

FACTORS INFLUENCING THE IMPLEMENTATION OF LEAN CONSTRUCTION PRACTICES AMONG INDIGENOUS AND MULTINATIONAL CONSTRUCTION FIRMS IN NIGER DELTA REGION OF NIGERIA

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ABSTRACT

Purpose: , there was need to assess the factors that determine the success or failure of lean construction adoption. Hence, this study assessed the factors influencing the adoption of Lean Construction Practices among construction firms in the Niger Delta, and also tested the hypothesis which states that there is no significant difference in the opinion of indigenous and multinational construction firms on barriers and drivers of LCP adoption.

Design/methodology/approach: Data for the study were obtained using 1174 copies of structured questionnaire administered through random sampling technique. The method of data analysis used included simple percentage, mean score, and Mann-Whitney test.

Findings: The study revealed that both the indigenous and multinational construction firms considered the identified drivers and barriers to have high level of influence on Lean Construction Practices adoption in the study area.

Research limitations/Implications: This study concluded that there is no significant difference in the opinion of indigenous and multinational firms on the drivers and barriers influencing lean construction practices adoption in Niger Delta region of Nigeria.

Practical implications: Based on the findings and conclusion, the study recommends that the construction firms should ensure sufficient supports and commitment by senior management, develop sufficient workforce skills to implement lean, develop adequate management/supervisory skills, ensure sustained efforts to engage employees in the meaningful learning experiences, acquire adequate technical knowledge, maintain adequate communication between management and employees/workers, as well as proper/adequate training and mentoring for lean methods.

Keywords: Adoption; Lean construction practices; Indigenous firms; Multinational firms; Niger- Delta, Nigeria.

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1. INTRODUCTION

According to The World Bank (2016), the CO₂ world emissions have increased by 369% from 1960 to 2011. This figure sustains the increasing concerns related to the growing sustainability problems that are currently affecting the environment. In addition, environmental indicators have demonstrated that other non-CO₂ gases present a similar behaviour. It can be noted that the annual contributions of both methane and nitrous emissions have increased by 151% and 142% respectively, which illustrates the level in which the air contamination has been continuously rising during the past decades. According to Carrington (2016), between 2000 and 2014, thirteen of the fifteen hottest years within the past 150 years of recorded temperature occurred in this period.

In Nigeria, the Government indicated its commitment on sustainable development by convening several awareness campaigns and conferences (Federal Ministry of Environment Housing and Urban Development, 2008). While several initiatives of the Nigerian government hint at encouraging development that is sustainable, there is very little guidance, nor legislation in place to direct the construction sector. This is even though there is evidence of this sector's adverse consequences on societies, the planet and economy (Dania 2016, Otali *et al.*, 2020). The operating climate for construction in Nigeria remarkably differs from what obtains in developed nations for instance where there is a strong sustainability drive in the construction sector. A lot of the sources of information helping to shape the practice of sustainable construction originate from outside of Nigeria (Dania *et al.*, 2013; Amade *et al.*, 2021)). Mohammed *et al.*, 2019 and Amade *et al.*, 2021 studied Lean Construction Practices (LCP) implementation in Nigeria. The study revealed that LCP is slightly implemented at firm level while they are moderately implemented at both individual and project level. Mohammed *et al.* (2019) stated that the level of LCPs' adoption in Nigeria falls below international standard. Mohammed *et al.* (2019) also posited that the level of awareness of the Lean Construction principles was still at the lowest level in the construction firms. Studies have shown that the level of sustainability performance among construction firms is low or moderate thereby construction projects executed in developing countries are not sustainable, and the Nigerian Construction Industry is no exception (Baron and Donath, 2016; Aje, 2015).

Research on Sustainable construction emanating from Nigeria are more focused on knowledge of sustainable construction issues than the practical (Ujene, 2014; Ekung *et al.*, 2016). This includes its perception, awareness, and sustainable facilities management (Nduka and Sotunbo, 2014; Magaji, 2015), renewable energy and energy efficiency, green buildings (Olanipekun, 2015, Otali *et al.*, 2020), materials and management tools in delivering sustainable construction (Oke *et al.*, 2015; Aghimien *et al.*, 2016).

The great level of energy consumption and incessant waste generation of the construction sector is a global phenomenon. The construction industry consumes 40%, 25%, 16%, 40%, and 35% of the total energy produced, raw materials, timber, total water consumption, and natural resources respectively extracted in developed nations. It is also responsible for 35% of global carbon dioxide (CO₂) emissions, 40% of the total global energy, and over 40% of the greenhouse gas released into the natural environment (Sirkeck 2017; Omuh *et al.*, 2018). Furthermore, Windapo (2014) stated that the construction industry consumes 50% of all global resources. Also, the infrastructural development and its related activities represent many destructive emanations, adding up to around 30% of the ozone harming substances delivered internationally because of the tasks that generally happen during the development procedure. In comparison, 18% of discharges are brought about by the transportation and handling of materials related with it.

Considering the adverse effects of construction activities to the natural and built environment (Oladokun *et al.*, 2017), it has been argued that Lean Construction has the potential and capability to significantly contribute towards helping and positioning the construction industry to overcome the challenges of sustainable development (Sarhan *et al.*, 2019). Lean Construction is a proven method for the management and optimization of the construction process; hence the requirements of customers can be reached using good

resources as well as its ability to provide the best quality from the first time (Bajjouet *et al.*, 2017). The idea behind the implementation of Lean in construction consists of a dynamic and rigorous articulation of ideas vis-à-vis waste disposal, value added, continuous improvement, teamwork and increase in project's stakeholders' satisfaction during the planning phase of the project to name but a few (Herrera *et al.*, 2020).

