Environmental Technology & Science Journal
Vol. 10 Issue 2 December 2019

Assessment of Readiness of Nigerian Construction Firms on Adoption of Lean Construction Principles

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Nigeria Construction firms are faced with the challenges of poor performance and waste of resources during the course of construction projects. Lean construction principles have been known as effective means of reducing wastage of resources during construction projects. The aim of this paper is to assess the level of readiness of Nigerian construction firms on the adoption of lean construction principles. A total of 120 questionnaires were distributed to Engineers, Quantity surveyors, Builders and Architects in selected construction firms in Abuja. The descriptive method of analysis was used to analyze the data obtained from the survey. The result shows that the level of awareness of the lean construction principles is still at the lowest level in the construction firms. It was also established that the construction firm's readiness on the adoption of lean construction principles was still at the lowest level. Especially; in all aspect of management, process/project, employees and technology. Therefore, the paper recommended that workshop/Seminar should be organized periodically to enlighten the management and employees of construction firms as means of creating awareness of the needs and the benefits drive from the adoption of lean construction principles.

Keywords*:* Building Projects, Construction Firms, Lean Construction and Project Performance

Introduction

Nigerian construction industry produces nearly 70% of the nation's fixed capital formation yet its performance within the economy has been and continues to be very poor (Isa *et al.,* 2013). This can be attributed to the movement of employees away from long term employment relationships and long-term rewards and the efforts are focused on short-term rewards (Osuji, 2014; Idrus & Sodangi 2007). The Nigerian economy continues to grapple with a number of challenges that has hampered efforts at economic transformation. The economy is yet to achieve the necessary structural changes required to start rapid and sustainable growth and development due to some challenges facing the nation (Isa *et al.,* 2013). However, construction industry in both developed and developing nations are generally characterized by low productivity, cost overruns, errors, poor reputation, shortage of skilled labour and poor safety (Hosseini *et al.,* 2012). The Nigerian construction Industry is not different from its counterpart around the globe in term of waste generation. Thus, it is the duty of the professionals to gear up and put into action, new ways of avoiding this common problem. Moreover, the lean construction principles have been established as means of minimizing the waste in the process, duration, cost and labour of construction projects (Aigbavboa *et al.,* 2016; Kasimu *et al.,* 2019). Due to its great potential in meeting the customer's objectives in terms of increasing added value and productivity, lean construction (LC) is seen as an alternative approach that might be implemented by the construction industry (Marhani *et al.,* 2013). Despite the potential benefits of lean construction principles, the

stakeholders in Nigeria construction firms are still left behind in the adoption of lean construction principles to improve on the performance of building projects. Therefore, Nigerian construction firms should focus attention on the adoption of lean construction principles in order to reduce or eliminate wastage, since it's have been characterized with poor quality performance. Although, the concept of lean construction is still considered as a new paradigm among Nigeria Construction practitioners (Aisha *et al.,* 2019). There are uncertainties whether Nigerian construction firms are ready to implement this concept of lean construction principles. Based on the aforementioned factors, this research is carried at identify the level of readiness of construction firms on adoption of application of lean construction principles in Nigerian, with a view to improving project performance towards satisfaction of client's needs. The objectives of this study are: to examine the level of awareness of lean construction principles within the Nigerian Construction Industry and to assess the level of readiness of construction firms towards adoption of lean construction principles.

Concept of Lean Construction

The concept of lean principle is to generally make the construction process leaner removal of wastes regarded as non- value generating activities (Koskela, 2000). Lean construction has the potential of bringing innovative changes in the construction industry. Dulaimi and Tanamas (2001) pointed out that the adoption of lean techniques to construction eliminates non-value steps i.e. waste of resource and effort to satisfy clients objectives. Howell (1999) explained that the lean production's concept to identify and deliver value to the client and eliminate anything that does not add value. It also perfects the products and create reliable flow through stopping the line, pulling and distributing information and decision making. Aigbavboa *et al.* (2016) provided a conceptual framework of lean construction as shown in Figure 2.1.

