AN APPRAISAL OF COLLABORATION REQUIREMENT FOR THE LAST PLANNER SYSTEM IMPLEMENTATION IN CONSTRUCTION PROJECTS

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DEPARTMENT OF QUANTITY SURVEYING,

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Declaration

I declare that the work in this Dissertation entitled **"An Appraisalof Collaboration Requirements forThe Last Planner System Implementation in Construction Projects"** was carried out by me in the Department of Quantity Surveying, Faculty of Environmental Design, Ahmadu Bello University Zaria. The information derived from the literature was duly acknowledged in the text and a list of references provided. No part of this work was previously presented for another degree or diploma at this or any other institution.

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Zainab Ibrahim Abdulkarim DATE

Certification

This Dissertation entitledAN APPRAISAL OF COLLABORATION REQUIREMENTS FOR THE LAST PLANNER SYSTEM IMPLEMENTATION IN CONSTRUCTION PROJECTSby ZainabAbdulkarim IBRAHIM meets the regulations governing the award of the degree of MSc Project Management of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

_____ _____ _____

Chairman, Supervisory Committee Signature Date
(Prof. B.A.Kolo)

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Member, Supervisory Committee Signature Date
(Prof. K.J. Adogbo)

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Head of Department Signature Date

(Prof. P. G. Chindo)

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Dean, School of Post Graduate Studies Signature Date

(Prof. M. N. Shuaibu)

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Dedication

This dissertation is dedicated to my ever-supportive and affectionate parents: Mr. and Mrs. Ibrahim Abdulkarim and Mr. and Mrs. AminuBambale, my husband Ibrahim, my baby Abdurrahman and my Siblings.

Abstract

The construction industry in Nigeria faces significant challenges related to project delays, cost overruns, and workflow inefficiencies. The Last Planner System (LPS), a lean construction management tool, has proven effective in improving planning reliability and reducing variability through enhanced collaboration among stakeholders. However, the successful implementation of LPS requires a structured, collaborative framework that is often underdeveloped in many Nigerian construction projects. This study examines the collaboration requirements essential for the successful application of LPS in Nigeria's construction industry. The study adopted a survey design approach for data collection whereby 140 questionnaires were distributed both online and offline and a total of 70 valid responses were retrieved, the data collected was analyzed using frequency distribution, mean scores, standard deviation and regression analysis. The results show that 83% of the participants agree that the requirements for LPS are achievable in construction projects while about 70%-83% of the respondents indicated that the requirements for team processes are averagely exhibited in construction projects. The research identifies key factors such as stakeholder's communication, commitment planning, early involvement of subcontractors and regular coordination meetings as critical elements for effective LPS deployment. The Findings highlight the need for a cultural shift towards more integrated team-based planning processes and provide recommendations for fostering collaboration to improve project outcomes in Nigeria's construction sector. Thus, to implement LPS in construction projects the team processes have to be highly exhibited or more than just averagely exhibited which will thereby lead to more adoption of LPS which will make the Nigerian construction industry to also benefit from its implementation. This research contributes to the growing body of knowledge on lean construction by providing insights into how LPS can be adapted to unique challenges of the Nigerian context.

Keywords: The last planner system (LPS), Implementation, Collaboration, Construction Industry.

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1.0 CHAPTER ONE

1.1 Background of the Study

Globally, the construction industry is generally evolving quickly in terms of organization and technology. It seems that the building sector gains its standing based on how well it is thought to function in terms of the value it creates. The construction industry in Nigeria faces persistent challenges, including project delays, cost overruns, and inefficiencies in workflow management (Ameh&Odusami, 2014; Oke, Aigbavboa&Khangale, 2018). Traditional project planning methods, such as Critical Path Method (CPM), often fail to account for real-time constraints, leading to unreliable schedules and poor coordination among stakeholders (Ballard, 2000). In response to these challenges, Lean Construction principles, particularly the Last Planner System (LPS), have emerged as a viable solution to enhance project planning and execution by improving workflow reliability through collaborative planning (Alarcón, Diethelm, Rojo& Calderón, 2011).

The Last Planner System (LPS), developed by the Lean Construction Institute, emphasizes commitment-based planning, continuous communication, and constraint removal to ensure work progresses as planned (Ballard & Howell, 2003). Unlike traditional top-down scheduling, LPS engages frontline workers, subcontractors, and suppliers in a participatory process, fostering accountability and transparency (Fernández-Solís, Porwal&Lavy, 2016). Studies in other regions, such as the UK, Brazil, and Chile, have demonstrated that LPS implementation reduces project delays by 20–30% and improves labor productivity (Sacks &Goldin, 2007; Picchi& Granja, 2004). However, despite its proven benefits, LPS adoption in Nigeria remains limited

due to cultural, organizational, and technological barriers (Ebekozien, Aigbavboa&Thwala, 2021).

The Nigerian construction industry is characterized by fragmented supply chains, adversarial relationships among stakeholders, and resistance to change (Dania, Kehinde&Bala, 2017). Additionally, there is a lack of awareness and training on Lean Construction principles, which hinders effective LPS implementation (Aigbavboa&Thwala, 2014). Given these challenges, collaboration among project stakeholders is critical for successful LPS adoption. Research indicates that trust, shared goals, and open communication are essential for LPS to function effectively (Mossman, 2009). In Nigeria, where contractual disputes and mistrust are common, fostering a collaborative culture is particularly challenging but necessary for LPS to thrive (Oladiran, 2009). This study appraises the collaboration requirements for LPS implementation in Nigerian construction projects, identifying key factors that influence its adoption. By examining stakeholder engagement, training needs, digital tools, and policy support, this research contributes to strategies for improving project delivery efficiency through LPS in Nigeria.

1.2 Statement of the Research Problem

The construction industry plays a pivotal role in Nigeria's economic development, contributing approximately 10% to the national GDP (National Bureau of Statistics, 2022). However, the sector continues to grapple with persistent inefficiencies, including chronic project delays, cost overruns, and suboptimal productivity (Ameh&Odusami, 2014). Studies indicate that over 70% of construction projects in Nigeria experience significant time extensions, often exceeding initial schedules by 30-50% (Oke et al., 2018). These delays stem from poor planning, weak coordination among stakeholders, and unreliable workflow management (Dania et al., 2017). Traditional project planning

methods, such as the Critical Path Method (CPM) and Gantt charts, have proven inadequate in addressing these challenges. These approaches rely on rigid, top-down scheduling, which fails to account for real-time constraints, unforeseen disruptions, and the dynamic nature of construction operations (Ballard, 2000). As a result, project teams often struggle with last-minute changes, resource shortages, and miscommunication, leading to rework, disputes, and financial losses (Oladiran, 2009).

In response to these shortcomings, the Last Planner System (LPS), a cornerstone of Lean Construction, has emerged as a transformative planning methodology. Developed by the Lean Construction Institute, LPS emphasizes collaborative, commitment-based planning to enhance workflow reliability (Ballard & Howell, 2003). Unlike conventional methods, LPS engages all key stakeholders—contractors, subcontractors, suppliers, and clients—in a participatory process to create realistic short-term work plans (Alarcón et al., 2011). By fostering transparency, accountability, and continuous improvement, LPS has been successfully implemented in various countries, reducing project delays by 20-30% and improving labour productivity (Sacks & Goldin, 2007).

Despite its global success, LPS adoption in Nigeria remains limited and poorly understood. Preliminary studies suggest several barriers to its implementation, including: Lack of Awareness and Training: Many Nigerian construction professionals are unfamiliar with Lean Construction principles or LPS methodologies (Aigbavboa&Thwala, 2014). Without proper training, firms struggle to integrate LPS into their existing workflows; Cultural and Organizational Resistance: The Nigerian construction industry is characterized by hierarchical decision-making and adversarial relationships between clients and contractors (Ebekozien et al., 2021). LPS requires a cultural shift toward collaboration, trust, and shared responsibility, which conflicts with traditional practices; Fragmented Supply Chains: Material delays, logistical bottlenecks,

and unreliable subcontractors disrupt LPS's pull planning process, making it difficult to maintain workflow continuity (Dania, Kehinde&Bala, 2017).

Given these challenges, there is an urgent need to investigate the collaboration requirements for successful LPS implementation in Nigeria. While existing research has explored Lean Construction in other contexts, few studies have examined how Nigerian firms can overcome collaboration barriers to adopt LPS effectively, this study seeks to fill that gap.

1.3 Need for Study

Last Planner System (LPS) implementation comes with a lot of benefits which will eventually help in reducing non-value adding activities and maximize efficiency in a project. The construction industry is a critical driver of Nigeria's economic growth, yet its performance is hampered by persistent inefficiencies, including delays, cost overruns, and low productivity (Ameh&Odusami, 2014). While the Last Planner System (LPS) has demonstrated success in improving project outcomes globally, its adoption in Nigeria remains limited, inconsistent, and under-researched (Ebekozien et al., 2021). The need for this study is underscored by Nigeria's urgent demand for improved construction productivity and the untapped potential of LPS as a solution. By addressing collaboration barriers, technological gaps, and policy shortcomings, this research will pave the way for sustainable, efficient, and timely project delivery in Nigeria's construction sector.

1.4 Aim and Objectives

1.4.1 Aim

The aim of this research is toappraise the collaboration requirements for the Last planner system implementation in Construction Projectswith the view to establish the

most favorable collaboration requirement that facilitate successful implementation of LPS.

1.4.2 Objectives

I. To identify collaboration requirements and LPS implementation task/activities.

II. To assess the collaboration requirements within the construction projects.

III. To assess the LPS tasks/activities within the construction projects.

IV. To examine the relationship between the team processes and the LPS tasks.

1.5 Scope and Limitation

1.5.1 Scope

Collaboration or teamwork can be further divided into three categories: processes, outcomes, and antecedents. This study focused on the team processes which have nine main components: three are the conditions that influence teamwork, and six are the essential processes for productive teamwork. The essential attitudes, actions, and thoughts that take place within the team and cover the fundamental elements of teamwork are the six core processes and emergent states that are outlined here as critical requirements. To be more precise, the three influencing conditions are those that determine how or to what extent teams collaborate, not the attitudes, actions, and thoughts that take place within the team. Therefore, for the purposes of this work, only the six core processes were evaluated.This study specifically focused on contracting organizations duly registered with the Corporate Affairs Commission in Kaduna. Also, focused on private and public sector including residential and commercial.

1.5.2 Limitation

The unwillingness of certain organizations to give unidentified individuals information about themselves, their operations, and their enterprises will restrict the research. Respondents will be guaranteed,that the data they provide will be kept completely private.The accuracy of the information provided by participants in the self-administered questionnaire survey determined how useful the study's conclusions were.

CHAPTER TWO

2.0LITERATURE REVIEW

2.1 NigerianConstruction industry

Construction industry is an important industry worldwide. The construction industry is generally defined as a sector of the economy. The industry is playing an important role in economic growth of the country but it faces many challenges currently that lead to affect project goal and steady growth of the economy. The Nigerian construction industry remains a pivotal sector in the nation's economy, contributing approximately 10% to the GDP and employing millions of workers directly and indirectly. Despite its significance, the industry continues to grapple with systemic inefficiencies that hinder its full potential. Recent studies highlight persistent challenges, including chronic project delays, cost overruns, and quality deficiencies, which are exacerbated by infrastructural deficits, regulatory bottlenecks, and economic volatility (Adebowale,Oladiran&Akinradewo, 2023). The sector operates within a complex ecosystem involving government agencies, private developers, contractors, and international investors, each facing unique constraints that collectively impede progress.
One of the most pressing issues in the Nigerian construction industry is the alarming rate of project delays. Research indicates that over 70% of construction projects experience significant time extensions, often exceeding initial schedules by six months or more (Olanrewaju, Tan & Kwan, 2022). These delays stem from multiple factors, including inadequate planning, unreliable supply chains, and frequent payment disputes. The ripple effects are profound, leading to escalated costs, contractual disputes, and diminished investor confidence. A study by Ibrahim and Umar (2023) found that material procurement challenges alone contribute to 40% of delays, particularly in public infrastructure projects where bureaucratic procurement processes slow down

progress. Furthermore, the industry's heavy reliance on imported construction materials—due to underdeveloped local manufacturing—exposes firms to foreign exchange fluctuations and logistical disruptions, further compounding delays.

