

Prospects and Challenges of Lean Construction Practice In The Building Industry In Nigeria: Architects' Perspective

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Abstract: *Lean construction is a new practice of designing and managing building projects to reduce project time and manage resources to eliminate waste, thereby giving the client maximum value for money spent. Globally, the implementation of lean construction has been on the rise as a result of waste and it is being strongly advocated for by building professionals. Some studies have identified some prospects and challenges of its adoption. However, the findings of such studies usually emanated from the researchers' evaluation of the lean construction practice and not based on the perception of practicing professionals of the building industry, particularly in Nigeria. Consequently, this study examined the principles and techniques of lean practice in literature and investigated the perception of practicing registered architects in Nigeria on the possibilities and constraints of implementing lean construction techniques in the building industry in the country. This was done in order to identify the unquestioned challenges and harness the potentials of implementing its principles and strategies, towards making contributions on how to achieve better building project delivery in Nigeria. Both qualitative and quantitative methods of research were adopted for the study. Qualitative data were gathered from relevant literature by textual analysis and analysed using content analysis procedure. Quantitative data were obtained via questionnaire administered to a sample size of 270 registered practicing architects in the study area. The quantitative data were analysed with statistical package for social sciences (SPSS) version 21 and the result presented descriptively with the aid of charts and tables. The findings revealed that 89% of the respondents are well informed of the lean construction techniques. Last planner technique has the highest adoption rate with 33%. The challenges of its implementation revolve around corruption, funding, remuneration, poor leadership and fear of unfamiliar practices. However, its prospects are very high, based on the responses of the respondents. Among the recommendations of the study is that periodic training programmes should be organised by professional bodies to equip professionals on the technical skills and benefits lean construction practice offers towards achieving better building project delivery.*

Index Terms: *Lean Construction, Prospects, Challenges, Architects Perspective and Nigeria.*

I. INTRODUCTION

At the inception of every building project, the team members set goals that are within the budget of the client to be

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completed within a stipulated time. However, poor building practices and unforeseen contingencies lead to time and cost overruns resulting to wastages which do not provide maximum value for the client's resources. Lean construction is a way of designing production systems to minimize waste of time, materials and efforts, thus maximizing the amount of value on investment [9]. There is an increasing body of research on lean construction practices globally which is aimed at curbing environmental degradation as a result of waste from construction and also, to facilitate the maximization of value for clients. [2] Reported that the concept of lean construction has maximized benefits and improved workflow reliability in countries like the United States of America (USA), United Kingdom (UK), Brazil and Korea. Also, [8] acknowledged the huge contribution of lean practices in the construction industry in developed and emerging countries.

In Nigeria, approximately 1.4% of the GDP is accrued from the construction industry [2] and the dominant contractors are medium sized, operating locally and executing mostly residential projects [17] and [10] However, these building projects have been characterized by shortfalls ranging from poor quality of works, to project cost and time overruns [19], which are consequences of poor planning, lack of detailed construction documents variations, poor site management, unethical behaviour of professionals and waste generation resulting from bureaucracy [18]. The issue of low productivity with regards to time, quality and cost of delivering building projects is a worrisome problem in the building industry in Nigeria. Lean construction practice is however a way of mitigating to reduce this problem. Consequently, there has been an increase in the awareness level of professionals on the concept of lean construction as identified by [7]. However, it is observed that the concept is not been fully implemented to derive its maximum benefits, especially in a country like Nigeria. To this end, this study examined the principles and techniques of lean practice in literature and investigated the perception of practicing registered architects in Nigeria on the possibilities and constraints of implementing lean construction techniques in the building industry in the country. This was done in order to identify the unquestioned challenges and harness the potentials of implementing its principles and strategies, towards making contributions on how to achieve better building project delivery in Nigeria. The perception of architects was sought after



because more often than not, they are lead consultants on building projects. The scope of the study was limited to registered practicing architects in Lagos State based on the premise that the State is a rapid developing mega city in Nigeria with a large pool of practicing architects from different parts of the country taking advantage of the job opportunities availed to architects to practice in the State. Also, at any point in time a large number of multi complex building and construction projects exist in Lagos State. Such projects usually produce wastes that have adverse effect on the teeming population of the State estimate at about 21 million by [25]. Hence, restricting the study area to Lagos State is justified because the State is considered to have what it takes to provide enough data to help achieve the aim of the study.