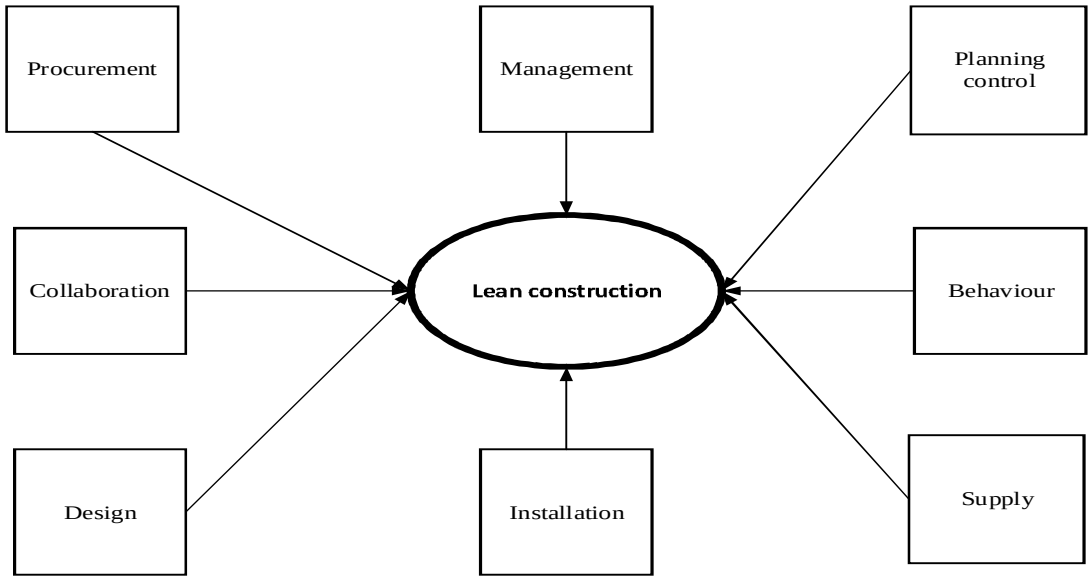

Figure 1: The conceptual frame work of lean construction (Aigbavboa *et al.*, 2016)

Research Methodology

The quantitative research approach was adopted through the use of survey questionnaire. The survey questionnaire was adopted to sample individuals from a population with a view towards making statistical inference about the population using the sample (Creswell, 2003). Also, the study pulls out public opinion, such as beliefs, perception, ideas, views and thought about the readiness of Nigerian Construction Firms on the adoption of lean construction principles using the questionnaire. In order to obtain the require population for this study, the stratified random sampling technique was adopted for the selection of the construction firms that participated in this study. This selection was in line with concept of Creswell and Tashakkori (2007) that respondents are arranged in strata for the convinienency in questionnaire distribution and assessment. In addition, the simple random sampling was adopted in each of the construction firms for the selection of construction professionals from the strata.

The questionnaire that was used to record the responses of each respondent contained mainly closed ended questions using a five-point Likert scale ranged from strongly not agree, not agree, neutral, agree and strongly agree. The scores of the respondents were computed based on the variables used in the questionnaire. As earlier explained that simple random sampling techniques was adopted in each of the construction firms for the selection of construction professionals. 120 numbers of professionals in the Construction Industry were selected. These professionals are: Quantity Surveyors fourth numbers (40), Architects thirty numbers (30), Builders thirty numbers (30) and Civil Engineers twenty numbers (20). However, only ninety-six (96) numbers of those selected professionals were able to return the questionnaire, while three (3) of the ninety-six (96) were ignored for incorrect entry.

The inference statistic was adopted to summarise the sample, rather than use the data to learn about the population and sample. In this paper, inference statistic was used to present means score, standard deviation and frequency counts. The mean value was used to rank the respondents' opinions or responses obtained and percentages was used to established the level of awareness on lean construction principles by construction firms in the Nigerian Construction Industry.