Another critical challenge is the pervasive issue of cost overruns, which plague both public and private sector projects. A 2023 report by the Nigerian Institute of Quantity Surveyors (NIQS) revealed that the average cost escalation in construction projects hovers around 30–40%, driven by inflationary pressures, fluctuating material prices, and weak contract management. The situation is particularly dire in government-funded projects, where budget misalignments, corruption, and funding gaps frequently derail progress. For instance, the Lagos-Ibadan Expressway project, initially slated for completion in 2017, has faced multiple cost revisions due to design changes and funding shortfalls (BusinessDay, 2023). Such inefficiencies not only strain public finances but also erode trust in the sector's ability to deliver critical infrastructure.

The Nigerian construction industry also faces a severe skills shortage, which limits its capacity to adopt modern construction techniques. Despite the growing demand for skilled labor, vocational training institutions remain underfunded, and many professionals seek opportunities abroad due to better remuneration and working conditions (Opawole,Jagbora&Babatunde, 2023). This brain drain has left the industry with a workforce that lacks expertise in emerging technologies such as Building Information Modeling (BIM), prefabrication, and sustainable construction methods. A survey by the Council for the Regulation of Engineering in Nigeria (COREN) found that fewer than 15% of construction firms use digital project management tools, highlighting a significant technology gap that stifles efficiency and innovation (Adeyemi et al., 2023). Despite these challenges, there are emerging opportunities that could reshape the industry's trajectory. The federal government's renewed focus on

infrastructure development, particularly through public-private partnerships (PPPs), offers a pathway to addressing funding constraints. Initiatives such as the Infrastructure Tax Credit Scheme and the Road Infrastructure Development and Refurbishment Investment Tax Credit Scheme have attracted private sector participation in critical projects like the Abuja-Kaduna-Zaria-Kano Expressway (PwC Nigeria, 2023). Additionally, the growing adoption of alternative building materials, such as interlocking bricks and bamboo, presents a sustainable solution to rising construction costs while reducing environmental impact.

The push for green building practices is also gaining momentum, driven by global sustainability trends and local environmental regulations. Projects like the Eko Atlantic City and the Nigerian Air Force Eco-Friendly Housing Scheme demonstrate the potential for energy-efficient designs and renewable energy integration in construction (UNEP, 2023). Moreover, advancements in modular construction techniques—pioneered by firms like Julius Berger Nigeria—are reducing project timelines and labour costs, offering a viable model for large-scale housing and infrastructure projects.While systemic challenges persist, strategic interventions in policy, technology, and workforce development could unlock transformative growth. Strengthening regulatory frameworks to curb corruption, incentivizing local material production, and investing in technical education are critical steps toward building a more resilient sector (Babalola, Ugah and Ndimako, 2024). Inadequate infrastructure and inconsistent policies are major obstacles for the construction sector. Long-term planning is hampered and investor uncertainty is increased by changes in government regulations, especially those pertaining to taxation, land acquisition, and procurement processes (Aiminhiefe, 2022).Furthermore, embracing digital transformation through BIM, IoT, and AI-driven project management tools could enhance efficiency and transparency.

The industry's future will largely depend on collaborative efforts between the government, private sector, and educational institutions to foster innovation and sustainable development. The Nigerian construction industry faces persistent challenges, including project delays, cost overruns, and quality deficiencies, which undermine its potential to drive economic growth. However, the adoption of Lean Construction principles offers a transformative pathway to overcoming these obstacles. Rooted in the elimination of waste and the maximization of value, Lean Construction methods, particularly the Last Planner System (LPS), have demonstrated significant potential to enhance efficiency and collaboration in Nigeria's construction sector (Ballard, 2000; Ebekozien et al., 2021).

One of the most pressing issues in the industry is the prevalence of project delays, which affect over 70% of construction projects (Olanrewaju et al., 2022). Traditional project management approaches, often characterized by rigid top-down scheduling, fail to account for the dynamic nature of construction workflows. In contrast, Lean Construction emphasizes adaptive, collaborative planning through LPS, where frontline supervisors actively participate in developing realistic work plans. Research by Aigbavboa and Thwala (2014) highlights that projects implementing LPS in Nigeria experienced a 30-40% reduction in delays, attributable to improved workflow reliability and proactive constraint removal. The system's "should-can-will" planning framework ensures that tasks are only scheduled when all prerequisites are met, thereby minimizing disruptions and enhancing predictability (Ballard & Howell, 2003). Cost overruns, another critical challenge, often stem from inefficient resource allocation and poor coordination among stakeholders. Lean Construction addresses this through principles such as pull planning and just-in-time (JIT) delivery, which align resource deployment with actual project needs. A study by Dania et al. (2022) found that Nigerian firms

adopting Lean practices reduced material waste by 18% through better inventory management and localized sourcing. Furthermore, the integration of digital tools, such as Building Information Modeling (BIM), with Lean methodologies has been shown to enhance cost control by providing real-time visibility into project progress and resource utilization (Adebowale et al., 2023).

Quality-related issues, frequently tied to inadequate workmanship and supervision, also plague the industry. Lean Construction's focus on continuous improvement and standardized work processes offers a viable solution. For instance, the use of quality function deployment (QFD) in Lean projects ensures that client requirements are systematically translated into actionable construction practices, reducing defects and rework (Oke et al., 2023). Additionally, the emphasis on team collaboration and accountability under LPS fosters a culture of quality consciousness, where tradespeople and supervisors jointly troubleshoot issues before they escalate (Fernández-Solís et al., 2016).

2.2 Lean Construction

Lean Construction represents a transformative approach to project management that originated from the Toyota Production System and has been adapted to address the unique challenges of the construction industry (Koskela, 1992). This philosophy fundamentally rethinks traditional construction practices by focusing on maximizing value while minimizing waste throughout the project lifecycle (Ballard & Howell, 2003). Unlike conventional methods that emphasize task completion, Lean Construction prioritizes workflow reliability and continuous improvement through collaborative planning and execution (Howell, Ballard &Tommelein, 2011). At its core, Lean Construction challenges the fragmented nature of traditional project delivery by emphasizing the importance of integrated processes and stakeholder collaboration

(Bertelsen, 2003). The theoretical foundation of Lean Construction rests on three fundamental principles: transformation, flow, and value generation (Koskela, 2000). The transformation view considers construction as a series of material conversions, while the flow perspective emphasizes the importance of uninterrupted workflow. The value generation principle focuses on meeting customer requirements while eliminating non-value-adding activities.

These principles have been operationalized through various tools including target value design, pull planning, and continuous improvement cycles (Zimina, Ballard &Pasquire, 2012). Implementation of Lean Construction requires significant cultural and organizational changes. Mossman (2009) emphasizes that successful adoption depends on developing a learning culture where problems are openly discussed and solved collectively. This contrasts sharply with the blame culture prevalent in many traditional construction organizations. Fernández-Solís et al. (2016) found that firms transitioning to Lean Construction need to invest substantially in training and change management to overcome resistance from employees accustomed to conventional practices.

The benefits of Lean Construction extend beyond schedule performance. Studies by Sacks and Goldin (2007) report 15-25% improvements in labor productivity and 10-15% reductions in project costs through waste elimination. Furthermore, Dave, Boddy&Koskela (2015) document significant improvements in safety performance and workforce morale on Lean Construction sites, attributing these outcomes to increased worker engagement and systematic problem-solving approaches. In developing country contexts like Nigeria, Lean Construction adoption faces unique challenges including fragmented supply chains, informal labor markets, and limited technical expertise (Ebekozien et al., 2021). However, research by Oke et al. (2018) demonstrates that adapted Lean approaches can yield substantial benefits even in resource-constrained

environments. The key lies in developing context-specific implementation strategies that account for local institutional and cultural factors (Aigbavboa et.al., 2014). Emerging trends in Lean Construction include the integration of digital technologies such as Building Information Modeling (BIM) and the Internet of Things (IoT) to enhance workflow transparency and decision-making (Fosse & Ballard, 2016). These technological advancements are creating new opportunities for real-time performance monitoring and collaborative problem-solving across geographically dispersed project teams (Dave et al., 2018). The future of Lean Construction lies in its ability to evolve in response to industry megatrends including sustainability requirements, labor shortages, and increasing project complexity (Salem, Solomon, Genaidy&Minkarah, 2006). As the construction industry faces growing pressure to improve its environmental and social performance, Lean principles are being extended to address broader sustainability objectives through concepts like Lean-Green integration (Martínez, González & Orozco, 2020).

Collaborative planning was introduced on the basis of these understandings. The earliest contributors focused on technological means available for the exchange of information between independent supply chain partners (Dudek, 2004). In recent times, collaborative planning has gained popularity due to an industry initiative 'Collaborative Planning, Forecasting and Replenishment' (CPFR). However, collaborative planning includes goals, tasks and resources and the development of a conjoint business plan and CPFR may be regarded as primarily a term of business planning. Kilger and Reuter (2002), viewed collaborative planning as a non-hierarchical, cooperative approach to the coordination of operations, planning tasks across the supply chain. Dudek (2004) has also adopted this understanding and focused on the decision making and negotiation aspects of collaborative planning. He developed a negotiation-based collaborative

planning scheme that coordinates master plans of individual supply chain partners each of whom have their own planning domain. Some researchers in the construction industry have begun to adopt the collaborative planning concept for project planning. For example, Verheij and Augenbroe(2006) argue that project planning is the tactical translation of the strategic objectives into project execution. They have developed a new approach to systematically generate comprehensive project plans by cultivating and enacting the logic and intelligence of incremental and collaborative planning strategies based on a methodology that treats project planning as the execution of a series of structured dialogues between prospective project partners. Despite the limited applications of the collaborative planning approach the system provides an opportunity for the construction industry to deal with the fragmented nature of industry and improve the collaboration within the supply chain.

Planning and control in LC are practically achieved through the implementation of the Last Planner System (LPS). It has been successfully implemented in different developed and emerging countries. LPS offers the promise to make assignments ready while supporting short term planning and minimizing non-value adding work. It makes projects more predictable, minimizes buffers, reduces uncertainties, encourages collaborative planning, creates reliable work plans and decreases workflow variability (Ballard *et al* 2009; Gonzalez *et al* 2010; Mossman 2012).

2.2.1 Last planner system

The construction industry has long been aware of deficiencies in the design and construction processes that are evidenced by cost overruns, project delays, and quality and performance shortfalls in the finished construction. In 2000, Glenn Ballard developed the Lean Project Delivery System (LPDS) which provides a means of

addressing these shortcomings and improving the entire design and construction process (Ballard and Howell 2003). The last planner system (LPS) is an important subset of the LPDS and is critical to its effective deployment.

Glenn Ballard and Greg Howell first used the term Last Planner to describe the person or group that produces assignments. They used Last Planner to name the system because they wanted to emphasize that everyone has managerial responsibility for project success, especially the front-line supervisor. They also intended to convey the message that the planning decisions of the front-line supervisor are qualitatively different from planning decisions made at higher organizational levels because they are not inputting to other planning processes, but directly drive action. Ballard pioneered the development of The Last Planner System in 1992. The LPS was based on the concept of reducing the hierarchical layers of construction management and empowering field-based actors in the construction process to optimize the allocation of available resources in the weekly planning, scheduling, and execution of work. Ballard further refined the LPS in 1998, transitioning from weekly work planning to look ahead planning and to phase scheduling.

This refinement focused on managing flows in the construction process, reducing flow variation from the plan, and using buffers to limit the impacts of any remaining variability in these flows. The LPS technique as refined by Ballard (2000) decentralizes decisions and empowers the crews that are in direct contact with the work to plan and schedule detailed tasks; in effect, they become the last planner. LPS has been extended to all stages of construction planning: pre-contract planning, tender planning and production planning. It has also been used in a design office environment.LPS rests on a belief that the world is inherently stochastic and all plans are forecasts and all forecasts are wrong. LPS works on the basis that there is no point in starting construction

activities if the construction team does not have all the resources required to complete the work. The LPS schedules the construction activities to start when everything required for completion of the task is available. All the trades involved with the construction activities agree production schedules collaboratively and helping to ensure work will be completed to anticipated timescales. LPS started as a system for short-term production planning immediately before construction. This recognizes that you only need to plan in detail prior to the commencement of work.

