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Barriers to the Adoption of Lean Practices (LPs) in the Nigerian Building Industry

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Abstract
This study focused on examining barriers affecting the adoption of Lean Practices (LPs) in Nigeria's building industry. These barriers limit the extent to which LPs can be incorporated in the building industry, thereby affecting advancement in construction methods. A quantitative research method was adopted using the survey approach with structured questionnaires administered to various firms in the Nigerian building industry, located in five geopolitical zones in Nigeria. The results obtained were presented in tables with a detailed analysis of each table. Findings from this study revealed that barriers to the adoption of LPs in the Nigerian building industry are of two important categories as the knowledge and support-related barriers was revealed not to limit the adoption of LPs in the Nigerian building industry. In addition, the study further revealed that culture and nature-related barriers, and cost and logistic-related barriers are the two categories of importance to the adoption of LPs in the Nigerian building industry. It was further revealed that the unsupportive nature of the Nigerian building industry and difficulty in finding and paying experts for LPs implementation were the most influential barriers in the two categories respectively. It is therefore recommended that stakeholders view these barriers and others as important to aid the efficient adoption of LPs in Nigerian building industry.

Keywords: Barriers, Lean Practices (LPs), Adoption of Lean Practices, Nigerian Building Industry, LPs implementation.

Introduction
Although the construction sector has been identified as an industry that does not easily lend itself to the adoption of innovation due to its fragmented nature, available evidence in literature indicates that this industry has not been left behind in the adoption of lean practices. This is because, among other issues, construction processes can lead to the generation of different kinds of wastes that can result in negative impacts on the environment and society (Dang & Sui Pheng, 2015; & Olanrewaju & Abdul-Aziz, 2015).

Iheme *et al.* (2011) mentioned that it is of great importance that the adoption of new technologies, methods, approaches and equipment be looked into in order to achieve efficiency in the delivery of products in the construction industry. Thereby enabling the elimination of waste and helping in the achievement of better performance by firms and stakeholders in the industry. Aziz and Hafez (2013) therefore, explained that the adoption of LPs in the building industry has successfully helped in the reduction of building material waste, projects delays, cost overruns, and lead to improvement of building performance and efficiency of the building construction process.

Barriers have been identified as factors that can inhibit the adoption of any innovation. These barriers could be of different categories depending on the innovation to

be adopted (Sahin, 2006). In Nigeria, Oladiran (2008) conducted a survey on ten Nigerian building construction companies to assess the state of adoption of lean practices and to identify barriers, strategies, and approaches to the adoption of LPs. Findings from that research revealed there was no adoption of LPs in the Nigerian building industry, however there was readiness in the industry towards the adoption of LPs as at the time the study was conducted. Amade et al., (2019) investigated 11 barriers on 5 construction firms located in Port Harcourt, the result of the study revealed lack of adequate lean awareness and understanding as the most limiting barrier to the implementation of LPs.

However, the two studies are not sufficient evidence to establish the barriers limiting the adoption of LPs in the Nigerian building industry. This is because the findings from the result is difficult to general to the entire Nigerian industry as Location and culture has been identified as one of the categories of barriers that could limit the adoption of any innovation. Therefore, this study aimed at filling this geographical research gap by examining if identified barriers from literature could serve as limitations to the adoption of LPs in the Nigerian building industry by conducting a cross-sectional survey a cross-sectional survey among selected building construction firms in different cities across the geopolitical zones of Nigeria. This will enable the findings from this study to be generalized to the entire Nigerian Building Industry.

Literature Review

Oladiran (2008) categorized barriers to the adoption of LPs in Nigeria into skill and knowledge, management, government, attitude, resources, logistics, and others such inflation-related barriers. Marhani, Jaapar, Bari and Zawawi (2013) adopted the same categorization but added the process of lean construction-related barriers to the identified barriers in the Malaysian construction industry.

