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Analysis of Challenges Bedeviling the Application of Last Planner System in Construction Project Delivery in Imo State

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ABSTRACT

This study analysed the challenges bedeviling the application of Last Planner System in Construction Project Delivery in Imo State. The study was guided by Project Management Theories. A descriptive and survey research design methods of investigation and a purposes sampling technique was used to select a sample size of 193 from a population of 374 respondents using the Slovin's formula for sample size determination from the sampled professionals in Imo state. The data collection and survey instrument included a well-structured questionnaire from respondents. The data collected was presented using frequency distribution, figures, and charts with aid of statistical tools via IBM SPSS Statistics version 26.0. While frequency distribution charts and Factor Analysis (FA) were used to analyse the main objectives of the study. The study's results show that out of the eighteen (18) main challenges of LPS implementation tested for factor analysis, the findings revealed seven (7) clusters named in other of significance. The study concludes that the most challenges bedeviling the application of LPS in construction project delivery in Imo State includes in this order; lack of guideline/standard practice, resistance to change, leadership and management commitment, attitude, commitment and partial implementation, lack of time for activities and learning and lack of training. This study recommends that concerted effort should be made at ensuring that some of the LPS implementation processes are deployed in facilitating the successful delivery of construction projects to fruition. The use daily huddle meeting is strongly advocated for as studied have shown holding meetings prior, during and after the construction project delivery processes have contributed the success in all ramifications.

Key words: Last planner system, Construction Projects, Factor analysis**,** Imo state

1. INTRODUCTION

The Last Planner System (LPS) is a collaborative and proactive method used for planning and managing construction projects. It enhances reliability through a structured, three-tiered approach: a master plan with pull sessions, a look-ahead plan that monitors preparatory activities, and weekly planning that ensures the completion of tasks [18]

The construction sector faces numerous operational challenges, resulting in frequent delays and budget overruns. In response, Lean Construction (LC) was developed by applying lean production principles to improve project management, reduce resource consumption, and enhance client satisfaction [3]. In LC, 'planning' defines success criteria and methods, while 'control' ensures tasks align with the plan, promoting ongoing re-planning and improvement.

Developed in the 1990s from industrial building research [10], the LPS serves as a collaborative platform, reducing uncertainty and improving project quality. Often called Pull or Collaborative Planning, the system brings stakeholders together for direct coordination, allowing each participant to contribute to the planning process. This collective effort reduces waste, boosts communication, and ultimately enhances project profitability.

LPS fosters proactive identification of constraints, ensuring smooth workflows and increasing accountability. It minimizes inefficiencies, such as rework and delays, by adhering to a clear, systematic approach. [14] define LPS's four stages: (a) the master schedule, (b) phase scheduling, (c) lookahead planning, and (d) weekly work planning. The master schedule identifies key milestones derived from contractual requirements, while phase scheduling divides these milestones into manageable phases, often using reverse scheduling techniques. Lookahead planning links the phase schedule to the weekly work plan, establishing task sequences and ensuring alignment with team capacity. The weekly work plan selects tasks that are well-defined and achievable, ensuring timely completion and smooth transitions to subsequent stages.

Ballard's creation of LPS in 1993 aimed to streamline the planning process, with particular emphasis on weekly work plans and lookahead scheduling, improving workflow management in both design and construction. Rooted in lean principles, LPS focuses on value creation and waste reduction across business processes, from development to customer relationships [15].

As a lean tool, LPS:

1. Increases planning detail as execution time approaches.
2. Encourages collaboration with those carrying out the work.
3. Identifies and eliminates constraints to enhance planning reliability.

4. Secures dependable commitments through active collaboration with project partners.
5. Learns from past planning mistakes to avoid future errors [7].

Lookahead schedules identify tasks for the upcoming period, ensuring feasibility and availability of necessary resources. If tasks are unachievable, adjustments are made, and a list of pre-tasks is generated. In project planning, lookahead schedules play a critical role in bridging the gap between theoretical plans and what is practically achievable.

Problem Statement

[2] identified a significant gap in the understanding of Lean Construction among Nigerian clients, with many lacking familiarities with its principles and tools. Their study also assessed the potential of implementing Lean practices, specifically the Life Cycle Performance System (LPS), within Nigerian construction. The integration of Lean methods could effectively resolve some of the sector's persistent challenges. Traditional project management approaches typically achieve a completion rate of only 54% for planned tasks weekly, while projects utilizing the Last Planner System (LPS) reach an average of 85%.

Lean Construction improves project value by fostering better coordination across all parties involved, outperforming traditional management methods. This collaborative approach not only benefits the construction company but also enhances outcomes for owners, architects, and engineers. By minimizing waste across materials, time, resources, and motion, Lean teams effectively reduce inefficiencies that would otherwise arise in conventional building processes.

Modern construction projects are complex, fraught with uncertainties, and often subject to planning changes. [16] highlight that the accuracy of project forecasts decreases with time, particularly for long-term planning. In Nigeria, the construction sector struggles with a high incidence of failed or abandoned projects due to missed deadlines, budget overruns, and compromised quality. Delays are common, and many projects become outdated before completion, driven by the rapid pace of technological advancement. This situation is exacerbated by a shortage of qualified Project Managers. Merely having expertise in design, civil engineering, or construction is insufficient for effective project leadership; proper training in project management is essential.

While the advantages of LPS in improving planning reliability are recognised, its adoption in Nigeria remains limited. Barriers to its implementation include the need for additional resources during the planning phase, insufficient knowledge and training, inadequate constraint analysis, resistance to change, and poor information flow among stakeholders [1]

If large-scale government projects in Nigeria were managed by qualified professionals who adopted the Last Planner System, they would be strategically planned, with constraints identified and addressed to minimise inefficiencies. Such an approach would drastically reduce the occurrence of failed or abandoned projects, leading to more successful, timely, and cost-effective outcomes.

