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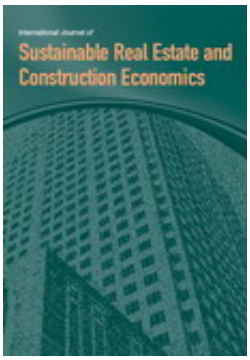

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Key performance indicators of sustainable housing projects in Lagos State, Nigeria

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Abstract: Tackling the effects of housing activities on the environment, sustainable housing has emerged as the guiding paradigm of development in construction. Thus, this paper focused on key performance indicators of sustainable housing projects in Lagos State, Nigeria. 203 responses were obtained from the 259 questionnaires distributed. The data obtained were analysed using mean ranking analysis and Analysis of Variance (ANOVA). The data were used to determine the significant key performance indicators of sustainable housing projects in Lagos State. Study showed that the top five key performance indicators used in measuring the performance of sustainable housing projects comprise of delivery within the time, delivery to specified quality, delivery within budget, overall sustainability rating and energy efficiency rating of the building. Knowledge of the significant key performance indicators provides invaluable information to stakeholders regarding the most important indicators to focus attention on in achieving sustainable housing.

Keywords: housing; indicators; performance; stakeholders; sustainability.

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1 Introduction

Building activities, ranging from extraction, processing and transportation of raw materials to design, construction, operation and demolition of built product adversely affect the environment in form of excessive resources use, wastages and Greenhouse Gas (GHG) emission (Ozorhon, 2013; Zou and Couani, 2012, 2017). The energy consumption from the housing sector alone accounts for approximately 25% of carbon emissions (United Nations, 2016). United Nations Environment Programme (2011) concluded that sustainable buildings save 19% of the comparative cost-in-use, and 36% of CO_2 releases while traditional buildings consume about 40% of universal energy, 40% of other resources, 25% of universal water and releases one-third of house gas emissions. As at 2012, energy consumption in residential structures was 135 petajoule (PJ), 3.5% of the year's total, and it was projected to rise by 24% during the duration of 2009 to 2020, attaining just under 170 PJ by 2020 (U.S. Green Building Council, 2017). These figures obviously point to the adverse consequence of construction activities on the environment and which make the obtaining of housing projects in the traditional way unsustainable. This evidence underlines the need for a market uptake of sustainable housing in order to protect ecological processes and safeguard the welfare of future generations. The above evidence among others also highlights the need to focus on research on sustainable housing provision. United States Environmental Protection Agency (2017) defined sustainable buildings as: 'The practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle and consists of design, construction, operation, maintenance, renovation and deconstruction'. This activity expands and stabilises the traditional building design in relation to economy, utility, durability and comfort.

To tackle the adverse effects of housing activities on the environment, sustainable housing has emerged as the guiding and encouraged paradigm of development in the building sector (Dobson et al., 2013). Sustainable housing projects are expected to alleviate poor performance in energy consumption, carbon emission of built environments and also reduction in the cost-in-use of buildings. Research indicates that in Europe, the implementation of sustainable housing projects can reduce energy use by 42%, the total GHG by 35%, materials extraction by 50% and water consumption by 30% (Dobson et al., 2013).

In Nigeria, there is a growing awareness of the need for sustainable housing (Leo-Olagbaiye, 2021). Some developers in Lagos State, which is the commercial hub of Nigeria have actually embarked on the construction of sustainable housing in the last few years, albeit, not in the quantity that can cater for the ever increasing population of the State. It is however of great importance to ensure the performance of such housing projects. There are some performance indicators normally used to examine the extent to which project targets have been achieved. Osuizugbo (2018) recommended project completion to time, cost, quality, freedom from defects, meeting stakeholders expectation and the volume of dispute as project performance measurement criteria. Korkmaz et al. (2011) categorised performance indicators in traditional mass housing to include energy rate, indoor air quality and energy efficiency rating. Furthermore, Sibiya et al. (2015) assessed the Key Performance Indicators (KPI) in construction projects. Findings from their study revealed that the most significant KPIs in construction projects comprise of construction time performance, profitability, project management, material ordering, handling and management, risk management, quality assurance, client satisfaction with

the constructed product, safety, time performance predictability (project, design, construction), productivity and client satisfaction (service). Whilst KPIs in different construction domain have been established in construction management literature, key performance indicators in sustainable housing projects in Lagos State, Nigeria have not been investigated. That makes this study a worthwhile one.