Findings and Discussion of Results

The results of the demographic profile of the respondents were presented in 4.1 to 4.3 respectively.

Years of Experiences of Respondents in Contracting Firms

Figure 2 shows years of experiences of respondents, thus with 11-15 years of working experience represent 34.41%. while 6-10 years of working experiences represent 25.81%. In addition, respondents with 16-20 years of working experiences constitute 19.35%. Furthermore, thus with 20 years of working experiences constitute 12.9%. And respondents with 1-5 years of working experiences which represent 7.53%. This indicate that majority of the respondents have working experiences in construction projects.

Qualification of the respondents

Figure 3 shows that 34.41% have B.Sc/B.Tech degree, 24.73% have MSc/M.Tech degree. In addition, 22.58% have HND and 6.45% have PGD. This signify that the respondents have required qualification in different background of knowledge of construction.

Profession of Respondents

Figure 4 shows 38.71% of respondents are Quantity Surveyors, 26.88% are Architect; 18.28% are Builders and 16.13% are Civil Engineers. This reflect that the professions of the respondents are relevant to construction.

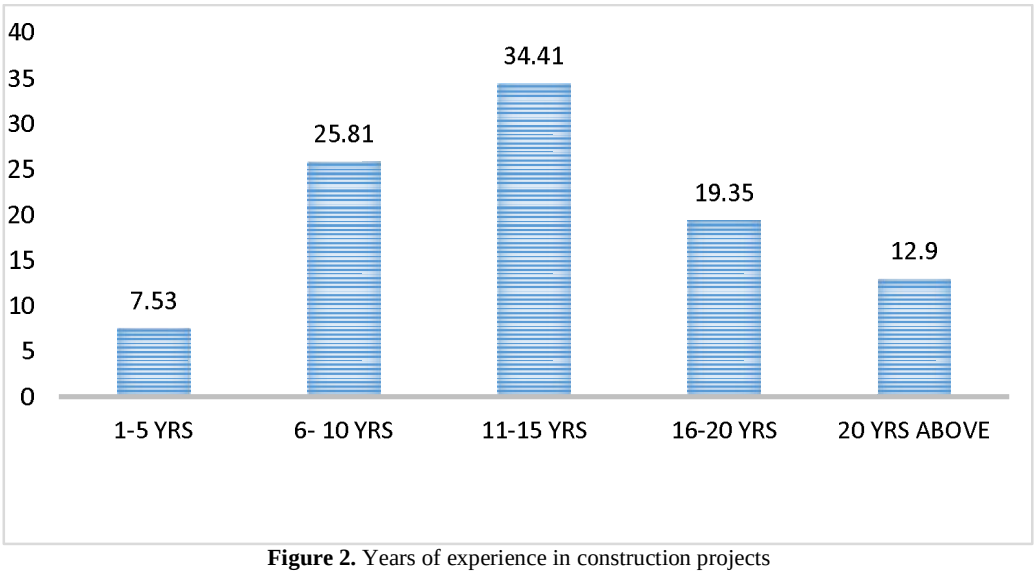

Figure 2. Years of experience in construction projects

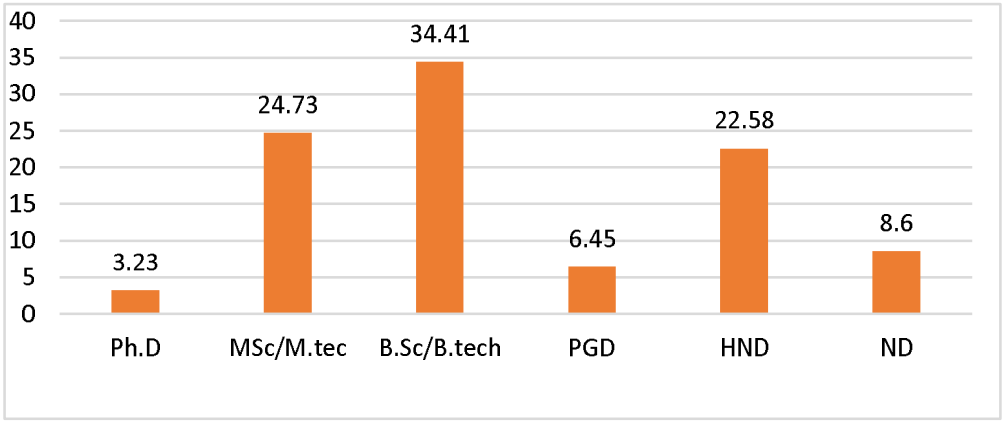

Figure 3: Qualification of Respondent

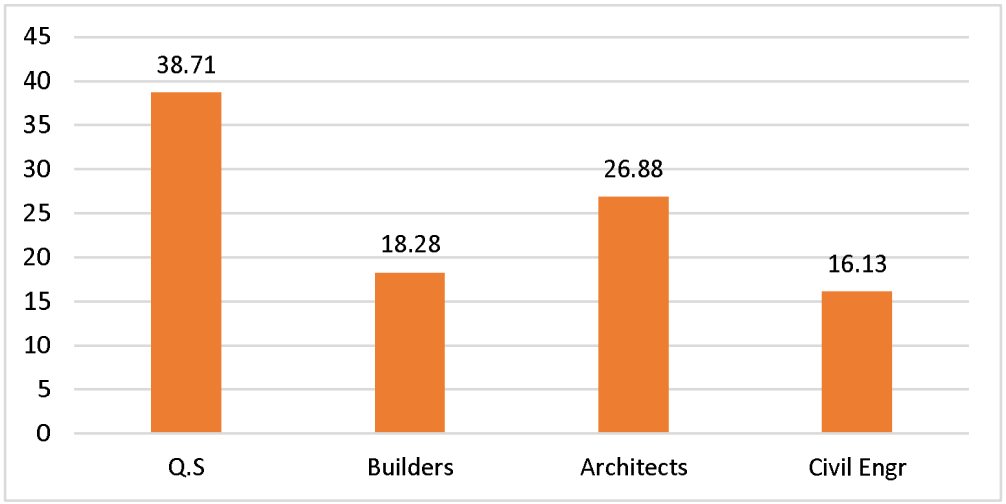

Figure 4: Profession of respondent in construction projects

Level of Awareness of Lean Construction

Figure 5 shows the level of awareness of the following's lean construction principles: just in time, total productive maintenance, continuous improvement, design for manufacturing and assembling, supplier management and effective human resource management in Nigerian construction firms are low in terms of awareness. In addition, the result shows the level of awareness of total quality management as slightly high. This result implies that all the six variables used to examine the level of awareness of lean construction principles in the study area are very low except total quality management. This result was in line with the views of previous researchers that lean construction is achieved through a set of mutually reinforcing practices, including just-in-time (JIT), total quality management (TQM), total productive maintenance (TPM), continuous improvement, design for manufacturing and assembly (DFMA), supplier management, and effective human resource management (Jadhav 2014; Jørgensen & Stephen 2008; Marhani, *et al.*, 2013).

Table 1 shows that just in time, total quality management and supplier management and effective human resource management have the RII values of 0.441; 0.439 & 0.417 with the followings mean scores of 2.204; 2.194 and 2.086 respectively. This signifies that the above variables mentioned are high in the level of awareness of lean principles. In addition, continuous improvement, design for manufacturing and assembling and total productive maintenance have the RII values of 0.374; 0.53 & 0.346 with the mean scores of 1.871; 1.763 and1.731 respectively. respectively.

