SUSTAINABILITY ASSESSMENT IN CONSTRUCTION ORGANISATIONS' PROJECT DELIVERY PRACTICE IN NIGERIA

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Abstract
Based on the growing ethos that construction organisations can benefit from implementing sustainable practices, this study evaluated main contractors' project delivery practices for sustainability. The objectives were to validate set of empirically weighted criteria for construction organisations' sustainability practice assessment. The weighted criteria were validated by assessing three main contractors' organisations' sustainability performance in four projects. The sustainability performance was evaluated based on sound environmental management principles, robust stakeholder engagement and responsible project management. Data were collected using questionnaire survey and project auditing. The study targeted 76 stakeholders in contractors and engineering consultancy organisations in Akwa Ibom State, Nigeria. Criterion suitability was based on respondents' agreement score in inter-rater agreement (IRA) scale. Correlational effects were explored in published and assessed weightings using Multiple Analysis of Variance (MANOVA). The finding indicated contractors' inclination towards sustainable construction practice must be strengthened. MANOVA correlation showed published and assessed weightings differ significantly with (*Lambda* (4, 2) = 0.056, p = 0.418). The study submits weighted criteria are suitable for assessing a practice. The criteria are by this means validated and form assessment benchmarks for use in the absence of standard tool. The region must institute incentive and reward systems to stimulate widespread sustainable practices application within the contracting sector.

Keywords: construction organization, project delivery practice, sustainability, sustainability assessment, weighted criteria.

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INTRODUCTION

Sustainability and sustainable construction have become the mainstream of the 21st century since the World Commission on Environment and Development rose from the world summit on Environment in 1987 (Abolore, 2012). Studies have established that construction organisations can benefit from implementing sustainable construction approaches (Dangana, Pan and Goodhews, 2012; Du Plessis, 2007; Olonade, 2015). Sustainable development is therefore obligatory even in the traditional construction project delivery organisations. This is based on the growing needs to save cost, optimised performance and meet external stakeholders needs (Dangana, Pan and Goodhews, 2012; Aberdeen Group, 2008). Embracing sustainability also triggers competitive advantage (Eaton, 2013; Kokkarinen and Cotgrave, 2010). It is clearly a factor of relevance to firm's viability (BRC, 2012). In recognition, a number of companies have adopted strategic plan and reacted towards achieving sustainability (Kokkarinen and Cotgrave, 2010). Current efforts represent an improvement to an earlier indication that construction and property organisations showed apathy towards new ideas (Myers and Katyoka, 2007). Nevertheless, the firms' response is seen to be reactive rather than a proactive strategy (Holton, Glass and Price. 2010; Elimualim, Valle and Kwawu, 2012).

A survey of the industry's status in Nigeria by Oladokun, Gbadegesin and Ogunba (2010) assert preparedness of stakeholders to adopt sustainable construction. Earlier works in the UK by Carter and Fortune (2007) and Cooper and Jones (2009) reported a related viewpoint. The reported intention raises the important question about the extent, the willingness is translated to implementation. The project delivery phase is the practical stage in which design decisions are translated to tangible results. The research space on sustainability assessment is expanding but with focus on the design and post-construction (Brandon and Lombardi, 2011; Higham and Fortune, 2012; Akotia and Fortune, 2012). Not much developed is the construction organisations' performance in sustainable project delivery during the delivery stage (Riley, Pexton and Drilling, 2012). Rather, emphasis has seen the overall team output (final product) being assessed. The status quo remains despite effort to reward contractors for best construction practices (Glass and Simmond, 2007; Halliday, 2008; and Ghumra, Frost, Watkins and Mundy, 2009). Examples of such assessment tools

include UK's CEEQUAL and Considerate Constructors Schemes (Ghumra, Frost, Watkins and Mundy, 2009, 2011; Glass and Simmond, 2007 and Murray, Forbes and Mason, 2010).

Today, growing volumes of literatures have emerged from the developed countries and very little is known about the state of affairs in developing countries. A study to investigate firms' practice is obligatorily certain about their pivotal role in sustainable development (Gleeson and Thomson, 2012 and Boyd and Schweber, 2012). This study is aimed at addressing two research problems. First, to validate empirically weighted criteria for evaluating contractor's sustainability practices during construction. Second, to assess firm's sustainability performance in real-life projects. The objectives of the study are relevant in promoting prevalent sustainable construction application in the tropics. The knowledge of the determinants of appropriate construction development is fundamental to better quality of life. Moreover, the need for in-country's sustainability criteria had been prioritized (Mpakati-Gama, Wamuziri, and Sloan, 2012). This is because (i) sustainability is domain dependent; and (ii) local value content assessment is essential in all objectives of sustainable construction practices assessment (Asmar and Underwood, 2013).

REVIEW OF RELATED LITERATURE

Understanding Sustainability

Moir and Carter (2012) assert there is a risk of not realizing sustainable future if the context of the concept is not exposed. Trivial issues surrounds sustainability and has been branded 'nebulous' 'riven' and 'contention' (Taylor, 2002). Despite these growing misconceptions, Moir and Carter (2012) assert sustainability has been institutionalised. The understanding of sustainability used in this study is tailored to an established definition provided in Brundtland Report (1987). Sustainability is seen as 'meeting the needs of the present without compromising the ability of future generations to meet their own needs'. Sustainable construction is the construction industry's response to sustainable development agenda (Ding, 2005). Within this understanding, sustainability is addressed under its three cardinal focal components: environmental; Social; and economic objectives. Sustainability in construction is achievable through six principles (Khalfan, Bouchlaghem, Anumba, and Carrillo, 2002; Miyatake,1999): reduction in resource use; encouraging resource reuse; use of renewable and recycled materials; protect the environment; ensuring quality in delivering built assets; and maintaining a healthy and non-harmful environment.