A last planner is the people closest to work, with authority to make decisions and create assignments at least one step closer to the physical work than traditional participant. Last Planners' are the people who are directly in charge of the work teams, that is, those responsible for organizing the work groups and supervising production on a day-to-day basis. 'Last Planners' work collaboratively with their counterparts from other companies to prepare the work schedules for the next work period. They use planning workshops to analyze where savings in time may be gained. They agree and initiate work assignments and monitor subsequent performance daily. Where anticipated production is not achieved, they consider why this is so and the changes that need to be made to the schedule.

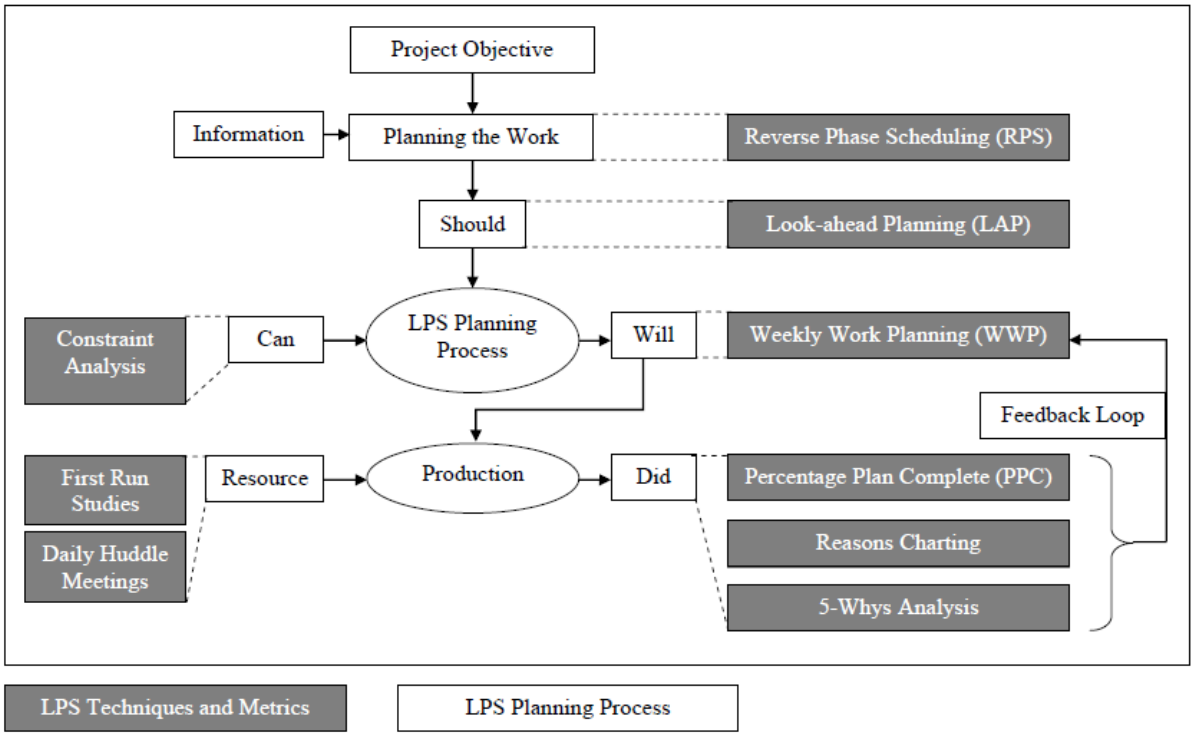

Figure 2.1: LPS Planning process and its components.

The figure above explains briefly LPS planning process and its components. Last planner system planning process is a procedure of creating a master schedule, a look-ahead, and a commitment/weekly work plan through front-end planning using lean construction planning techniques. Weekly work planning is referred as “commitment planning” because, at this stage, specific resource assignments need to be made so that work can actually be performed. The primary function of LPS is the collaborative planning process that involves „last planners“ for planning in greater detail as team gets closer to doing the work. Moreover, LPS incorporates ‘‘pull scheduling’’ principle where only the work that can be done is promised by last planners in weekly work plan meetings as opposed to conventional ‘‘push scheduling’’ principle where the work that should be done is planned in weekly meetings and emphasis is on adhering to the master schedule. Constraint analysis is an integral part of LPS that is applied to take a proactive approach to problem solving as faced during the day-to-day life on construction projects. According to Ballard: last planner system of production control can be

characterized in terms of the principles that guide thinking and action, the functions it enables to be performed, and the methods or tools used to apply those principles and perform those functions.

2.2.1.1 Principles of LPS

- Plan in greater detail as you get closer to doing the work
- Produce plans collaboratively with those who will do the work
- Reveal and remove constraints on planned tasks as a team
- Make and secure reliable promises
- Learn from breakdowns.

2.2.1.2 Functions of LPs

- Collaborative planning
- Making ready
    - Constraints identification and removal
    - Task breakdown
    - Operations design
- Releasing
- Committing
- Learning

The functions of the LPs include: productive unit and work flow control, and completing quality assignments. In addition, it makes it easier to get to the root of the problems, and to make timely decisions regarding adjustments needed within the operation, in order to execute actions opportunely, thereby increasing productivity.

2.2.1.3 Components of Last Planner System

- Master Schedule

The master schedule represents an overall view that identifies major project phases and documents milestones for these phases. In traditional construction, the master schedule is typically included in the contractor's bid. Hence it is an optimistic forecast of the major stages in carrying out a project, based on the early information provided in the contract documents. The purpose of the master plan is to develop and display execution strategies, demonstrate the feasibility of completing the work within the available time and identify the important milestones to clients or stakeholders (Alsehaimi, 2011).

- Phase Scheduling

Phase scheduling is a collaborative planning process, where the team: defines a project phase or milestone; breaks it down into constituent activities; schedules activities backward from the milestone.Phase schedule is used to develop a plan for completing work within a phase of the master plan, so as to produce the best possible plan by involving the representatives of all organizations that work within the phase and to develop a more detailed work plan (Hamzeh, 2009). After incorporating input from different project partners and identifying hand-offs between specialists, the team performs reverse phase scheduling back from important phase milestones. Development of a phase schedule is an integral part of the application of the LPs to a project. In fact, the phase schedule is the basis for a 6 week look-ahead plan and ultimately the weekly work plan, all essential components of the LPs.

- Look Ahead Planning (Lap)

Compared to long-term planning resulting in a master or phase schedule and short-term planning resulting in weekly work plan, look-ahead plans are the outcomes of mid-term planning showing activities initially at the level of processes and subsequently at the level of operations. It uses items pulled from the master pull schedule. Look-ahead planning breaks activities down into the level of processes/operations, identifies

constraints, assigns responsibilities, and makes tasks ready by removing constraints (Hamzeh and Bergstrom, 2010). They make tasks ready so that they can be done when the right time comes (Ahiakwo, 2017). The construction industry commonly uses look-ahead schedules to focus supervisors‟ attention on what work is supposed to be done in the near future. Ballard followed a set of rules for allowing scheduled activities to remain or enter into each of the three primary hierarchical levels (i.e. Master schedule, look-ahead schedule, and weekly work plan) of the scheduling system:

- Allow scheduled activities to remain in the master schedule unless positive knowledge exists that the activity should not or cannot be executed when scheduled.
- Allow scheduled activities to remain in the look-ahead window only if the planner is confident that the activity can be made ready for execution when scheduled.
- Allow scheduled activities to be released for selection into weekly work plans only if all constraints have been removed.

- Constraint Analysis

Once assignments are identified, they are subjected to constraints analysis. Different types of assignments have different constraints. The construction example includes contract, design, submittals, materials, prerequisite work, space, equipment, and labor; plus, an open-ended category for all other constraints.

Constraints analysis requires suppliers of goods and services to actively manage their production and delivery, and provides the coordinator with early warning of problems, hopefully with sufficient lead time to plan around them. In the absence of constraints analysis, the tendency is to assume a throw-it-over-the-wall mentality; to become reactive to what happens to show up in your in-box or lay down yard.

- Weekly Work Planning (WWP)

Weekly work plans are the most detailed plans in the LPs. These plans are developed in collaborative weekly meetings where last planners representing all project stakeholders are present. Kalsaas (2012) explained that the Preparation of a weekly work plan is in consultation with the last planner, which involves negotiating with all project team managers in a meeting to achieve a plan that is considered feasible and which has everyone's commitment. This meeting is different from the standard planning meetings for the week ahead in that instead of the management dictating a pre-conceived plan, the team leaders select the tasks to be performed using a strict "can be done" filter in their selection. Last planners are team leaders and frontline supervisors directly overlooking work execution such as team leaders overlooking design planners. The purpose of these weekly meetings is to increase plan reliability and reliable promising by making quality assignments, requests, and commitments.

- Daily Huddle Meetings

Meetings where team members quickly give the status of what they had been working on since the previous day's meeting, especially if an issue might prevent the completion of an assignment. This tool is similar to the lean manufacturing concept of employee involvement, which ensures rapid response to problems through empowerment of workers, and continuous open communication through the tool box meetings.

- Percentage Plan Complete (PPC)

PPC (percent plan complete) is the number of planned activities completed divided by the total number of planned activities, expressed as a percentage. PPC measures whether the planning system is able to reliably anticipate what will actually be done. Determining whether an assignment was completed or not according to the plan is

mandatory in calculating PPC, but elaborating on reasons for failure to complete the work as planned is even more important.

A weekly analysis of the PPC results in identifying the reasons for the disruption of the pace observed in the work and, consequently, contributes to systematic learning on the jobsite, generating a mind-set effectively geared to improving competitiveness in construction companies. Focus on process improvement can be achieved through the use of the indicator PPC.

2.2.1.4 Benefits of the Last Planner System

Last Planner can significantly improve production performance. Ballard (2000) says:

"With adherence to the Last Planner rules, with extensive education and involvement of participants, and the use of techniques such as task explosion, constraints analysis and make ready actions shielding production from uncertainty through the selection of quality assignments planned performance completion levels of 76% or higher can be consistently achieved, a significant improvement on performance using traditional planning methods." (Section 10, p. 3).

Mossman (2013) stated the benefits of using LPS which include reduced schedules, continuous knowledge development within teams, better collaboration, communication and understanding, simplification of design management, facilitation of better coordination and collaboration, improved schedules by reducing rework and creating a more stable workflow with better matched availability of labor force and increased productivity.

Experience has shown that when using the LPS, subcontractors work to achieve the targets set. Professional pride develops and not letting the team down becomes important, no one wants to admit failure to deliver on time at the next meeting.

LPS provides evidence that subcontractors have acted within the terms of the contract. Records show when work was undertaken in which areas and the time taken for production.

One specialist contractor who implemented the system found that using LPS improved the managerial skills of their foremen on site and led to a freeing up of senior management time. The managing director commented:"The Last Planner System [enables] our site supervisors to plan their workload on a weekly basis and assess their team's performance on a daily basis [and] to make an accurate prediction of the labor required on a weekly/daily basis.

This plan is based on facts, not a site manager's wish list. Once supervisors understand Last Planner and are confident in using the documentation, it can reduce the frequency of senior management visits to site. The foremen are capable of handling situations as they arise as their decisions are based on facts that are documented weekly." (Mossman, 2012, p. 4).

2.2.1.5 Barriers to the adoption of Last Planner

Last Planner requires a new approach to production planning.

- Adopting the LPS means that managers and contractors have to accept a decentralized control system. This may be unacceptable to some. The idea of centralized control still dominates the construction industry. Many managers want to control information so that they can control staff and subcontractors.
- Adopting the LPS requires a change of thinking, changes at operational level and a change of management philosophy.
- Project managers need to accept responsibility for effective planning and learning taking place, and review and respond to the measured results. They should routinely participate in Last Planner meetings to emphasize the

importance of this way of working, their commitment to its use and to provide help in removing constraints when needed.

- Some find it difficult to link the weekly work plans to the activities listed on the master schedule. (This has always been a problem of short-term production planning. Working collaboratively simply emphasizes the problem.)
- Last Planners need the confidence to ignore activities and activity start dates on the master schedule and focus on achieving the milestone dates for the next stage of the construction work. This is overcome if the master schedules are expressed in milestones between phases and the phases down into processes in pull planning sessions with those who will do the work in the phase. The processes within these phases should then be broken down into operations during the 'Look ahead' process. Operations are then broken down into steps. Using virtual prototyping, physical prototyping or first-run studies enables you to test the proposed operations.