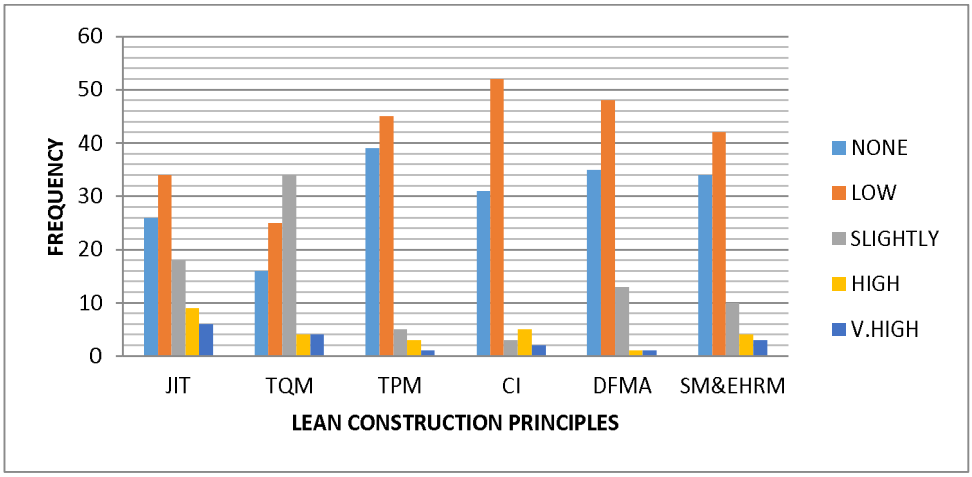

Figure 5: The level of awareness of lean construction principles

(Note: JIT= Just in time, TQM= Total Quality Management, TPM = Total productive maintenance, CI= Continuous Improvement, DFMA= Design for Manufacturing and Assembling and SM&EHRM= Supplier management and effective Human Resources Management.)

Table 1: Relative Importance Index for Level of Awareness of Lean Principles

Lean construction principles	Fx	RII
Just in time	205	0.441
Total Quality Management (TQM)	204	0.439
Supplier Management and Effective Human Resources Management	194	0.417
Continuous Improvement (Kaizen)	174	0.374
Design for Manufacturing and Assembling (DFMA)	164	0.353
Total Productive Maintenance (TPM)	161	0.346

The RII indexes and mean scores of all variables used are below average, which implies that the respondents are not much aware about the lean construction principles. Although, Salem *et al.* (2006) argued that to fully and effectively apply lean principles in construction, the focus must be on the construction process. All stakeholders must be committed, involved and work together to overcome obstacles.

Level of Readiness towards Adopting Lean Construction

The result of the level of readiness of construction firms to adopt lean construction principles were categorized into four namely; Management readiness, Process/Project readiness, employee's readiness and Technology readiness. The level of readiness indicated in Table 2 to 5 were based on RII.

Table 2 shows that the management awareness of LC and recognized the benefits of LC have RII value of 0.458. However, provision of adequate financial resources to facilitate LC practices, LC strategy well communicated to all levels within the organization, levels of management in the organization have a LC mind approach, and policy for training and capacity building to keep employee up to date with practice have RII values 0.348,0.325, 0.323 and 0.314 respectively. From the result, all variable used in RII indexes are below average which implies that the management of construction firms are not fully ready to adopt lean construction principles. Salem *et al., (*2006) and Hudson, (2007) agreed that the top management of every organisation has a major role to play in achieving a successful implementation of innovative strategies. The result was also supported by Azevedo *et al.* (2010) that it is important to consider the company's strategy when implementing lean construction, so that the long-term objectives are achieved and the real needs are met.