Several authors (Alarcon, Diethelmand, & Rojo. 2002; Abdulrazak, Abubakar & Sarrazin, 2009; Alsehaimi, Tzortzopoulos & Koskela, 2009; Ahiakwo *et al*., 2012; Aniekwu & Igboanugo, 2012; Devaki & Jayanthi, 2014; Riached, Hraoul, Karam and Hamzeh 2014; Ogunbiyi, 2014; Omran & Abdulrahim, 2015; Ayalew, Dakhli, & Lafhaj, 2016) have identified several barriers to the adoption of LPs in different countries of the world. Most of the barriers fall into the categorization presented by Oladiran (2008) as shown in the following sub-section:

Skill and knowledge-related barriers**:** These barriers include lack of knowledge of lean practices as a concept; lack of exposure to lean tools; lack of lean practices technical know-how among construction staff and professionals; non-engagement of new knowledgeable staff; illiteracy characterizing the industry and lack of training and inconsistency in lean-enhanced training.

Management and organizational-related barriers**:** These barriers are linked to management's support of the idea of lean practices. They are such as the use of central decision-making; the lack of commitment and support from top management; unpractical expectations from the management; weak and lack of commitments in contracts; management workforce style not being participative; insufficient understanding of clients' brief; lack of involvement of suppliers and client in the process of construction; and lack of project definition.

Government-related barriers**:** These barriers are associated with government involvement in some phases of the procurement process. These barriers manifest in the forms of bureaucracy in the approval process, insecurity, and instability in government due to constant change in government; and lack of continuity.

Attitude and culture-related barriers**:** Attitude-related barriers have to do with people's response and reaction to the adoption of lean practices. Such barriers include (i) wrong motives; (ii) selfishness among professionals; (iii) lack of

transparency; (iv) lack of trust; (v) corruption; (vi) lack of integrity; (vii) wrong attitude to change; (viii) lack of confidence in indigenous professionals leading to over-reliance on expatriates; (ix) lack of team spirit among professionals and (x) difficulty in formation of teams in the industry. Other attitudinal barriers faced in the industry are organization resistance to adoption; arrogation of unnecessary power to Architects; tendency to use the traditional construction methods; common use of the "price-oriented tendering method"; absence of the idea of continuous improvement in the industry; fragmented nature of the industry; lack of time to implement LPs; and adoption of short-term visions.

Resources-related barriers: These mainly have to do with finance and facilities. They include a lack of basic social amenities that can enhance the implementation of lean; lack of equipment; and inadequate funds for projects.

Logistic-related barriers: These barriers arise in the course of planning a project. They could be a delay in delivery; uncertainty and a long list in the supply chain; scarcity of some materials, lack of defined processes; complex design; and incomplete designs.

Other barriers: These barriers seem to be beyond the control of the professionals and the industry. They include inflation; unplanned additional costs due to the cumbersome and complex nature of Lean practices and processes; the peculiar nature of construction as different from the manufacturing industry; unstable construction markets and lack of incentives. In addition, the geographical factor is another in this category barrier.

As explained earlier, many studies have identified the most prevalent barriers to lean construction adoption as those related to attitude and culture of the people and the industry, knowledge, and awareness of lean construction and tools, and management and organizational support for the adoption of lean construction across countries.

Research Methods

This research is a quantitative research. The research strategy adopted is survey approach. Structured questionnaires were used in collecting data and were administered to firms in the Nigerian building industry comprising of architectural, building contracting and consulting, and quantity surveying firms in Nigeria. The research scope consists of five selected cities from five geopolitical zones in Nigeria excluding the Northeast zone because of insecurity issues. The cities selected are Abuja representing the Northcentral zone, Kaduna representing the Northwest zone, Enugu representing the Southeast zone, Port-Harcourt representing the South south zone, and Lagos representing the Southwest zone. The criteria for the selection of these cities were because they were revealed to have the highest number of registered firms in that geopolitical zone based on the data from the Council of Registered Builders of Nigeria (CORBON), Architect Registration Council of Nigeria (ARCON), and the Nigerian Institute of Quantity Surveyors (NIQS).