Measuring Sustainability Practices of Construction Organisations

Increasing concern subsists about firm's sustainability outputs in road, housing, infrastructure and others. The expectation is weaned by the difficulty associated with achieving them. Studies on sustainability indicators at construction project implementation level portray heterogeneity. But outputs lean towards health and safety, social, economic and environmental perspectives. Different contexts both related and non-related underpinned individual study. The overarching conclusion shows that the effective consideration of sustainable construction practices can minimise cost and ensures projects are completed on time (Jones, Comfort and Hillier, 2006). Differing assessment systems utilising varying criteria have been developed for evaluation in different places. But inclusive parameters have not wafted from '*sound environmental management practice; water sensitive urban design, use of advanced and recycled materials, and environmentally responsible project management and construction*' (Sattary and Thorpe, 2011). The evaluation is conducted either during design or through the life cycle of the constructed facilities (Thorpe, 2012). Current assessment practices however emphasise design and post-construction phases (BREEAM, 2008 and LEEDS, 2007). However, the decisions of when to assess influences energy use, management of resources and waste management (Sinclair, 2009; Thorpe and Zhuge, 2010; Ochieng *et al.*, 2014).

In delivering its objectives, firms' output can be assessed based on closure, flood damage, energy use and others. The closure of an arterial road for construction work may necessitate the close of other link roads. Flooding from construction site can extend to other places. This is distinct to the damage, wares and discomfort, long travelling time incurred as a result of these related events. Firms' activities are infrequently assessed based on the construction process. Issues such as waste creation, energy use and emission via manufacturing, transportation and emission are evaluated (Wallace, 2005). Material selection and usage is unequivocally prioritized as determinant of embodied carbon in the constructed facilities (Sattary and Thorpe, 2011). The use of recycled material invariably signifies sustainable practice since it embodies low carbon (Fisher, 2010). Elimualim, Valle and Kwawu (2012) highlights energy management, waste management and health and safety. Carbon footprint, ethical purchasing, specification of sustainable product, community engagement, training,

flexible working, biodiversity and staff productivity are increasingly adopted (Technical Guide, 2010; Thivaharan, 2015). Life cycle criteria are expectedly very relevant and popular in assessment tools.

Thorpe (2012) generated eleven criteria based on life cycle management approach. These include ability to use the facilities at all time; quality of materials and processes. Others are safety in design, water sensitive design and construction, management of waste, sustainable procurement practices, and use of recyclable materials. There are also in-situ stabilization criteria, use of locally occurring materials and energy use over the life cycle. Thorpe's approach adopted a scoring matrix system. The methodology, though similar in application to extant rating tools is however different in its flexibility and in considering sustainability objectives. The research design case studied two projects thereby limiting generalization. Subjective evaluation criteria were adopted: this is fine but utility score cannot be assigned without consulting wide. Leiringer (2015) questioned the over dependence on subjective perception of respondents. This is popular even in studies aimed at measuring real-life practice. It is therefore incumbent on this study to measure in real terms, firm's sustainability performance. There is also an assumption of variables independence in previous studies; it remains therefore undetermined whether sustainability objectives are independent.

The above parameters are not exhaustive, but however provide robust criteria for further development. The review submits sustainable construction practice does not necessarily involve additional responsibility but ethical implementation of good practices. This is true when sustainable construction is seen as the restraint of inappropriate development practices (Halliday, 2008). The best way therefore to evaluate firms' performance in lack of standard assessment tool is to adopt good practice perspective. This view is supported in the foregoing literatures. Accordingly, the study builds on existing literature to generate for validation, criteria for assessing firms' sustainability performance. The study by Ugwu, Kumaraswamy, Wong, and Ng (2005) in Hong Kong validated 55 factors. Building on an earlier study, Ugwu and Haupt (2007) validated 61 factors for the South African context. Due to domain and practice difference, and current low uptake in Nigeria, 40 indicators were validated in this study. Energy related dimensions are silenced to reflect current understanding and interpretation of sustainable construction in the tropics.

RESEARCH METHODOLOGY

To gain insight into construction organisation sustainability performance, thorough literature review and questionnaire survey were conducted. The literature search surveyed research views on firms' practices sustainability criteria. During the survey, factors generated individually and collectively were compiled and administered. The administration targeted stakeholders in main contractors and engineering consultancy organisations in Akwa Ibom State, Nigeria. Self-administration was adopted based on the need to adopt snowballing. Snowballing was most appropriate based on multi-national contracting party's apathy towards survey for related exercise. A network was built around key middle level management staff in 6 multi-national firms and 6 indigenous firms. The survey was conducted in Akwa Ibom State, Nigeria. The rationale for the choice of the study location has not wafted from the inherent need to diffuse sustainable construction in developing countries. Emphasis was on mega projects including other mega projects. Again, mega projects because 'best in class' practices were targeted. Snowballing refers to sampling using network of respondents (Kumar, 2011; Bhatterchejee, 2012). This involves identifying relevant respondents, administering them; and the respondents identified useful network that might be dispose to providing requisite information. The aim of the survey was to develop criteria for evaluating sustainability performance of firms in related projects. A total of 72 respondents were snowballed. Forty (40) criteria were rated for criticality using scale 1-5; 1 being very low and 5 very high. Criticality index was calculated for all criteria using inter-agreement agreement (IRA). IRA refers to the absolute consensus in scores provided by multiple judges for one or more targets (LeBreton and Senter, 2008). Estimates of IRA are used to determine whether rating provided by a respondent is interchangeable or equivalent in absolute terms. IRA represented by $\boldsymbol{RWG}$ was calculated using the equation 1 (LeBreton and Senter, 2008):