The study provides information to better understand issues associated with the challenges of lean construction practice as well as its prospects which can be harnessed to add value to the building industry. The results of the study will be useful to construction regulatory bodies, construction professionals, construction firms, research students and educators in helping to identify issues associated with the lean construction concept and how to implement it. The lean construction principles and techniques identified with their benefits will particularly be useful to professionals in terms of the techniques that integrate more seamlessly with building construction projects.

The paper is divided into six sections as follows: introduction; literature review; research methodology; results, analysis and discussions; conclusion; and acknowledgments.

II. LITERATURE REVIEW

2.1 Overview of the Nigerian Building and Construction Industry

The construction industry deals with the design and construction of buildings and structures through processes of planning, design, approval, manufacture, construction and maintenance [15]. The activities typically involve erecting new structures, demolition, repair of structures and installation of fittings and fixtures. These activities encompass the extraction of natural resources and processing them into tangible building components. However, there is a blurry demarcation between these processes, thus leading to waste and loss of value on investments [5]. Globally, the construction industry contributes a major quota to the revenue of both developed and developing countries and is also responsible for about 40% of waste generated. [3] Stated that construction waste arises from mistakes, executing works out of sequence, repetitive activities, making inputs earlier or later than required and services that do not meet client's requirements.

In Nigeria, housing is the major component of the construction and building industry and it contributes hugely to the economic, social and civic development of the nation. The sector has been pivotal in its linkages with other sectors

thereby having a multiplier effect on them, most notably the real estate and building materials. The construction industry predominantly consists of medium sized contractors operating locally and executing mostly residential projects [10]. The contractors adopt traditional management techniques for work plan schedules. This approach entails scheduling of activities and work items in terms of what ought to be done from the master plan without taking cognizance of the personnel or workers capability [2]. This workflow pattern has made the industry experience delays completion of projects, cost overruns, ethical issues, poor quality of workmanship and consequently waste generation.

2.2 Concept of Lean Construction

Lean concept is a philosophical management tool which focuses on identifying and eliminating waste in the entire process of a product's value stream, which seeks to extend not only within the producing organizations but also along the supply and implementation chain network [22]. Similarly, [13] defined lean construction as a systematic approach employed to enhance the value to the customer by highlighting and eliminating waste through a cyclic process of improvement in pursuit for perfection. The concept and principles of lean construction are therefore aimed at removing waste from the construction process in project management and delivery. The basic concept of lean construction emanated from the lean manufacturing principles introduced by Toyota motors in their Toyota production system (TPS) and have been successfully adopted in the construction industry globally [24].

2.3 Principles and Techniques of Lean Construction

Lean principles refer to the approaches, strategies and tools used in achieving the objectives of the concept aforementioned in its definitions. According to [7], lean construction is hinged on five major principles namely: specification of value; identification of value stream; continuous flow; pull scheduling; and perfection pursuance. The lean construction techniques in practice include: last planner, reduce variability, increase transparency, flow variability, continuous improvement, just in time and seek perfection techniques.

2.3.1 Identifying Value

This principle is considered from the customers' view point. Value can either be based on market or utility perspective and it tends to be very subjective and complex. [11] explored the term and reported that value in lean construction is created through fulfilling the customer or client's requirement.

2.3.2 Value Stream Mapping

This principle entails the identification of all the steps that are required to create and deliver products that fulfils the customer's requirement. The first step is usually mapping of the current situations and identifying alternative routes that will maximize output of construction processes [4].



