Daniel, E.I., Pasquire, C., and Dickens, G. (2016). "Exploring the Factors that Influence the Implementation of the Last Planner System on Joint Venture Infrastructure Projects: A Case Study Approach." In: *Proc. 24th Ann. Conf. of the Int'l. Group for Lean Construction*, Boston, MA, USA, sect.6 pp. 23–32. Available at: <www.iglc.net>.

EXPLORING THE FACTORS THAT INFLUENCE THE IMPLEMENTATION OF THE LAST PLANNER® SYSTEM ON JOINT VENTURE INFRASTRUCTURE PROJECTS: A CASE STUDY APPROACH

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ABSTRACT

There has been an increase in the use of joint venture (JV) especially in the delivery of infrastructure projects. There is also great pressure from the public sector clients for the use of lean techniques such as the Last Planner System (LPS) in the delivery of infrastructure projects in the UK for more certainty in delivery. Previous studies have explored factors that influence LPS implementation under various contracting structures and project types. However, no much study has explored the factors that influence LPS implementation on highways infrastructure project under JV contracting structure. In view of this, the study explored the factors that influence LPS implementation on JV highways infrastructure projects in the UK. Two in-depth JV case study projects on highways infrastructure construction were conducted over a 12 month period. Data was obtained via: document analysis, physical observation and semi-structured interviews. The study reveals that the early inclusion of the LPS practice in the contract and the long term relationship that existed among the supply chains and the main contractors in the JV were among the factors that supported the process. The study established that the JV platform and the LPS implementation synergise each other on the project. Poor promising was identified among the major blockers to LPS implementation on the projects. To overcome this, the study recommends that the five key elements of reliable promising identified should be adopted when implementing LPS on projects.

KEYWORDS

Last Planner System, collaborative contract, joint venture, highways infrastructure, success factor.

INTRODUCTION

Very limited studies have been conducted to examine JV practice in construction (Sillars, 2003). Project based JV in construction is a mechanism that brings two or more

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organisations to work together in order to deliver client's expectation or to out-perform likely competitors (Sillar, 2003; Smith, 1994). The aim of such partnership is to share risk, utilise skill, knowledge and resources of each partner in the JV (Smith, 1994). In the UK, there is an increasing use of JV especially in the delivery of infrastructure projects because of the risk involved and the skills required in the execution. There is also great pressure from public sector clients for the use of lean techniques such as the LPS (or collaborative planning in the UK) in the delivery of infrastructure projects for better project performance in the UK (Pasquire *et al*, 2015).

The LPS is a production planning and control approach that focuses on reducing workflow uncertainty which has been identified as a missing component in the traditional project management kit (Ballard and Howell, 2003). Its implementation in construction is growing and recent studies indicate that it has been implemented in sixteen countries and in all the major continents of the world (Daniel *et al*, 2015). Studies have explored LPS implementation under various contracting structure such as; Integrated Project Delivery (Cheng *et al*, 2011; Hamzeh *et al*, 2009), Integrated Form of Contract (Hamzeh *et al*, 2009) and Lean Project Delivery System (Yong-Woo, 2009; Ballard, 2008). However, no much study has explored the factors that influence the implementation of the LPS on infrastructure project under the growing practice of JV contracting structure, especially in the UK. The research question therefore is; *what are the factors that influence the implementation of the LPS on JV infrastructure construction projects in the UK?*

Previous studies reported high failure rate of between 45-50% on JV projects (Allen *et al*, 2013; Beamish, 1998). However, the LPS has the potential to reduce such risk because of its capacity to engender collaboration and improve certainty of delivery. A clear identification of the factors for successful implementation of the LPS, its blockers, and strategies to overcome them on JV projects evidenced in this study, provides a contribution to future practice of production planning and control practice in the construction industry and on JV highways infrastructure projects in particular.

LITERATURE REVIEW

LAST PLANNER SYSTEM IMPLEMENTATION ON CONSTRUCTION PROJECTS

The LPS is a lean construction technique developed by construction industry practitioners for managing Architecture and Engineering Construction since the early 90's (Daniel *et al*, 2015; Ballard and Howell, 1998). A review of published papers on LPS implementation between 1993 and 2014, obtained from the international group for lean construction (IGLC) database reveals that the LPS has been implemented on over 56 construction projects across the major continents of the world (Daniel et al, 2015). These include building construction, heavy civil engineering construction, highway infrastructure projects, ship building, and pit mining. This indicates that the implementation of the LPS in construction is on the increase.