$$RWG = 1 - \frac{S_x^2}{\sigma_E^2} \quad (1); \text{ where,}$$

$$\sigma_E^2 = \frac{A^2 - 1}{12} \quad (2)$$

A = number of response option in the scale; S_x^2 = the observed variance. Interpretation is according to LeBreton and Senter (2008): 0.00 - 0.30-lack of agreement; 0.31 - 0.50-weak agreement; 051 - 0.70-moderate agreement; 0.71 - 0.90-strong agreement; and 0.91 - 1.00-very strong agreement. The IRA is unique from other critical index parameter in exploring consensus using variance in respondents' judgement rather than mean score seen in others.

Reliability and validity tests were conducted on both data collection instrument and abstract concepts selected for measurement. External validity was used to evaluate the quality of the research design by its ability to generalised observation. The study, by its survey research design is established to have a high degree of external validity (Bhattachejee, 2012, Liu and Fellow, 2008). Construct validity was also conducted. This seeks to evaluate the fitness of scale in capturing the hemisphere of the theoretical construct (Dada, 2013). Lee Cronbach co-efficient is widely used. Internal consistency reliability was conducted. This is the extent of agreement in multiple respondents rating (Farrell, 2011); Lee Cronbach co-efficient was also calculated. Alpha Cronbach value of 0.71 was obtained for both construct validity and internal consistency. This co-efficient is valid at the baseline of 0.6 and above (Pallant, 2010).

A total of 21 weighted sustainability criteria were used to assess firms' sustainability performance in four projects. The sustainability score was calculated using the equation (adapted from Ugwu and Haupt, 2007; Thorpe, 2012):

$$TWS = \sum_{i=1}^{n} d_{ij} w_i \quad (3)$$

Where TWS = total weighted score; d_{ij} = the assessor's utility score; and w_i = weight assign to sustainability criteria (that is the agreement index, IRA). The assessor utility score was the authors' assessment based on a 9-point value rating where 1 = poor; 3 = pass; 5 = very good; and 9 = excellent. The sub-criteria score was validated with CEEQUAL by comparing those indicators that is directly similar.

In order to accelerate exposure of the weighted criteria to assessment, it is pertinent to statistically test assessed and published weightings. The context is seen as a rating experiment in three roads and mix-used sport facilities with at least three dependent variables. The study assumes therefore that the dependent variables are correlated. The viable tool for capturing all relationship is the multivariate analysis of variance (MANOVA) (Bordens and Abbott, 2011; Tharenou, Donohoe and Cooper, 2007). In performing the test, CEEQUAL weightings were held constant (independent variables) and the assessed weighting dependent variables. The hypothesis states that there is no significant statistical effect of published weightings on assessed weightings. Validation was based on the critical p-value (accept if $p > 0.05$; and reject if $p < 0.05$).

RESULTS ANALYSIS AND DISCUSSION

Characteristics of Respondents

The survey involved a unit of analysis comprising the requisite professionals in infrastructure projects delivery. Forty (40) valid questionnaires were retrieved which represents a response rate of 55.55%. Figure 1 shows the professional affiliations of the respondents. In the figure, it was shown that 20 representing 50% of the respondents are civil/structural engineers; ten representing 25% of the respondents are quantity surveyors, five representing 12.5% of the respondents are builders, three are electrical engineers, while the remaining two are mechanical engineers. Figure 2 indicates the type of practice of the respondents. Half of the study's sample (50%) participated from the contractors' organisations and another 50% from consultants' organisations. Figure 3 shows the type of engagement of the respondents. Every respondent had one type of employment of either full time, contract or project-based. Twenty eight 28 (70%) had full time employment, 4 (10%) are on contract/consultants while 8 (20%) are engaged on project basis. The group engaged on project basis are recruited as need or workload increases. In terms of management position of the respondents, Figure 4 shows that there are 12 (30%) top management level staff in the sample, 24 (60%) middle level and four (10%) low/line management staff. Figure 5 shows respondents' experience. Twenty-six (65%) have above five years' experience but less than ten years; 14 (35%) had above ten years working experiences. Data relating to the respondents characteristics showed consistency in the appropriateness of the targeted population. The mix of the professionals, and years of experience exhibit homogeneity require to eliminate biases.