2.3.3 Achieving Flow in Processes

Flow is pivotal in the process of achieving perfection and balancing the activities that are interwoven in product delivery. It is therefore very paramount to give attention to the flow of product and processes in construction. [11] presented seven flows towards executed projects perfectly. They include: space, crew, previous work, equipment, information, materials and external conditions such as climate.

2.3.4 Allowing Customer to Pull

Pull simply refers to the ability to deliver the product to the client at the appropriate time. This principle entails adopting just in time applications to ensure the client requirements are met at the earlier possible time. Construction projects are very complex with uncertainties that may deter delivery within the stipulated time with minimum resources [12].

2.3.5 Pursuing Perfection

At the strategic level, perfection is seen as been an inherent organizational culture. In achieving this, considerations have to be constantly made on what is being done, how it is done and harnessing knowledge and expertise that is involved in the processes. The principle of perfecting entails producing the quality and quantity of the client's requirement at the right time with minimal or zero waste [20]

2.4 Challenges of Implementing Lean Construction in Nigeria

Generally, literature on the constraints of implementing lean construction practice in the Nigerian building industry are limited. However, [23] identified shortage of technical, skilled and professional works, poor remuneration, client's inconsistency, poor organizational structure and poor government regulations as the key barriers to the implementation of lean practices in Nigeria. Similarly, [16] grouped the barriers into six categories namely; financial, educational, governmental, attitudinal, managerial and technical issues. The success of this concept lies in the commitment of developing and implementing effective plans and providing resources adequately to support its implementation [14]. In general, the barriers to the implementation of lean construction practice in Nigeria identified in literature are directly linked to management issues.

2.5 Prospects of Implementing Lean Construction in Nigeria

[1] reported that if an approach can be employed to alleviate weakness and failure, the approach is considered to be suitable for adoption. Waste generated from construction is considered to be the greatest weakness of the construction industry in Nigeria, hence it has become imperative to adopt processes that will minimize waste and add value to client's investments. Lean construction has been seen as an enabler that will help in alleviating issues of waste generation and improvement in productivity of construction by ensuring effective collaboration and communication among stakeholders from inception to execution of projects [21]. The

researchers enumerated several case studies across the globe with evidence that lean construction facilitates effectiveness and efficiency in the construction process. [1] also identified categories of waste at different stages of construction in Nigeria as a result of defects, over production, equipment's, transportation, process, that is, design errors, poor workmanship and excess material consumption. However, these can be eliminated in the Nigerian building industry via government policies, facilitation of professionals, professional bodies and client commitment. [6] also revealed in a systematic review of lean construction implementation that lean construction practice is beneficial to the quality of buildings to promote a sustainable built environment, but a critical understanding of the techniques by professionals is central to its implementation.

III. METHODOLOGY

The study adopted a pragmatic research approach that uses both qualitative and quantitative research methods. To this end, both secondary and primary data were gathered. To gather qualitative (secondary) data, books, journals and reliable internet materials relevant to the subject matter were reviewed. A structured questionnaire developed for the study was used to obtain quantitative (primary) data. The survey instrument was designed with four sections namely: social demographics of respondents; lean construction awareness level and techniques adopted; architects' perspective on prospects of lean construction; and architects' opinion on challenges and barriers facing lean construction implementation in Nigeria. Textual analysis was used to analyse qualitative data, while statistical package for social sciences (SPSS) version 21 was employed to analysed quantitative data. The result is presented descriptively with the aid of charts and tables. The study population of architects was extracted from the Architect's Registration Council of Nigeria (ARCON) register published in 2016. According to the register, 831 registered architects are domiciled in Lagos State, Nigeria, the study area. The study has a finite population size, hence the Yamane Taro equation was considered most appropriate to determine the sample size and was adopted. The formula is $n_Y = N / (1 + Ne^2)$, where N = Population size and e = alpha level, which is stipulated at 0.05 based on a confidence level of 95%. Using the formula, the sample size of 270 was arrived at.