2 Literature review

2.1 Conventional versus sustainable housing projects

A conventional housing project follows a thin sense of environmental, social and economic profits at the expense of others. Sustainable housing on the other hand is defined as the creation of structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from design to construction, operation, maintenance, renovation and deconstruction (U.S. Green Building Council, 2017). They are built with clean and resource efficient methodologies towards achieving a lesser environmental and carbon footprint compared to conventional housing (Hwang and Tan, 2012; Waniko, 2012). Also, sustainable housing projects differ in principle in terms of design, material sourcing, construction, operation and maintenance compared to the traditional building system. For example, new technologies and techniques as well as environmental-friendly materials are used (Hand et al., 2015; Li et al., 2011). Furthermore, sustainable housing projects often require a closer coordination especially during design between the architects, engineering service team and other stakeholders as a result of the complexity introduced and the consideration required for meeting the sustainability goal target (Palanisamy and Klotz, 2011). Generally, relative to traditional housing, sustainable housing projects are much more resource and energy efficient, healthier, comfortable and attractive (Korkmaz et al., 2011; Hwang and Ng, 2013).

Countless sustainable housing appraisal arrangements were recognised in various countries, regions and territories alongside the speedy growth of sustainable construction. This is with the aim of establishing the sustainability or non-sustainability of housing projects. Among the rating system is the Leadership in Energy and Environmental Design (LEED) in the USA; Green Building Tool in Canada; Building Research Establishment Environmental Assessment Method (BREEAM) in the UK; National Australian Built Environment Rating System/Green Star Certification (NABERS/GSC) in Australia; Comprehensive Assessment System for Built Environment Efficiency (CASBEE) in Japan; Green Mark Scheme in Singapore; Building Environmental Assessment Method (BEAM) in Hong Kong; etc. Structures of these sustainable building appraisal systems are closely large. However, the comprehensive principles applied differ to blend with the local conditions (Zuo and Zhao, 2014). Consequentially, a SB Tool (a sustainable Housing Task method for assessing the sustainable performance of structures) is accepted because it integrates more societal, financial, cultural and perceptual fundamentals.

2.2 The concept of sustainability

The idea of 'Sustainability' conceptualised for the first time by Brundtland Report as issued in 1987 by United Nations of the World Commission on Ecology and Development has been placed in the focus of different research. Sustainability suggests maximising natural resources in such a stable condition that they do not attain decay, depletion and unrenewable point and passing down the succeeding groups by growing them. Sustainability seems to be an idea labelling to all aspect and ranging from worldwide growth policy to consumption of energy sources and from original arrangement to architectural design (Patel and Chugan, 2013). Anvari and Turkay (2017) defined sustainability as a multi-faceted structure which focuses on increasing the quality of living of all humans through solving people's difficulties, making meaningful networks among people by emphasising importance to partnership and social benefit and engaging in restructuring of economics fed from these natural resources. Sustainable buildings are the outcome of sustainable environment strategies in the built environment which is broadly answerable for usage of natural resources and for environmental waste.

2.2.1 Environmental sustainability

Environmental sustainability indicates turning the world to upcoming group better than taken shielding biological equilibrium and normal systems against obliteration (Sev, 2009). It is compulsory to put into consideration ecological steadiness and saving in usage of unrenewable materials. Sustainability of a product is dependent on capability of self-renewal simultaneously. For example; the major procedure of water cycling is rising of water in the form of evaporation and then dropping again on the earth after condensation as rainfall. Therefore, for consumption rate of natural resources; attention must be given to not exceeding rates of revitalisation of these resources and rates of these resources for clearance of pollutants (Patel and Chugan, 2013). Environmental sustainability involves paying attention in the subjects of protection of lives and irregularity on earth, protection of life-support measures, sustainable consumption of renewable resources, saving in maximising unrenewable resources, reducing negative impacts to the environment and fortification of cultural and olden environments (Anvari and Turkay (2017).

