have an impact on the application of the Last Planner System. The investigation shows that the prevailing traditional mindset exhibited by the designer in the traditional DBB influences the quality of promises and commitments that could be made during the lookahead and make-ready planning, however the impact of these was minimised because of the client’s support for LPS implementation. The study found that, it seems no single procurement method is a sure way to the full application of the LPS process on a project. The study observes that irrespective of the procurement route used, a mindset change towards collaboration among the different stakeholders on the project is fundamental to successful LPS implementation. For instance on project where DBB was used and the subcontractors were in framework agreement the LPS implementation worked well among the subcontractors.

The study recommends that the procurement approach to be used on LPS project should not be too static, but agile enough to integrate collaborative working among the different stakeholders on the project for a smooth workflow. Additionally, the study suggests that the LPS should be included in the contract clause in DBB procurement method to encourage full commitment of all stakeholders on the project especially the design team. This study exposes how the traditional DBB and the D&B procurement methods influenced the implementation of the LPS in a real life project context which provides some empirical evidence for future applications of project production planning principles in the construction industry. This would benefit both lean construction practitioners and scholars. However, the finding is limited to few procurement methods. Future study should explore more procurement method in an international context and examine contract clauses in more detail.

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