2.2.1.6 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. In addition to certain benefits, academicians and practitioners have reported the challenges faced by AEC (Architecture, Engineering, and Construction) professionals during the implementation of using LPS. AEC professionals face challenges at two stages. First is the implementation stage, when the project team is introduced to LPS and pilot projects are in progress. These are organizational challenges faced by senior and mid-level management in the initial stages. During the second stage, LPS is used by an experienced team and technical challenges associated with skill building and human capital needed for using LPS are introduced. Below lists the challenges and their occurrences in the literature:

- Cultural Issues

Ankrah (2007) identified that different dimensions of culture are significantly associated with project performance outcomes. For lean thinking to work, it requires employees to change the way they execute their work (Liker, 2004). Changing old traditions and behavior and adopting new traditions and behavior is a necessary prerequisite for implementing Lean Construction tools especially the LPS (Olatunji, 2008, Abdullah, Abdul-Razak, Abubakar& Mohammed,2009, and Mossman, 2009). This is often seen as a cumbersome task and in most cases threatening for construction workers to change their status-quo from a somewhat dysfunctional system which they have operated relatively successfully to a new system.

The 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 (Ballard, 2000; Ballard *et al.*, 2009; Alsehaimi*et al*., 2009; Hamzeh*et al*., 2009; Gonzalez *et al.*, 2010; Alsehaimi, 2011)

- Resistance to Change

For a successful implementation of Lean Construction and the LPS, the support of the organization and the top management is required (Sarhan and Fox, 2013). Bashir *et al.*, (2010) 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. Some causes of resistance to change include;lack of top management support, short-term vision, organizational resistance, unclear strategic goals.

- Lengthy Approvals

For a successful implementation of Lean Construction and LPS a fast approval of orders free from delays as this can create unnecessary bottle necks that in turn will negatively impact on project durations is required (Bashir *et al.*, 2010). Olatunji (2008), identified that lack of government control and enforcement, can adversely affect the approval processes within the construction industry. In traditional contractual procedures, the design and implementation of project are treated as separate entities (Rooke *et al.*, 2007). This causes an altercation 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 (Shammas-Toma*et al.*, 1998; Rooke *et al.*, 2007).

- Fluctuation and Variation

According to Dulaimi and Tanamas (2001) for a successful implementation of Lean Construction and LPS, some common financial barriers that need to be carefully addressed. These include: lack of stakeholders' support, inflation, inadequate funding of projects and unstable markets for construction. Also, Bashir *et al.*, (2010) recognized that political instability could cause fluctuations and pose barriers to the successful implementation of Lean Construction tools.

- Lack of Subcontractor's Involvement

Sarhan and Fox (2013) an adversarial relationship between the contractor and the subcontractors tend to undermine the application of Lean techniques within construction projects. Fragmentation and poor contracting or legal issues, delay from suppliers and subcontractors and lack of collaboration are grouped as some of the causes to lack of subcontractors' involvement. Johansen and Walter (2007) added, stating that fragmentation separates the design from the construction process; and therefore, misses the Lean aim of collaboration and integration.

- Poor Supervision and Quality Control

The implementation of any new process requires skilled and professional workers to drive the change process (Ahiakwo, 2017). However, poor supervision and quality control issues hamper the application of Lean construction (Bashir *et al.*, 2010). Studies conducted by Sarhan and Fox, 2013; Fernandez-Solis *et al., 2013* indicated that the main 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.

Table 2.1; List of LPS tasks/activities derived from literature

S/N	LPS tasks/activities
1	Team collaboratively consider critical dependencies
2	Collaborative planning between all parties involved
3	Construction team members must make reliable promises
4	Plan failures are treated as an opportunity for learning not negative actions
5	Smooth work flow depends on the parties making and keeping promises to carry out assignments
6	Weekly measurement evaluates accomplishment and permits fine turning for improvement
7	The duration and work force requirement are determined for each activity
8	Activity durations are adjusted through resource utilization
9	Planning workshops are used to analyze where savings in time may be gained
10	Team members agree and initiate work assignments and also monitor subsequently
11	Plan in greater detail as you get closer to doing the work

12	Undertake a constraints removal process o planned and ask publicly with those who can remove constraints
13	Learn from past failures
14	Identify and act on root causes to prevent reoccurrences
15	Identification of unclear design details
16	Build commitment to programme and reduce overall program period
17	Enables team members to test options to improve work flow, buildability and program reduction
18	Task are ready for production when required
19	Each team member is formally required to commit to undertaking the work they propose
20	Team discuss and agree on work schedule

2.3 Collaboration

Collaboration refers to the act of working together towards a common goal. It can happen within or between teams and it emphasizes interaction, communication, and mutual problem-solving. Collaboration can occur between individuals who are not part of a formal team as long as they are working together on a shared task or project. In a collaborative effort, individuals contribute their skills, knowledge, and resources, leveraging diverse perspectives to solve or complete tasks more effectively than they could do alone. Performance is the most important part of what teams are made of. It establishes the basic idea of a team, where the team and how well they do are closely connected. So, it's very important for every team, no matter how big or small, to be the main part of how well an organization does. No team forms without a challenge that matters to the people involved. A common set of important goals that a group agrees on will usually help improve both performance and teamwork. To build a strong team, you should follow some important steps: have common interests, goals, and plans — share values — define individual roles — work well together — agree on expected behaviours — share leadership — and always look to improve (Spatz 1998).Profoundly effective teams have demonstrated to lay out great working connections and possibly

accomplish more noteworthy results, since clashes inside teams are limited (Demkin 2008). Because of this moreover, Evbuonwan and Anumba (1998) demonstrated that piece of the purposes behind poor performance of project delivery in the construction industry is due to the incapability of project participants to work collaboratively. Fong and Lung (2007) showed the greater part of the research conducted just centred around factors vital for group achievement, rather than teamwork issues.

In a study conducted by Omid and Medi(2016) they concentrated on the degree to which team effectiveness is importance in adequacy elements can prompt make viable development project groups and how these elements ought to be overseen for hierarchical benefit. From their work, it tends to be summed up that group viability is significant in development project groups and task execution. The group viability factors distinguished (Group authority, Team Goals and Objectives, Team Roles and Responsibilities, Team Relationship, Team Communication, and Trust and Values) affect the execution of the development project and conveying an incentive for cash.In this situation, each team member has a set of expectations for how they will act as an individual. They will also have preconceived notions, beliefs, and assumptions about how others would act. These two sets of sensations come together to offer a person a situational awareness.

Individual behavior is influenced by constructs. The most well-known proponent of team roles is Belbin (1981, 1993). A team role, according to him, is "a predisposition to behave, contribute, and interact with others in diverse ways." The significance is found in one person's typical behavior in respect to another or in connection to the team's growth. Belbin has established a number of distinct team responsibilities, as well as a psychometric test that may be used to evaluate an individual's underlying personality traits and behavior, enabling for team matching. The following personality qualities are

grouped together: action oriented, people focused, and cerebral oriented. Collaboration can enhance productivity, innovation, and the quality of outputs by enabling diverse teams to work together seamlessly. Collaboration requirements are essential conditions and elements that facilitate effective teamwork and communication among individuals or groups such as team processes. Team processes are the building blocks of collaboration.

Each process represents a requirement that must be met for a team to collaborate effectively — from clear communication and coordinated planning to shared decision-making and support. Without these processes, collaboration will likely break down, even if the team has the right tools or goals.Team processes encompass the structured methods and practices that guide how team members interact, communicate, and work toward shared goals.

2.3.1 Team Processes

Six key emergent states and processes, as well as three influencing factors, are included in these considerations. Processes are described as interconnected activities that support task work, whereas emergent states are the ensuing dynamic qualities of a team, achievement in the pursuit of objectives (Marks et al., 2001). Salas et al (2014) identified six processes and emergent states as important team processes: (1) cooperation, (2) conflict, (3) coordination, (4) communication, (5) coaching, and (6) cognition. They also comprise three influencing conditions: (1) composition, (2) culture, and (3) context, all of which work as influences on the aforementioned basic processes and emerging states.

These influencing conditions reflect the wide range of elements that influence how teams' function, as well as how variability within those parameters can influence team

results both directly and indirectly (through the aforementioned processes and emergent states).

The basic attitudes, behaviors, and cognitions that occur inside the team and cover the essential features of collaboration are the core processes and emerging states described herein as crucial processes. These processes have emerged as crucial as a result of decades of empirical research recognizing their importance in good teamwork.These include team members' attitudes and reasons for cooperating (i.e., cooperation), behavioral interactions among members (i.e., conflict, coordination, communication, coaching), and the shared knowledge that results from these interactions (i.e., cognition).

2.3.1.1 Cooperation

In essence, the motivational drivers of collaboration are the team's attitudes, beliefs, and feelings that drive behavioral activity. Cooperation is a broad teamwork consideration that encompasses the motivational drives required for successful collaboration. A variety of team-level markers of cooperation are important for team effectiveness.For example, Cannon-Bowers, Tannenbaum, Salas, and Volpe (1995) discussed collective efficacy (i.e., a collective sense of competence or perceived empowerment to control the team's function or environment; e.g., Katz-Navon&Erez, 2005; Mathieu, Gilson, & Ruddy, 2006; Zaccaro, Blair, Peterson, &Zazanis, 1995), trust (i.e., shared belief that all team members will contribute as required by role and protect the team; e.g., Bandow, 2001; Salas, Sims, & Burke, 2005), and team/collective orientation (i.e., general preference for and belief in the importance of teamwork; e.g., Eby& Dobbins, 1997; Jackson, Colquitt, Wesson, & Zapata- Phelan, 2006) as team- level attitudes important for successful teamwork.

Relationships between these cooperative mechanisms and desirable team outcomes have been empirically demonstrated through research. Teams whose members feel they can achieve their objectives successfully are more likely to (1) put up more effort, (2) take more strategic risks, (3) perform better, and (4) be happy (Knight, Durham, & Locke, 2001; Lester, Meglino, &Korsgaard, 2002). Another facet of cooperation, trust, has been discovered to influence the amount of monitoring inside a team (Langfred, 2004) and modulate the links between (1) team training proficiency and performance, as well as (2) task and relationship conflict (Langfred, 2004).

2.3.1.2Coordination

Positive team outcomes are mostly dependent on effective coordination. Coordination is the process of putting in place the behavioral mechanisms required to complete a job and turn team resources into results (Sims & Salas, 2007).Behavioral mechanisms are unquestionably important for successful team activities and results. One systematic evaluation included 29 frameworks that focused on cooperation behaviors specifically, with coordination frequently cited as an important characteristic (Rousseau, Aube, &Savoie, 2006), owing to their importance and prevalence.

Coordination is defined as "the orchestration of the order and timing of interdependent actions" (Marks et al., 2001, p. 363). Arrow, McGrath, &Berdahl, 2000; Brannick, Prince, Prince, & Salas, 1995) define coordination as the use of team-level techniques to coordinate knowledge and actions in order to achieve common goals. Individuals within a team may be executing the same or complimentary duties, which may vary depending on their interdependence; therefore, coordination can take different forms (Guastello&Guastello, 1998).Furthermore, coordination can be explicit, in which team members use mechanisms like planning and communication to manage interdependencies, or implicit, in which team members anticipate team needs and

dynamically adjust their behaviors accordingly without being instructed (Rico, Sa’nchez-Manzanares, Gil, & Gibson, 2008).

2.3.1.3 Conflict

Conflict arises when one or more team members' interests, opinions, or points of view are seen to be incompatible. During the course of a team's life cycle, conflict will undoubtedly arise. Indeed, a "storming" step is included in one of the most classic models of team growth, during which members are supposed to hash out differences in viewpoints and ideas (Tuckman, 1965). Conflict can be as minor as a brief argument over who is accountable for completing a certain task or as serious as a furious brawl when personalities clash (Jehn, 1995, 1997).Conflict is a problem for teams since it can lead to mistakes and breakdowns in performance (Salas et al., 2008), and the impact on performance is amplified by the team's task's complexity (De Dreu&Weingart, 2003). Conflict is characterized as perceived incompatibility in one or more team members' interests, beliefs, or points of view (Jehn, 1995).

There are various points of view on the impact of conflict on team procedures and outcomes. Some say that relational conflict is the most destructive to team performance, but task conflict might have a positive benefit under specific circumstances (Bradley, Postlethwaite, Klotz, Hamdani, & Brown, 2011).