2.2.2 Economic sustainability

In current economic progressive model, it is anticipated that economic activities will increase in the market by growth in acquiring strength of everybody and rise in Gross National Product (GNP) will add to people. This development concept depends on immeasurable invention and usage. From ecological perspective, the said concept demands maximising existing materials like they are immeasurable. Nevertheless, it is true that materials which can satisfy the important need of individuals are inadequate and the materials are becoming scarce without replacement as a result of excessive high demands. In contrast, visibly, there are ecological challenges due to wastes which was as a result of the level of usage (Banihashemi et al., 2017). In economic development, because demand-supply balance must be set by bearing in mind environmental susceptibilities and societal affairs, the sustainability of the people is the most significant concept of sustainable development. Sustainability involves; forming new opportunities,

decrease in cost through supplying competence by reducing energy and resource input in production, and provision added value (HKU Architecture, 2002). In summary, economic sustainability is balancing of a stable line of savings with strong consumption and arrangement of resources; valuation of economic effectiveness with social values as against organisation the profits of Organisations (Anvari and Turkay, 2017).

2.2.3 Social sustainability

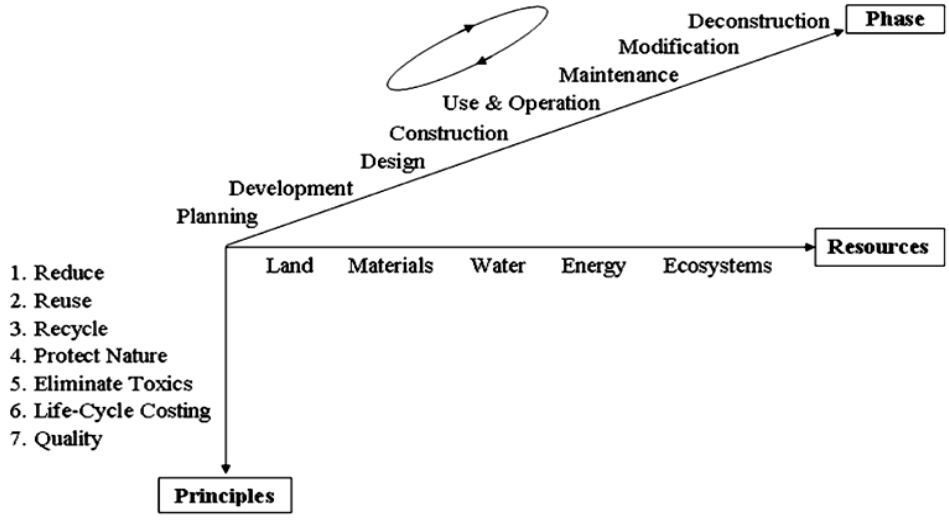
According to Anvari and Turkay (2017) social sustainability has to address multidisciplinary and multi-stakeholder measures and therefore accounting for this is extremely challenging. Social sustainability which is the most important focus of sustainable development focuses on major power which has a link with existence of humans and the most significant is balance among groups (Hammer and Pivo, 2016). Global interest on sustainability has greatly increased, for a while now; sustainability concept is among the increasingly accepted concepts around the world (Pitt et al., 2009). According to Parkin et al. (2003) huge effort has been made towards deepening the understanding of sustainability as far back as 1992 when government at the Earth Summit agreed to sustainable development as a target.

2.3 Sustainable construction

Sustainable construction is a certainty for disabling the negative effect of construction and attaining sustainable development in the process (Anigbogu, 2015). With construction being fundamental to all nature of growth, it is unavoidably connected to sustainable (or unsustainable) development (Anigbogu, 2015). Construction involves infrastructural facilities like roads and railways, harbours and ports, airfields, dams and power stations, fresh water supply, drainage and buildings by this means actualising the built environment (Mogbo, 2014; Jiang and Wong, 2016). Globally, the built infrastructural facilities constructed in 2016 are valued at US$9.1 trillion. These provisions have great effect on human lives different sectors and lifestyles (Xiong et al., 2016). Sustainable construction is execution of sustainable development goals to a building evolution from planning of the project, development, mining raw material to production and becoming construction material, operation, demolition, maintenance and waste disposal. It is a complete process which purpose is to guarantee harmonisation between the nature and built environment by generating permissions which suit human and support economic fairness. In the exhibited concept by Kibert (2005) (see Figure 1), sustainable construction exists at the joining of mechanisms of principles, phases and resources (Kibert, 2005). In this model, sustainable construction concepts are valuable to any desirable resources at all the different stages throughout the construction process which are the planning, development, design, extraction, processing and transportation of raw materials, construction, use and demolition of built products which are construction activities use a lot of resources and energy (Zhao et al., 2012), which is destructive on the physical environment network in the form of greenhouse gas emission, wastes and carbon emission (Zou and Couani, 2012; Ozorhon, 2013), and social existences in the plan of poor health and safety (Close and Loosemore, 2014; Jiang and Wong, 2016). The First International Conference on Sustainable Construction in Tampa, Florida in 1994