Objectives of the Study

The aim of this research work was to determine the challenges bedeviling the application of LPS in construction project delivery in Imo State.

Research Questions

To what extent can the challenges bedeviling the application of LPS in construction project delivery in Imo State be determined?

2. LITERATURE REVIEW

Concept of the Last Planner System

The Last Planner System (LPS) was introduced to construction by Glen Ballard in 1993 [25]. LPS embodies lean thinking, which is a business philosophy focused on improving processes across product development, design, production, operations, supply chains, and customer relationships, aiming to maximize value and minimize waste. Lean thinking is an ongoing pursuit of perfection, emphasizing organizational purpose, efficient processes, and human development.

Ballard's goal with LPS was to enhance weekly work planning and control the workflow in design and construction. The system functions as a planning, monitoring, and control tool grounded in lean principles such as 'just-in-time' (JIT) delivery, value stream mapping (VSM), and pull scheduling (also known as reverse phase scheduling). The master plan's objectives are then translated into more detailed planning, including the 'look-ahead schedule' and weekly work plans. The look-ahead process includes:

- Identifying tasks to be completed in the upcoming work period.
- Consulting production experts to ensure tasks can be completed within the timeframe and that materials and equipment are available.
- Updating the schedule for tasks that cannot be completed as planned.

LPS's core feature is its collaborative approach, with 'last planners' involved in refining plans as the work nears. This includes pull scheduling, where only achievable work is promised in weekly meetings, in contrast to traditional push scheduling, which focuses on adhering to a master schedule and planning tasks that "should" be done. Another key aspect of LPS is constraint analysis, which proactively identifies potential problems during the daily management of construction projects [22]. Additionally, LPS follows the Plan-Do-Check-Act (PDCA) cycle, which uses the Five-Whys analysis to identify reasons for non-compliance and ensures a continuous feedback loop for improvement. Figure 1 illustrates the LPS planning process.

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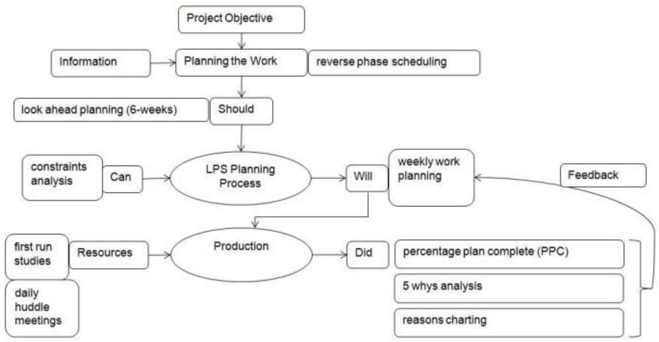

Figure 1: Last Planner System Planning Process. Source: [22].

History and Development of the Last Planner System (LPS)

Glenn Ballard, a key inventor of LPS, began his research on crew planning in the 1980s while serving as the Productivity Improvement Manager for Brown and Roots Construction in the United States. However, it took over ten years for LPS to be officially recognized as a system for managing construction production. The development of LPS in the 1990s resulted from the consulting work of Ballard and Gregory Howell in the industrial construction sector. Early principles such as 'make ready' and shielding workers from poor assignments were central to LPS practice. Additionally, Professor Lauri Koskela's seminar on Production Principles in Construction significantly contributed to the creation of Lean Construction, leading to the establishment of the International Group for Lean Construction (IGLC) in 1993. The term 'Last Planner' was first introduced during an IGLC conference in Expo, Finland.

Between 1993 and 1994, more projects implemented LPS, and by 1995-1996, it was fully deployed on a major refinery project in Venezuela. By 1996, the connection between the 'lookahead plan', the 'make ready process', and their impact on improving the 'Percentage Plan Complete' (PPC) was incorporated into LPS. Over time, LPS integrated with systems like Building Information Modelling (BIM), Location-Based Management System, Takt Time Planning, and Visual Management. Global research continues to refine LPS, and Glenn Ballard is currently working on creating an LPS benchmark, incorporating input from industry practitioners and academics. The goal is to standardize the language, offer Q&A for common queries, and provide a benchmark for organizations to measure their LPS implementation.

Some claim that LPS originated from the Toyota Production System, but evidence shows it was developed by construction professionals for construction-specific benefits. LPS has now been implemented in over 16 countries across all [11]. [29] mphasises that LPS was "developed by construction people for construction people" and precedes Lean Construction in management discourse. Though Lean Thinking is associated with Toyota, LPS addresses the unpredictable nature of project environments, enhancing reliability and productivity. The first LPS experiment in 1981 showed that 54% of planned tasks were completed in a given week. LPS aims to make project work more reliable, improving productivity, safety, and overall project outcomes.

Fuemana et al. (2019) describe LPS as a production planning and control system designed to address irregularities in construction workflows and drive change in the global construction industry. According to [5], the birth of LPS can be traced to studies by Ballard and Howell at the University of Berkeley in the 1990s, alongside Koskela's work at the University of Helsinki. Ballard's doctoral thesis, presented at the University of Birmingham in 2000, formalised LPS as a comprehensive planning system, marking a significant evolution in construction planning methods.

Challenges Faced During the Implementation and Use of LPS

The introduction of the LPS to a site, into a company or into a country is not an easy and uncomplicated task (Powal, 2010). In addition to certain benefits, academics and practitioners have reported the challenges faced by construction industry professionals during the implementation of using LPS.