2.3.1.4 Communication

When it comes to defining team communication, there are two approaches to consider. Communication is merely a movement of information between sender and recipient, according to a more simplified interpretation (Deetz, 1994). However, in a team setting, this communication transmission model may not fully represent the internal and external aspects that may influence information conveying, interpretation, and response.Communication is more of a transactional process in which communicators

provide and receive information at the same time, with aspects including how and from whom the message is sent influencing interpretation and response (Barnlund, 2008). As a result, team communication is characterized as a reciprocal process in which team members transmit and receive information that shapes and reforms the attitudes, behaviors, and cognitions of the team (Craig, 1999). The importance of team communication as a determinant in team effectiveness has long been recognized.

Furthermore, as previously noted, team communication can have an impact on other important components of cooperation, such as coordination and conflict (LePine, Piccolo, Jackson, Mathieu, & Saul, 2008; Rosen et al., 2011). The way information flows among team members can therefore influence the team's capacity to work together and achieve goals, so team communication structure plays a role in influencing crucial team processes (Dyer, 1984)

2.3.1.5 Coaching

Teams may not be able to notice when breakdowns occur or where knowledge may be found within the team if they are working alone (Hackman, 2011). Internal and external coaches (i.e., leaders) can give the essential guidance and support to help team members overcome the risk of process loss (Hackman &Wageman, 2005; Zaccaro, Rittman, & Marks, 2001). Furthermore, numerous individuals may be required to share leadership characteristics, either formally or informally, in order to effectively support teamwork (Morgeson, DeRue, &Karam, 2010). Burke, Stagl, Salas, Pierce, and Kendall (2006) cite a plethora of empirical evidence to support the usefulness of leadership actions such as initiating structure and providing attention in contributing to total team performance.

Coaching is a term that has been used to describe a variety of actions that are carried out by both people and teams in order to improve team effectiveness (Hackman &Wageman, 2005). Coaching is defined as the application of leadership characteristics

to develop goals and provide direction that leads to the achievement of these objectives (Fleishman et al., 1991).

So, why is coaching important for teams? Most importantly, effective leadership behaviors support the formation of effective processes and states in groups (Hackman, 2011; Zaccaro et al., 2001). Coaching can assist to dynamically lead and encourage team development and performance across the team life cycle by spotting performance and process gaps that arise within a team (Hackman &Wageman, 2005; Kozlowski, Watola, Jensen, Kim, & Botero, 2009). Coaching is especially important for recognizing and correcting critical team faults or difficulties, as well as aiding in difficult situations.

2.3.1.6 Cognition

Team cognition, also known as shared team knowledge, is one of the most studied aspects of team research, and with good reason. The cornerstone for team cognition is team cognition.In that it allows teams to start a team performance episode with a clear concept of how the team will participate in the job at hand, it is an effective team procedure.Team cognition (Klimoski& Mohammed, 1994) is defined as a shared understanding (e.g., shared mental models, transitive memory systems) among team members that develops as a result of team member interactions.

It includes knowledge of roles and responsibilities, team mission objectives and norms, the situation in which the team is operating, and familiarity with teammate knowledge, skills, and abilities (Wildman et al., 2012a). Failure to build a shared knowledge of the situation in an organizational setting can lead to hampered teamwork and undesirable outcomes, including life-threatening blunders. Teams can avoid potential blunders and failures by having a shared understanding of team objectives, roles, expertise, and the

operational circumstances. According to research, team training and interventions can help develop team cognition and reduce errors.

Table 2.2; Team processes statement derived from literature

S/N	TEAM PROCESS
	COOPERATION
1	Ability of members to control the behavior of individuals
2	A firm belief in the truth and ability of someone
3	Sense of competence and improvement towards achieving organizational goal
4	Belief that your contribution is respected and protected
5	Preference for and belief in importance of teamwork
6	Positive attitude towards the team and every individual
	COORDINATION
1	Well defined purpose of the team
2	Set goals and objectives
3	Role clarity and appropriate assignment
4	Discuss issues and find solutions together
5	Encourage team members to take ownership and responsibility for completing specific task
6	Describe the process the team would use to function
	CONFLICT
1	Recognize and encourage the desirable but discourage the undesirable team conflict
2	Recognize the type and source of conflict
3	Implement an appropriate conflict resolution strategy
4	Employ a win-win negotiative strategy
5	Members take initiatives to resolve issues between themselves
6	Define corrective measures and actions for falling to meet expectations and reward for going beyond and above duties
	COMMUNICATION
1	Focus on both verbal and non-verbal communications
2	Active listening to other team members
3	Decide what type of communication works best
4	Communicate clearly to avoid misinterpretation
5	Deliver information effectively
6	Express one's emotion freely
	COACHING
1	Learning to have difficult conversations effectively
2	Identifying teams' roles and challenges
3	Alignment of individual strengths with team strategy
4	Expanding the team's ability to produce results with minimum

	supervision
5	Effective leadership and mentoring
6	Learning together
	COGNITON
1	Building effective working relationship
2	Team building exercise
3	Combined abilities and expertise to accomplish the required task
4	Work productively with others
5	Clear and shared understanding on how the team would operate
6	Effective skills and knowledge

2.4 Construction Teams

Construction project teams are created as soon as they start a new project. The objective is for a team is to feature its attractiveness of agreeable connections through project execution. Project management is about overseeing the people working on a project, who usually come from different firms, unless they all work for the same organization as the client. Its only goal is to finish the project well for the client. It usually goes beyond company limits, and temporary management teams are set up just for the time the project lasts. They will be disbanded when the project is finished, but they can be brought back together for future projects. It is important for the contributing companies to understand that there are temporary management teams and to arrange things so that their members can fully join those teams. This means that companies need to be ready to assign employees to projects, even if it might sometimes seem like it could hurt the company's internal setup.

Firms should be organized so that employees can commit to the projects they work on and only take on as many projects as they can manage well. Working hard on projects should improve a firm's reputation, and focusing on helping the firm to increase profits in the short term. If neither can be achieved, a compromise happens that is not good for one or both. This situation needs careful and skillful handling to make sure the firm

does well and earns money, while also keeping the staff motivated and happy in their jobs, staff should be recognized for finding the right balance. The ideas from regular management might not be very relevant to construction project management, but team building is an important topic from general management that could be helpful for construction projects (Walker 2011). Teamwork is important in the construction industry, where different professionals work together as a team to complete building projects.

Working as a team can be challenging because many people find it hard to be part of a group and often like to work alone this is especially true in specific areas of construction. Team building involves everyone's participation the key thing is for the whole team to notice when things aren't going well and to work together to figure out how to make things better. There are different methods being used to reach these goals, like “formal retreats” and various “outdoor adventures”. Many people, especially in the construction industry, are doubtful and critical of these activities. While these activities might not fit well with construction, team building is often not taken seriously by construction project managers. We need to find ways for project teams to learn how to work together better. These days, more and more teams are being used in construction. Because of this, companies are always trying to find better ways to evaluate their teams. It's been said that creating a strong project team will lead to great project results that are better than expected, which will also make everything work more efficiently. Also, it's important for construction teams to understand what makes them work well together on building projects (Muhammad, 2021).

Construction teams in Nigeria operate within a complex ecosystem characterized by diverse skill levels, fragmented organizational structures, and evolving project demands. The composition of these teams typically follows a hierarchical model, with project

managers overseeing site engineers, foremen, and skilled and unskilled laborers (Ameh&Odusami, 2014). However, this traditional structure often struggles to adapt to the dynamic requirements of modern construction projects, particularly in urban centres like Lagos and Abuja where high-rise developments and infrastructure projects demand more sophisticated coordination (Olanrewaju et al., 2022). The effectiveness of Nigerian construction teams is frequently compromised by several systemic challenges. A significant issue lies in the skills gap, where only about 15% of workers possess formal technical training, while the majority learn through informal apprenticeships (COREN, 2023). This knowledge disparity creates communication barriers between professionally educated supervisors and tradespeople, often resulting in misinterpretation of designs and specifications (Aigbavboa&Thwala, 2014). Furthermore, the transient nature of construction employment in Nigeria leads to high team turnover, with workers frequently moving between projects and companies in search of better wages, thereby disrupting team cohesion and continuity (NBS, 2023).

Team dynamics are further complicated by cultural factors unique to the Nigerian context. The high-power distance index identified by Hofstede (2010) in Nigerian society manifests in construction teams as reluctance among junior staff to question decisions or report problems to superiors. This cultural tendency contributes to the persistence of errors and safety violations, as frontline workers often hesitate to voice concerns (Ebekozien et al., 2021). Additionally, ethnic and linguistic diversity within teams, while potentially enriching, sometimes leads to communication breakdowns on multilingual construction sites (Opawole et al., 2023). The traditional adversarial relationships between different project stakeholders - clients, consultants, and contractors - create additional team performance barriers. A study by Ibrahim and Umar (2023) found that 65% of Nigerian construction professionals reported experiencing

destructive conflicts arising from unclear role definitions and competing priorities among team members. These conflicts frequently result in project delays and cost overruns, with mediation processes often hampered by the absence of formal dispute resolution mechanisms (Dania et al., 2017).

Emerging strategies are being implemented to enhance team performance in Nigeria's construction sector. The adoption of collaborative technologies represents one promising approach. Research by Adebowale et al. (2023) demonstrated that construction teams using mobile collaboration platforms improved information sharing accuracy by 40% compared to teams relying solely on paper-based systems. Building Information Modelling (BIM) is gradually being introduced on larger projects, facilitating better coordination between design and construction teams (FMB, 2023). Team training initiatives are also gaining traction. The Council for the Regulation of Engineering in Nigeria (COREN) has introduced mandatory continuing professional development programs that emphasize teamwork and communication skills (COREN, 2023). Furthermore, some progressive firms are implementing cross-functional training where engineers, architects, and tradespeople participate in joint workshops to foster mutual understanding of different professional perspectives (NIQS, 2023).

The most significant innovations involve restructuring team organization and incentives. Pilot projects implementing the Last Planner System (LPS) have shown particular promise, with reported 30% improvements in workflow reliability (Ebekozien et al., 2021). This Lean Construction approach empowers frontline teams to participate in planning decisions, thereby increasing commitment and accountability. Similarly, performance-based incentive systems that reward collective achievement rather than individual output are demonstrating positive impacts on team motivation and productivity (PwC Nigeria, 2023).

Looking ahead, the evolution of construction teams in Nigeria will likely be shaped by three key factors: technological integration, skills development, and cultural transformation. The increasing availability of affordable digital tools offers opportunities to bridge communication gaps, while vocational education reforms aim to produce better-trained workers (NIOB, 2023). Perhaps most crucially, changing workplace cultures to encourage flatter hierarchies and open communication could unlock significant improvements in team performance (Ameh&Odusami, 2014). As Nigeria's construction industry continues to grow, the teams that embrace these changes will be best positioned to deliver projects successfully in an increasingly competitive environment.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

Research methodology is defined as "the general approach the researcher takes in carrying out the research project".

This section seeks to discuss and show in details the research methodology adopted for this study. It includes the research design, sampling technique, sampling size, population of the study, data collection instrument, the research instrument and also method of data analysis. This section provides the assurance that appropriate procedures were followed in the course of the study.

3.2 Research Approach

A research approach refers to the overarching strategy or plan that guides how a study is conducted, from data collection to analysis and interpretation. It determines the methodological framework of the research, influencing the choice of methods, tools, and techniques used to answer research questions.Quantitative research deals with the collection and analysis of data in numeric form or nature (Hughes, 2006). Fellow and Liu (1999) stated that quantitative research approach is suitable for collecting data and in examining relationships between facts and help in linking those facts with theories and findings of any research carried out. It deals with measurable and quantifiable issues under research. Furthermore, it also deals with aspects for the measurement of quantity and amount (Eboh, 2009).

Quantitative research involves the collection of data so that information can be quantified and subjected to statistical treatment in order to support or refute "alternate knowledge claims" (Adehi, 2017). Quantitative research approaches used scientific techniques to obtain measurements (quantified data) from social surveys such as; questionnaires, interview surveys, telephone survey etc.The survey method of research was employed to reveal the extent to which the requirements of LPS are met in construction projects, also because there is time constraint that we can't interview everyone personally and in-depth in the construction projects, thus, the survey will provide the focus required on the respondents and the emphasis on professionalism. This feature of the survey strategy fits perfectly with the aim of the objectives of this study.