discussed growth in the new innovation of 'sustainable construction' or, as it has definitely been named, 'green construction'. In addition, sustainable construction accepted the concept of sustainability and relates it to construction activities. At first, the term 'sustainable construction' was anticipated to describe the apprehension of the construction industry in achieving 'sustainability'. Sustainable construction was initially defined as promoting a wealthy construction environment using well-structured resources, environmentally based principles' (Kibert, 2013). Mostly, it is used to describe a development which starts well initially in the planning and design stages and remains after the project team has moved away from the site. It is also the organisation of the serviceability of a building during its lifecycle and up till its final demolition and the re-use of properties to reduce the rate of waste commonly related with demolition (Saunders et al., 2016).

Figure 1 Sustainable construction model



Source: Kibert (2005).

The complete level of the construction activities suggests that it is probably one of the major significant industrial sectors in which positive results of sustainability is achieved. The outcome of the division makes up about 10%)of universal Gross Domestic Product (GDP) even though also making use of about 7% of the worldwide labour force (Pearce et al., 2012). The term '*Sustainable Construction*' (SC) was fashioned to create the concept of sustainable development amongst the construction industry. Nevertheless, sustainable construction has various challenges like definitions, in depth knowledge and transition to practice (Murray and Cotgrave, 2007; Bourdeau, 1999; Hill and Bowen, 1997). The construction sector has a 'portioning' and it is a complex construction with the responsibilities of design far separate from the construction responsibilities. This peculiarity is also extended by the collaboration between different types of stakeholders in the construction industry. This structural portioning and complexity of projects has

impacts on how sustainability is implemented in each sector, for better consideration and the social networks amongst different business concerns and how it can be handled.

2.4 Performance indicators for sustainable housing projects

Traditionally, the success of projects has been largely assessed with the traditional measures of delivery to budget, delivery within scheduled time and to specified quality. However, beyond the traditional measures, sustainability metrics have been utilised in more recent studies. This sustainability metrics include energy rate, sustainability rating, indoor air quality and energy efficiency rating (Olanipekun, 2017). Performance Indicators (PIs) are metrics for assessing construction project success. This is the reason why performance measurement of construction projects is usually carried out by establishing KPIs which offer objective criteria to measure project success (Sibiya et al., 2015). Korkmaz et al. (2011) and Mogbo (2014) highlighted the interest in improving the performance of buildings and the need to make construction projects perform sustainably. Generally, performance indicators are measures that describe the efficiency with which project resources have been managed to achieve objectives (Mao et al., 2015). Over time, a number of studies have been conducted on project performance. Osuizugbo (2018) pointed out that the success of a project can be differently conceived by the stakeholders on the project.

However, there are variety of criterion for evaluating whether a sustainable project has been successful or otherwise. Mulligan et al. (2017) divided project success into four dimensions which are: meeting design goals, benefit to end users, benefit to organisation, and benefit to national infrastructure. Osuizugbo (2018) recommended project completion to time, cost, quality, freedom from defects, meeting stakeholders expectation and the volume of dispute as project performance measurement criteria. The study's submission is very similar to the position of Ametepey et al. (2015) that classified sustainable performance indicators into four, which are: environmental, customer satisfaction, overall cost and time, and quality. As a result of the complexities associated with sustainable building projects, Korkmaz et al. (2011) highlighted the need for a clear focus on the performance of such projects. Basically, the eventual performance of a project describes available resources that have been utilised to achieve the desired outcome (Gultekin et al., 2013).

Furthermore, Banihashemi et al. (2017) highlighted compliance with anti-corruption rules and regulation in the decision-making process, awareness of sustainable project delivery in the Project Management Team (PMT), safety records, human resource management and public acceptance towards the project as the key performance indicators for integrating sustainability into construction project management practices and public acceptance of the projects. Arising from the above review, a comprehensive list of sustainability PIs is provided in Table 1.