[19] suggest that lack of appropriate education and training on LPS is likely to lead to LPS being implemented incorrectly, and thus ineffectively. [4] identified the following inhibitors that prevents successful LPS implementation: lack of time to implement change, lack of training, poor organizational role definition, inadequate understanding of LPS concepts, weak administration, poor communication, and a lack of integration. To counter this, it is suggested that LPS teams work together to plan effectively and share knowledge around the planning of tasks. [15] suggests that LPS implementation challenges the old practice of developing schedules during the early feasibility phases of the project without input from the implementation team. Instead, there is an emphasis on collaborative planning and constraint analysis in a continuous learning environment. They further assert that meaningful participation of all parties is crucial for successful LPS implementation. The challenges bedeviling LPS implementation are discussed below.

Attitude

Implementation of new systems and programs might be difficult as there's always people who are resistant to changes and new ideas (Westö, 2018). In LPS these can be, for example, refusal of commitments, refusal to include sub-contractors in meetings and negative attitudes towards different components in the LPS system [12].

Late Implementation

Implementing LPS after the project has been started and partially completed – for example using LPS after the project is 25% complete - is reported as an obstacle in successful LPS implementation. Introducing a new practice on a project where different trades are working at the same time and many activities going on simultaneously is an obstacle [26].

Lengthy Approvals

The successful implementation of Lean Construction and LPS requires a fast approval of orders free from delays as this can create unnecessary bottle necks that in turn will negatively impact on project durations [2]. Similarly, Olatunji (2008), identified that lack of government control and enforcement, can adversely affect the approval processes within the construction industry. In the same vein the traditional procurement methods involves a lot of bottlenecks which result in lengthy approval of orders. Similarly, in traditional contractual procedures, the design and implementation of project are treated as separate entities. This causes a conflict border between the two phases and creates lots of waste generating a lot of variation from values specified in the design which cannot be constructed or design changes made by designers. In their article, [17] reported challenges to the implementation of the LPS in two different projects. Regarding the first project, the significant barriers identified were Lengthy approval procedure by the client and Short-term vision. In the second project, the researchers reported the same barriers as the first project, in addition to one more hurdle, which was due to the high number of subcontractors on the p can differ dramatically depending on the culture people came from, and the location of the implementation of the LPS. In other words, what we call a barrier in a country can be neglected in another country.

Lack of time for activities and learning

In a Chilean project, time needed for training, meetings and preparations exceeded the capacity of the project personnel [27]. Introducing lean concepts and teaching the different techniques are time consuming.

Meetings, training activities, preparation of forms, etc., were not usual activities and surpassed the capacity of the project personnel in a Chilean (LPS) implementation experiment. This condition became more critical in the extent that these activities were relayed exclusively to the field administrator [4].

Bad Work Ethics

Bad attitude towards time affected the LPS implementation in Saudi Arabian construction project this includes arriving one hour late in a meeting etc.

Misinterpretation of 5-whys' analysis

Using 5-whys for evaluating one's work can sometimes create barriers in the project organization as evaluation in some cases can be interpreted as being accused for not being able to complete promised tasks [27].

The use of PPC indicator as a form of controlling and evaluating the individual completion of tasks affected seriously the implementation and generated barriers at every level of the organization of some projects in Chilean experiments with LPS implementation [4; 23].

Contractual and Legal Issues

Traditional contracts between main contractors and sub-contractors are defined with specified conditions, demands and obligations. Extent of work and work boundaries are defined as well [27]. As collaboration between trades is a crucial point in LPS, having traditional contracts might cause problems and allow sub-contractors to only care for their own work within the defined contractual boundaries. This results in contractors neglecting other contractors work and the total outcome of the project. This so called "fishing for profit" between trades often results in conflicts and usually ends with less profit for everyone involved.

Making or finding suitable contracts for this can be challenging. There is a quite new form of contract named Integrated Form of Agreement (IFOA) where parties (client, designer, contractor and other trade partners) are bound to a single agreement which requires them to share risks and rewards. In Finland this agreement has been used on several massive construction projects with great results where the projects have finished within schedule and budget.

Traditionally, facility owners have been presented with a standard set of project delivery options: design-bid-build, construction management (agency or at-risk), or design-build. Despite this range of options, many owners remain dissatisfied: projects take too long, they cost too much, and the work fails to meet quality expectations [22] Integrated form of Agreement (IFOA) is new form of contract. It binds all the parties — client/owner, designers, constructor and trade partners into a single agreement which requires them to share risks and rewards. This encourages everyone in the team to think of the project first as their commercial interests are clearly bound up with the overall success of the project. In turn this means that leadership and decision making is both more inclusive and distributed. The integrated agreement for lean project delivery offers improved project performance both from the owner's perspective (reduced cost and time, improved quality and safety) and from the viewpoint of the designers and contractors (increased profit and profit velocity, improved safety, and employee satisfaction).

Lack of guideline/standard practice

Lack of guideline/standard practice for updating the higher-level schedules, such as the master schedules and the phase schedules. The lack of flow back to high-level plans hindered the overall production control [17].

Commitment and partial implementation

Not implementing all the components of LPS is a challenge, i.e. missing out one or more of phase scheduling, look ahead planning, weekly work planning, constraint analysis, PPC, Reasons Charting, first run studies, Daily huddle meetings, Five Whys' analysis and Learning process. An analysis of a database of 77 Chilean projects, where LPS was implemented, revealed that the projects with a more complete implementation had a higher PPC than projects with basic implementation [4; 23]. The results of a research effort to study the critical factors in the implementation LPS in 12 Chilean construction companies show that the partial implementation, intermittent implementation and insufficient preparation of the planning meetings were barriers to its implementation. This situation had an impact on the effectiveness of the system and increased the need for more time for implementation.