3.2 Population of the Study

The population of the study refers to the entire group of individuals, cases, or elements that meet specific criteria and are the focus of a research investigation (Creswell & Creswell, 2018). It represents the complete set of units from which a sample is drawn to make statistical inferences or qualitative generalizations (Saunders et al., 2019).The population of the study comprised registered construction contractors operating within Abuja and Kaduna State, Nigeria, particularly those actively involved in project planning and execution. According to the Council of Registered Builders of Nigeria (CORBON)and the Nigerian Institute of Building (NIOB) directories (as of

2024), there are approximately 312 registered building contractors in Abuja and 258 in Kaduna**,** giving a total population of 570 contractors.

3.3 Sampling Frame

A sampling frame is the actual list or database from which a researcher selects participants (or units) for a study. It serves as the foundation for sampling and must accurately represent the target population to ensure valid results. If the sampling frame is incomplete or biased, the study's findings may not be generalizable.The sample frame for this study consisted of registered construction contractors operating in Abuja and Kaduna State, drawn specifically from official records maintained by professional regulatory bodies such as the Council of Registered Builders of Nigeria (CORBON) and the Nigerian Institute of Building (NIOB). These organizations provide an up-to-date and verifiable list of licensed contractors who are actively involved in project execution, planning, and supervision — making them appropriate participants for a study focused on the implementation of the Last Planner System (LPS) and collaboration practices in construction.

3.4 Sample Size

Esan and Okafor (1995) describe a sample as a sub-set of a population selected to meet specific objectives. They further added that the sample must as much as possible have essential characteristics of the target population. For the purpose of this study, the number total number of registered contractors is 570.

To determine an appropriate sample size, **Yamane's (1967) formula** was adopted for finite population sampling:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

- n = required sample size
- N = total population (570)
- e = margin of error (0.05)

$$n=\frac{570}{1+570(0.05)^2}=\frac{570}{1+1.425}=\frac{570}{2.425}\approx 235$$

Based on this calculation, the minimum sample size required for this study was 235 respondents.

3.5 Sampling Technique

For the purpose of this study, the most suitable sampling technique would be purposive sampling (also known as judgmental sampling).This technique involves deliberately selecting individuals or organizations based on their knowledge, experience, or involvement with construction project planning and execution in Nigeria. The reason purposive sampling is most appropriate is that the study requires insights from professionals who are either familiar with or actively engaged in planning processes, collaborative practices, and potentially with LPS or lean construction methodologies. These could include project managers, site engineers, consultants, contractors, and clients who have firsthand experience with planning systems in Nigerian construction projects.

Purposive sampling ensures that the data collected is rich, relevant, and contextually grounded. Unlike random sampling, which might include respondents with little to no experience in the subject matter, purposive sampling targets knowledgeable stakeholders who can provide meaningful insights into the collaboration dynamics necessary for LPS implementation. This approach enhances the depth and relevance of the findings, especially in a context where LPS awareness and adoption may still be limited, making general random sampling less effective.

3.6 Data Collection Instrument

The instrument for the collection of data was a well-structured questionnaire which enabled the quantitative analysis of the variables considered for this study. The questionnaire designed for this study was in three sections. The Part C dwells on background information of the respondent, the information from this section provided quality check to the data gotten from other sections of the research instrument. The Part A dealt with questions on collaboration requirement. This section has six team process requirements as stated by Salas *et.al,* (2014) with each of the six requirements having six variables also. The Part B dealt with questions on last planner implementation, the section has twenty last planner system activities/tasks identified for literature review. For Part A the respondents were requested to indicate their level of agreement on a five (5) point Likert scale(1-strongly disagree, 2-disagree, 3-neutral,4-agree and 5-strongly agree)with the characteristics that assess their team process. And Part B the respondents were requested to indicate their level of agreement on a five (5) point Likert scale (1-strongly disagree, 2-disagree, 3-neutral, 4-agree and 5-strongly agree) with the characteristics that investigates their willingness to implement last planner system activities/tasks.

The questionnaires were administered to respondents via hard copy distribution at various sites.

3.7 Method of Data Analysis

Using IBM SPSS Statistics, the gathered data was analyzed in a structured manner using both descriptive and inferential statistical techniques to investigate the relationship between collaboration factors and the Last Planner System's implementation in Nigerian construction projects.The first step of the analysis was to summarize the respondents' demographic details and answers to the most important survey questions. Percentages and frequency distributions were calculated to give a

summary of participant profiles, including years of experience, professional responsibilities, and previous exposure to Lean Construction concepts. The relative importance of different collaboration needs was assessed using mean scores for Likert-scale items; higher scores indicated greater agreement or perceived significance.

To assess the predictive relationship between collaboration factors and LPS implementation success, a multiple linear regression analysis was conducted. The regression model treated LPS implementation effectiveness as the dependent variable, measured through performance metrics such as schedule reliability and workflow efficiency. Independent variables included critical collaboration dimensions identified in the literature: stakeholder commitment, communication quality, trust levels, training adequacy, and institutional support.

The overall model fit was evaluated using the coefficient of determination (R^2), while the significance of individual predictors was assessed through standardized beta coefficients and associated p-values. Post-hoc tests were performed to verify the robustness of the findings. This analytical approach provided empirical evidence on which collaboration factors most significantly influence LPS adoption, offering practical insights for industry practitioners and policymakers seeking to enhance construction project delivery in Nigeria.

CHAPTER FOUR

4.0 DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

This section presents the result of the field survey which was undertaken to examine the collaboration requirements for last planner implementation in construction projects and in accordance with the objectives of thestudy.Respondents' information was also discussed. Based on this calculation using Yamane's (1967) formula, the minimum sample size required for this study was 235 respondents. However, due to practical constraints such as access, location, time, and response willingness, 140 questionnaires were distributed, with 90 returned. Of the 90, 70 were found to be valid, yielding a usable response rate of 50%. While this falls below the calculated ideal sample size, it still provides a robust dataset for meaningful analysis, particularly within the context of exploratory construction management research, where response rates of 30–60%are considered acceptable (Babbie, 2015).

Data presentation, analysis and discussion for Sections A, B and C will follow the format of presenting and discussing the frequency distribution table for each requirement followed by the mean value table which will also have its discussion below it. Therefore, for each of the value study requirement it will have two tables for discussion.

4.2 Descriptive Data Presentation and Analysis

4.2.1Respondent General Information

Respondents were asked to report their years of experience, years with the organization, their responsibility within the organization, and lastly numbers of projects handled within the last three years. Below are table showing the response.

4.2.1.1 Working experience

Table 4.1 shows the percentage response of working experience of the respondent's base on the categories. 38.6% of the respondents had less than 5 years of experience, 40% of the respondents had 5-10 years and 21.4% had greater than 10 years of experience. Majority of the respondents had 6-10 years of experience. Given the preponderance of the uniformity of this distribution about 60% of the respondents indicated having working experience of less than 10 years.

Therefore, given the mix between the working experience of the respondents, data was collected from a set of respondents suitable for the purpose of the study.

Table 4.1 Working experience

Years of experience	Frequency	%
Less than 5 years	27	38.6
5-10 years	28	40
greater than 10 years	15	21.4
	70	100

Source: Field Survey (2024)

4.1.1.2 Services rendered on the project by respondents

Table 4.2 below shows the data concerning the years with the organization of the respondents. 52.9% of the respondents had less than 5 years of experience, 35.7% of the respondents had 5-10 years and 11.4% had greater than 10 years of experience. Majority of the respondents had 6-10 years of experience. Majority of the respondents are with the organization for less than 5 years.

Table 4.2 Years in organization

Years in organization	Frequency	%
Less than 5 years	37	52.9
5-10 years	25	35.7
greater than 10 years	8	11.4
	70	100

Source: Field Survey (2024)

4.1.1.3 Role in the organization.

Table 4.3 below shows the data concerning the role of respondents in the organization. 30% of the respondents are project managers, 24.3% of the respondents are site managers, 21.4% of the respondents are foremen and 24.3% of the respondents falls under the others category.

Table 4.3 Responsibility within organization

Responsibility within organization	Frequency	%
Project manager	21	30
Site manager	17	24.3
Foreman	15	21.4
Others	17	24.3
	70	100

Source: Field Survey (2024)

4.1.1.4 Number of projects handled within the last three years.

Table 4.4 shows the percentage response of number of projects handled within the last three years of the respondent's base on the categories. 21.4% of the respondents had less than 3 projects, 42.9% of the respondents had 4-6 projects and 35.7% had greater than 6 projects.

Table 4.4 Number of projects handled in the last 3 years

Number of projects handled in the last 3 years	Frequency	%
less than 3 projects	15	21.4
4-6 projects	30	42.9
greater than 6 projects	25	35.7
	70	100

Source: Field Survey (2024)

4.2 Assessing team processes

Below are six (6) team processes in which each has six (6) statements and using a Likert scale of 1-5 (1- strongly disagree, 2- disagree, 3- neutral, 4- agree and 5- strongly agree) the respondents were asked to indicate the extent to which they agree or disagree it is demonstrated or exhibited in their organization towards aiding interaction between management and operations personnel.

As presented in Table 4.5, survey responses regarding cooperation as a team process revealed that 83.4% of respondents agreed that their organizations exhibited cooperative behaviors, while 6% disagreed, and 13.6% remained neutral.To assess data distribution

normality, mean values and standard deviations were computed, the six cooperation requirements yielded an average mean of 3.92, indicating strong overall agreement. For instance:The requirement *"Ability of members to control others' behavior"* had a mean of 3.7, aligning with the frequency distribution where 77% of respondents rated it "Average" (i.e., achievable).Similarly, the second through fifth requirements reflected comparable patterns, with mean values approximating 3.92 and the *"Average"* response category dominating the frequency distributions.

These results suggest that respondents perceived cooperation-related requirements as consistently achievable, based on their project involvement or professional experience.

Table 4.5: Descriptive Analysis of the team process -Cooperation

Measuring Cooperation	**Percentage**					
	SD	**D**	**N**	**A**	**SA**	**M**
Ability of members to control the behavior of individuals	2.9	8.6	11.5	64.3	12.9	3.7
A firm belief in the truth and ability of other workers		7.1	14.3	61.4	17.1	3.8
Sense of competence and improvement towards achieving organizational goal	1.4	1.4	8.5	64.3	24.3	4.0
Belief that your contribution is respected and protected	1.4	1.4	8.5	62.9	25.7	4.1

Preference for and belief in importance of teamwork	1.4	2.9	11.4	45.7	38.6	4.0
Positive attitude towards every individual working in organization	2.9	4.3	10	52.9	30	3.9
	1.7	**4.3**	**10.7**	**58.6**	**24.8**	**3.9**

Source: Field Survey (2024)
Legend: SD- Strongly Disagree, D- Disagree, N- Neutral, A- Agree, SA-Strongly Agree. M- Mean

Based on the six identified requirements for the second team process—Coordination—respondents were asked to indicate the extent to which these practices are demonstrated in construction projects. As shown in Table 4.6, between 30% and 53% of respondentsreported that these coordination-related requirements are highly exhibited, with responses ranging from *"Agree"* to *"Strongly Agree."* In most cases, the percentage of respondents selecting "Agree" was higher than those selecting "Strongly Agree," suggesting a general perception of the presence of these practices, albeit with moderate intensity. An exception to this trend occurs with the fourth requirement, where both "Agree" and "Strongly Agree" responses were recorded at equal rates. Overall, 3.1% of respondents disagreed**,** 15.5% were neutral, while a significant 82.6% agreed that the coordination requirements are demonstrated in their organization. The computed average mean value was 4.0**,** indicating that respondents generally perceive coordination practices as being moderately to highly exhibited in construction projects. The consistency between mean scores and frequency distributions supports the reliability of the findings.

The results suggest that coordination is a well-recognized and moderately practiced team processin construction projects. A majority of respondents affirm the presence of coordination behaviors, especially in areas such as role clarity, task ownership, and collaborative problem-solving. However, the varied levels of "Strongly Agree"

responses across the six requirements highlight inconsistencies in how these practices are applied, with some areas being more mature than others. The mean score of 4.0 and high agreement rate (82.6%) reflect that coordination is a core part of project execution, though opportunities remain to enhance its uniformity and deepen its integration across all team activities.