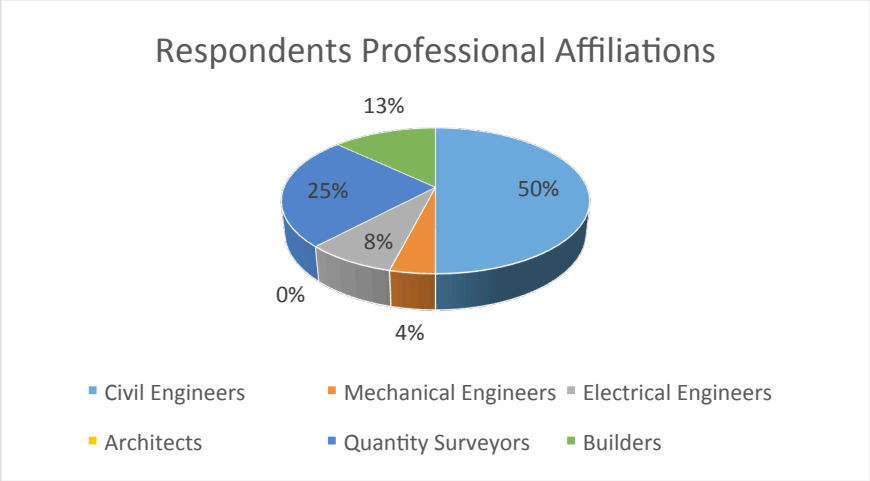

Figure 1: Respondents' professional affiliations

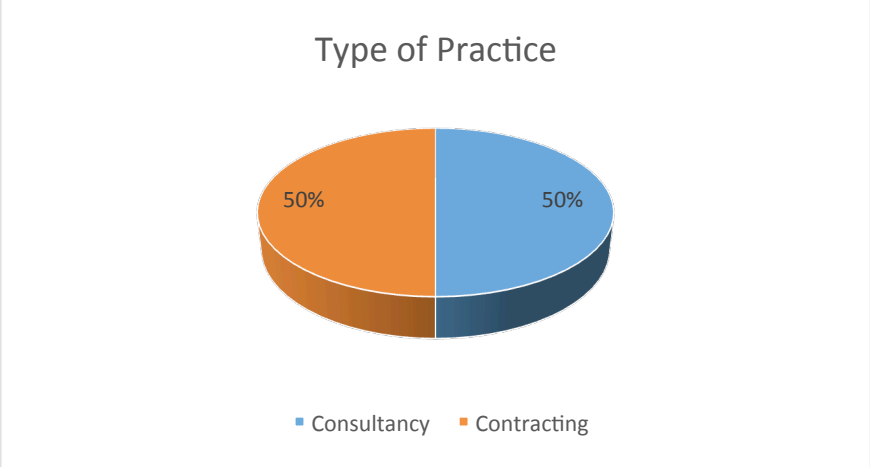

Figure 2: Type of practice

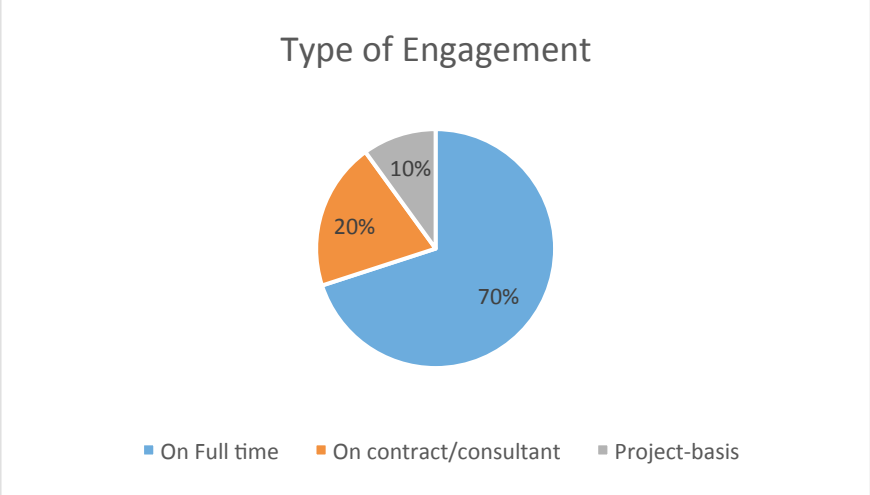

Figure 3: Type of engagement

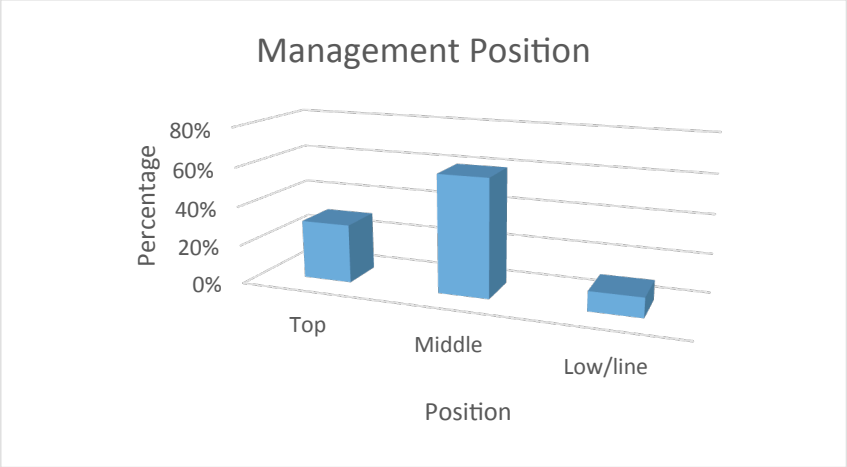

Figure 4: Management position

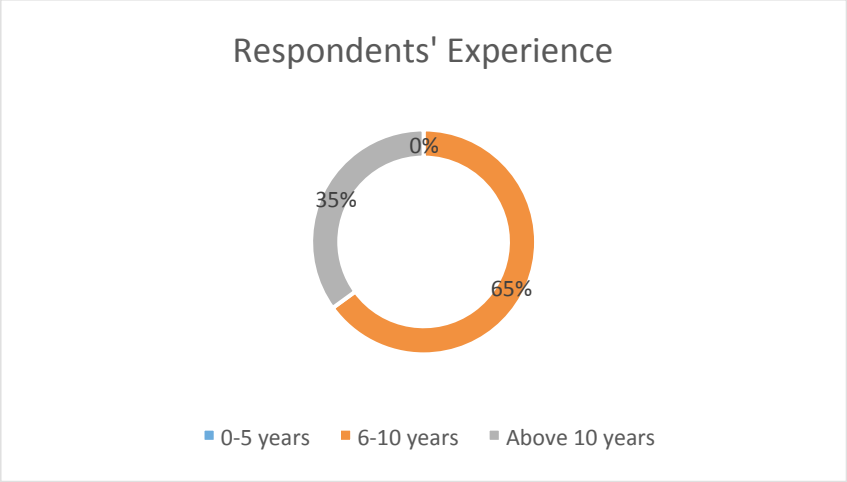

Figure 5: Respondents' experience

Weighted Sustainability Criteria

The triple objectives of sustainable development are captured under eleven (11) main criteria and forty (40) sub-criteria (Table 1). There are three (27.50%) main criteria each under the environmental and the social perspectives. The economic objective had five (5, 45%). Twenty (20, 50%) sub-criteria are economic; (8, 20%) social and (12, 30%) environmental. The dominance of the economic criteria is due to the attribution of best practices. The respondents' perceptions of the suitability of 18 sub-criteria (45%) lacked agreement on the IRA scale. In this category, five (12%) are environmental; (2% each from land use and ecology; and 8% from waste management). Three (7%) are social sustainability objective (5% health and safety related; and 2% public access). Nine (22%) are economic sustainability sub-criteria (10% resource utilization related; 2% constructability, 2% reusability, and 10% project management related). The failings of the project management related criteria suggest failure to include sustainability related clauses in contracts. Integrated delivery approach and integrated supply chain are less developed.