To select the sample size of 270 respondents, the practicing architects were first grouped into their respective strata of those whose practice are located on the island and those domiciled on the mainland. The stratification was done because statistics from Lagos State development agencies revealed that architectural firms domiciled on the island undertake more complex projects, therefore it was assumed that their views might be slightly different from that of the architects on the



mainland. The respondents were randomly selected from each strata and questionnaire sent to them using online google survey forms. The online method of data collection was preferable because of the difficulty in physically accessing the architects in the study area as a result of traffic congestion. The data was obtained and analysed between January and April, 2019.

IV. RESULT, ANALYSIS AND DISCUSSION

4.1 Response Rate

A number of 270 questionnaires were administered randomly to practicing architects in the study area via google survey forms. The analysis of location and response rate is shown in Table 4.1.

Table 4.1: Location of Respondents and Response Rate

| Location | Number of Questionnaire Distributed | Number of Questionnaire Retrieved | Response Rate in Percentage (%) |
|----------------|-------------------------------------|-----------------------------------|---------------------------------|
| Lagos mainland | 130 | 121 | 93.1% |
| Lagos Island | 140 | 127 | 90.7% |
| Total | 270 | 248 | 91.7% |

Table 4.1 revealed that out of the 270 questionnaires distributed, 248 were retrieved to give a response rate of 92%. The response rate recorded is considered reasonable to generalize the study as a fair representation of the practicing architects' perspective on the subject matter in the study area.

4.2 Social Demographics of Respondents

The social demographics were categorized into sex, education qualification, professional experience, location, sector and professional registration and the results obtained are presented in Table 4.2.

Table 4.2: Social Demographics of Respondents

| Variable | Frequency | Percentage (%) |
|--|-----------|----------------|
| Sex | | |
| Male | 164 | 66.1 |
| Female | 84 | 33.9 |
| Total | 248 | 100 |
| Educational Qualification | | |
| B.sc/B.Tech | 35 | 14.1 |
| M.Sc./M.tech | 182 | 73.4 |
| Ph.D. | 31 | 12.5 |
| Total | 248 | 100 |
| Professional Experience (Years) | | |
| 2-5 | 60 | 24 |
| 6-10 | 52 | 21 |
| 11-15 | 92 | 37 |
| 15 and above | 45 | 18 |
| Total | 248 | 100 |

Location

| | | |
|----------------|-----|------|
| Lagos Mainland | 120 | 43.4 |
| Lagos Island | 128 | 56.6 |
| Total | 248 | 100 |

Sector

| | | |
|--------------|-----|------|
| Public | 92 | 37.1 |
| Private | 156 | 62.9 |
| Total | 248 | 100 |

Professional Registration

| | | |
|----------------------|-----|------|
| ARCON | 248 | 100 |
| NIA | 220 | 81.5 |
| NIA and ARCON | 201 | 74.4 |

Table 4.2 revealed that a greater percentage (66.1%) of the respondents are male while female architect respondents constitute 33.9%. Most (73.4%) of the respondents are M.Sc./M.Tech. holders, 14.1% have B.Sc./B.Tech. and just 12.5% are Ph.D. holders. The dominant experience range of the respondents is 11-15 years with a percentage of 37%. While the lowest is 15 years and above with just 18%. The respondent's location was divided into Lagos Mainland and Lagos Island with frequencies of 120 and 128 respectively. Most (62.9%) of the respondents are in the private sector and majority (74.4%) of them are registered with both ARCON and the Nigerian Institute of Architects (NIA) which are the professional bodies that regulate the study and practice of architecture in Nigeria. Based on the forgoing, the respondents in this survey are not only a fair reflection of what is obtainable in the study area, but considered competent and experienced enough to supply data that was used in the study. This is because of their diversity, high level of education and years of experience.

4.3 Lean Construction Awareness Level and Techniques Adopted

Close ended questions were used to elicit information from respondents on how informed they are about lean construction techniques and the techniques adopted in their architectural practice. Figure 4.1 and 4.2 is a presentation on the results of the awareness level of the respondents and lean techniques adopted by the respondents respectively.