LPS is identified as the leading lean construction concept in German construction industry. Although it may be possible to employ some of LPS techniques (weekly work plan, look-ahead plan etc.) separately, it has been recognized that they are most effective when applied together. This includes the techniques of constraints analysis and the Activity Definition Model (ADM), which usually come into play during the preparation of look-ahead schedules.

Implementation requires a very active role from everybody in the project organization. Leadership and good management play a key role in order to succeed. It's important to carry out all different components of LPS. According [28], studies of Chilean construction projects, studies showed that projects with more complete implementation including all components had higher PPC rate than other projects with partial or intermittent implementation. In Germany where LPS is seen as the leading concept of Lean Construction, companies have partially implemented LPS components, showing it's possible. Though they claim they function better when applying them together. Challenges faced during the implementation phase" as follows: Lack of training, Lack of leadership/failure of management commitment or organizational climate, Organizational inertia & resistance to change, stakeholder support, contracting and legal issues/contractual structure, and partial implementation of LPC & late implementation of LPC [26].

Fluctuation and Variation

Fluctuation and variation serve as major barrier to LPS implementation. [3] indicated that for the successful implementation of Lean Construction and LPS, some common financial barriers that need to be carefully addressed. These include: lack of stakeholder's support, inflation, inadequate funding of projects and unstable markets for construction. Additionally, [3]. recognized that political instability could cause fluctuations and pose barriers to the successful implementation of Lean Construction tools.

Incomplete PPC process

The project team identified the Reasons for Non-Completion of tasks, but they did not use the root-cause analysis and did not effectively utilize the information acquired from the Reasons for Non-Completion process. The participants did not address the constraints or develop an action plan despite conversations regarding how this would be addressed in the immediate future. According to [17], the PPC process requires non-completed tasks to undergo root-cause analysis to uncover the root cause for noncompletion and develop preventative actions to inhibit the same failure from recurring

Poor Supervision and Quality Control

The implementation of any new process requires skilled and professional workers to drive the change process. However, poor supervision and quality control issues hamper the application of Lean construction [2]. Some studies, [25; 13] indicated that the root causes of poor supervision and quality control issues are management related and they include: incompetent project managers, lack of skilled and professional workers, poor planning, logistics' problems, absence of look-ahead planning and poor coordination.

Resistance to Change

Human factor is critical to LPS implementation. Resistance to change, for example the refusal to assume commitments, refusal to include subcontractors in planning meetings or negative reactions to the theoretical concepts of LPS and to its application in the project are evident [4; 22]. Considering the implementation of LPS from a sociological viewpoint, it was concluded that cultural barriers are inherent in construction industry.

The successful implementation of Lean Construction and the LPS requires the support of the organization and the top management. [3] indicated that it is usually the top managers that provide sufficient resources, time and commitment to develop plans that will sustain and manage changes that occur from the implementation process.

Resistance to change is directly correlated to the organizational inertia. Technological barriers may have a significant effect on the success of failure of the new systems [17]. There can be a lack of experience with new technologies or incompatibility of this technology with the current systems. Finally, the climate is the organizational characteristic that employees live through and experience while working for an organization. The climate shapes their behavior, performance, and the way they perceive the organization.

Lack of Training

Lack of training and resistance to change are among the commonly reported challenges in LPS [9]. This shows that any organization seeking to deploy the system across its business must be committed to training at all levels. According to [13] developing human capital within the organization will enable the organization to implement LPS effectively. The best investment to improve the construction industry should be in human resource development. However, as crucial as training is to LPS implementation, it is initially an additional cost to the organization even though it can be offset by improved performance.

[22] showed the need for training to improve on LPS implementation. Liker in his book The Toyota Way highlighted the need for training in its 9th principle. The principle states that "Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others". Training as emphasized here is not just in having mere technical knowledge of the LPS process, but rather, a mind-set change training, which could

further help in overcoming some of the other identified challenges.

Training last planners is critical to the implementation of LPS. Lack of understanding of conceptual aspects (lean principles) and perceiving LPS as a "microplanning-system" hinders the successful implementation (Powal, 2010). An empirical study on LPS implementation concluded that training will be a key aspect of implementation and its success at the site. The staff and workers will need to be trained to use this tool effectively.

In order to motivate people to change, the researchers recommended an incentive strategy [17]. Secondly, for eliminating the short-term vision challenge, the researchers advocated the importance of implementing the lookahead plans and utilizing the make ready process at least six weeks ahead of execution. Finally, the researches highlighted the value of self-questioning for continuous improvement of the team.

Lack of Subcontractor's Involvement

Adversarial relations between contractor and subcontractors tend to undermine the application of Lean techniques within construction projects [3]. Similarly, fragmentation and poor contracting or legal issues, delay from suppliers and subcontractors and lack of collaboration are grouped as the perceived root causes to lack of sub-contractor's involvement. These adversarial relationships create transaction costs, delays and stoppages. These are all considered as 'waste' thus opposing the notion of Lean Thinking that fragmentation separates the design from the construction process; and therefore, misses the Lean aim of collaboration and integration.

The Underutilization of Look Ahead Plans

The lookahead plans were directly developed from the master schedule. The project team and the trade contractors should collaboratively work together to identify the most suitable sequence and apply the lookahead plan. Lack of standardized flow of reporting between shorter planning functions such as weekly and daily planning to long range plans (i.e. Phase and Master plans) [12].