Twenty-two (55%) criteria obtained various degrees of agreement ratings including strong agreement (10%); moderate agree (20%), and weak agreement (25%). The economic criteria dominates other criteria (10, 22.5%); social (5, 11.5%), and environmental (7, 17%). Based on the sub-criteria agreement rating, environmental concern is the most important. The average inter-rater agreement index (IRR_{av} = 0.69-moderate agreement) is obtained. Economic objective is 2nd most important (IRR_{av} = 0.53 –moderate agreement), and social least important (IRR_{av} = 0.43-weak agreement) (Table 2). Similarly, re-usability and public access are jointly most important main criteria (IRR_{av} = 0.88). The resultant high index is partly due to the absence of more than one sub-criteria. However, increased public access signifies poor health and safety checks and is responsible for the low health and safety index (IRR_{av} = 0.42- weak agreement) in the study. Ecology (IRR_{av} = 0.74,

strong agreement) and land use (IRR_{av} = 0.62, moderate agreement) are 2nd and 3rd most important main criteria. Resource utilization (IRR_{av} = 0.49-weak agreement), 4th; and constructability (IRR_{av} = 0.46, weak agreement), 5th. Health and safety (IRR_{av} = 0.42- weak agreement), 6thand community (IRR_{av} = 0.24-lack of agreement), 7th respectively.