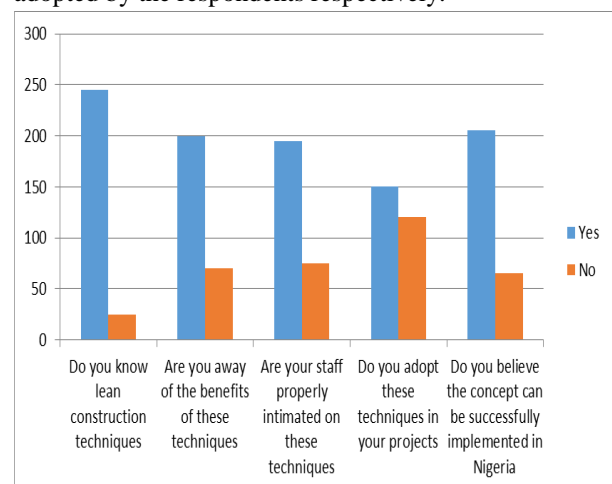


Figure 4.1: Lean Construction Techniques Awareness Level of Respondents

| SN | Statement on Prospects of Lean Construction | 1 Strongly Disagree (%) | 2 Disagree (%) | 3 Undecided (%) | 4 Agree (%) | 5 Strongly Agree (%) |
|----|---|-------------------------|----------------|-----------------|-------------|----------------------|
| 1 | The construction industry will produce less waste and improve client gains if these techniques are implemented. | 5 | 10 | 5 | 25 | 55 |
| 2 | The outcome of projects will be more predictable from the onset if these techniques are adopted. | 15 | 25 | 5 | 25 | 30 |
| 3 | The nature of construction industry will be properly shaped if firms are mandated by government policies to adopt these techniques. | 8 | 12 | 20 | 45 | 15 |
| 4 | The techniques will facilitate increased safety and health of workers on site. | 6.5 | 14.5 | 5.5 | 48 | 25.5 |
| 5 | The quality of construction products will be better with fewer defects if these techniques are adopted. | 2 | 8 | 10 | 10 | 70 |
| 6 | Cost and time overruns will be hugely reduced if these techniques are adopted. | 10 | 20 | 0 | 25 | 45 |
| 7 | Commitment and cooperation of professional bodies in the construction sector is key to the adoption of the lean concept. | 0 | 0 | 5 | 10 | 85 |
| 8 | Education and workshops on lean construction should be organized among professionals to facilitate its adoption. | 0 | 10 | 10 | 20 | 60 |

Table 4.1 on the respondent's level of awareness on lean construction indicated that majority (88.9%) of the respondents are aware of the lean construction techniques. Also, most (74%) of the respondents indicated that they are fully aware of the benefits of the lean construction techniques. Majority (70.4%) also revealed that their workers are well enlightened on the techniques. However, a little above half of the respondents (55.6%) revealed that they adopted the techniques in executing projects, while a higher percentage (74%) believe that the concept can be successfully adopted in the Nigerian construction industry. The findings on the awareness level and rate of adoption are in line with that of [7] and [16] on the readiness of construction firms to adopt lean construction. Inferentially, to a reasonable extent, architects in the study area are well informed about lean construction, though the rate of adoption is just above average, their responses show a better likelihood of implementation as time goes on.

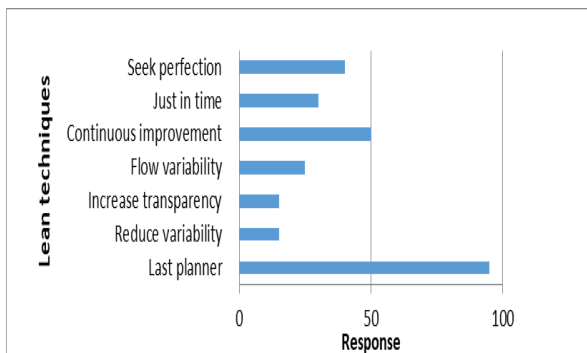


Figure 4.2: Techniques Adopted by Respondents

The result presented in Figure 4.2 on lean techniques adopted indicated that the last planner technique has the highest adoption rate of 33.3%. This is followed by continuous improvement with 18.5%, seek perfection with 14.8% and the least are increase transparency and reduce variability both with recording 7.4% each. This result is in line with the