Table 1 Performance indicators for sustainable housing projects

SN	*Indicators*	*Literature sources*
1.	Delivery within scheduled time	Sibiya et al. (2015) and Korkmaz et al. (2011)
2.	Delivery within budget	Sibiya et al. (2015) and Osuizugbo (2018)
3.	Delivery to specified quality	Korkmaz et al. (2011) and Osuizugbo (2018)
4.	Energy efficiency rating achieved by the project	Sibiya et al. (2015) and Korkmaz et al. (2013)
5.	Overall sustainability rating achieved by the project	Sibiya et al. (2015) and Mulligan et al. (2017)
6.	Indoor air quality	Mulligan et al. (2017) and Osuizugbo (2018)
7.	The amount of rework for defective work or call backs	Mulligan et al. (2017) and Osuizugbo (2018)
8.	The amount of dispute	Sibiya et al. (2015) and Ametepey et al. (2015)
9.	Overall stakeholder satisfaction rating	Ametepey et al. (2015) and Olanipekun (2017).
10.	Safety record	Chen et al. (2012) and Olanipekun (2017).
11.	Transparent and competitive procurement process	Chen et al. (2012) and Olanipekun (2017).
12.	Human Resource Management	Gudiene et al. (2013) and Banihashemi et al. (2017)
13.	Productivity/periodic productivity	Banihashemi et al. (2017)
14.	Risk assurance	Chen et al. (2012) and Olanipekun (2017).
15.	Compliance with anti-corruption rules and regulation in the decision-making process	Olanipekun (2017) and Chan et al. (2004)
16.	Knowledge and awareness of sustainable project delivery in the project management Team (PMT)	Sibiya et al. (2015) and Banihashemi et al. (2017)
17.	Satisfaction of user needs	Sibiya et al. (2015) and Banihashemi et al. (2017)
18.	Public acceptance of the project	Banihashemi et al. (2017) and Olanipekun (2017)

3 Methodology

3.1 Study population

The study population comprised of stakeholders involved in LEED and EDGE sustainable housing projects in Lagos State, Nigeria. The identified projects were described as sustainable because they have adopted sustainability principles and obtained an international sustainability rating certification(s) from Leadership in Energy and Environmental Design (LEED) and EDGE between 2010 and 2020. The target population of respondents comprised of all the stakeholders that participated essentially on the supply side of project delivery. This consists of Architects, Structural Engineers,

Quantity Surveyors, Project Managers, Electrical Engineers, Mechanical Engineers and Builders and Government Regulatory Agencies.

3.2 Data collection

Structured questionnaire survey was distributed to identified 259 stakeholders involved in sustainable housing projects in Lagos State, Nigeria. A total of 203 responses were returned, representing 78% response rate. Primary data regarding the level of importance of key performance indicators on the delivery of sustainable housing projects were collected. The data collected were analysed using mean score analysis alongside analysis of variance (ANOVA). The data collected were used to determine the key performance indicators of sustainable housing projects in Lagos State, Nigeria. The target population of respondents comprised of all the stakeholders that participated essentially on sustainable housing projects in the study area. This consists of Architects, Structural Engineers, Quantity Surveyors, Project Managers, Electrical Engineers, Mechanical Engineers and Builders and Government Regulatory Agencies. The mean score and analysis of variance was adopted for this study. A 6-point Likert-type scale was employed for data collection and a mean analysis was done using the mean score analysis formula given as:

$$MS = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1 + 0n_0}{n_5 + n_4 + n_3 + n_2 + n_1 + n_0} \quad (1)$$

where MS = Mean Score

where n_o= no of respondent who answered 'Not applicable'

n_1 = no of respondent who answered 'very low'

n_2 = no of respondent who answered 'low'

n_3 = no of respondent who answered 'Moderate'

n_4 = no of respondent who answered 'high'

n_5 = no of respondent who answered 'very high'.

ANOVA was used to examine the difference in perceptions of the respondents based on the identified stakeholders.