Khaba and Bhar (2017) looked at the key barriers to implementing Lean Construction using Interpretive Structural Modelling (ISM). ISM identifies relationships among factors surrounding an issue by identifying cross reactivity and develops a hierarchy in which identifies factors with the most influence over other factors. Of the 13 barriers analysed, no barrier was found to be autonomous, meaning a change to one barrier had an impact on the performance of the others. The most dependent barriers were resistant to change, lack of performance measurement systems, lack of technical capabilities, and lack of green initiatives. The least dependent barriers which drove the dependence of other barriers were lack of understanding of customer needs, cultural differences, inconsistency in government support, Not recognizing financial advantage, Lack of awareness and understanding of Lean Construction, Financial Constraints, Lack of planning for quality, Lack of lean consultants and trainers and project subcontracting (Khaba and Bhar, 2017). Despite the various studies on factors affecting lean construction adoption/implementation, none of them has empirically established the level of influence of each of the drivers/facilitators or barriers/inhibitors of lean construction adoption in construction project delivery in the Niger Delta region of Nigeria.

The Niger Delta region of Nigeria is a complex project environment. The region is unique and dynamic with respect to physical, social and economic environment. The region has suffered significant environmental degradation/pollution due to oil exploration and construction activities. Construction project delivery in the region is prone to risks due to the physical terrain in addition to social and economic variability. There have been general calls for implementation of sustainable construction practices/principles in project delivery so as to achieve sustainable infrastructural development in the region. Implementation of lean construction practices as one of the sustainable construction practices in construction project delivery is a panacea to many problems that have bedevilled the region. In view of this, there is need to assess the factors that determine the success or failure of lean construction adoption. Hence, this study assessed the factors influencing the adoption of Lean Construction Practices among construction firms in the Niger Delta, and also tested the hypothesis which states that there is no significant difference in the opinion of indigenous and multinational construction firms operating in the Niger Delta region of Nigeria.

2. LITERATURE REVIEW

The factors influencing the implementing lean construction in construction project delivery were reviewed. The factors were categorized into two groups namely drivers/facilitators and barriers/inhibitors.

2.1 Factors Inhibiting the Implementing Lean Construction in Construction Project Delivery

The factors that hinder or limit the extent of lean implementation were reviewed and extracted from literature. Movaghar (2016) identified the barriers to implementation of lean construction principles in developing countries". The study concluded that, lack of adequate lean awareness and understanding, culture and human attitudinal issues and top management commitment, are the most significant barriers hindering the implementation of lean construction in the developing countries. Furthermore, barriers to adopting lean construction in the construction industry were assessed by Al-Balky *et al.* (2021). The findings showed that the absence of support from the top management, low awareness toward lean construction (LC), lack of training, and the absence of transparency are amongst the most serious factors that hinder the adoption of LC. Furthermore, Albalkhy and Sweis, 2020 conducted a systematic literature review (SLR) to identify the list of barriers that face the adoption of LCP in general, without any geographic determination. the study identified the following factors as critical inhibitors to implementation of lean

construction. they include poor understanding of the customer needs and lack of customer focus, management resistance to change, lack of support and commitment from top management, lack of involvement and transparency among stakeholders, lack of adequate lean awareness and understanding, lean may lead to additional cost/implementation cost, the reluctance of project participants to share risks, lack of planning for quality, poor leadership and insufficient management skills, and inadequate administration of the necessary information to generate a learning cycle and take corrective actions, poor understanding of the customer needs and lack of customer focus, management resistance to change, and lack of support from the government.

Other critical barriers to lean construction implementation that were identified by different authors include absence of management commitment and support, Poor leadership and management skills, and Poor knowledge of lean benefits and value, Lack of adequate Lean skills, training, and education, Lack of knowledge about Lean (Philosophy, principles, tools), Lack of adequate Lean awareness and Understanding Financial capability and implementation Cost, Culture and human attitudinal issues (Bayhan et al. 2019; Oguntona et al. 2019; Oke et al., 2021; Bayhan et al., 2019; Sarhan et al., 2018).

2.2 Factors Facilitating the Implementation of Lean Construction Practices in Construction Project Delivery

The factors facilitating the Implementation of Lean Construction Practices in Construction Project Delivery were critically reviewed. Some of the factors extracted from literature include availability of Lean tools and techniques, existence of a clear marketing strategy, long term profit of implementing lean tools, customer satisfaction, lean training, government incentives, availability of resources for lean, and existence of communicating lean practices (Sarhan and Fox, 2013, Almanei *et al.*, 2017; Okere, 2017). Others are willingness to invest in lean practices, creating awareness for lean, incentive mechanisms, management commitment, and lean leadership (Jagdish *et al.*, 2014). In addition, morning huddles for lean, effectiveness of value stream mapping, supportive environment for workforce efficiency, advances in technology and adopting a lean culture, education and training factors were considered as drivers of lean adoption in the construction sector (Dave *et al.*, 2013; Sarhan and Fox, 2013; Shang and Pheng, 2014; Demirkesen and Tommelein, 2016; Howell *et al.*, 2017; Kumar, 2017).