Leadership and Management Commitment

An adequate administration at the project level is a must to undertake the challenge of performing planning meetings in large projects, where a meeting that gathers project managers, foremen, subcontractor, and other participants, can become not viable due to the high number of participants [4; 22].

The internal organization for a company implementation requires the active presence and involvement of upper management in some of the key activities (Porwal, 2010). Application of LPS at Advanced Communication and Information Technology Center (ACITC) building construction at Virginia Tech Campus confirmed that in order to implement a new concept, support and commitment from management is essential.

Based on the classification of linear causality criteria, the perceived root causes of cultural issues include: lack of commitment to the LPS implementation, lack of experience on Lean and LPS, unethical practices, partial or late implementation of LPS, bad work ethics, lack of commitment, lack of ability to work in group [3].

Commitment to implementing all components of LPS and learning from own mistakes are important factors to the successful implementation. Lack of self- criticism of last planners may hamper the successful implementation efforts [4; 22].

Parallel Implementation with other Improvement Programs

The results of a research effort to study the critical factors in the implementation of LPS in 12 Chilean construction companies revealed that the LPS implementation was mainly affected in companies that were making parallel efforts to implement LPS and quality. However, companies where other improvement systems functioned, or those that had participated in similar programs before, were better able to deal with the implementation by doing an integration effort of both programs [4; 22].

[9] also classified the LPS implementation challenges into local factors and general factors. The local factors relate to the project related challenges while the general factors are those relating to the organisation implementing the LPS. This implies likely strategies for overcoming LPS implementation should take due consideration for these classifications. In the implementation of lean, the organisation must be willing to change and the people (workers) must be ready to accept the new approach for the needed change to happen.

Theoretical Literature

Project Management Theory has been employed as the undermining theory for this study.

Project Management Theory

The evaluation of the development of collaboration in planning in other fields is crucial as various construction management scientists argue that there is no uniform theory guiding the construction management practice [11]. For instance, if there is any theory for construction management, such theory is still in hiding. In addition, Koskela, (2000a) argued that the current construction project management approach is based on the theory of production that emerged from economics. Koskela, therefore, postulated that the concept of Transformation, Flow, and Value (TFV) be adopted as the fundamental theory to build construction project management upon.

The TFV theory according to [23] introduced a new paradigm of production centered on flow to reduce waste and maximize customer value. This theory advocates designing, operating and continuously improving production from the combined perspective of transformation, flow, and value. In reality, the current practice of construction project management is only limited to the 'transformation view' which entails the conversion of input into an output. The RCM used in the planning process could be said to be based on the transformation view theory. Similarly, the Waterfall process model used in software development and the traditional approach to planning in construction can be said to be based on CPM. This is so, since the tenets of the 'transformation view' is on how tasks would be executed effectively following a defined or structured process without considering the influence of external phenomena. The focus of the transformation view is on task management. The theory of project management states that the value-laden outputs of organizational inputs result from reconciling the goals of stakeholders and transforming manageable chunks of interdependent, complex activities, relationships, regulations, resources, and processes, through job dispatching and work authorization system under continuous performance evaluation, learning, and improvement into a deliverable(s) (i.e., project) that meet well-defined objectives and expectations of stakeholders in a specified time frame under budgetary constraints.

Though good, it cannot manage variability and meet customer requirements. This means that the application of transformation view alone in construction project management and planning cannot mitigate variability in the construction process. Researchers and practitioners [23] should recognise that LPS was specifically designed as a system for planning and controlling production on projects and extended to both production (i.e., striving for targets) and project planning and control (i.e., setting targets) in the 2020 Current Process Benchmark [6].

Thus, as stated by [28]. the theory of project management decomposes the residential modular construction project delivery chain into several processes, including initiation (i.e., conceptualization), planning, execution (i.e., design, production, transportation, buffering, storage, and onsite assembly), controlling (i.e., performance measurement, learning, and continuous improvement), and closure.

Empirical Literature

[13] did a study on survey of motivations, benefits, and implementation challenges of last planner system users. The study was limited to the building sector and deployed a systematic literature and testimonial search of the perceived motivations and benefits or challenges for choosing LPS. The study substantiated the claims of those perceptions through a structured survey of senior and mid-level managers. Quantitative statistical tools infer that practitioners who use LPS experience more reliable planning, better supply chain integration, and less work flow time. However, managers who directly implement LPS are faced with external resistance from clients and subcontractors and feel that their organization does not offer the necessary incentives for adopting LPS, indicating a possible clash of paradigms. The case studies and testimonials were available in the literature referenced in the paper, but the survey and the method for analysis are new and have not been published elsewhere, either wholly or in part.

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

[8] investigating the challenges related to combining BIM and Last Planner System on construction sites. The construction industry is facing a gradual but important transformation towards more productivity and collaboration. In this framework, two major approaches are often cited in the literature as having the potential to improve the practices in the industry: Building Information Modeling (BIM) and Lean Construction. Several scientific studies have demonstrated the synergy of these two approaches and very recent research has reported positive results from the use of software applications as support for their implementation on construction sites. However, the stakes of such integration have been very little studied. This article presents the results of a research project conducted within a general contractor firm that decided to implement BIM and Last Planner System (LPS) on its construction sites. The research uses a four-stage action research approach, including the characterization of the research issue, the establishment of an action plan, its implementation and its evaluation. Compared to recent related studies, the research is less enthusiastic. While it highlights the need for new tools to improve production planning and control, it also points to a strong resistance to change by practitioners at the site. They emphasize the necessity for adequate pre-service training and the need for new resources that can work full-time on the ongoing training of site teams. In addition, some limitations of the tool lead workers to believe that it can quickly become a factor that slows down their daily work rather than improving it. Based on the advice of professionals, the paper formulates some recommendations to the industry, the researchers and the software developers.