findings of [16] on the most adopted lean construction technique in Nigeria. Based on this result, it is imperative to

expand the knowledge base of architects on the other techniques which appeared not to be well adopted in the execution of projects in the study area.

4.4 Perspective on Prospects of Lean Construction

A five point Likert scale was used to measure the perception of respondents on the prospects of lean construction in Nigeria. The findings are presented in Table 4.2.

Table 4.2: Frequency of Respondent's Perspective on the Prospects of Lean Construction

The result presented in Table 4.2 revealed that less waste will be generated if the lean techniques are adopted. Also, cost and time overruns will be reduced and client gains will be improved. More than half of the respondents (55%) believe that the outcome of projects will be more predictable, while majority (60%) believe that it is essential to regulate the adoption of these techniques via government policies. Also, most (85%) agreed that the professional bodies commitment should be highly sort after for the successful implementation of the techniques. Based on this result, the prospect of implementing lean construction in the building industry in Nigeria is high.

4.5 Perspective on Challenges of Lean Construction Implementation

From literature, the challenges of lean construction are classified into six categories namely; financial, educational, governmental, attitudinal, managerial and technical issues. Based on these, variables were designed to evaluate the perception of respondents on the challenges. Results of financial and educational challenges are presented in Figure 4.3, governmental and educational challenges are presented in Figure 4.4, while attitudinal and technical challenges are presented in Figure 4.5.



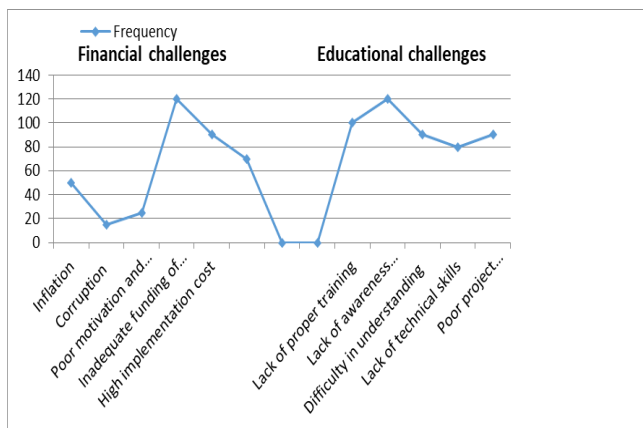


Figure 4.3: Financial and Educational Challenges

The result on financial challenges and educational challenges shown in Figure 4.3 revealed that under financial challenges, inadequate funding of projects is the highest occurring variable followed by implementation cost then poor professional remuneration. While educational challenges and lack of awareness programmes is the highest occurring variable, followed by lack of proper training before difficulty in understanding the concept. Based on this result, the awareness level of architects needs to be backed up with technical programmes that will enlighten them more on lean construction practice. This result also suggests that an upward review of remuneration of architects in Nigeria is necessary to facilitate better implementation of lean construction techniques, as it is observed from the study that the technique requires additional services through planning and execution of building projects.