3. METHODOLOGY

This study was aimed at assessing the drivers and barriers influencing the level of Lean Construction Practices (LCP) implementation among Indigenous and multinational construction firms in the Niger Delta region of Nigeria. A survey design was adopted in the study, and random sampling techniques was used to obtain the sample for this study. Quantitative approach was adopted for this study. Data for the study were obtained using 1174 copies of structured questionnaire administered to the construction firms in Niger Delta. The data used in the study were collected using a five-point scale of 1 to 5 (Anyanwu, 2018). Scale 1 represents a very low level of influence, while scale 5 represents a very high level of influence. The method of data analysis used included simple percentage, mean score, and Mann-Whitney test. Using a 5-point scale, the decision rule in this study is that any factor with an overall mean score of 1.0-1.49, 1.5-2.49, 2.5-3.49, 3.5-4.49, and 4.5-5.0 is considered to have a very low level of influence, low level of influence, moderate level of influence, high level of influence, and very high level of influence, respectively (Ogenma 2018).

4. RESULTS AND DISCUSSION

This section contains the results of the analysis of data collected for the study. It contains the descriptive results of the response rate of questionnaire distributed, firm characteristics. This section also contains the result of evaluation of the critical drivers and barriers of lean construction implementation, and the result of the hypothesis which states that there is no significant difference in the opinion of indigenous and multinational

construction firms on factors influencing the implementation of lean construction practices in the study area.

4.1. Questionnaire Distribution and Response Rate of the study

Structured questionnaire was the research instrument used in this study. The results of analysis were presented in Figure 1. As shown in Figure 1, a total of 1,174 questionnaire were administered to construction firms within the study areas to respond to the research questions. From the questionnaire distributed, the response rate ranges between 69.1% and 78.8%. Akwa Ibom state got the highest response rate of 78.8% while Imo state got the least rate of 65.6%. In all, 856 duly completed questionnaires were returned representing an overall 72.9% response rate. Groves (2006) noted that a response rate of at least 50% is considered adequate for analysis and reporting, a 60% response rate is good and a response rate of 70% is very good. As a guide, researchers typically seek response rates of at least 70% to feel confident that their sample is representative of the sample frame. Hence, the overall response rate of 72.9% in this study is considered very good and adequate.

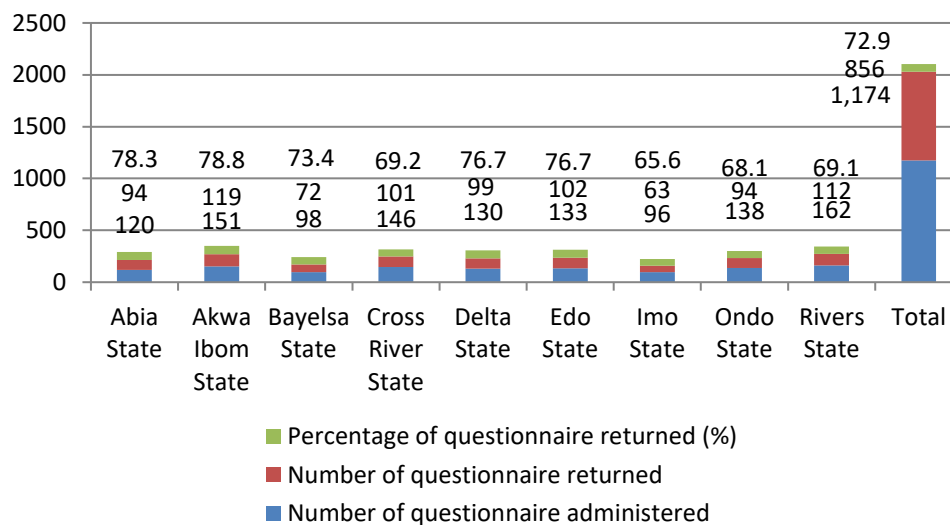


Figure 1: Questionnaire Distribution and Response Rate of the study

4.2. Age of Construction Firms used for the Study

Figure 2 explains the years of experience of the construction firms. 3.6% of the construction firms have 5 years' experience, 29.8% have around 10 years' experience, 46.6% have 15 years while 15% have 21 years' experience and 5% have above 21 years. This indicates that construction firms used for the study had cognate firm experience in the construction industry.

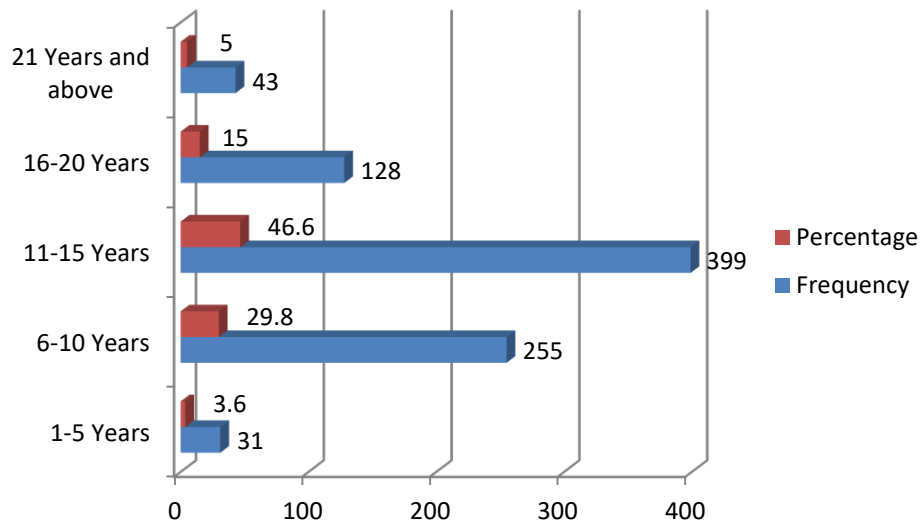


Figure 2: Age of Construction Firms

4.3. Professional Discipline of the Respondents

Figure 3 explains the professional background of the respondents used for the study. 18.0% were architects, 28.6% were civil engineers, 13.1% were mechanical, electrical and plumbing engineers, while 28.7% were builders and 11.6 constituted quantity surveyors. The implication of this result is that, Builders were the majority of respondents from the built environment in the study. It also shows a fair representation of the professionals in the construction industry.