Fernandez-Solis *et al* (2012); Porwal *et al*, (2010) summarised the benefits and challenges associated with the implementation across the projects studied. Their studies identified barriers and challenges to LPS implementation on construction projects. Some of the challenges includes; lack of commitment to LPS implementation, partial implementation, contracting and legal structure, lack of management support, and

resistance to change among others. The identification of contracting structure as barrier to LPS implementation cannot be overlooked, considering the crucial role contract plays in the execution of construction projects. In recent times, collaborative or relational contracting structures are now incorporated into the implementation of lean principles. These include: Integrated Project Delivery, Lean Project Delivery System, Integrated Form of Agreement, and Target Value Design among others (Cheng *et al*; 2012; Yong-Woo, 2009). Evidence from literature shows that the LPS has been implemented under various contracting structures; while some are collaborative, some are not. Little or no study has explored and reported how LPS works on JV highways infrastructure projects.

JV AND LPS IMPLEMENTATION ON INFRASTRUCTURE IN THE UK

There is a global increase in demand for infrastructure projects across the globe. McNichol, (2014) reported that the current global demand for infrastructure is $4 trillion annually. JV is among the current approaches used in the delivery of infrastructure projects. This could be due to the complex and critical nature of infrastructure projects. Ideally, the purpose of a JV is to enable the companies involved to achieve the common goal of the project, with all having shared ownership and control, while utilising the strengths of one another (Smith, 1994). However, this is not always the situation, as there are several reported cases of failed JV projects. For example, EC Harris' report, in 2013 reveals that one in five JV projects in the UK resulted in formal disputes between the parties in the JV (Allen *et al*, 2013). Mason, (2013) conclude that this is due to lack of clear communication among the parties in the JV.

Again, this shows that JV itself would not naturally bring about collaboration among the team at the project level. It further magnifies the need to deploy a system that has the potential to support the development of collaborative relationship such as the LPS, in managing the project production system with such contracting structure. The LPS implementation on JV projects has the potential to improve collaborative relationship at the project level, and could also influence the behaviour at the organisational level. In the UK, it could be argued that the push from public sector clients on their supply chains to adopt LPS in the delivery of infrastructure project could be due to this understanding.

RESEARCH METHOD

An interpretive case study approach was adopted for the study. Yin, (2014) identified conditions that should inform the choice of a case study approach. These include: when the goal of the study is not to have full control over the phenomenon being investigated and when the goal of the study is to focus on real life situations in a given context. Thus, case study approach was adopted to explore and understand the factors that influence the implementation of the LPS on highways infrastructure projects under JV contracting structure. To overcome the issue of lack of rigour in case study approach, multiple techniques were used in collecting data from the two case studies investigated as suggested in Yin (2014). The techniques used include; semi-structured interview, document analysis and unstructured observation.

The study commenced with literature review. The purpose of this was to understand the implementation of LPS in construction and its underlying principles. In selecting the case study projects, various factors associated with case study design as suggested in Yin, (2014); Bryman, (2014) were adhered to. Two case projects were

selected from top 10 UK construction companies. Purposive sampling was used in selecting the case projects; this was done to enable the study answer the questions sufficiently (Bryman, 2014). The case studies were conducted over a 12 months period. On each of the projects, data was collected using three major approaches for deepening and authenticating the results (Yin, 2014). These enabled further clarification on findings from the unstructured observation and documents analysis. The physical environment observed include: production planning and control meetings sessions and production planning and control centres. On each case study, senior manager (SM), middle manager (MM), operational managers (OP), and subcontractors (SC) were interviewed. A total of 21 interviews were conducted and production planning and control documents were also analysed.

The interviews were transcribed verbatim and cross checked with findings from documents analysis and observation. In doing this, the data was categorised based on qualitative data analysis techniques as suggested by Bryman (2014). The data analysis process was supported using computer aided qualitative data analysis software known as 'NVivo'. According to Bryman, (2012) 'NVivo' software does not only manage large data sets, it also supports transparency, replicability, and validation of qualitative data. The 'model' tool in NVivo 10 was used to analyse and present the emerging themes and sub-themes from the study. The findings are presented and discussed hereafter.