[22]. in his study on last planner system – areas of application and implementation challenges. The study offered practitioners and researchers an account of LPS implementation challenges and an indication of how LPS can be applied. The study qualitatively aggregates the results of 26 test case projects of LPS applications to show researchers and practitioners reasons why LPS was applied, what benefits were realized and what challenges were found during the implementation. Senior and

mid-level managers in AEC industry were surveyed to assess the implementation challenges that they encountered. The main findings of the analysis are; (1) that practitioners have used LPS for the purpose of making plans more reliable, (2) get smooth work flow (3) improve productivity. The survey findings imply that improvements in LPS implementation strategies can be made which will facilitate LPS adoption by the industry. The findings of this thesis suggest that further research on the integration of LPS into work and business processes of project teams is needed to further the widespread use of LPS throughout the building industry.

3. METHODOLOGY

This section discusses the methodology and model to achieve objectives through implementing Last Planner System in construction projects.

Research Design

The actual state of LPS evaluation and how it is applied in construction sector are extracted from the help of a designed questionnaire which is a primary source of collecting data as a base of feedbacks.

Population of the Study

The population of the study is the entire sets of units which are references from the findings of the primary source of collecting data which are targeted on population of the construction firm in Imo state. The population size (N) in Owerri comprised a total sample size of (n) = 6 of construction firm, which are operational and provide effective result.

Sample and Sampling Technique

The study adopted a technique of sampling considering the population of the targeted area and its sample size, this sampling designs and sample techniques that is aimed at achieving a dependable result through the application of simple random sampling which is a type of sampling techniques.

This simple random sampling is a tool that produces a scheme which ensures that each sub group of the population size (N) has an equal probability of being chosen as the sample (n)

Population = N

Sample size = n

To justify the result obtained from the population (N) a statistical technique of simple random sampling without replacement to show that the sample obtained by the probability of choosing the same value will affect the population sample size (n).

The sample size for this study was determined using the Slovin's Formula, which is a method for calculating the required sample size (n) based on the population size (N) and desired margin of error (e). The formula for estimating the sample size is based on a random sampling technique. The population size is specifically aimed at construction professionals operating in Imo State, namely: architects, quantity surveyors, engineers, builders, project managers and others.

It is computed as $n = \frac{N}{[1+ N (e)^2]}$

Where:

n = the no. of sample

N= total population

e = error margin

$$n = \frac{374}{[1+ 374 (0.05)^2]}$$

n = 193

Upon analyzing the output, it is evident that a total of 193 questionnaires was distributed to the respondents and subsequently collected. In sampling without replacement, the two sample values aren't independent. Practically, this means that what we got on the first one affects what we can get for the second one. Mathematically, this means that the covariance between the two isn't zero. That complicates the computations. In particular, if we have a SRS (simple random sample) without replacement.

Data Analysis and Presentation

The gathering of the questionnaire contributed a qualitative and quantitative data with the use of closed-end and open-end questions. In addressing the objective of the study, factor analysis (FA) was used. FA refers to a multivariate statistical method used to condense and cluster a large corpus of inter-related variables into fewer factor groupings [28]. It employs a structure detection technique to cluster correlated variables within a set. It is extensively used in construction management research to manage factor complexity through structuring and clustering large sets of correlated variables into fewer factors.

4. RESULTS AND DISCUSSIONS

Presentation of Results of Data

Professionals from construction firms working on some projects completed the self-administered questionnaires. Amongst a total of 193 professionals, 188 completed and submitted the questionnaires, while 176 were found to be fit for the analysis proper resulting in a response rate of 89.64%. The substantial response rate of 89.64% facilitated the acquisition of sufficient data that could be extrapolated to ascertain the realization of the research objectives set. A response rate of over 50% is always considered necessary to be used to represent the opinions of the respondents in the target population. The response rates are displayed in table 1.

Table 1: Details of Responses from the professionals

	Professionals	Population	Sample Sent	Sample Returned	Sample Used
1	Architects	95	52	40	36
2	Builders	92	40	38	34
3	Project Managers	45	30	29	25
4	Quantity Surveyors	51	24	47	41
5	Civil Engineers	49	25	28	22
6	Others	42	21	25	18
	Total	**374**	**193**	**188**	**176**

Source: *Analysis of Field Survey data, 2024.*

The challenges bedeviling LPS implementation

Research Question: To what extent can the challenges bedeviling the application of LPS in construction project delivery in Imo State be determined?

In identifying the challenges bedeviling LPS implementation on construction projects, data analysis was carried out using the factor analysis approach (FA). Tables 2 through to table 5.

Table 2: KMO and Bartlett's test for challenges bedeviling LPS implementation

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.756
Bartlett's Test of Sphericity	Approx. Chi-Square	844.801
	Df	551
	Sig.	.000

Eighteen (18) items of the challenges bedeviling LPS implementation in construction projects were subjected to principal component analysis using IBM SPSS Statistics version 25.0. Before this, the suitability of data for analysis was assessed. Inspection of the correlation matrix showed many of the coefficients had values of 0.5 and above. The Kaiser-Meyer- Olkin (KMO) measure of sampling adequacy of 0.756 was obtained. This value is within the desirable value of 0.6. From the table above, Bartlett's test of sphericity was 844.801 with an associated significance of 0.000, also, suggesting an acceptable level of internal consistency and reliability in the measures and the scale.