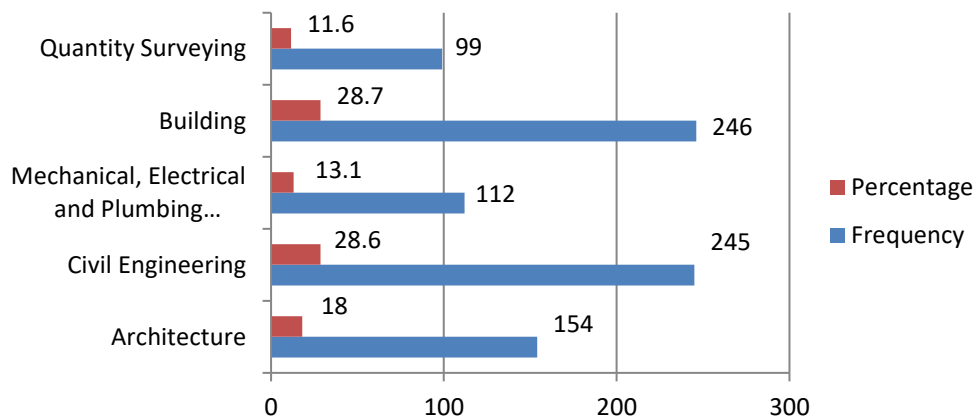


Figure 3: Professional Discipline

4.4 Academic Qualification of the Respondents

Figure 4 illustrates the educational level of the respondents. 68.2% had Bachelor's degree, 20.6% had Higher National Diploma, 8.1% had Master's degree, 1.6% had Ordinary National Diploma, while 1.5% of the respondents had a Doctorate degree. It is clear from the result that majority of the respondents have a B.Sc. as a minimum qualification, implying that the respondents had the required academic ingenuity to participate in this magnitude of study.

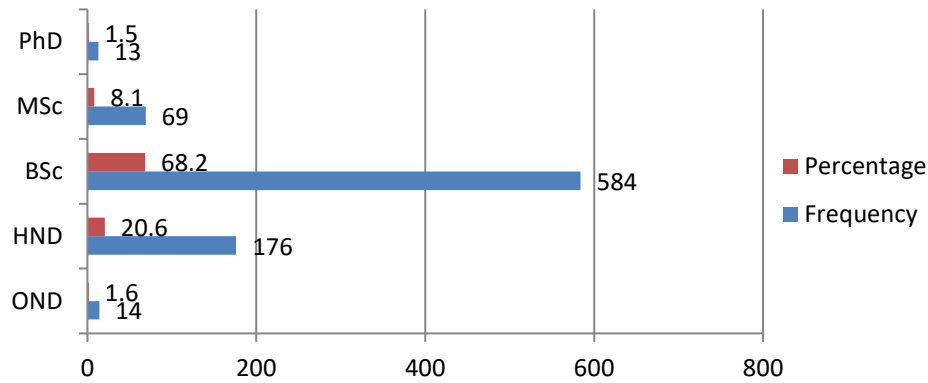


Figure 4: Academic Qualification

4.4. Years of Professional Experience

Figure 5 explains the total years of experience of the respondents in the study. Almost 1.5% of the respondents have 5 years' experience in their construction firm, 20.8% have 10 years' experience, 66.5% have 15 years, while 9.6% have 20 years' experience and 1.6% have above 21 years. This implies that a good number of the respondents have adequate years of professional experience in the construction industry to make knowledgeable contribution to this study.