4 Data analysis and discussion of findings

4.1 Respondents' general information

Table 2 below displayed the respondents' years of experience in sustainable construction and number of projects handled in the last ten years. The Table reveals 66% of the stakeholders had less or equal to 5 years of experience in sustainable construction, 27.1% had between 6 years to 10 years of experience, 5.4% had between 11 years and 15 years of experience, 0.5% has between 16 years and 20 years of experience while 1% had between 21 years and 25years of experience; this is an indication that over 70% of the respondents had up to 10 years of experience in sustainable construction in the study

area, this may not be surprising because sustainable construction is still coming up in Nigeria and not many projects are within the status of sustainable construction, hence the findings of this study. Considering the number of projects handled in the last ten years, the result of analysis showed that 63.1% of the respondents had handled more than five projects in the last ten years while 36.9% of the respondents had handled less or equal to five projects in the last ten years. From Table 2 which reveals the general characteristics of the respondents, it is evident that the respondents to the questionnaire survey are well educated, professionally qualified and experienced to a good degree in sustainable construction. As such, it can be inferred that the data received from them can be relied upon for this study.

Table 2 Profile of respondents

Background information	*Parameter*	*Frequency*	*Percent*	*Mean*
Type of organisation	Government Agency	39	19.21	
	Contractor	74	36.45	
	Developer	90	44.33	
	Total	203	100	
Designation of respondent	Architects	20	9.85	
	Quantity Surveyors	62	30.54	
	Engineers	25	12.32	
	Builders	30	14.78	
	Project Managers	27	13.30	
	Government	39	19.21	
	Total	203	100	
Background information				
Years of construction industry experience	1–5 years	48	23.6	11 years
	6–10 years	80	39.4	
	11–15 years	26	12.8	
	16–20 years	26	12.8	
	21–25 years	23	11.3	
	Total	203	100	
Years of experience on sustainable construction	1–5 years	134	66	5 years
	6–10 years	55	27.1	
	11–15 projects	11	5.4	
	16–20 years	1	0.5	
	21–25 years	2	1	
	Total	203	100	
Professional membership of the respondents	Probationers	52	25.6	
	Corporate Members	111	54.7	
	Fellows	40	19.7	
	Total	203	100	

Table 2 Profile of respondents (continued)

Background information	*Parameter*	*Frequency*	*Percent*	*Mean*
Number of projects handled in the last ten years	1–5 projects	75	36.9	10 projects
	6–10 projects	48	23.6	
	11–15 projects	43	21.2	
	16–20 projects	17	8.4	
	21–25 projects	20	9.9	
	Total	203	100	

The objective of this research is to assess the level of importance of key performance indicators for sustainable housing projects in Lagos State, Nigeria. In order to achieve this, the level of importance of 18 identified key performance indicators for sustainable housing projects were rated by the respondents on a scale of 0–5. The data obtained were subjected to Mean Response Analysis (MRA) and Analysis of Variance (ANOVA). The result obtained is as presented in Table 3. The result of MRA presented in Table 3 shows that seventeen (17) of the identified key performance indicators had mean value of more than 3.50 which signifies that these key performance indicators have a high level of importance in sustainable housing projects. This implies that the respondents attach high importance to these key performance indicators. The five (5) top important key performance indicators include: delivery within the scheduled time; delivery to specified quality and delivery within budget; overall sustainability rating achieved by the project and energy efficiency rating of the building.

It is worth noting that the topmost five key performance indicators according to this study were selected for discussion; The traditional measures are delivery to time, quality and budget while the ones that focused more on sustainability are overall sustainability rating and energy efficiency rating of the project. These are in agreement with Li et al. (2014), Robichaud and Anantatmula (2010) and Olanipekun (2017). Assessing the various stakeholders and how they analysed result ranked the importance of listed performance indicators on the delivery of sustainable housing projects, it is observed that the results are not too far from each other. There was no much variation in how stakeholders perceived the most important performance indicators. This shows that level of importance attached to the listed performance indicators by the individual surveyed categories were high; hence these performance indicators should be given due consideration by the stakeholders in the delivery of sustainable housing projects.

The paper also categorised the surveyed stakeholders into Government, Project Managers, Quantity Surveyors, Architects, Builders and Engineers, etc. On Project Managers level of awareness of key performance indicators, Table 3 shows that the Project Managers view the most important key performance indicator is delivery to specified quality with a mean score. This is followed by delivery within budget, delivery within scheduled time, overall stakeholders satisfactory rating, sustainable project delivery in the project management team.