As indicated in Table 3 business process support and encourage interdisciplinary/inter organizational collaboration has RII value of 0.527. This implies that the construction firms are doing well in terms of business process support and encouragement of interdisciplinary/inter organizational collaboration which aids the adoption of lean construction principles. In addition, organization focus on client expectations and organization flexibility to accommodate LC have RII values of 0.411 and 0.488 respectively. However, other variables record lower RII values, which include; use of LC to improve health and safety during project delivery, adequate competent design team and construction process, display high level of quality assurance, current ICT infrastructure is adequate for supporting LC and use of LC to reduce risks on overall project management has RII values of 0.398, 0.396, 0.381, 0.344 & 0.316 respectively. This implies that majority of the construction firms are not ready for the adoption of LC based on the RII values obtained. Song and Liang (2011) agreed with the result that implementation of lean concept requires a re-thinking of the processes and practices of conventional construction, and a change of culture and the introduction of new tools.

Table 2: Management Readiness on Adoption of Lean Construction Principles

Variables	Fx	RII
The management is aware of LC and recognized the benefits of LC	213	0.458
Provided adequate financial resources to facilitate LC in our practices	162	0.348
LC strategy is well communicated to all levels within the organization	151	0.325
All levels of management in our organization have a LC mind approach	150	0.323
Have a policy for training and capacity building to keep our staff up to date with LC tools	146	0.314

Table 3: Construction Readiness on Adoption of Lean Construction Principles

Variables	Fx	RII
Business process support and encourage interdisciplinary/inter organizational collaboration	245	0.527
Organization focus on client expectations	227	0.488
Organization is flexible enough to accommodate LC	191	0.411
Use of LC will improve Health and Safety during project delivery	185	0.398
Competent design team and construction process	184	0.396
Display high level of quality assurance	177	0.381
Current ICT infrastructure is adequate for supporting LC	160	0.344
Use of LC will reduce risks on overall project management	147	0.316

Table 4. Employees Readiness on Adoption of Lean Construction Principles

Variables	Fx	RII
Possession of necessary levels of IT literacy, functional expertise and skills to use LC	171	0.368
Commitment to address any issues/inhibitions that any staff may have about using LC principles	170	0.366
Organizational structure provides an environment that is well suited to use LC principles	151	0.325
Training procedures that will enable our staff to effectively use LC tools	134	0.288
Workers with ability to implement change and move quickly to adopt the use of LC	127	0.273
Importance of training required for using LC tools	120	0.258

Table 4 indicates level of IT literacy, functional expertise and skills of employees to use LC and commitment to address any issues/inhibitions that any employee may have about using LC principles has RII values of 0.368 and 0.366 respectively. Furthermore, organizational structure provides an environment that is well suited to use LC principles have the RII has of 0.325. Training procedure that will enable workers to effectively use LC tools, workers with ability to implement change and move quickly to adopt the use of LC and importance of training required for using LC tools has RII value of 0.288, 0.273 and 0.258 respectively. This results signifies that employees have devised trained procedure that will enable workers to effectively use LC tools. It also shows that workers have the ability to implement change and committed to adopt the LC principles. Miranda Filho *et al.* (2001) argued that lean construction can be successfully implemented, when consider the particular strategic and organizational characteristics of each company and its relationship that defines the success or failure of the implementation.

Table 5 indicate that construction firm have well defined IT policy with RII value of 0.357. In terms of whether they are familiar with the use specialist software applications related to our expertise have RII value of 0.338. For whether ICT systems are flexible to accommodate rapid change and scalability have RII value of 0.32. while availability of effective intranet and extranet facilities to facilitate information sharing and interoperability have RII value of 0.31. All variables have RII values below the average which implies that the construction firms are not ready for the adoption of LC principles in terms of availability and usability of cutting-edge technologies. The result was supported by Radhika & Sukumar (2017) that IT facilitates the effective application of lean construction principles to reduce waste in construction works.

Table 5. Technology Readiness on Adoption of Lean Construction Principles

Variables	Fx	RII
Construction firms have well defined IT policy	166	0.357
Familiar with the use specialist software applications related to expertise	157	0.338
ICT systems are flexible to accommodate rapid change and scalability	150	0.323
Availability of effective intranet and extranet facilities to facilitate information sharing and interoperability	144	0.31

Summary of Findings

The level of awareness of lean construction principles.