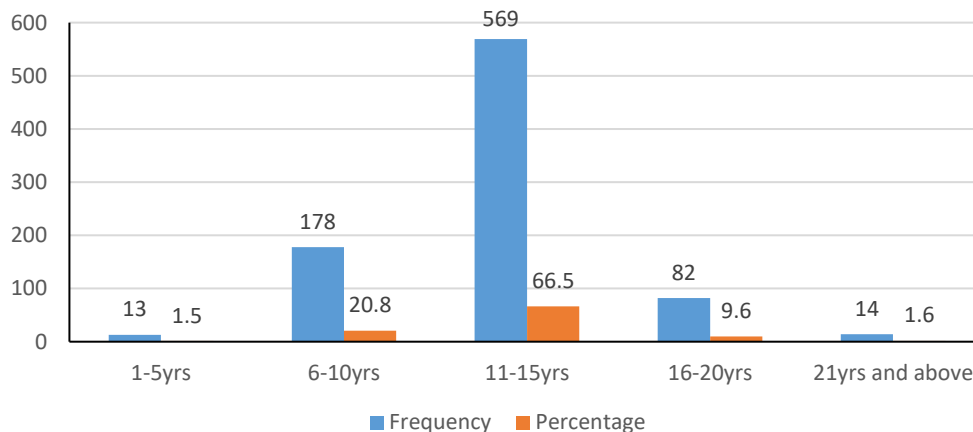


Figure 5: Number of years of professional experience

4.5. Drivers to the Adoption of Lean Construction Practices by Construction Firms in Niger Delta

Table 3 shows the drivers influencing the application of lean construction practices in project delivery among indigenous and multinational construction firms in Niger Delta region of Nigeria. The results indicated that for indigenous firms, the following set of lean construction practices have a high level of influence; existence of lean research groups and initiatives with a mean score of 4.69, adopting a lean culture/lean training (M.S=4.42), lean as a firm strategy (M.S=4.39), management commitment (M.S=4.35), morning huddles for lean (M.S=4.06), employee moral (M.S=3.51). Furthermore, existence of certified and qualified Lean personnel (M.S=3.30), efficiency of human resource management activities (M.S=3.27), Willingness to invest in Lean practices (M.S=3.26), growth and increase in market share will lead to improvement in Lean implementation (M.S=3.21) have a moderate level of influence among indigenous firms.

Moreso, the analysis also indicates that this following set of drivers are considered to have high level of influence among multinational firms; Existence of lean research groups and initiatives (M.S=4.67), adopting a lean culture (M.S=4.51), adopting customer satisfaction as the firm policy ensures the success of lean implementation (M.S=4.47),

lean as a firm strategy (M.S=4.41), management commitment (M.S=4.41). However, willingness to invest in Lean practices (M.S=3.43), effectiveness of value stream mapping (M.S=3.44), growth and increase in market share will lead to improvement in Lean implementation (M.S=3.40), employee moral (M.S=3.20), efficiency of human resource management activities (M.S=2.93) have moderate level of influence on lean construction practices among multinational firms in the Niger Delta region of Nigeria.

Table 3: Drivers of Lean Construction Practices Adoption among Construction Firms

Drivers of Lean Construction Practices Adoption	Indigenous Firms		Multinational Firms		Combined Mean		Remark
	Mean	Rank	Mean	Rank	Mean	Rank	
Existence of a clear marketing strategy	3.20	25	3.64	20	3.42	21	M.L.I
Long term profit of implementing Lean tools	3.75	18	3.96	18	3.86	18	H.L.I
Willingness to invest in Lean practices	3.26	23	3.43	23	3.35	23	M.L.I
Growth and increase in market share will lead to improvement in Lean implementation	3.21	24	3.40	24	3.30	24	M.L.I
Management commitment	4.35	5	4.41	4	4.38	5	H.L.I
Incentive mechanisms	3.94	16	3.96	18	3.96	16	H.L.I
Creating awareness for Lean	3.87	17	4.01	12	3.94	17	H.L.I
Adopting customer satisfaction as the firm policy ensures the success of Lean implementation	4.05	7	4.47	3	4.26	6	H.L.I
Lean training	4.42	3	4.40	6	4.41	3	H.L.II
Available resources in Lean and familiarity with Lean techniques	4.03	9	4.16	8	4.09	8	H.L.I
Clear understanding of technical requirements in Lean practices	3.98	15	4.00	13	3.99	14	H.L.I
Morning huddles for Lean	4.06	6	4.36	7	4.20	7	H.L.I
Effectiveness of Value Stream Mapping	2.98	27	3.44	22	3.21	25	M.L.I
Supportive environment for workforce efficiency	3.52	19	4.16	8	3.84	19	H.L.I
Existence of certified and qualified Lean personnel	3.30	21	3.56	21	3.43	20	M.L.I
Efficiency of human resource management activities	3.27	22	2.93	26	3.10	26	M.L.I
Availability of consulting team members in Lean	3.17	26	2.86	27	3.03	27	M.L.I
Adopting a Lean culture	4.42	2	4.51	2	4.46	2	H.L.I
Lean as a firm strategy	4.39	4	4.41	4	4.40	4	H.L.I
Availability of Lean leaders and managers supporting Lean activities	4.04	8	4.12	10	4.08	9	H.L.I
Employee moral	3.51	20	3.20	25	3.36	22	M.L.I
Supportive nature of governmental regulations in Lean	3.99	14	3.98	17	3.98	15	H.L.I
Government incentives	4.02	10	4.00	13	4.01	11	H.L.I
Availability of resources for Lean	4.02	11	4.02	11	4.02	10	H.L.I
Existence of clear roles in Lean	4.00	12	4.00	13	4.00	12	H.L.I
Existence of Lean research groups and initiatives	4.69	1	4.67	1	4.68	1	VH.L.I
Existence of communicating Lean practices	4.00	13	4.00	13	4.00	13	H.L.I
Overall Mean Score	3.83		3.93		3.88		

The combined mean score in Table 3 implies that; existence of lean research groups and initiatives (4.68), adopting a lean culture (M.S=4.46), lean training (M.S=4.42), lean as a firm strategy (M.S=4.40), management commitment (M.S=4.38) recorded high level of influence for the adoption of lean in construction firms in the region. In addition, the combined mean score also shows that employee moral (M.S=3.36), existence of certified and qualified Lean personnel (M.S=3.43), efficiency of human resource management activities (M.S=3.10), willingness to invest in lean practices (M.S=3.35), growth and increase in market share will lead to improvement in lean implementation (M.S=3.30)

have moderate level of influence for the adoption of lean construction practices in firms in Niger Delta.