• ANALYSIS, RESULT AND DISCUSSION

• CASE STUDY ATTRIBUTES

Table 1 reveals the case studies attributes. CSP01 is an upgrade to replace a dual carriageway with a three lane motorway. The project is segmented into three sections (north, south, and central). CSP01 comprises of two top UK contractors in a JV

Table 1: Case Study Project Attributes

Project Attributes	CSP01	CSP02
Nature of project	Highways and Infrastructure	Highways and Infrastructure
Nature of works	Upgrade to replace existing dual carriage way with three new lanes	Improvement of motorway to Smart motorway
Mode of contractor selection	Framework agreement and ECI	Framework agreement
Proposed project duration	30 months	24 months
Project delivery structure	Joint venture (D&B)	Joint Venture (Design bid and build
Contract sum	£380 million	£120 million
LPS facilitation process	Internally facilitated	Internally facilitated

Both contractors have a long history and expertise in the delivery of construction and engineering projects. However, one of the contractors has a strong record in the delivery of mega highways infrastructure projects with sustainable approaches. The JV was formed to benefit from this, due to the scale and critical nature of the project.
Similarly, CSP02 JV comprises two top UK contractors. The project is an improvement of an existing motorway to a smart motorway. One of the contractors on CSP02 has expertise in transforming roads into intelligent network using technology. The second

contractor has good record of successful delivery of highways infrastructure projects. The JV was formed to build on this skills and expertise from the different organisations.

- **DEMOGRAPHIC INFORMATION OF RESEARCH PARTICIPANTS**

The interviewees comprise of 8 SMs, 4 MMs, 5 OMs, and 4 SCs. These shows all the key stakeholders were involved in the interviews; however, the number interviewed varied across the projects. The least response is from the subcontractors. Some of the subcontractors were reluctant to participate in the study, although they were also constrained by their work schedule. This is part of the limitation of this study. All the respondents have some level of experience and knowledge on the application of LPS principles in construction. This means their responses could be relied on.

- **SUCCESS FACTORS FOR LPS IMPLEMENTATION ON JOINT VENTURE**

The factors for successful implementation of LPS on JV infrastructure identified below are from the analysis of the semi-structured interviews, the document analysis, and the observation of the physical environments.

#1 Reduced Batch Size

The study reveals that the batching of the projects into segments supports the implementation of the LPS on the highways infrastructure project. This was observed on both projects. On CSP01, the project was batched into three segments: the north section, south section and central section. While CSP02 was batched into two sections: north bound and south bound. The division could be due to the linear and extended nature of the road network. However, it supported the implementation of the LPS on the project. For instance, on CSP01, a production planning and control centre was created for each section, with each running meetings with support from the central facilitating team. It is worth noting that problems inbetween sections are centrally addressed at the weekly senior management meeting. On CSP02, though the project was also batched into segments, only one production planning and control centre was provided. It is worth noting that the length of the road network on CSP02 is shorter compared to that of CSP01.

- **#2 Inclusion of LPS practice in the Contract**

On the projects investigated, LPS practice was formally included in the contract agreement between the main contractor, client, and subcontractors. A senior manager on CSP01 stated that: "We have agreed with the client and our supply chains that LPS will be used on this project and we use it on our other project too" [Operational Manager]. Similarly, a subcontractor on CSP02 stated that: "It is part of the main contractor's policy, so if we do not want to do it, we can't go away with it. My signing into it in the contract, supports my commitment to it, and it benefits us as subcontractors" [Subcontractor's, Senior Site Manager]. Most of the respondents identified the role of the inclusion of the LPS approach in the delivery of the project. Doing this is essential, as it would make it a formal process on the project, thus encouraging more commitment to the process. It would also encourage the required stakeholders to get engaged in the process. This is important, as it was observed in a previous study, that subcontractors were not involved in production planning meetings on a project that claimed to be managed with LPS (Pasquire *et al*., 2015). Furthermore, construction is filled with

many formal processes (Kadefors, 2004), which sometime may not even support the goal of the project. However, the goal of LPS is to engender collaboration among the project team, while focusing the team to achieve the common goal of the project (Ballard and Howell, 2004). According to Kadefors (2004), formalisation of construction process should not be in relation to cost alone, but should include other practices that would support the actualisation of the project goal. The LPS could be considered to be among such practices or processes.