Table 4.6: Descriptive Analysis of the team process -Coordination

	Percentage					
	SD	**D**	**N**	**A**	**SA**	**M**
Well defined purpose of the team	1.4	2.9	10	62.9	22.9	4.0
Setting goals and objectives		1.4	11.4	57.1	30	4.1
Role charity and appropriate assignment	1.4	4.3	12.9	44.3	37.1	4.0
Discussing issues and find solutions together		4.3	17.1	44.3	34.3	4.0
Encouraging team members to take ownership and responsibility for completing specific task	1.4	1.4	14.3	51.4	31.4	4.1
Describing the process, the team would use to function	2.9	2.9	14.3	57.1	22.9	3.9
	1.8	**2.9**	**13.3**	**52.9**	**29.8**	**4.0**

Source: Field Survey (2024)
Legend: SD- Strongly Disagree, D- Disagree, N- Neutral, A- Agree, SA-Strongly Agree. M- Mean

Table 4.7 presents the distribution of responses regarding the third team process—Conflict—and the extent to which its six identified requirements are exhibited in construction projects. The analysis reveals that for each of the six requirements, the "Average" response recorded the highest frequency**,** indicating that respondents generally perceive these conflict-related practices as moderately implemented in their respective organizations. The response trend follows a fluctuating pattern, with a slight increase-decrease progression across the requirements. For instance, the first and second

requirements showed 60% and 49% respectively, followed by 54% and 53% for the third and fourth requirements, and a similar 54% and 53% for the fifth and sixth. Additionally, the overall response data shows that 5.0% of respondents disagreedwith the conflict-related statements, 19.5% remained neutral**,** and78.4% expressed agreement, indicating a general acknowledgment of these practices within organizational settings. The computed mean value across all six requirements was 3.9, further supporting the notion that conflict-related processes are moderately exhibitedin construction projects. This average aligns with the frequency distribution, reinforcing the idea that while conflict is being managed to some extent, there is room for more proactive and structured engagement.

The findings indicate that conflict as a team process is moderately recognized and practicedwithin construction projects. While a majority of respondents agree that conflict resolution practices are present, the prevalence of "Average" responses and a mean score of 3.9 suggest that these practices are not consistently applied or deeply embedded. The slightly fluctuating response pattern also implies a lack of uniformity in how different conflict management behaviors are implemented across teams. As such, the results point to an opportunity for construction organizations to strengthen their approach to managing conflict, making it a more proactive and systematic component of team dynamics.

Table 4.7: Descriptive Analysis of the team process -Conflict

	Percentage					
	SD	**D**	**N**	**A**	**SA**	**M**
Recognizing and encouraging the desirable but discourage the undesirable team conflict	1.4	7.1	11.4	60	20	3.8
Recognizing the type and source of conflict	1.4	4.3	20	48.6	25.7	3.8

Implementing and appropriate conflict resolution strategy	1.4	2.9	5.7	54.3	35.7	4.2
Employing a win-win negotiative strategy		2.9	18.6	52.9	25.7	3.9
Members take initiatives to resolve issues between themselves	1.4	2.9	20	54.3	21.4	3.9
Defining corrective measures and actions for failing to meet expectations and reward for going beyond and above duties		4.3	24.3	52.9	18.6	3.7
	1.4	**4.1**	**16.7**	**53.8**	**24.5**	**3.9**

Source: Field Survey (2024)

Legend: SD- Strongly Disagree, D- Disagree, N- Neutral, A- Agree, SA-Strongly Agree. M- Mean

For the fourth team process requirements – communication, amajority (78.8%) of respondents agree that communication-related practices are present in their construction projects, though most lean toward "Agree" rather than "Strongly Agree." This suggests that while communication is being practiced, it may not always be fully optimized or deeply embedded in team culture.The fluctuating pattern in agreement levels across the six requirements (e.g., from 56% to 46% and back up to 50%) shows that some aspects of communication are stronger than others. For instance, verbal/non-verbal awareness and emotional expression are more recognized, while practices like choosing the right communication method or delivering information effectively are slightly less so.The average mean score of 3.9 supports the conclusion that these communication behaviors are moderately exhibited—not poor, but not exemplary either.The data also reflect a need for improvement in how communication processes are embedded and consistently practiced within construction teams—especially if the goal is high-performance collaboration.

Communication processes are generally recognized and moderately exhibited in construction projects, but with varying levels of consistency across different communication behaviors.This result suggests a solid foundation of communication, but one that could benefit from more deliberate, consistent, and strategic implementation across project teams.

Table 4.8: Descriptive Analysis of the team process -Communication

	Percentage					
	SD	**D**	**N**	**A**	**SA**	**M**
Focusing on both verbal and non-verbal communications	1.4	4.3	18.6	55.7	20	3.8
Actively listening to other team members		4.3	12.9	51.4	31.4	4.0
Deciding what type of communication works best	1.4	2.9	20	45.7	30	3.8
Communicating clearly to avoid misinterpretation	2.9	1.4	8.6	48.6	38.6	4.1
Delivering information effectively	1.4	2.9	10	54.3	31.4	4.0
Expressing one's emotion freely	1.4	7.1	25.7	45.7	20	3.5
	1.7	**3.8**	**16.0**	**50.2**	**28.6**	**3.9**

Source: Field Survey (2024)
Legend:SD- Strongly Disagree, D- Disagree, N- Neutral, A- Agree, SA-Strongly Agree. M- Mean

For the fifth team process—Coaching—six key requirements were identified as essential for effective implementation. Respondents were asked to indicate the extent to which these coaching practices are exhibited within their construction projects. As shown in Table 4.9, approximately 6.7% of respondents disagreed**,** 23.6% remained neutral, while a significant 75% agreed that these coaching-related behaviors are present in their organizational settings. Looking at individual responses, the second requirement, *"Identifying team and role challenges,"* had the highest level of agreement

at 59%, indicating strong recognition of its importance. Similarly, 44% of respondents agreed that the first requirement is evident in practice. The third requirement, *"Aligning individual strengths with team strategy,"* also garnered 44% agreement, suggesting a moderate level of practice. The fourth requirement, which focuses on *"Expanding the team's ability to produce results with minimal supervision,"* was rated highly by 54% of respondents. For the fifth and sixth requirements— *"Effective leadership and mentoring"* and *"Providing continuous support to develop team potential"*—47% and 51% of respondents, respectively, agreed that these are well demonstrated in their work environment. To evaluate the distribution and consistency of responses, mean values were computed for each requirement. The average mean value for the six coaching requirements was 3.8, indicating that these behaviors are moderately exhibited.

The findings suggest that coaching as a team process is moderately practiced in construction projects, with a significant majority of respondents affirming its presence. However, the variation in agreement levels across specific coaching behaviors indicates that while certain aspects, like identifying team challenges and minimizing the need for supervision, are more actively demonstrated, others such as aligning strengths or providing consistent mentoring may need more focused development. Overall, these results reflect a positive but uneven implementation of coaching practices, highlighting an opportunity for construction organizations to enhance team performance by more systematically embedding coaching strategies.

Table 4.9: Descriptive Analysis of the Team process -Coaching

	Percentage					
	SD	**D**	**N**	**A**	**SA**	**M**

Learning to have difficult conversations effectively	2.9	7.1	28.5	44.3	17.1	3.4
Identifying team roles and challenges	1.4	1.4	20	58.6	18.6	3.8
Aligning of individual strengths with team strategy	2.9	5.7	24.3	44.3	22.9	3.5
Expanding the team's ability to produce results with minimum supervision		7.1	14.3	54.3	24.3	3.8
Effective leadership and mentoring	4.3	2.9	8.6	47.1	37.1	4.0
Learning together	1.4	2.9	14.3	51.4	30	4.0
	2.6	**4.5**	**18.3**	**50.0**	**25.0**	**3.8**

Source: Field Survey (2024)
Legend: SD- Strongly Disagree, D- Disagree, N- Neutral, A- Agree, SA-Strongly Agree, M- Mean.

To assess the extent to which the requirements for the final team process—Cognition—are exhibited in construction projects, respondents were asked to rate their experiences based on six identified cognitive collaboration practices. Table 4.10 reveals that for each requirement, a strong majority of participants selected "Agree" or "Strongly Agree." Specifically, the first requirement, *"Building effective working relationships,"* received 30% "Strongly Agree" and 54% "Agree." The second requirement, *"Team building exercises,"* was endorsed by 29% "Strongly Agree" and 53% "Agree." For the third requirement, *"Combining abilities and expertise to accomplish tasks,"* 33% "Strongly Agree" and 54% "Agree" were recorded. The fourth, *"Working productively with others,"* received similar ratings with 33% and 57% respectively. Additionally, *"A clear and shared understanding of how the team operates,"* saw 36% "Strongly Agree" and 53% "Agree," while the final requirement, *"Effective use of skills and knowledge,"* had 43% and 54%, respectively. To further support the analysis, mean values were calculated to assess the normality and consistency of the responses. The average mean

across the six cognitive requirements was 4.1, indicating a generally strong agreement among respondents regarding the presence of these cognitive practices in their teams. Overall, only 1.4% of respondents disagreed**,** 13.3% remained neutral, and a significant 88.1% agreed that these cognitive elements are evident in their organizational practices.

The findings clearly indicate that cognitive team processes are highly recognized and actively exhibitedwithin construction project environments. The consistently high levels of agreement across all six cognitive requirements suggest that cognition is one of the most mature and well-integrated team processeswithin construction teams, reflecting a high level of collective awareness, coordination, and cognitive synergy.

Table 4.10: Descriptive Analysis of the Team process -Cognition

	Percentage					
	SD	**D**	**N**	**A**	**SA**	**M**
Building effective working relationship		1.4	14.3	54.3	30	4.0
Team building exercise	1.4	4.3	12.9	52.9	28.6	3.9
Combining abilities and expertise to accomplish the required task			12.9	54.3	32.9	4.1
Working productively with others			10	57.1	32.9	4.2
Clear and shared understanding on how the team would operate		1.4	10	52.9	35.7	4.2
Effective skills and knowledge			2.8	54.3	42.9	4.4
	1.4	**2.4**	**10.5**	**54.3**	**33.8**	**4.1**

Source: Field Survey (2024)
Legend:SD- Strongly Disagree, D- Disagree, N- Neutral, A- Agree, SA-Strongly Agree, M- Mean.

4.3 Assessing last planner system

To assess the implementation of Last Planner System (LPS) activities/tasksduring construction scheduling, respondents were presented with a list of twenty (20) distinct tasksand asked to indicate the extent to which each is carried out in their organizations.

As shown in Table 4.11, 83.3% of respondents agreed that their organizations actively engage in LPS-related activities during planning and scheduling processes. In contrast, 4.34% disagreed, and 16.90% remained neutral on the extent of implementation. To further support the analysis, mean and standard deviation values were calculated for each of the twenty LPS activities to assess the distribution of responses and evaluate their alignment with the observed frequency data. The computed average mean value across all activities was 3.9, indicating that the majority of respondents perceive these LPS practices as being consistently and actively undertaken within their construction scheduling processes.

Table 4.11: Descriptive Analysis of LPS task/activities

		Percentage					
S/N	**LPS Activities/tasks**	**SD**	**D**	**N**	**A**	**SA**	**M**
1	Team collaboratively consider critical dependencies	2.9		22.8	51.4	22.9	3.6
2	Collaborative planning between all parties involved		2.9	18.5	61.4	17.1	3.7
3	Construction team members must make reliable promises		2.9	22.9	54.3	20	3.8
4	Plan failures are treated as an opportunity for learning not negative actions	1.4	10	12.8	57.1	18.6	3.8
5	Smooth work flow depends on the parties making and keeping promises to carry out assignments			10	57.1	28.6	3.0
6	Weekly measurement evaluates accomplishments and permits fine turning for improvement		1.4	10	58.6	24.3	3.9
7	The duration and work force requirement are determined for each activity		2.9	12.9	55.7	25.7	4.0
8	Activity durations are adjusted through resource utilization		2.9	12.9	57.1	22.9	3.9
9	Planning workshops are used to analyze where savings in time may be gained	1.4	2.9	10	60	14.3	3.5

Table 4.11: Descriptive Analysis of LPS task/activities cont'd

		Percentage					
S/N	**LPS Activities/tasks**	**SD**	**D**	**N**	**A**	**SA**	**M**

10	Team members agree and initiate work assignments and also monitor subsequently	1.4	1.4	8.6	71.4	15.7	3.9
11	Plan in greater detail as you get closer to doing the work			7.1	55.7	35.7	4.2
12	Undertake a constraints removal process on planned task and ask publicly with those who can remove constraints		4.3	10	61.4	12.9	3.5
13	Learning from past failures	1.4	1.4	1.4	52.9	42.9	4.3
14	Identifying and acting on root causes to prevent reoccurrences	1.4		7.1	45.7	44.3	4.3
15	Identification of unclear design details		1.4	5.7	54.3	38.6	4.3
16	Building commitment to programme and reduce overall program period	2.9	1.4	15.7	61.4	14.3	3.7
17	Enabling team members to test options to improve work flow, buildability and program reduction		4.3	17.1	64.3	14.3	3.7
18	Task are ready for production when required	1.4	1.4	8.5	65.7	22.9	4.0
19	Each team member is formally required to commit to undertaking the work they propose	1.4	4.3	18.6	50	25.7	3.7
20	Team discuss and agree on work schedule	1.4		10	47.1	41.4	4.2
		1.8	**2.6**	**12.6**	**57.1**	**26.2**	**3.8**

Source: Field Survey (2024)
Legend: SD- Strongly Disagree, D- Disagree, N- Neutral, A- Agree, SA-Strongly Agree, M- Mean.