The overall mean score of 3.83 indicated that indigenous construction firms in Niger Delta considered the identified drivers to have high level of influence on Lean Construction Practices adoption. Furthermore, the overall mean score of 3.93 implied that multinational construction firms in Niger Delta region of Nigeria also considered the identified drivers to have high level of influence on Lean Construction Practices adoption.

In addition the overall mean score of 3.88 empirically showed that the overall level of influence of identified drivers of lean construction practices adoption among construction firms operating in the Niger Delta region of Nigeria is high.

This study is in agreement with the studies by Tommelein and Ballard, 2017, Kumar, 2017, Okere, 2017, Almanei *et al.*, 2017, Howell *et al.*, (2017), Sarhan *et al.* (2018), and Hasan *et al.* (2019) who revealed that top management support and commitment, education and skills development, client interest in the use of lean construction in their project, commitment and cooperation of professional bodies, attitudinal change, government policy and availability of trained professionals are among the facilitators to adopting lean construction principles across organizations.

4.6. Mann Whitney U Test for Comparing the Drivers Influencing the Adoption of Lean Construction Practices among Indigenous and Multinational Construction Firms in the Niger Delta Region of Nigeria

The hypothesis which states that there is no significant difference in the opinions of indigenous and multinational construction firms on the level of influence of drivers of Lean Construction Practices was tested. Mann Whitney U-test was carried out on the hypothesis and the decision rule is such that if the p-value is less than 0.05, it means the null hypothesis is rejected. The result of the Mann-Whitney U test in Table 4 shows that the P-value is 0.41. This value is greater than the 0.05 significant level set for the test. This therefore implies that there is no significant difference in the opinion of indigenous and multinational construction firms operating in Niger Delta on drivers influencing the implementation of lean Construction Practices. The similarity in the opinion of the firms can be attributed to their level of knowledge of the factors, and the extent the factors have influenced the level of lean construction adoption in project delivery in the study area.

Table 4: Mann Whitney U Test for Comparing the Opinions of Indigenous and Multinational Firms on Drivers Influencing the Implementation of Lean Construction Practices

Drivers Influencing the Level of Adoption of Lean Construction Practices based on Type of Organization Ownership	Mean Rank	Sum of Rank	Decision @ 0.05 Significant Level
Indigenous Firms	25.74	695.00	
Multinational Firms	29.26	790.00	
Mann Whitney U	317.000		
Wilcoxon W	695.000		
Z	-.822		
P-Value	0.41		Accept

4.7. Barriers to the Adoption of Lean Construction Practices by Construction Firms in Niger Delta

Table 5 shows the barriers influencing the adoption of lean construction practices in project delivery among indigenous and multinational construction firms in Niger Delta region of Nigeria. The results indicated that the following set of barriers have a high level of influence among indigenous firms; Failure to document Lean benefits challenges implementation of Lean Construction (M.S=4.23), employees/workers are not aware of lean methods (4.17), waste accepted as inevitable (4.14), lack of sufficient workforce skills to implement Lean (M.S=4.13), senior management was not supportive and committed enough (M.S=4.12), lack of sustained efforts to engage employees in the meaningful learning experiences hinders implementation of lean Construction (4.11), employees/workers are often not empowered enough (M.S=4.09), project complexity and

lack of technical knowledge was a barrier to the implementation of Lean Construction (M.S=4.03). In addition, the results also showed that misconceptions about lean methods, for example lean was a gimmick (MS=3.22), incapability of project teams to maintain alignment with each other (MS=3.04), employees/workers are resistant to change (MS=3.08), subcontractors/suppliers are not participating and are not collaborative (MS=3.07) and employees/workers are incapable to deliver quality performance (MS=3.01) have a moderate level of influence among indigenous firms. Moreso, increase in labour productivity causes labour lay-offs (MS=2.18), wrong methods of lean tools are selected (2.13), high workforce turnover (workers leave during certain period) (MS=2.09) and Lean journey to increase productivity cause overloading workers and create unsafe conditions and was not culturally fit (1.93) have a low level of influence among indigenous firms.

Furthermore, the analysis also indicates that the following set of barriers are considered to have high level of influence among multinational firms; employees/workers do not participate in continuous improvement processes (M.S=4.40), senior management was not supportive and committed enough (M.S=4.20), lack of sustained efforts to engage employees in the meaningful learning experiences hinders implementation of lean construction (4.07), There was no actual performance measurement system (4.06), Failure to document lean benefits challenges implementation of Lean Construction (M.S=4.04).

Therefore, from the combined mean score, the result implies that; failure to document Lean benefits challenges implementation of lean Construction (M.S=4.15), employees/workers do not participate in continuous improvement processes (4.14), employees/workers are not aware of lean methods (MS=4.09), senior management not supportive and committed enough (M.S=4.08), lack of sufficient workforce skills to implement Lean (4.07), lack of communication between management and employees/workers (M.S=4.02), recorded high level of influence on adoption of lean construction in the Niger Delta Region of Nigeria. In addition, the combined mean score also shows that; hierarchies in the organization discourages change initiatives (MS=3.11), incapability of project teams to maintain alignment with each other (MS=3.10), subcontractors/suppliers are not participating and are not collaborative (MS=3.03), there was insufficient time and money to implement lean methods (MS=3.09) and employees/workers are incapable to deliver quality performance (MS=2.98) have moderate level of influence on the adoption of lean construction practices. Moreso, wrong methods of lean tools are selected (MS=2.07), increase in labour productivity causes labour lay-offs (2.09) and Lean journey to increase productivity cause overloading workers and create unsafe conditions and was not culturally fit (MS=1.86) have low level of influence to the adoption of lean construction practices in the Niger Delta. The overall mean score of 3.53 indicated that indigenous construction firms considered the identified barriers to have high level of influence on Lean construction practices adoption. The overall mean score of 3.46 implied that multinational construction firms in Niger Delta region of Nigeria considered the identified barriers to have moderate level of influence on lean Construction practices adoption. However, the overall mean score of 3.50 showed that majority of the construction firms operating in the Niger Delta region of Nigeria considered the identified barriers to have high level of influence on lean Construction Practices adoption.

