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# Sustainability in Building Construction: Strategy for Achieving Sustainable Development Goals

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**Abstract –** *The consequence of quest for knowledge, individual actions, absolute involvement and commitment to the principle depends on the understanding of sustainability creation and awareness. The research is significant in that it helps to assess the wide-spread of sustainable building construction and the level of awareness of the building professionals/developers on sustainability in building construction. To elicit information from the professionals in the built industry on sustainability practicability and awareness level of sustainability concept, structured questionnaire was used. The study revealed that there is a low awareness level in a developing country like Nigeria being the studied area. In achieving sustainable development goals, another area of enquiry was the economic, social and environmental features that constitute the triple bottom line of sustainability. The response indicated that building professionals define sustainability more in terms of effective protection of the environment other than inclusion of both social and economic feature. In strategizing for a sustainable built environment, stakeholder and professionals in the building industry have been identified as the hubs towards enhancing a sustainable built environment. The study recommended that to promote the awareness and understanding of sustainability concept in other to achieving sustainable development goals, much have to be done in the arena of educating the construction players through training, seminars, workshops and conferences. A virile collaboration and consultation between the professional and stakeholders in the building industry is also canvassed, since they are the major players.*

***Key Words***: **Building Construction Projects, Sustainable Construction, Sustainable Building, Environment, Economics. Social.**

## 1. INTRODUCTION

The number of factors surrounding environmental performance is enormous and knowing which area to address should be project specified. Rating systems do not currently reflect the complexities of our environment, nor are we capable of moulding a fixed measuring system to a vastly multi-dimensional environment (Cole, 2003). Every growing society is characterized by the erection of either temporary structures for the purpose of shelter which is the second necessity of life for the dynamism and sustenance of livelihood (George, 2002)

The state of the environment is a matter of growing concern (Parkin, 2000). It is a concern based on the observation that waste generated in the environment is already affecting the quality of life of people throughout the world. Waste minimization is identified as one of the key factors for achieving sustainability (Abdellatif and Othman, 2006). Environmental impact according to Rubin and Davidson (2001), Babawale(2004); CIOB(2014) and majundar (2006), are used to describe some implication of human activities on the environment. A review made by Koleosho and Adeyinka (2006). Horsley (2003) and Hardy (2007), also shows the need for cross examination of the activities of the built environment that causes environmental changes so as to identify their impacts for the purpose of mitigation. (4) To this effect, the impacts of building construction project are felt by all the elements that constitute the environment (Howard 2000 and Chrisna, 2006). According to Malik (2002) sustainable construction could be best defined as the creation of a healthy built environment based on resources efficiency and ecological principles.

Much literature suggests that economic interests are one of if not the biggest driver in decision related to building, frequently out – weighing sustainability considerations when in competition (Cole, 2003; Ding, 2008; Reed,2007). However, industry is beginning to recognize that the designation or appearance of sustainability has economic value (Figge and Hahn, 2012). Ecology is the study of how organisms interact with their environment, more commonly, the term ecosystem is used to refer to any biological community that functions as a cohesive unit within its physical environment (Rubin and Davidson, 2001). The basic message from the study of ecosystems is that everything is connected to everything else, even though these links may not be obvious or immediate.

Therefore, sustainable construction could also be identified as a subset of sustainable development, which includes design, site planning, tendering, material selection, recycling and waste minimization (Langston and Ding, 2001)

### 1.1 Literature Review

Often, in the building industry, economic and sustainability interests may be strange and many times stakeholders choose to pursue economic over environmental advancement. Sometimes, they may be eager to falsely claim environmental motivation, even when economic concerns

override. Kibert(2005) stated that: Seven principles of sustainable construction were suggested by the CIB which during each stage of the design informs the decision makers which are: reducing resource consumption; reusing resources; using recyclable resources; nature protection, eliminating toxics; applying life-cycle costing; and emphasizing quality .