Table 3: Communalities for challenges bedeviling LPS

Communalities	Initial	Extraction
Attitude	1.000	.816
Late Implementation	1.000	.988
Lengthy Approvals	1.000	.791
Lack of time for activities and learning	1.000	.901
Bad Work Ethics	1.000	.963
Misinterpretation of 5-whys' analysis	1.000	.698
Contractual and Legal Issues	1.000	.990
Lack of guideline/standard practice	1.000	.890
Commitment and partial implementation	1.000	.708
Fluctuation and Variation	1.000	.781
Incomplete PPC process	1.000	.906
Poor Supervision and Quality Control	1.000	.756
Resistance to Change	1.000	.944
Lack of training	1.000	.882
Lack of Subcontractor's Involvement	1.000	.911
The underutilization of lookahead plans	1.000	.937
Leadership and Management Commitment	1.000	.909
Parallel Implementation with other Improvement Programs	1.000	.966
Extraction Method: Principal Component Analysis.		

From the table above, the average communality of the variables after extraction was 0.874. Hence, the communalities extracted support the use of factor analysis on the variables. It can be observed that no item had extracted eigenvalues less than the 0.50 cut-off point, hence all the variables are qualified for further analysis.

Table 4: Total variance explained for challenges bedeviling LPS

Total Variance Explained									
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.273	23.738	23.738	4.273	23.738	23.738	2.394	13.302	13.302
2	2.217	12.318	36.056	2.217	12.318	36.056	2.295	12.747	26.049
3	1.831	10.173	46.229	1.831	10.173	46.229	2.116	11.756	37.804
4	1.701	9.448	55.677	1.701	9.448	55.677	2.050	11.388	49.192
5	1.603	8.903	64.580	1.603	8.903	64.580	1.992	11.069	60.261
6	1.391	7.730	72.311	1.391	7.730	72.311	1.748	9.710	69.971
7	1.013	5.625	77.936	1.013	5.625	77.936	1.434	7.965	77.936
8	.905	5.028	82.964						
9	.829	4.607	87.570						
10	.731	4.063	91.633						

11	.578	3.211	94.844						
12	.493	2.740	97.584						
13	.378	2.100	99.684						
14	.057	.316	100.000						
15	2.807E-16	1.560E-15	100.000						
16	1.190E-16	6.611E-16	100.000						
17	-1.594E-16	-8.856E-16	100.000						
18	-5.573E-16	-3.096E-15	100.000						
Extraction Method: Principal Component Analysis.									

From the result presented in table 4.4 above, a seven-factor component solution which explained a total of 77.936% of the variance was obtained. The first component explained 23.738% of the variance; the second component explained 12.318%; while the third component 10.173%; while the sixth and seventh component were 7.730% and 5.625% respectively. The total variance explained is above the recommended minimum of 50%. The seven components were named according to the factor with the highest loading in the cluster. These are explained in greater details in the discussion section. Also, the screen plot for the factor analysis is shown in figure 2 below.

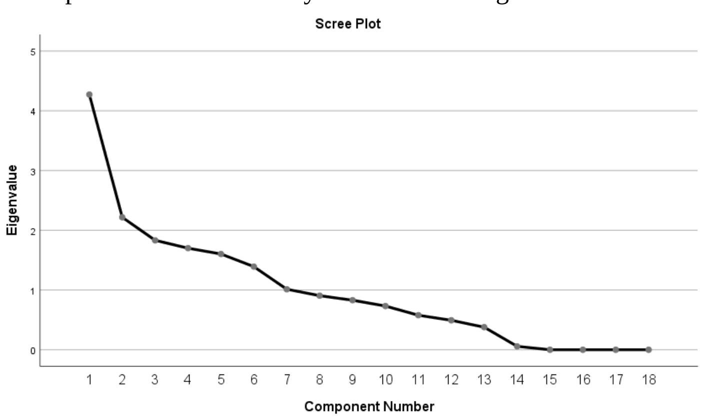

Figure 2: Screen plot for challenges bedeviling LPS

Figure 2 shows the scree plot derived from the EFA conducted. The report retains seven factors based on Kaiser's rule which recommends maintaining elements with eigenvalues greater than unity and the fact that the scree plot showed a sharp curve between the sixth and seventh factors. The seven factors account for over 50% of the total variance explained.

Table 5: Component matrix for challenges bedeviling LPS

Component Matrix[a]							
	Component						
	1	2	3	4	5	6	7
Attitude	.541		.422	***.591***	.515		
Late Implementation	.634	.124	.200	.565	.104	.411	.113
Lengthy Approvals	.631		.418	.256	.145		
Lack of time for activities and learning	.625	.354	.355	.412	.178	***.627***	
Bad Work Ethics	.623	.354	.355	.266	.178	.327	
Misinterpretation of 5-whys' analysis	.612	.127	.187	.419		.409	.104
Contractual and Legal Issues	.600	.203	.253		.234	.259	
Lack of guideline/standard practice	.638	.118			.358	.140	.415
Commitment and partial implementation	.426		.296	.225	***.533***	.217	
Fluctuation and Variation	.347			.116	.181	.276	.300
Incomplete PPC process	.210	.637		.363		.391	
Poor Supervision and Quality Control	.210	.335		.335		.309	
Resistance to Change	.254	***.836***			.274	.220	
Lack of training	.414	.344	.156	.173	.370	.117	***.651***
Lack of Subcontractor's Involvement	.455	.364	.688	.140	.334	.113	.134
The underutilization of lookahead plans	.456	.148		.274	.512	.351	.203
Leadership and Management Commitment	.342		***.699***	.147	.314	.231	.119
Parallel Implementation with other Improvement Programs	.323	.302		.237	.179	.435	.451
Extraction Method: Principal Component Analysis.							
a. 7 components extracted.							