The outcome of this study agrees with studies by Bashir *et al.* (2015), Khaba and Bhar (2017), Albalkhy and Sweis (2020) who identified lack of support and commitment from top management, hierarchies in organizational structures/unsuitable organizational structure, insufficient training for workers, and lack of adequate lean awareness and understanding as critical barriers inhibiting the implementation of lean construction practices in the construction sector. This study is also in conance with Nwaki *et al.* (2021) who found that the key barriers to lean implementation are lack of technology and inadequate knowledge, poor leadership and management, poor engagement and relationship, and communication barriers. This study aligns with Oke *et al.* (2021) who noted that Lack of knowledge about lean is a critical barrier to lean construction adoption in the construction sector. Furthermore, this study agrees with Ahmed *et al.* (2020) who

posited that absence of employee's skill and expertise is a critical barrier inhibiting the implementation of lean construction practices in the construction industry.

Table 5: Barriers to Lean Construction Practices Adoption among Construction Firms

Barrier Influencing Adoption of Lean Construction Practices	Indigenous Firms		Multinational Firms		Combined Mean		Remark
	Mean	Rank	Mean	Rank	Mean	Rank	
Employees/workers are not aware of Lean methods	4.17	2	4.00	10	4.09	3	HLI
Management/supervisory skills are insufficient to implement Lean	4.08	9	3.94	16	4.01	12	HLI
There are misconceptions about lean methods, e.g., Lean was a gimmick	3.22	27	3.04	29	3.13	27	\MLI
There was a lack of training and mentoring for Lean methods	4.10	7	3.99	11	4.05	9	HLI
Lack of sufficient workforce skills to implement Lean	4.13	4	4.01	8	4.07	6	HLI
Wrong methods of Lean tools are selected	2.13	42	2.00	43	2.07	42	LLI
Senior management was not supportive and committed enough	4.12	5	4.20	2	4.08	4	HLI
Employees/workers are resistant to change	3.08	33	2.73	40	2.91	39	MLI
Subcontractors/suppliers are not participating and are not collaborative	3.07	34	2.98	34	3.03	35	MLI
There was insufficient time and money to implement lean methods	3.16	30	3.02	30	3.09	30	MLI
Lack of client support	3.21	28	2.84	38	3.03	35	MLI
Employees/workers are often not empowered enough	4.09	8	3.75	24	4.06	8	HLI
Employees/workers are not rewarded	4.00	13	3.98	13	3.92	19	HLI
Slow decision-making processes due to a complex organizational hierarchy	3.10	32	3.00	31	3.05	33	MLI
Hierarchies in the organization discourages change initiatives	3.05	35	3.17	27	3.11	28	MLI
Multi-functional layout of the job sites	3.03	37	2.99	32	3.01	36	MLI
Multi-layer subcontracting	3.20	29	2.95	37	3.08	31	MLI
Increase in labour productivity causes labour lay offs	2.18	41	2.00	43	2.09	41	LLI
High workforce turnover (workers leave during certain period)	2.09	43	2.01	41	2.05	43	LLI
Lack of communication between management and employees/workers	4.07	10	3.96	14	4.02	10	HLI
Incapability of project teams to maintain alignment with each other	3.04	36	3.16	28	3.10	29	MLI
Lack of communication between management and subcontractors/suppliers	3.97	16	3.84	21	3.91	21	HLI
Lack of sustained efforts to engage employees in the meaningful learning experiences hinders implementation of Lean Construction	4.11	6	4.03	5	4.07	6	HLI
Employees/workers do not participate in continuous improvement processes	3.87	22	4.40	1	4.14	2	HLI
Lack of Lean culture in subcontractors/suppliers leads to barrier in Lean Construction implementation	3.91	20	4.02	6	3.97	15	HLI

Barrier Influencing Adoption of Lean Construction Practices	Indigenous Firms		Multinationals Firms		Combined Mean		
	Mean	Rank	Mean	Rank	Mean	Rank	Remark
Lack of shared vision, consensus, and group culture in the organization hinders implementation of Lean Construction	3.85	24	3.83	22	3.84	24	HLI
There's a cultural difference between project stakeholders	3.88	21	3.93	17	3.90	22	HLI
Lean journey to increase productivity cause overloading workers and create unsafe conditions and was not culturally fit	1.93	44	1.79	44	1.86	44	LLI
Traditional practices are just fine	3.12	31	2.96	35	3.06	32	MLI
Lack of long-term continuous improvement strategy	3.93	19	3.95	15	3.94	18	HLI
Waste accepted as inevitable	4.14	3	3.98	13	4.06	8	HLI
There are liability consequences over implementing Lean project delivery	2.95	39	2.98	34	2.96	38	MLI
Lack of support from government for technological advancements	3.99	14	3.92	18	3.96	16	HLI
Lean methods can be applied in parallel with traditional project delivery methods	2.91	40	2.83	39	2.87	40	MLI
Material delivery just when required	3.97	16	4.00	10	3.98	14	HLI
Lack of public infrastructure in transportation	3.58	26	3.69	25	3.64	26	HLI
Material quality	4.01	12	3.80	23	3.91	21	HLI
Suppliers are not aligned with the project due to absence of a sound strategic (long-term) relationship	3.82	25	3.63	26	3.73	25	HLI
There was no actual performance measurement system	3.95	18	4.06	4	4.01	12	HLI
Employees/workers are incapable to deliver quality performance	3.01	38	2.95	37	2.98	37	MLI
Limited use of offsite construction methods (prefabrication) deters implementation of Lean Construction	3.96	17	4.01	8	3.99	13	HLI
Limited involvement of construction firm in the design obstructs implementation of Lean Construction	3.86	23	3.90	19	3.88	23	HLI
Failure to document Lean benefits challenges implementation of Lean Construction	4.23	1	4.06	4	4.15	1	HLI
Project complexity and lack of technical knowledge was a barrier to the implementation of Lean Construction	4.03	11	3.86	20	3.95	17	HLI
Overall Mean Score	3.53		3.46		3.50		HLI