The results clearly indicate that LPS activities are well-integrated and practicedduring the planning and scheduling stages of construction projects. With over 83% agreementand anaverage mean of 3.9, the data reflects a strong institutional commitment to implementing LPS principles. The relatively low disagreement rate and stable mean scores further suggest that these practices are not only familiar but also actively embedded in the workflow of most respondents' organizations. This points to a mature level of adoption of lean construction methods**,** particularly the Last Planner System, as a strategic tool for enhancing planning reliability and project performance.

4.4 The relationship between team process and LPS

Below in table 4.12showthe result for regression analysis conducted using SPSS. Whereas P value is 0.05. Following the assumption, if the significance value determined is greater than 0.05, then homogeneity of variances is assumed.

Table 4.12: Regression analysis of LPS and team processes

Team processes(x)	Standardized Coefficients Beta(y)	Sig.
Mean of Cooperation	0.002	0.99
Mean of Coordination	0.317	0.01
Mean of Conflict	0.233	0.06
Mean of Communication	-0.04	0.73
Mean of Coaching	0.314	0.02
Mean of Cognition	0.001	0.99

Source: Field Survey (2022)
Independent Variable(x): Mean of Team process
Dependent variable (y): Mean of Last planner system

Table 4.12 presents the results of a regression analysis conducted to examine the relationship between team processes (independent variable, *x*) and the Last Planner System (LPS)implementation (dependent variable, *y*) within construction project organizations. The analysis evaluates the extent to which each of the six team processes influences the mean value of LPS activity execution, using standardized coefficients to indicate the rate of change and corresponding significance levels to determine statistical relevance. The findings show that if the mean value of cooperation increases by one unit, the LPS mean increases by only 2% (0.002**)**—a change that is not statistically significant. For coordination, a one-unit increase results in a 32% (0.317)rise in LPS mean, with a significance level of 0.009, indicating a strong and statistically significant influence. Similarly, a one-unit increase in conflict management leads to a 23% (0.233) increase in LPS mean, although this change is not statistically significant.

Interestingly, communicationhas a negative effect, where a one-unit decrease results in a 4% (-0.004)change in LPS, also not significant. Thecoaching process demonstrates a 31% (0.312) positive effect on LPS mean, with a significance level of 0.016, making it the second team process with a statistically significant influence. Finally, cognition shows a negligible and non-significant 1% (0.001) decrease in LPS when increased by one unit. Overall, five out of the six team processes exhibit a positive relationship with the Last Planner System, while only one—communication—shows a negative effect. Of these, coordination demonstrates the strongest positive influence (32%)**,** followed closely by coaching (31%)**.** However, only coordination and coaching are statistically significant in influencing the implementation of LPS.

The regression results suggest that while most team processes positively influence the adoption and effectiveness of the Last Planner System, only coordination and coaching show statistically significant impacts**.** Coordination emerges as the most influential factor, reinforcing the importance of role clarity, goal alignment, and synchronized task execution in enhancing lean construction practices. Coaching, with its focus on team development and leadership, also plays a critical role. The findings imply that to improve LPS implementation, construction organizations should prioritize strengthening coordination and coaching processes**.** Conversely, although other processes such as cooperation, conflict management, and cognition show positive trends, their effects are not strong enough to be considered statistically impactful. Notably, the slight negative relationship observed with communication suggests a need to re-evaluate how communication is structured or interpretedwithin teams using LPS.

CHAPTER 5

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of Findings

- In order to achieve the first objective of this research work, twenty LPS activities/tasks were identified. Six team processes were identified also as part of

the first objective of this study: Cooperation, Coordination, Conflict, Communication, Coaching and Cognition.The findings indicate that 83% of the participants firmly concur that their team in their organization demonstrates the necessary levels of cooperation. 82% of respondents concur that their team has a strong propensity to coordinate, and 78% concur that there is some degree of internal conflict. While 88% of respondents concur that their team has a strong cognitive tendency, 79% agree with communication measures, and 78% agree with coaching measures.

- According to the descriptive analysis results for the LPS tasks/activities, 82% of the respondents, on average, do agree that their organization is willing to engage in LPS tasks or activities. The results also indicate that the respondents strongly agree, with a high mean score of 4.9.The result of the descriptive analysis for the LPS tasks/activities shows that on an average, 82% of the respondents do agree that their organization is willing to undertake LPS activities or tasks, also the results shows that the respondents highly agree, having a high mean of 4.9.
- The results indicate a positive correlation between the LPS tasks and team processes, indicating that as team processes grow, so too will the LPS tasks. Only one of the six team processes have an adverse effect on the LPS tasks; the other five have a beneficial effect. The only team process that significantly affects LPS tasks is conflict.
- The findings indicate that effective collaboration among all team members is essential for successful LPS implementation. This collaboration leads to improved communication, trust and shared responsibility, which are critical for reducing delays and optimizing project outcomes.

5.2 Conclusion

The findings suggest that fostering a collaborative environment enhances communication, promotes shared responsibility and leads to improved project outcomes, including reduced delays and increased efficiency. By aligning the goals and expectations of all parties involved, the LPS can significantly minimize waste and enhance workflow predictability. Therefore, to maximize the potential of LPS in the Nigerian construction industry, it is imperative for stakeholders to commit to enhancing collaborative practices.

5.3 Recommendations

Based on the findings and conclusions, the following recommendations are put forward:

- The study suggest that it is essential to engage all parties in the planning process. This engagement ensures that diverse perspective is considered and that there is collective ownership of project goals and outcomes.
- Construction organizations need to cultivate a culture that values transparency, trust, and mutual respect among team members. Establishing clear communication channels and encouraging open dialogue can facilitate this cultural shift.
- Construction organizations should invest in comprehensive training programs that emphasize lean principles and the functionalities of LPS, training should focus on communication, teamwork and problem-solving skills to foster a collaborative mindset among all participants.

5.4 Contributions to Knowledge

- The findings of this study provide a comprehensive analysis of specific collaborative practices required for effective LPS implementation, highlighting the interactions between various stakeholders in the

construction projects. This fills a gap in existing literature that often emphasizes technical aspects of LPS over the interpersonal dynamics.

- By focusing on the Nigerian construction context, this research adds a unique perspective to the global discourse on lean construction practices. It highlights the cultural barriers and enablers specific to the Nigerian industry, thereby providing a way for understanding how local factors influence the implementation of the global best practices.
- By addressing these areas, this research not only enhances understanding of LPS but also provides actionable insights for practitioners aiming to improve project outcomes through better collaboration.
- Thisstudy opens avenue for future research to explore the long-term effects of LPS on project performance in Nigeria and other developing countries. It encourages further investigation into the integration of emerging technologies and lean practices in construction.

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APPENDIX

DEPARTMENT OF QUANTITY SURVEYING FACULTY OF ENVIRONMENTAL DESIGN AHMADU BELLO UNIVERSITY

M. Sc PROJECT MANAGEMENT

QUESTIONNAIRE SURVEY

AN APPRAISAL OF COLLABORATION REQUIREMENTS FOR THE LAST PLANNER SYSTEM IMPLEMENTATION IN CONSTRUCTION PROJECTS

Dear Respondent,
I am undertaking a research as part of my M.Sc. Programme in the Department of Quantity Surveying, Ahmadu Bello University-Zaria. The title of the research work is: An appraisal of collaboration requirements for the last planner system implementation in construction projects. The study, if successfully completed, will provide a clear indication of whether the industry has what it takes to implement the last planner system; this gap would be bridged by providing appropriate solution to the problems which will ultimately help in implementing the last planner system in the industry.
I would be grateful if you spare your time to answer the questions.
The information provided would be treated confidentially and used for data analysis only.
I would be glad to share the summary of my findings with you, if you provide your contact details.
Thank you so much for your time.
Ibrahim ZainabAbdulkarim
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PART A: INFORMATION ON TEAM PROCESS

Based on your experience within your organization, to each statement below indicate the extent of your agreement and disagreement. Please tick the most appropriate number using the following scale 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5

= Strongly Agree					
TEAM PROCESS	SD	D	N	A	SA
Ability of members to control the behavior of individuals					
A firm belief in the truth and ability of someone					
Sense of competence and improvement towards achieving organizational goal					
Belief that your contribution is respected and protected					
Preference for and belief in importance of teamwork					
Positive attitude towards the team and every individual					
Well defined purpose of the team					
Set goals and objectives					
Role clarity and appropriate assignment					
Discuss issues and find solutions together					
Encourage team members to take ownership and responsibility for completing specific task					
Describe the process the team would use to function					
Recognize and encourage the desirable but discourage the undesirable team conflict					
Recognize the type and source of conflict					
Implement an appropriate conflict resolution strategy					
Employ a win-win negotiative strategy					
Members take initiatives to resolve issues between themselves					
Define corrective measures and actions for falling to meet expectations and reward for going beyond and above duties					
Focus on both verbal and non-verbal communications					
Active listening to other team members					
Decide what type of communication works best					
Communicate clearly to avoid misinterpretation					
Deliver information effectively					
Express one's emotion freely					
Learning to have difficult conversations effectively					
Identifying teams' roles and challenges					
Alignment of individual strengths with team strategy					
Expanding the team's ability to produce results with minimum supervision					
Effective leadership and mentoring					
Learning together					
Building effective working relationship					
Team building exercise					
Combined abilities and expertise to accomplish the required task					
Work productively with others					
Clear and shared understanding on how the team would operate					
Effective skills and knowledge					

PART B: INFORMATION ON LAST PLANNER SYSTEM TASK/ACTIVITIES

Based on your experience within your organization, to each statement below indicate the degree of willingness to undertake last planner system tasks/activities in your organization. Please tick the most appropriate number using the following scale 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree					
LAST PLANNER SYSTEM	SD	D	N	A	SA
Team collaboratively consider critical dependencies					
Collaborative planning between all parties involved					
Construction team members must make reliable promises					
Plan failures are treated as an opportunity for learning not negative actions					
Smooth work flow depends on the parties making and keeping promises to carry out assignments					
Weekly measurement evaluates accomplishment and permits fine turning for improvement					
The duration and work force requirement are determined for each activity					
Activity durations are adjusted through resource utilization					
Planning workshops are used to analyze where savings in time may be gained					
Team members agree and initiate work assignments and also monitor subsequently					
Plan in greater detail as you get closer to doing the work					
Undertake a constraints removal process o planned and ask publicly with those who can remove constraints					
Learn from past failures					
Identify and act on root causes to prevent reoccurrences					
Identification of unclear design details					
Build commitment to programme and reduce overall program period					
Enables team members to test options to improve work flow, buildability and program reduction					
Task are ready for production when required					
Each team member is formally required to commit to undertaking the work they propose					
Team discuss and agree on work schedule					

PART C: GENERAL INFORMATION Years of practice

1-5years [ ] 5-10years[ ] 10-15years[ ] 15years&above[ ]

Service rendered on the project
Foreman [ ] Sub-contractor [ ] Clerk of works [ ] Site Manager [ ] Contactor [ ]

How frequently do you meet as a team?
Never [ ] Sometimes[ ] Often [ ] Always [ ]