- **#3 Use of Collaborative Form of Contract and Long Term Relationship Focus**

Empirical evidence from observation and document analysis in this study reveals that collaborative form of contract was used on the projects. This includes, Framework agreement, ECI and D&B. The study reveals that even when DBB (e.g. CSP02) is used on a project, and the supply chains have a framework agreement, collaborative relationship still develops. The contractual behaviour that occurs here could be better explained with relational contracting theory. According to Macneil, (1980) as parties to the contract have more and frequent conversations on the project, improved relationship begins to develop. Also, the clear assurance of the possibility of securing a future job, for example, in framework agreement, could motivate the team to get committed on the project. Harper, (2014) asserts that when there is shared expectation between teams on a project, it influences their behaviour on the project. This suggests that contractual behaviour has the potential of supporting collaboration on a project. Also, the two main contractors on CSP02 and the supply chains have delivered similar projects using LPS; this contributed to the implementation of LPS on the JV project.

- **#4 Training and Creation of Awareness**

Majority of the respondents, including subcontractors and main contractors, identified the need for provision of training. For instance, some respondents stated that: "There is need for guidance on LPS right from conception by the management; we do receive some training on LPS" [CSP02SC01, Project Manager] and "training is very essential, without it, the facilitation would not have worked on this project" [CSP02SM01, Programme Manager]. A senior manager suggested that the nature of training on the LPS to be provided should be tailored for each stakeholder on the project. For instance, it was argued that the initial training for the smaller subcontractor should be to explain the benefits of the process in order to get their buy-in before full implementation. Also, a senior manager stated that "for an organisation that is venturing into it, trainings and demonstration of tangible benefits from previous implementation is important" [CSP01SM01, Planning Manager]. Previous studies (such as Porwal *et al*, 2010; Hamzeh *et al*, 2009) have also identified the importance of training in the implementation of LPS. LPS awareness on CSP01 was through training workshops and monthly project briefing by the JV project director. This show there was also top management support.

- **#5 Appointment of Facilitators and Lean Champions**

The study reveals that the appointment of facilitators and lean champions contributes to LPS implementation on the JV project. A respondent stated that: "The appointment of lean champion and facilitators, promotes the practice across the business" [CSP02SM01, Programme Manager]. Also, on CSP01, the respondents believe that a

facilitator supports the implementation process. One respondent said "A facilitator is needed to coordinate the process for the initial start; this is an early stage support" [CSP01MM02, Section Engineer]. This is because the process cannot really progress if not duly facilitated, as observed in the South section on CSP01. This is crucial as the process would not progress if there are no capable and experienced personnel to man the process. On both case study projects, the process was internally facilitated. Although on CSP01, it was argued that after the initial facilitation, the process should be left with the team. As good as this may seem, it could lead to the abandonment of the entire process as each member of the team has a specific role to perform on the project. On both projects, LPS facilitation was the primary responsibility of the facilitators which yielded better results. Leaving the process to the team will make no one accountable. The role of LPS facilitators and lean champions in implementing a new process has been identified (Mossman, 2015).

- **#6 Provision of Physical Space and Co-location of the Team**

The study reveals that the provision of designated space for production planning and control and co-location of the team supports the implementation of the LPS. A contractor stated that: "Allow for a suitable rooms/facility on site for production planning and control" [CSP01SC02, Project Manager]. It was observed on both case studies that designated spaces provided for production planning and control were also close to the work station. The physical space created includes those for working and visual production planning and control centre. This is essential, as the board located in the room has the potential of communicating information visually to the team during and out of meeting times. However, such locations should be readily accessible to all the required stakeholders on the project including the subcontractors. It should also be located close to work station to prevent non-value adding activities that could come from unnecessary movement. The team were co-located in the physical space provided on CSP01 and CSP02 which further improves the level of communication among them, including the subcontractors. It has been observed that face to face communication is one of the most active ways to communicate on construction projects (Dainty, 2007). However, a co-located team without a mind-set change would not contribute to the development of collaborative relationship as demonstrated by the design team on CSP01.