Source: Researcher's Field Data (2024)

4.8. Mann Whitney U-Test for Comparing Barriers Influencing Lean Construction Practices Based on Ownership of the Firms in Niger Delta

The hypothesis which states that there is no significant difference in the responses of the firms on the barriers influencing the adoption of Lean Construction Practices among indigenous and multinational firms in Niger Delta was tested. Mann Whitney U-test was carried out on the hypothesis and the decision rule is such that if the p-value is less than 0.05, it means the null hypothesis is rejected. The result of the Mann-Whitney U test in Table 6 shows that the P-value is 0.777. This value is greater than the 0.05 significant level set for the test. This therefore implies that there is no significant difference in the opinion of indigenous and multinational firms on the barriers influencing Lean Construction Practices adoption in Niger Delta region of Nigeria.

Table 6: Mann Whitney U Test for Comparing the Barriers Influencing Lean Construction Practices Adoption Among Indigenous and Multinational Construction Firms in the Niger Delta Region of Nigeria

Barriers Influencing Adoption of Lean Construction Practices among indigenous and multinational construction firms in the Niger Delta region of Nigeria	Mean Rank	Sum of Rank	Decision @ 0.05 Significant Level
Indigenous Firms	43.73	1924.00	
Multinational Firms	45.27	1992.00	
Mann Whitney U	934.000		
Wilcoxon W	1924.000		
Z	-0.284		
P-Value	0.777		Accept

5. CONCLUSION AND RECOMMENDATION

The study assessed the drivers and barriers influencing the implementation of lean construction practices in construction project delivery in the Niger Delta region of Nigeria. Two hypotheses were tested to determine if there is significant difference in the opinion of indigenous and multinational firms on the drivers and inhibitors influencing the adoption of lean construction practices in the study area. The study found that the critical drivers having high influence on the implementation of lean construction practices in construction project delivery among indigenous firms in the Niger Delta region of Nigeria are existence of lean research groups and initiatives, adopting a lean culture/lean training, adopting lean as a firm strategy, extent of management commitment, and morning huddles for lean. The study concluded that the indigenous construction firms in Niger Delta considered the identified drivers to have high level of influence on Lean Construction Practices adoption.

Moreso, the study found that the critical drivers that were considered to have high level of influence among multinational firms include existence of lean research groups and initiatives, adopting a lean culture, adopting customer satisfaction as the firm policy ensures the success of lean implementation, adopting lean as a firm strategy, and top management commitment towards lean implementation. Furthermore, the multinational construction firms in Niger Delta region of Nigeria also considered the identified drivers to have high level of influence on Lean Construction Practices adoption in the study area. This study concluded that there is no significant difference in the opinion of indigenous and multinational construction firms operating in Niger Delta on drivers influencing the implementation of lean Construction Practices. The similarity in the opinion of the firms can be attributed to their level of knowledge of the factors.

The barriers that were considered to be critical with high influence on the level of implementation of lean construction practices by indigenous firms are failure to document Lean benefits, employees/workers are not aware of lean methods, waste accepted as inevitable, lack of sufficient workforce skills to implement Lean, poor or lack of senior management support and commitment, lack of sustained efforts to engage employees in the meaningful learning experiences hinders implementation of lean Construction, employees/workers are often not empowered enough, project complexity, and lack of technical knowledge.

Furthermore, the study indicates that the following set of barriers are considered to have high level of influence among multinational firms; employees/workers do not participate in continuous improvement processes, senior management was not supportive and committed enough, lack of sustained efforts to engage employees in the meaningful learning experiences hinders implementation of lean construction, no actual performance measurement system, failure to document lean benefits. This study concluded that majority of the construction firms operating in the Niger Delta region of Nigeria

considered the identified barriers to have high level of influence on lean construction Practices adoption. In addition, This study concluded that there is no significant difference in the opinion of indigenous and multinational firms on the barriers influencing Lean Construction Practices adoption in Niger Delta region of Nigeria.

Based on the findings and conclusion, the study recommends that the construction firms should ensure sufficient supports and commitment by senior management, shared vision, develop sufficient workforce skills to implement lean, develop adequate management/supervisory skills, ensure sustained efforts to engage employees in the meaningful learning experiences, acquire adequate technical knowledge, maintain adequate communication between management and employees/workers, as well as proper/adequate training and mentoring for lean methods

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