A justifiable approach suggested to be used among social scientists by Alreck and Settle (1985) was used in selecting the sample size of the study. According to Alreck and Settle (1985) 40.0% or more of the population can be selected if the population is a few hundreds, however if the population is many hundreds, 20.0% of the population can be selected to make up the sample size of a study. Furthermore, Alreck and Settle (1985) indicated that for a population of a few thousand, 10% of the population can be selected while if the population is several thousands, 5.0% or less will be sufficient as the sample of the study. Thus, 40% from each category of firms was systematically selected to make up the sample size for the study. Therefore, the sample size used for the study was 446 firms as shown in Table 1.

Table 1: Distribution of Study Sample Size

Cities/Type of Firms	Architectural	Building Contracting and Consulting	Quantity Surveying	Population	Sample size
Lagos (Population)	330	12	120	462	-
Sample size	**132**	**5**	**48**	**-**	**185**
Abuja (Population)	253	31	84	368	-
Sample size	**101**	**12**	**34**	**-**	**147**
Port-Harcourt(Population)	67	6	22	95	-
Sample size	**27**	**2**	**9**	**-**	**38**
Kaduna (Population)	70	5	43	118	-
Sample size	**28**	**2**	**17**	**-**	**47**
Enugu (Population)	56	-	17	73	-
Sample size	**22**	**-**	**7**	**-**	**29**
Total	-	-	-	1116	**446**

Clustering sampling was used which involved the identification of natural clusters of these building firms within the five selected cities and then a random selection of firms within these clusters to make up the sample size. However, a person was appointed by each of the firms to represent the firm in filling the questionnaire.

In the questionnaire, respondents were asked to indicate their opinion as regards thirteen identified barriers from literature using the 5-point Likert Scale of 5 to represent Strongly Agree, 4 to represent Agree, 3 to represent Undecided, 2 to represent Disagree and 1 to represent Strongly Disagree. Between June and July 2018, 670 copies of the questionnaire were administered, 69% of questionnaires were administered making up 462 copies which were retrieved, 97% of the retrieved (446 copies) questionnaires were properly selected and used for the purpose of analysis. The analysis conducted on the data was descriptive statistics and factor analysis using Statistical Package for Social Sciences (SPSS). The results were presented descriptively with the aid of tables.

Results and Discussion of findings

In this study, 13 barriers to the adoption of LPs were investigated within the context of the Nigerian building industry. The barriers investigated include:

Unable to afford the LPs cost implementation
Unaware of the LPs modality
Never heard about LPs (Lack of awareness)
Company's policies do not support
Cumbersomeness of LPs adoption process
Company's Lack of skill toward LPs adoption
Government policy does not support LPs adoption
Nature of the Nigerian building market does not support it
Clients usually complain about the cost implication
Difficulty in finding and paying experts to put it in the design and implementation
Due to the fragmented nature of the building industry its adoption is not feasible
Building construction stakeholders believe that it is not in their culture to minimize waste.
Methods used presently in the industry do not support its adoption

Factor analysis was used to categorize the barriers. The correlation matrix from the analysis revealed many of the coefficients have values of 0.3 and above, the Kaiser-Meyer-Oklin (KMO) measure of sampling adequacy was 0.77, which surpasses the recommended value of 0.6, and the Barlett's Test of Sphericity was statistically significant at a value of 0.000.

In determining the number of factors to be extracted for the rotated factor analysis, non-rotated factor analysis was conducted using the principal component analysis method, and three major components with

Eigen Values greater than 1 were extracted. To ascertain if the extracted components should be selected for the Rotated PCA, the values were compared with Monte Carlo parallel analysis conducted randomly for the 13 barriers investigated in this study as presented in Table 2. The Monte Carlo parallel analysis was conducted because literature reported that explorative factor analysis is insufficient to determine the number of factors underlining a particular construct or variable.

Table 2 Initial Non-Rotated Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.064	23.569	23.569	3.064	23.569	23.569
2	2.839	21.835	45.404	2.839	21.835	45.404
3	1.282	9.860	55.264	1.282	9.860	55.264
4	.960	7.382	62.646			
5	.839	6.455	69.101			
6	.754	5.799	74.900			
7	.583	4.483	79.383			
8	.572	4.400	83.783			
9	.520	3.999	87.781			
10	.471	3.625	91.407			
11	.413	3.180	94.587			
12	.387	2.980	97.567			
13	.316	2.433	100.000			

The non-rotated Eigen value produced from PCA as presented in Table 2 was compared with the random Eigenvalue produced from the parallel analysis presented in Table 3, and it was observed that the values of the three categories extracted from the PCA on barriers to LPs adoption in the Nigerian building industry were all greater than their corresponding values produced in the parallel analysis.