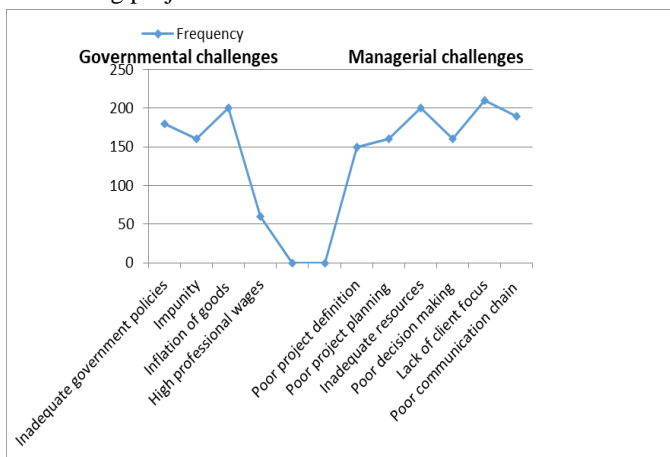


Figure 4.4: Governmental and Managerial Challenges

The results on governmental and managerial challenges presented in Figure 4.4 revealed that under governmental challenges, inflation of goods has the highest frequency, followed by inadequate government policies and then impunity. Under managerial challenges, lack of client focus has the highest frequency, followed by inadequate resources, poor communication chain, poor decision making before poor project planning. Based on these results, it can be inferred that poor policies by government agencies is a major bottleneck that needs to be addressed. Also, construction firms need to focus more on meeting the client's needs within the shortest possible time.

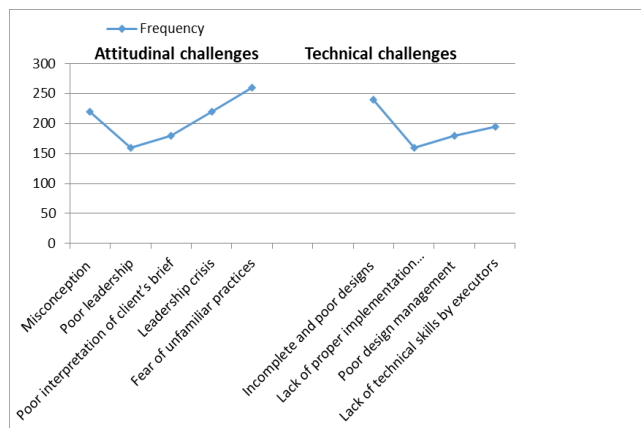


Figure 4.5: Attitudinal and Technical Challenges

The result presented in Figure 4.5 showed that under attitudinal challenges, fear of unfamiliar practices has the highest frequency, followed by leadership crisis, misconception and poor interpretation of client's brief, before poor leadership. Under technical challenges, incomplete and poor designs have the highest frequency. This is followed by lack of technical skills, poor design management and lack of proper implementation. Based on this result, the challenges facing the implementation are peculiar to the Nigerian building industry. However, they are considered not sufficient to hinder its implementation. This is because they can be easily addressed with proper education, seminars and workshops.

V. CONCLUSION AND RECOMMENDATIONS

The study investigated the prospects and challenges of lean construction practice in the Nigerian construction industry from the architect's perspective. The study found that the awareness level of architects and their readiness to adopt the lean construction techniques on projects is high, hence the likelihood of its successful implementation in Nigeria. The result of this study is similar to the findings of [7] and [16] on the awareness level of professionals and their readiness to adopt lean construction techniques in Nigeria. This affirms the need to create enabling programmes that will help professionals build a critical mass of understanding to promote sustainability in the built environment. The high adoption rate of the last planner technique also supports the findings of [10] that the Nigerian construction industry is characterised by medium sized contractors operating locally. Based on the outcome of the study, it is recommended that periodic training programmes should be organized by professional bodies to equip professionals on the technical skills and benefits lean construction practice offers, towards achieving prompt building project delivery and reduction of waste generated on such projects. The study was limited to Lagos State in Nigeria and centred on the perspectives of architects. Similar studies could be carried out to evaluate the perception of other construction industry stakeholders such as



contractors, quantity surveyors, estate managers and engineers in the study area. Such a studies can also be expanded to other parts of Nigeria to provide more insight on issues associated with the practice of lean construction in the country. In addition, seminars and workshops on lean construction should also be organised by construction firms for their staff to avoid issues of misconception and low technical knowledge on the subject matter, as both issues are considered key contributing factors that may hinder its implementation to produce the desired result.

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