Table 1: Inter-rater Agreement of Sustainability Criteria

SN	Objectives	Category	Criteria	S_x^2	σ_E^2	S_x^2/σ_E^2	RWG	Sig.
1	**Environmental**	Land use	Extent of land acquisition	2.25	2	1.13	-0.13	LA
2			Extent of tree felling	0.92	2	0.46	0.54	MA
3			Extent of loss of feeding ground	0.33	2	0.17	0.83	SA
4			Connectivity with hinterland	1.00	2	0.50	0.50	WA
5		Ecology	Measure to reduce dust	0.25	2	0.13	0.88	SA
6			Measure to reduce noise	1.58	2	0.79	0.21	LA
7			Re-provision of habitat (re-green/tree planting	0.92	2	0.46	0.54	MA
8		Waste management	Safe disposal of excavated materials	2.25	2	1.13	-0.13	LA
9			Safe disposal of construction materials	0.25	2	0.13	0.88	SA
10			Safe management of other wastes	0.67	2	0.33	0.67	MA
11			Extent of encroachment at dump site	1.58	2	0.79	0.21	LA
12			Inclusion WMP/clauses in contract	3.00	2	1.50	-0.50	LA
13	**Social**	Community Relation	Provide opportunities for learning	0.88	2	0.79	0.40	WA
14			Provide employment opportunities	1.10	2	1.46	0.46	WA
15		Health and safety	Cleanliness of site	1.58	2	0.79	0.21	LA
16			Accidents, injuries, fatalities	1.58	2	0.79	0.21	LA
17			Health and safety management systems	1.33	2	0.67	0.33	WA
18		Public access	Extent of congestion	3.58	2	1.79	-0.79	LA
19			Extent of blockage	0.98	2	0.49	0.51	MA
20			Ability to use completed road at all times with minimum disruption	0.25	2	0.13	0.88	SA
21	**Economic**	Resource Utilization	Use of local raw materials	1.20	2	0.60	0.40	WA
22			Use of recycled materials	0.92	2	0.46	0.54	MA
23			Use of prefabricated/offsite method	1.67	2	0.83	0.17	LA
24			Use of innovative materials	0.92	2	0.46	0.54	MA
25			Cut and fill optimisation using mass haul diagram	2.25	2	1.13	-0.13	LA
26			Re-use of excavated materials	2.25	2	1.13	-0.13	LA
27			Use of approved borrow-pit without encroachment	2.67	2	1.33	-0.33	LA
28		Constructability	Early suppliers involvement	1.00	2	0.50	0.50	MA
29			Early sub-contractor's involvement	1.58	2	0.79	0.21	LA
30			Durability maintenance during construction	1.33	2	0.67	0.33	WA
31			Long maintenance plan	0.92	2	0.46	0.54	MA
32		Reusability	Re-use of moulds, formworks etc.	0.25	2	0.13	0.88	SA
33			Disposal of scrap after decommissioning	2.92	2	1.46	-0.46	LA
34		Project management	Inclusion of sustainability related clauses (e.g. EMP and WMP) in project specification	3.58	2	1.79	-0.79	LA
35			Ditto; during tendering	1.78	2	0.89	0.11	LA
36			Initial cost	1.45	2	1.83	0.35	WA
37			Project duration (timely completion)	1.56	2	1.00	0.34	WA
38			Amount of paperwork (Level of ICT uses)	1.70	2	1.46	0.30	WA
39		Procurement method	Use of integrated delivery systems	2.25	2	1.13	-0.13	LA
40			Integrated supply management approach	2.35	2	1.18	-0.18	LA

LA = lack of agreement; WA = weak agreement; MA = moderate agreement; SA = strong agreement; Sig. = significance.

Table 2: Weightings of Sustainability Objectives and Main Criteria

SN	Objectives	IRRav	Main Criteria	IRRav
1	Environmental	0.69 (1st)	Land use	0.62 (3rd)
2			Ecology	0.74 (2nd)
3	Social	0.43 (3rd)	Public access	0.88 (1st)
4			Community relation	0.24 (7th)
5			Health and safety	0.42 (6th)
6	Economic	0.53 (2nd)	Resource Utilization	0.49 (4th)
7			Constructability	0.46 (5th)
8			Reusability	0.88 (1st)

IRRav = average inter-rater agreement

Sustainability Assessment

The projects assessed consist of three highway projects (designated P_1 – P_3) and a mix-use sport complex (P_4). The characteristics of the projects are shown in Table 3. P_1, P_2 and P_3 are dual carriage highways. They were executed by two multi-nationals and one national contractor (A, B and C). P_4 is sport stadium executed by multi-national contractor (B). The project cost is between $42.85m to $267.85m. Half of the sampled projects were completed on schedule and the other half suffered delays. The results of the assessment is presented are shown in Table 4.

Table 3: Project Characteristics

Projects	Type	Capacity	Contractors	Mileage	Cost ($)	schedule	Stage
P_1	Road	Dual Carriage	A	38Km	57.14M	Delayed	Completed
P_2	Road	Dual Carriage	B	32Km	42.85M	On time	Completed
P_3	Road	Dual Carriage	C	21Km	78.57M	On time	Completed
P_4	Sports	30,000 spectators	B	-	267.85M	Delayed	Completed

Source: Anonymous (2015) 1$ = N280 (₦ is Nigerian Naira).

The results in Table 4 present the performance of three main contractor sustainability performances in four projects. As would be expected, the performance level of the projects varies with the indicator used and by the organisation involved. The average performances of the projects (P_1-P_4 - land use, 12.35%; ecology, 9.6%; waste management, 10.62%; health and safety, 11.65%; community relation, 5.02%; resource utilization, 6.24%; constructability, 9.64%; re-usability, 7.92%; and project management, 6.71%) demonstrate strong heterogeneity except in community relation. Homogenous score is observed in the criteria: 'extent of tree felling; health and safety; provide employment; and re-use of moulds and formworks'. Similar trend is observed in P_1-P_3 for criteria 'long maintenance plan; durability maintenance during construction; early suppliers involvement; use of innovative materials; use of local raw materials; re-provision of habitat (re-greening/tree planting; and connectivity to hinterlands'. However, P_3 achieved high score in criteria 'use of innovative materials and extent of loss of feeding ground. P_3 performed poorly in many criteria including re-provision of habitat; and ability to use completed facilities at all time with minimum maintenance disruption. Others include use of local raw materials; long maintenance plan; and project duration. The aggregate score (TWS) was not computed since the overall objective was not to award performance but to demonstrate application of the weighted criteria. Performance cannot be awarded for incomplete sustainability objective assessment.