Hence, the rotated PCA was limited to three major factors. Findings in Table 2 further revealed that the total percentage variance explained by the three components was 55.26% where factor 1 accounted for 23.57%, factor 2 accounted for 21.84% and factor 3 accounted for 9.86% all before rotation.

Table 3 Monte Carlo PCA for Parallel Analysis

Factors	Random Eigenvalue	Standard Dev
	1.2941	**0.0392**
	1.2186	**0.0300**
	1.1640	**0.0243**
	11161	0.0216
	1.0728	0.0201
	1.0314	0.0189
	0.9930	0.0185
	0.9545	0.0191
	0.9155	0.0187
	0.8764	0.0200
	0.8352	0.0214
	0.7903	0.0233
	0.7380	0.0290

After the rotated PCA was conducted, using Varimax rotation, the percentage variance accounted for by factors 1(knowledge and support), 2 (Culture and Nature of the Nigerian building industry), and 3 (Cost and Logistics) were 22.10%, 21.90, % and 11.27%, respectively. This implies that although the distribution changed from the initial variance accounted for, before rotation, the total variance of the three factors remained the same after rotation

only the distributions of the factors loaded with each factor changed as shown in Table 4. This result also revealed that factor 1 explains 22.10% of the barriers that influence LPs adoption by Firms in the Nigerian building industry, while factor 2 accounts for 21.90% and factor 3 accounts for 11.27%.

The result presented in Table 4 further revealed that six items were loaded under knowledge and support related barriers, while 4 items fell into the culture and nature of the Nigerian building industry related barriers, and Cost and Logistics related barriers loaded 3 items. The values of the components loaded under each categories implies how correlated these variables are to the category. For every rotated components matrix correlations of less than 0.3 or 0.4 are regarded as trivial while -0.4 or -0,3 to 0.0 is seen as trivially small (Ehrenberg, 1981). The result presented in Table 4 further indicated that all the barriers investigated are potential limitation to the adoption of LPs in the Nigerian building industry as all correlation loadings was higher than 0.4.

However, it's important to identify has respondents perceived that barriers to be of importance. Thus the result presented in Table 5,6,7 showed the descriptive analysis of respondent's perception towards identifying which of the barriers respondents believed inhibit LPs adoption in the Nigerian building industry, they (the respondents) were asked to indicate their levels of agreement with the 13 barriers investigated. The results are presented in Tables 5, 6, and 7 based on the categories from the factor analysis carried out.

The results presented in Table 5 revealed that all the investigated barriers under Knowledge and support seem not to have a major influence on the adoption of LPs by firms in the Nigerian building industry as all the mean scores were below 3.0. In cases where the mean scores are above 3.0, it implies that the factors are critical barriers to the adoption of LPs in the Nigerian building industry, while those below 3.0 are not critical barriers to the adoption of LPs in the industry. Based on the interpretation of the framework, it is evident that the "cumbersomeness of its processes" (mean score =2.86) is the most critical of the barriers to the adoption of LPs by firms in the study area even though its mean score value is less than 3.0.

Table 4: Rotated Component Matrix for LPs adoption Barriers

Factors	**Barriers to LPs Adoption**	**Component loading for each category**		
		1	2	3
Knowledge and Support (22.1% explained)	Lack of skill for its adoption	.791		
	Lack of Awareness	.763		
	Lack of Firms Support	.754		
	Lack of Know-how knowledge	.652		
	Cumbersomeness of its processes	.441		
	Lack of support for government policies	.421		
Culture and Nature of the Nigerian building industry (21.90% explained)	Fragmented nature of the Building Industry		.781	
	Building Industry stakeholders believe it's not in their culture to minimize waste		.710	
	The nature of the building industry does not encourage innovation adoption		.662	
	Present methods used in the building industry do not support it		.658	
Cost and Logistics (11.27% explained)	Clients can't afford the cost of its implementation			.762
	Firms can't afford the cost of its adoption			.674
	Difficulty in finding and paying expert implementation it			.441