The findings from the results shown above indicate that 18-factors can be grouped into seven (7) decision matrix (components) for challenges bedeviling LPS implementation. However, seven-principal components were later extracted for effectiveness. In the first component, 8 factors in that order loads positively maximally, 2 factors loaded positively maximally in the second component, while 2 factors load positively maximally in the third component. In the fourth component, 2 factors loaded, positively maximally. In the fifth, sixth and seventh components, 3,1,1 factor loaded positively maximally respectively. From this result, the components that emerged could be the dominant underlining challenges bedeviling LPS implementation on construction project delivery in Imo state.

Discussion of Results

The results of the factor analysis have highlighted several key barriers hindering the adoption of the Last Planner System (LPS) in building projects in Imo State. The analysis revealed seven underlying components accounting for nearly 78% of the variance, with significant factors such as external resistance, lack of integration between planning phases, and insufficient stakeholder buy-in emerging as prominent issues. These findings are consistent with a range of studies that have explored similar implementation challenges in various contexts.

One key challenge identified was external resistance from stakeholders, particularly clients and subcontractors. This aligns with the findings of [13] who reported that LPS practitioners often face significant resistance from external parties, which impedes its effective adoption. In their study, LPS was associated with more reliable planning and improved workflow; however, the external resistance highlighted the clash of paradigms between traditional practices and lean approaches. This resistance appears to be a major factor in limiting the widespread use of LPS, as stakeholders who are not familiar with the system may be unwilling to adapt to its requirements. Additionally, lack of integration between planning phases emerged as a recurring theme in the present study. According to [12], one of the primary challenges in LPS implementation is the lack of standardized reporting flow between shorter-term planning (such as weekly or daily planning) and longer-term strategic plans (e.g., Master or Phase plans). The inability to effectively bridge these planning gaps was observed as a significant barrier to LPS's effectiveness, as it creates inconsistencies and disruptions in the execution of projects. This finding corroborates the results from this study, where difficulties in integrating planning phases were observed as one of the major factors impeding successful LPS implementation.

Another barrier identified was insufficient attention to long-term planning, which also parallels the findings in the empirical literature. [12] pointed out that the lack of attention to long-range plans is a critical issue in LPS adoption. Without proper consideration of future stages, the planning system becomes fragmented, leading to inefficiencies. This factor was reflected in the present study, where the long-term planning component appeared underdeveloped in many of the case projects analyzed. Lack of proper incentives and training was also found to hinder LPS adoption, echoing the challenges reported by [8]. Their research found that the integration of Building Information Modeling (BIM) and LPS faced resistance, partly due to the lack of adequate pre-service training and continuous professional development. Similarly, the results of the current study suggest that the absence of proper incentives for adopting LPS, along with inadequate training for key personnel, could be a significant barrier. The resistance to adopting new tools and methods, such as BIM and LPS, may stem from a perceived increase in workload or a lack of perceived benefits, as highlighted in the empirical studies of both [8; 13]. This underscores the importance of comprehensive training programs and the development of a more integrated approach to implementing LPS across the entire project team.

Moreover, the complexity of LPS itself, as well as the lack of support from upper management, emerged as barriers to its widespread adoption. [22]. emphasized that LPS was often viewed as a complex system that required significant effort for proper implementation. This complexity, coupled with insufficient leadership support, is a challenge in many construction projects. The current study echoes these findings, where the lack of organizational commitment and understanding from senior management was identified as a critical issue. The alignment of senior and mid-level managers is essential for the system to function effectively, and when this alignment is missing, the system's potential is not fully realized. In line with the literature, partial implementation of the LPS was identified as another issue in this study. [12] found that the lack of full deployment of LPS and its partial application in certain phases of construction leads to inefficiencies and failure to achieve desired results. The study indicates that for LPS to be effective, all components of the system must be deployed cohesively, without gaps or omissions. This comprehensive implementation allows the system to function as intended, facilitating smoother workflows and improved project outcomes.

Therefore, findings of this study resonate strongly with the broader empirical literature on LPS adoption challenges. In particular, the barriers related to resistance to change, integration of planning phases, lack of incentives and training, and partial implementation mirror issues explored by [13; 12; 8]. These shared themes underscore the need for targeted interventions to address the challenges identified in the current study.

5. CONCLUSION

From the outcomes of the results, the study now concludes that the most challenges bedeviling the application of LPS in construction project delivery in Imo State includes in this order; lack of guideline/standard practice, resistance to change, leadership and management commitment, attitude, commitment and partial implementation, lack of time for activities and learning and lack of training.

6. RECOMMENDATIONS

Given the outcome of our findings, this study recommends;

1. Concerted effort should be made at ensuring that some of the LPS implementation processes are deployed in facilitating the successful delivery of construction projects to fruition. The use daily huddle meeting is strongly advocated for as studied have shown holding meetings prior, during and after the construction project delivery processes have contributed the success in all ramifications.

2. It is advocated that government and professional associations as well as all stakeholders in a project should see it as a matter of urgency to enact or promulgate laws and standards that would help strengthen the adoption and implementation of LPS in the successful delivery of construction projects as it is done in other climes. This effort would accord practitioners in the industry the needed push to deploy LPS in the delivery of the projects. On the aspect of resistance to change, all and sundry are expected to make a change by drifting from this idea of always trying to stick to doing things "the old ways".

7. CONTRIBUTION TO KNOWLEDGE

This study contributes to the body of literature on LPS implementation in that the study was able to extract more of the challenges bedeviling LPS from the literature compared to other researches done to date. With the revelation of these imminent challenges, the adoption and implementation of LPS would have been made easier thereby ensuring construction projects are delivered to their expected objectives.

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