Table 4: Validated Criteria and Sustainability Assessment

Sustainability Criteria	W_i	Assessor Assigned Utility (d_{ij})				Aggregated Weighting ($W_i d_{ij}$)			
		P_1	P_2	P_3	P_4	P_1	P_2	P_3	P_4
Extent of tree felling	0.54	5	5	5	5	2.70	2.70	2.70	2.70
Extent of loss of feeding ground	0.83	3	7	7	9	2.49	5.81	5.81	7.47
Connectivity with hinterland	0.50	9	9	9	7	4.50	4.50	4.50	3.50
Measure to reduce dust	0.88	7	5	5	7	6.16	4.40	4.40	6.16
Re-provision of habitat (re-green/tree planting	0.54	9	9	9	5	4.86	4.86	4.86	2.70
Safe disposal of construction materials	0.88	5	9	7	9	4.40	7.92	6.16	7.92

Safe management of other wastes	0.67	3	7	7	7	2.01	4.69	4.69	4.69
Health and Safety management systems	0.33	7	7	7	7	2.31	2.31	2.31	2.31
Extent of blockage	0.51	1	3	5	9	0.51	1.53	2.55	4.59
Ability to use completed road at all times with minimum disruption	0.88	9	9	9	5	7.92	7.92	7.92	4.40
Provide opportunities for learning	0.40	3	5	5	5	1.20	2.00	2.00	2.00
Provide employment opportunities	0.46	7	7	7	7	3.22	3.22	3.22	3.22
Use of local raw materials	0.40	9	9	9	3	3.60	3.60	3.60	1.20
Use of innovative materials	0.54	5	5	5	9	2.70	2.70	2.70	4.86
Early suppliers involvement	0.50	9	9	9	7	4.50	4.50	4.50	3.50
Durability maintenance during construction	0.33	7	7	7	5	2.31	2.31	2.31	1.65
Long maintenance plan	0.54	7	7	7	3	3.78	3.78	3.78	1.62
Re-use of moulds, formworks etc.	0.88	9	9	9	9	7.92	7.92	7.92	7.92
Initial cost	0.35	7	9	3	3	2.45	3.15	1.05	1.05
Project duration (timely completion)	0.34	7	9	9	3	2.38	3.06	3.06	1.02
Amount of paperwork (Level of ICT uses)	0.30	7	7	9	9	2.10	2.10	2.70	2.70
Total Weighted Score (TWS)									

The aggregated scores of the main criteria for P_1-P_4 alongside CEEQUAL weightings are presented in Table 5. The data is presented at section level and only those that bear semblance to CEEQUAL levels are shown. Table 5 is drawn up not to make inference about the total level of comparison but to explain the inter-relation of one level with another. Otherwise, such comparison constitutes outlier to the differing terms of reference of CEEQUAL and this study. It is also intended to validate the study's criteria, weightings and assessment; and to enhance adoptability. The performance levels of the projects are used to evaluate how well the weighted criteria correlate. The correlation involves MANOVA and is used to test the study's hypothesis.

Table 5: Comparing Assessed Weightings to CEEQUAL

	Aggregated Weighting ($W_i d_{ij}$)				**CEEQUAL**
	P_1	**P_2**	**P_3**	**P_4**	
Land Use	9.69	13.01	13.01	13.67	8.20
Ecology	11.02	9.26	9.26	8.86	8.50
Waste Management	6.41	12.61	10.85	12.61	8.70
Community relation	4.42	5.22	5.22	5.22	7.70
Resource Utilization	6.30	6.30	6.30	6.06	9.50
Project Management	6.93	8.31	6.81	4.77	12.00

Test of Hypothesis

The objective of the hypothesis testing is to test statistical dependence (correlation) of the assessed weightings on the dependent variables (published (CEEQUAL). In other words, it is desirous to determine whether published weightings influenced assessor's evaluation of the four projects. The result is presented in Tables 6, 7 and 8. A three-way MANOVA test was calculated to explore the effects of published weightings on assessed weighting using SPSS. The result is not significant at p = 0.418; the null hypothesis is therefore accepted. The inference is that there is no statistical significant effect of published weightings on assessed weightings of P_1-P_4 at (*Lambda* (4, 2) = 0.056, p = 0.418). Follow-up univariate ANOVAs show a significant variation between published and assessed weightings. The ANOVA are P_1($F(2) = 2.19$, $p = 0.314$); P_2($F(2) = 0.822$, $p = 0.549$); P_3($F(2) = 0.403$, $p = 0.713$); and P_4($F(2) = 13.592$, $p = 0.549$) (Table 7). The results also support the hypothesis that there is no significant between assessed weighting and published weightings. The homogeneity test of error variance in assessment across the projects are also significant P_1 (F (2, 2) = 3.200, p = 0.238);

P_2 (F (2, 2) = 3.200, p = 0.238); P_3 (F (2, 2) = 1.84, p = 0.352); and P_4 (F (2, 2) = 3.200, p = 0.238) using Levene's test (Table 8).