The result implies that the adoption of LPs mainly among consulting firms in the Nigerian building industry is not limited by the knowledge of LPs, skills, support of the building industry and firm, and all other barriers under the category of knowledge and support. This result is not consistent with findings from Ahiakwo *et al*. (2012), Ogunbiyi (2014), and Cano, Delgado, Botero, & Rubiano (2015) which show that a lack of technical know-how, skills, professional workers, and training are some of the foremost barriers to the adoption of LPs in the Nigeria, UK, and Columbia construction industry, respectively. This could be because based on the result of an earlier study which revealed that the level of awareness about LPs have increased and above average (Babalola, Ibem & Ezema, 2018), thereby eliminating knowledge and support-related barriers as critical barriers to the adoption of LPs by firms in the Nigerian building industry.

Table 5 Knowledge and Support Related Barriers of LPs Adoption

Knowledge and Support Barriers	Scale	Frequency	Percentage (%)	Mean Score	SD	Rank
Lack of skill for its adoption	Strongly Disagree	77	17.3	2.41	1.073	4th
	Disagree	117	26.2			
	Not Sure	90	20.2			
	Agree	48	10.8			
	Strongly Agree	10	2.9			
	Non-Response	104	23.3			
Lack of Awareness	Strongly Disagree	110	24.7	2.08	0.991	6th
	Disagree	136	30.5			
	Not Sure	61	13.7			
	Agree	33	7.4			
	Strongly Agree	4	0.9			
	Non-Response	102	23.0			
Lack of Firms Support	Strongly Disagree	81	18.2	2.27	1.012	5th
	Disagree	134	30.0			
	Not Sure	80	17.9			
	Agree	34	7.6			
	Strongly Agree	8	1.8			
	Non-Response	109	24.4			
Lack of Know how knowledge	Strongly Disagree	54	12.1	2.47	1.040	3rd
	Disagree	141	31.6			
	Not Sure	83	18.6			
	Agree	43	9.6			
	Strongly Agree	14	3.1			
	Non-Response	111	24.9			
Cumbersomeness of its processes	Strongly Disagree	47	10.5	2.86	1.148	1st
	Disagree	91	20.4			
	Not Sure	92	20.6			
	Agree	93	20.9			
	Strongly Agree	22	4.9			
	Non-Response	101	22.6			
Lack of support of government policies	Strongly Disagree	45	10.1	2.63	0.959	2nd
	Disagree	103	23.1			
	Not Sure	146	32.7			
	Agree	44	9.9			
	Strongly Agree	10	2.2			
	Non-Response	98	22.0			

Table 6 shows the result of how influential culture and nature related barriers are on the adoption of LPs in the Nigerian building industry. The result in Table 6 revealed that out of the four culture and nature related investigated barriers, three have capacity in inhibiting the adoption of LPs by mostly architectural, quantity surveying and a few building consulting and contracting firms in the Nigerian building industry. The most crucial of the barriers is the unsupportive nature of the Nigerian building industry to innovation adoption (mean score =3.21 and SD= 1.218). Next is the present traditional method used in building procurement process do not support LPs processes and the fragmented nature of the Nigerian building industry cannot aid the adoption of LPs with mean scores of 3.11 and 3.05, respectively. The only barrier in this category that seems to have low influence on the adoption of LPs in the Nigerian building industry is that people in building industry believe that it is not in their culture to minimize waste. This result implies that culture and nature related barriers are the most important among the categories of barriers investigated in the study. This result aligns with other findings from the literature, which identified culture related barriers as the most occurring and highly influential barriers to the adoption of LPs (Aniekwu & Igboanugo, 2012; Devaki & Jayanthi, 2014; Riached, Hraoul, Karam & Hamzeh, 2014; Ogunbiyi, 2014; Omran & Abdulrahim, 2015; Ayalew *et al*., 2016)