#7 **Team Integration and Less Parent Company Identity**

The study reveals that various practical approaches were adopted on both CSP01 and CSP02 that supported the integration of the team. The teams on the JV projects viewed themselves as a single entity. This implies that all members of staff on the project have to ignore their original company culture or identity in performing their responsibility on the project and create a shared culture. However, whether the target was achieved on CSP01 and CSP02 still remain unanswered. One of the strategies adopted to reduce parent company culture and integration of the team was; the recruitment of some staff directly on the JV, hence, such staff only had one identity at the time. For instance, the LPS facilitator on CSP02 was employed on the JV project. Other strategies used include, shared spaces and offices, email addresses, and every facilities used were purpose made in the name of the JV. All this could reduce the influence of the parent company culture, which could support the integration of the team in the LPS implementation. According

to Smith, (1994) for a JV to work successfully, there is a need to make provision for cultural compatibility, shared ownership, and joint control.

- **BLOCKERS TO LAST PLANNER SYSTEM IMPLEMENTATION ON JV**

The study reveals various blockers to the LPS implementation on the JV projects. These include: (1) poor promising (2) culture of old thinking and attitude among middle managers (3) lack of discipline and trust (4) resistance through procurement. While most of the barriers identified in this study are similar to those identified from previous studies (Fernandez-Solis *et al*, 2012; Porwal *et al*, 2010), the issue of poor promising seems to be obvious in this study. "Poor promising" here entails making commitments that are not sound, it could be under or over commitment. This issue was raised on CSP01 and CSP02. One respondent stated that: "one of the biggest things during the production planning meeting is people not telling the truth, you got to be honest with yourself and members of the team, it is no use to say, I will finish the work today while you know you still need 3 or more days. It is no good to say I will do it next week and you know you have not got the men to do" [CSP02SM01, Programme Manager]. Also, on CSP02 some of the subcontractors stated that: "Some subcontractors agree dates knowing they cannot achieve it!!!" [Subcontractor's, Senior Site Manager]. "The process is fine; one of the barriers is people committing to things they cannot do and also unrealistic expectation from the main contractor" [Subcontractor's, Contract Manager].

The statements above highlight why stakeholders at the project level should not be pressurised into making promises or commitments as it could turn out to be unrealistic sometimes. In the LPS, workflow reliability is achieved via reliable promising (Macomber and Howell, 2001). Macomber and Howell, (2001) identified five elements in making a reliable promise among project stakeholders. These are: (1) understanding the condition for satisfaction (2) competency to perform the task (3) capacity to perform the task (4) sincerity (trust among team) and (5) commitment to clean the mess, if failing. This clearly suggests that in making promises during LPS implementation, the team must be transparent and sincere that the needed capacity is available.

• CONCLUSIONS

The aim of this study is to understand the factors that influence the implementation of the LPS on highways infrastructure projects under JV contracting structure. The study identified seven factors that support the implementations of the LPS. The study found that the use of JV platform on the projects support the implementation of LPS and the implementation of the LPS equally supports the activities of the team members in the JV. While the JV created the initial collaborative platform and the framing of the LPS into the contract which supports team members' commitment to the implementation; the implementation of the LPS components improved the level of communication among the different stakeholders in the JV.This shows that the JV platform and the LPS implementation synergise each other on the project. The study established that the use of some form of collaborative contract such as; early contractor involvement, framework agreement that supports long term relationships and the framing of LPS into the contract were among the major aspects of the JV that enabled LPS implementation.

The study identified four major blockers to LPS implementations on JV infrastructure projects. These blockers include: poor promising, culture of old thinking

and attitude, lack of discipline and trust, and resistance through procurement. A closer look at the above barriers shows that they are behaviour related rather than process. This shows that people and human behaviour still remain the major barriers to LPS implementation irrespective of the contracting structure. Although the blockers to LPS implementation on the JV highways infrastructure project are not entirely different from those identified in previous studies, the issue of poor promising seem to be very prominent in this study. To overcome the problem, the study suggests that the five key elements of reliable promising identified in Macomber and Howell, (2001) should be adopted. This study is limited to the two case studies in the UK

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