Table 6: Multiple Variance Analysis (MANOVA) Test

Tests	P -value	F	Hypothesis df	Error df	Sig.
Pillai's Trace	1.115	1.261	4.000	4.000	0.414
Wilks' Lambda	0.056	1.608	4.000	2.000	0.418
Hotelling's Trace	13.721	0.000	4.000	0.000	0.000
Roy's Largest Root	13.495	13.495	2.000	2.000	0.069

Table 7: Analysis of Variance Test

Dependents	df	Mean Square	F	Sig.
P_1	2	8.043	2.189	0.314
P_2	2	0.849	0.822	0.549
P_3	2	4.115	0.403	0.713
P_4	2	2.900	13.592	0.069

Table 8: Levene's Test of Equality of Error Variances

Dependents	F	df1	df2	Sig.
P1	3.200	2	2	0.238
P2	3.200	2	2	0.238
P3	1.840	2	2	0.352
P4	3.200	2	2	0.238

Discussion of Results

Assessment of sustainability in project cases (P_1-P4) involved both valued scoring and objective mark assignment. The assessor's view therefore is either related to the observation on the exact indicator in the project or in respect of related indicators. The overall perception of the assessment method is very good. High index of two main criteria deserved a second look. Their resultant high indices are partly due to the absent of other sub-criteria. Further indication means increased public access to the work area and poor health and safety checks. It is responsible for the low agreement index of health and safety (weak agreement). However, the context with re-usability is not a surprise since materials and processes are mainly re-used for increase profitability. The community relation (IRR_{av} = 0.24- lack agreement) reflects the overall low agreement with that of the social objectives. Community engagement misgiving is a global issue both to the academics and practitioners. The study of Teo and Loosemore (2012) focussed on community-based protest in construction in Australia. Ekung, Ogboji and Okonkwo (2013) studied project related community protest in the Niger Delta, Nigeria. Glass and Simmonds (2007) evaluated contractors' performance within Considerate Constructor's Scheme. The studies found dearth of training and knowledge are responsible for poor community stakeholders' engagement. Improvement is reported in Murray, Forbes and Mason (2010).

The result of the project management related criteria suggests the need to improve all perspectives of economic sustainability objective. The result though not surprising, is attributable to the extensive traditional project management practice (Ogunsanmi; 2012; Idoro, Iyagba and Odusami, 2007). The development of construction project in the research area deploys traditional organisation systems. The failings of this system are popular in the related literature. The laggard implication to the sagacious objectives of sustainable development calls for immediate improvement. Otherwise, the seminal misinformation used to object sustainable project decisions might be difficult to impugn (Shen, Tam, Tam, and Ji, 2010). The result of the environmental objective also merits some reflective observations. The high agreement index of the main criteria (land use and ecology) though not expected, is never surprising. The global pursuit of sustainability goals is mainly environment driven (Emmanuel, 2011; Higham and Fortune, 2012; Akotia and Fortune, 2012). Assessment tools and systems are also environment focus (BREEAM, 2009). Various regulations and governmental interventions are driven towards environmental sustainability. Although less developed in practice based on social awareness and discussion, the overall result of the study is not unexpected.

The extent to which weighted criteria measures and compares with indicators in assessment tools shows vast validity of collected data. But there are needs for improvement notably in community relation, resource utilization and project management perspectives. The deviation between the weighting criteria and CEEQUAL weighting, though insignificant, requires improvement. However, environmental criteria: land use; ecology and waste management portend high sustainability performance of the firm. The test of the hypothesis strongly indicated no significant effect of published weightings on assessed weightings. This is true to the extent of explaining the semblance

in both weightings. Further indication advances that, the validated criteria are appropriate for assessment. It is also an unbiased view of the stakeholders. In other word, the knowledge of the published weighting did not influence assessor's perception sustainability performance of P_1-P_4.

CONCLUSION

The lucid devoted searchlight on firms' activities may have been interminably documented. But the impact of construction on the ecosystem and the quality of life thrust overarch. Consequently, firms favour appropriate (sustainable) development practice for beneficial evidences. Differing regions have developed various systems and matrices to assess and have been assessing firms' practices. In the persistent lack of standard assessment tool, this study assessed firms' practices for sustainability in the Nigerian construction industry.

To achieve set-out goals, the study generated a set of empirically validated criteria using key stakeholders' inter-rater agreement judgement. The resultant criteria were further adopted in evaluating firms' sustainability performance in four projects. Twenty-two criteria representing all perspectives of sustainable construction were validated with varying degrees of agreement on IRA scale. Environmental objective criteria ranked most important; economic 2nd most important and social 3rd, and least important. Criteria under economic objectives (22.5%) dominates other criteria; social (11.5%), and environmental (17%). The resultant assessment indicated varying level of sustainability performance. Since the intention was not to award any project, the total weighted scores were not computed. The overarching implication submits firms' proclivity to sustainability requires improvement. This is particularly important in the economic (project management) and the overall social sustainability objectives. Firms' performance weightings on land use; ecology; waste management; community relation; resource utilization; and project management compares directly with published weightings in CEEQUAL. Multiple variance analysis (MANOVA), analysis of variance (ANOVA) and Levene's test of homogeneity supports the hypothesis that published weightings did not affect assessed weightings. The polar position from the hypothesis tests implies that weighted criteria are suitable for assessing a practice. This is the stakeholders' unbiased views; the criteria are therefore validated. The problem however is how to improve practice in the study area.

The study is of the view that the holistic sustainability agenda should be pursued in phases. The baseline is to institute incentive and award systems to promote best practice. The study has advanced state of knowledge about current level of sustainability assessment performance. Prospect of future study is widened by the need to adopt validated criteria in developing standard assessment tool for in-country use. The result possesses appropriate scientific inquiry attributes for generality. First, it is precise in its measurement, logical in approach and systematic in delivery. Second, the results can be replicated using the systematically laid down approach. Its statistical conclusion is valid by the appropriateness of the tools and conclusion. However, assessed project are best in class infrastructure. The projection is that exploring other projects could result in findings that can lead to further insightful discussions. There is need therefore for all-inclusive criteria validation using samples in other regions.

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