Table 3 Importance of key performance indicators

S/N	*Performance indicators*	*All*		*Project manager*		*Quantity surveyor*		*Architect*		*Engineer*		*Builder*		*Government*		*ANOVA*	
		MS	*R*	*MS*	*R*	*MS*	*R*	*MS*	*R*	*MS*	*R*	*MS*	*R*	*MS*	*R*	*F-value*	*P-value*
1	Delivery within scheduled time	4.07	1	4.19	3	3.81	8	4.15	1	4.36	1	4.23	1	4.08	1	1.456	0.206
2	Delivery to specified quality	4.04	2	4.44	1	4.00	3	3.9	3	3.96	3	3.90	4	4.08	2	1.271	0.278
3	Delivery within budget	4.04	3	4.33	2	3.90	5	4.05	2	4.16	2	4.03	2	3.97	3	0.747	0.589
4	Overall sustainability rating achieved by the project	3.91	4	4.11	6	3.97	4	3.65	7	3.68	13	3.97	3	3.92	4	1.178	0.321
5	Energy efficiency rating of the building	3.83	5	3.96	10	3.90	6	3.70	6	3.72	10	3.70	5	3.87	5	0.531	0.753
6	Needs assessment of people	3.82	6	4.04	8	4.02	2	3.85	4	3.92	4	3.43	9	3.59	9	2.16	0.06
7	Indoor air quality	3.74	7	4.11	6	3.69	12	3.60	8	3.76	8	3.67	6	3.67	7	1.009	0.413
8	Knowledge and awareness of sustainable project delivery in the project management team (PMT)	3.71	8	4.15	5	4.03	1	3.45	14	3.68	14	3.27	14	3.41	16	4.303	.001*
9	Overall stakeholder satisfaction rating	3.7	9	4.19	3	3.73	11	3.75	5	3.76	9	3.23	15	3.64	8	2.811	.018*
10	Safety	3.68	10	3.85	13	3.69	13	3.60	9	3.72	11	3.40	10	3.79	6	0.741	0.593
11	Risk assurance	3.66	11	3.96	10	3.82	7	3.60	10	3.72	12	3.13	18	3.56	10	2.397	.039*
12	Productivity	3.63	12	3.81	14	3.81	9	3.60	11	3.64	16	3.17	17	3.56	11	1.848	0.105

Table 3 Importance of key performance indicators (continued)

		All		*Project manager*		*Quantity surveyor*		*Architect*		*Engineer*		*Builder*		*Government*		*ANOVA*	
		MS	*R*	*MS*	*R*	*MS*	*R*	*MS*	*R*	*MS*	*R*	*MS*	*R*	*MS*	*R*	*F-value*	*P-value*
13	Human Resource Management	3.61	13	3.81	14	3.63	14	3.50	12	3.84	7	3.37	11	3.51	13	0.905	0.479
14	Transparent and competitive Procurement process	3.6	14	3.81	14	3.58	15	3.50	13	3.88	5	3.33	12	3.54	12	1.065	0.381
15	Public acceptance towards the project	3.59	15	4.04	8	3.76	10	3.35	15	3.64	17	3.3	13	3.31	17	2.447	.035*
16	Compliance with anti-corruption rules and regulation in the decision-making process.	3.53	16	3.93	12	3.53	16	3.15	17	3.88	6	3.23	16	3.44	15	2.015	0.078
17	The amount of rework for defective work or call backs	3.51	17	3.81	14	3.4	17	3.2	16	3.68	15	3.53	7	3.51	14	0.961	0.443
18	The amount of dispute	3.22	18	3.44	18	3	18	2.55	18	3.56	18	3.53	8	3.28	18	3.294	.007*

Note: MS = Mean Score; *R* = Rank; * Sig at $p < 0.05$.

Similarly, Quantity Surveyors view the most important key performance indicator to be sustainable project delivery in the Project Management Team (PMT) with a mean score. This is also closely followed by need assessment of people, delivery to specified quality, overall sustainability rating achieved by the project, delivery within budget. The Architects view the most important key performance indicator to be delivery within scheduled time with a mean score. This is followed by delivery within budget, delivery to specified quality, needs assessment of people, and overall stakeholders satisfaction rating. Engineer's most important key performance indicator to be delivery within scheduled time. This is followed by delivery within budget, delivery to specified quality, needs assessment of the people and transparent and competitive procurement process. In the same vein, Builders view the most important key performance indicators to be delivery within scheduled time. This is followed by delivery within budget, overall sustainability rating achieved by the project, delivery to specified quality, energy efficiency rating of the building. Government category view the most important key performance indicator to be delivery within scheduled time with a mean score, delivery to specified quality, delivery within budget, overall sustainability rating achieved by the project, energy efficiency rating of the building.