Table 6 Culture and Nature Related Barriers to LPs Adoption

Culture and Nature Related Barriers	Scale	Frequency	Percentage (%)	Mean Scores	SD	Rank
Fragmented nature of the Building Industry	Strongly Disagree	28	6.3	3.05	1.052	3rd
	Disagree	71	15.9			
	Not Sure	128	28.7			
	Agree	92	20.6			
	Strongly Agree	27	6.1			
	Non-Response	100	22.4			
Building Industry stakeholders believe it's not in their culture to minimize waste	Strongly Disagree	48	10.8	2.86	1.172	4th
	Disagree	96	21.5			
	Not Sure	89	20.0			
	Agree	88	19.7			
	Strongly Agree	27	6.1			
	Non-Response	98	22.0			
Unsupportive nature of the Nigerian building industry to innovation adoption	Strongly Disagree	34	7.6	3.21	1.218	1st
	Disagree	68	15.2			
	Not Sure	91	20.4			
	Agree	96	21.5			
	Strongly Agree	57	12.8			
	Non-Response	100	22.4			
Present methods used in the building industry do not support it	Strongly Disagree	28	6.3	3.11	1.165	2nd
	Disagree	86	19.3			
	Not Sure	94	21.1			
	Agree	89	20.0			
	Strongly Agree	45	10.1			
	Non-Response	104	23.3			

The result in Table 7 presents the last category of barriers (cost and logistics-related barriers) investigated in this study. The result reveals that two out of the three barriers in this category have a major influence on the adoption of LPs among mainly consulting firms in the Nigerian building industry. The result revealed that difficulty in finding and paying experts for the implementation of LPs (mean score=3.29 and SD=1.085) as the barrier in this category with the highest possibility of limiting the adoption of LPs. Next to this is Clients' inability to pay for the cost of LPs implementation on their projects (mean score=3.03 and SD=1.132).

However, the only barrier in this category presented in Table 7 that has a low influence on the adoption of LPs in the Nigerian building industry is firms' inability to afford the cost of its adoption. This implies that the barriers in this category also have the capacity to inhibit the adoption of LPs by most of the architectural and quantity surveying and a few building consulting and contracting firms in the Nigerian building industry sampled in the survey. This result agrees with the findings from Oladiran (2008) which identified resources and logistics as factors that have the possibility of inhibiting the adoption of lean construction in the Nigerian construction Industry.

Summarily, barriers to the adoption of LPs in the building industry were of three categories, which are the knowledge and support related barriers, culture and nature-related barriers, and cost and logistic related barriers. However, based on the result of this study only culture and nature related and cost and logistics related barriers are critical towards the adoption of LPs in The Nigerian building Industry. Among the barriers in the culture and nature related category, unsupportive nature of the Nigerian building industry was the most influential, while difficulty in finding and paying experts for LP implementation was the most threatening barrier in the cost and logistic-related category. Therefore, it is important that stakeholders look at these barriers as important limitation towards the adoption of LPs and other innovations in the Nigerian Building Industry.

Table 7: Cost and Logistic Related Barriers to LPs Adoption

Cost and Logistic Related Barriers	Scale	Frequency	Percentage (%)	Mean Scores	SD	Rank
Clients can't afford the cost of its implementation	Strongly Disagree	38	8.5	3.03	1.132	2nd
	Disagree	71	15.9			
	Not Sure	116	26.0			
	Agree	90	20.2			
	Strongly Agree	33	7.4			
	Non-Response	98	22.0			
Firms can't afford the cost of its adoption	Strongly Disagree	80	17.9	2.32	0.988	3rd
	Disagree	122	27.4			
	Not Sure	96	21.5			
	Agree	44	9.9			
	Strongly Agree	2	0.4			
	Non-Response	102	22.9			
Difficulty in finding and paying experts for implementation it	Strongly Disagree	22	4.9	3.29	1.085	1st
	Disagree	62	13.9			
	Not Sure	93	20.9			
	Agree	130	29.1			
	Strongly Agree	39	8.7			
	Non-Response	100	22.4			

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