The results obtained shows the low level of awareness of the followings lean construction principles in Nigerian construction firms: just in time, supplier management & effective human resource management, continuous improvement, design, for manufacturing & assembling and total productive maintenance are low in contracting firms in Nigeria. This implies that the construction firms in Nigeria are not fully aware of lean construction principles. There is no adequate knowledge of lean construction principles in Nigerian construction firms.

The level of readiness of contracting firms toward adoption of lean construction principles.

The result was summarized as follows:

a) **Management readiness**:

The result obtained under management readiness shows that: (1) there are no adequate financial resources to facilitate adoption of lean construction, (2) lean construction strategy is not properly communicated to all levels in the construction firms, (3) there is low level of awareness of lean construction by management (4) all level of management in construction firms do not have lean construction mind approach. This reflects that, the top management of construction firms are not fully committed to the application of lean construction principles due to inadequate financial resources and lack of proper communication of lean construction strategies.

b) Construction readiness

As indicated, all variables analyzed under construction readiness shows the construction firms are not fully ready for application of lean construction principles: The variables are (1) inadequate ICT infrastructure to support LC, (2) Construction firms readiness to adopt LC, (3) lack of readiness by construction firms to fully adopt LC to reduce risk in overall project management, the construction firms are not fully ready to adopt LC, (4) the business process support & encourage interdisciplinary/inter-organizational collaboration, but the construction firms are still yet to utilize the opportunity and (5) the construction firms focus on clients expectation but yet to adopt LC strategies to fast track the construction process. The result deduced that, construction firms are not fully ready to accommodate the lean construction principles due to inadequate ICT infrastructure and lack of flexibility.

c) Employees readiness

Similarly, the result obtained under employee's readiness to adopt LC shows the followings: (1) the level of employees who fully understand the importance of training required to use LC tool is low (2) there is no devised training procedures that will enable the firms effectively use LC tools (3) despite the fact that the construction firms have the employees with ability to implement change and move quick to adopt the use of LC, the construction firms are not ready to adopt the LC principles. It was deduced that, the employees of construction firms have the ability to implement lean construction principles, but they lack knowledge of application of lean construction principles.

d) Technology Readiness

The result obtained under technology readiness in adoption of lean construction principles are: (1) The level of effective internet and extranet facilities to facilitate

information sharing and interoperability is low in term of readiness to accommodate lean construction (2) Despite the fact that some employees are familiar with the use of specialist software application, the use of ICT facilities is very low in construction firms in Nigeria. (3) The level of flexibility of ICT system to accommodate rapid change and scalability is very low to fast track the application of lean construction principles. The study deduced that the staff of construction firms are not fully ready to adopt the lean construction principles due to the challenges of lack of training and ability to implement changes.

Conclusion

Lean construction principles have been identified as means of delivering value to the customers and eliminating things that do not add value to clients. Therefore, the application of lean construction principles in Nigerian construction firms will deliver expected value to the clients. This paper established that the level of awareness of the lean construction principles are still at the lowest level in the construction firms. It was also established that the construction firm's readiness to adopt lean construction principles is still at lowest level. Especially, in aspects of management, process/project, people and technology readiness. The paper recommended that workshop/Seminar should be organized periodically to enlighten the management and employees of construction firms as means of creating awareness on the needs and the benefits drivable from the adoption of lean construction principles. The top management of construction firms should be committed and support the application of the lean construction by ensuring teamwork among the staff, avoidance of corruption and adopt the habit of changes from the traditional method of doing things. There should be adequate provision of necessary infrastructures like ICT that would facilitate the application of lean construction principles. The paper contributes to the body of knowledge by identifying the level of awareness of lean construction principles and commitment to its application in construction firms in Nigeria.

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