Differences in the perceptions of the respondents on the importance of the identified key performance indicators in sustainable housing projects based on these categories were further assessed through Analysis of Variance (ANOVA). The result revealed that significance difference existed in the perception of the respondents on importance level of 5 of the identified key performance indicators in sustainable housing projects based on the category of stakeholders. This is revealed by their *f*-values at $p<0.05$. These Key Performance Indicators include knowledge and awareness of sustainable project delivery in the project management team (PMT); overall stakeholder satisfaction rating; risk assurance; public acceptance towards the project; and amount of dispute. This implies that the respondents, based on their categorisation, perceived the level of importance of those identified 5 key performance indicators on sustainable housing projects in different ways. It can be inferred that category of stakeholders had significant effect on the views of the respondents on the level of importance of only 5 (28%) of 18 key performance indicators in the delivery sustainable housing projects while their views on the level of importance of other 13 (72%) key performance indicators had no significant effect. This depicts that the category of stakeholders doesn't affect the importance of most of the key performance indicators in the delivery of sustainable projects.

The high ranked performance indicators as observed by the study have been inferred to be very important in the delivery of sustainable projects which is in agreement with Sibiya et al. (2015). According to the study, delivery within the agreed and scheduled time as shown by the surveyed respondents should be highly prioritised by all stakeholders. Considering the importance of these project objectives (cost and time) and the possible consequences of mismanaging them in the course of construction, especially, in achieving sustainable building; identifying them in his study is very apt and should be attached such essentiality. As to maintain the goal of a sustainable society, delivery to specified quality and delivery within budget by the Project Managers, Quantity Surveyors, Architects, Engineers and Builders should be taken seriously and not with levity. All stakeholders should be well involved in the overall sustainability rating achieved by the project so as to ensure prompt delivery of the proposed sustainable project. The Energy efficiency rating of the building should be well measured as energy efficiency is focus for consideration in sustainable or green building; its rating should be

of concern to achieve the purpose of sustainability in building projects especially in the study area. Thus, it should be accorded the respect of an important indicator in the delivery of sustainable project.

Zahirah et al. (2013) established an influence of stakeholder on energy efficiency of housing: development which confirmed the reality of this study and energy efficiency as one of the performance indicators of sustainable construction in the study area. Pulaski et al. (2016) alluded that sustainable construction aimed at saving energy, reducing costs and adhering to policy; hence sustainable projects should be recognised when it saves energy, reduces cost and responses appropriately to any laid down rules guiding performance. These performance indicators are expected to be present as appropriate for a project to be rated as sustainable; they are important measurement of project sustainability as established by this study. This study corroborated (Zedan and Miller, 2018) which identified energy efficiency as one of the key performance indicators of sustainable construction and Menassa and Baer (2014) alluded that sustainable construction aimed at saving energy, reducing costs and adhering to policy; hence sustainable projects should be recognised when it saves energy, reduces cost and responses appropriately to any laid down rules guiding performance.

5 Conclusion

This paper concluded that the five (5) top important key performance indicators include: delivery within scheduled time; delivery to specified quality, delivery within budget; overall sustainability rating achieved by the project and energy efficiency rating of the building. Three of these relate to the traditional cost, time quality performance measures while two are specific to sustainability issues. The implication is that in the construction of sustainable housing, the traditional key performance indicators are as important as the sustainability metrics. The study further concluded that significance difference of opinions existed in the perception of the different categories of stakeholders regarding the level of importance they attached to the identified key performance indicators in sustainable housing projects. This is an indication that the perspectives of the differing stakeholders have to be taken into consideration in the delivery of sustainable housing. This study examined the level of key performance indicators on sustainable housing project in Lagos State, Nigeria, it is suggested that further studies could examine the level of importance of key performance indicators of other types of sustainable building project for comparable results. Furthermore, other studies to compare key performance indicators on sustainable housing projects between Lagos and other States as well as regional comparison could be instituted.

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