However, in order to achieve the suggested principles by the CIB, there is a need to pay attention to sustainability techniques to ensure our built environment last for the next century and beyond. Changing the linear construction process to a cyclical process as it increases the use of reused resources; recycled and renewed. With regards to a whole system, sustainability in this way expresses solutions. One of the objectives of sustainable construction is creating better – built environment for human lives (Malik, 2002). In managing the whole life of the building projects, planning is the most important process (kerzner, 2003; Zwikael, 2009). During this stage, the relevant stakeholders involved to perform and understand their part in the project. After this stage, incorporation of sustainability principles will be a burden and should be avoided.

To ensure efficient sustainability integration into a sustainable building project during its planning process, a theoretical concept was developed to define the most significant strategies to be considered. Four (4) main strategies have been unfolded as the most important to be implemented during the project planning as follows: sustainable project orientation, integrated project team, integrated design process and sustainability regulations and code compliances (Isa, et al, 2014)

Sustainable buildings are designed with the use of recycled – content products and special emphasis on waste prevention. Deconstruction and renovation are done in a manner that captures significant cost savings and reduces solid waste. Building with access to day lighting decrease demand for fossil fuel for heating and lighting, this results to lowering energy wasting (Acuff, et al, 2005).

Training and continual communications for all project personnel are important during the planning phrase to ensure the accomplishment of sustainable project goals in a cost effective manner and within the time frame (Mochal and Krasnoff, 2010). For the acceptance of the sustainable building construction, the sustainable development education needs to reach beyond designers. The project personnel should be educated to ensure they concentrate on sustainability in their work for the projects (Halliday, 2008. Without a sustainable building project knowledge background, they will not be able to deliver and evaluate such projects effectively and accurately (Choi, 2009, Mochal and Krasnoff, 2010). Sustainability capability and quality should be considered during the selection of the team members during the feasibility and planning stage. They are taken based on their familiarity with the market and product type, and will have knowledge to all phases of the sustainable building project (Doyle et al, 2009, Bogenstitter, 2000)

Sustainable design can be defined as integration of architecture with structural works, mechanical and electrical works. Sustainable design also means conception and realization of environmentally sensitive and responsible expression as part of involving matrix of nature (William and partners, 2000)

Lack of effective communication among various technical experts who attempt to use their own protocol, tools and industry standards for tracking information and making decisions (Sappe, 2007). On the other hand, when the expended group of stakeholder work together to concentrate the majority of their creative effort as early in the planning process, sustainable building project works best (Prowler, 2011; Muidarin, 2010; Bogenstatter, 2000). The adoption of these strategies enhances the lowering of overall building costs by the promotion of synergies between building systems that may eliminate or minimize the need for certain building features. The strategy also enable the production of more durable structure and efficient which will reduce long term replacement and operating cost, a review made by (Choi,2009, Doyle et al,2009,Lapinski et al, 2006; Beheiry et al, 2006; Reed and Gordon, 2000)

Sustainability regulations and codes according to Muldavin, (2010) and Choi, (2009) that meet the sustainability goals can help to enhance sustainable building practices. To encourage a sustainable development, codes and ordinances can be used as a regulatory tool by setting clear criteria that stakeholders need to meet.

## 2. Methodology

A non probability convenience sampling method was adopted according to Teddie and Yu (2007) and Collins, Onwuegbuziu and Jiao (2007) this is a sampling method that involves choosing from a sample that is not only accessible but the respondent are willing to take part in the study. Data for the study were collated through a survey questionnaire administered to participant on building construction stakeholders in Ondo , Osun, Oyo, and Lagos state in Nigeria. The study population comprised of professional bodies, practitioners, developers and other estate practitioners who are involved in building construction projects. Research instruments used is the questionnaire designed to elicit information on respondents' views on issues such as the knowledge/ awareness rate, the nature of projects executed; the perception and interest rate, application / incorporation of sustainability concept in the current and past projects; instruments to improve the knowledge of sustainable construction; the present and implementation status of the subject matter in Nigeria amongst other. A total of ninety

questionnaires were distributed but eight two were retrieved which was used for the analysis. This shows a response of 91.1% which was adequate for the study. Qualitative descriptive method of analysis (SPSS) was used to summarize all the data generated from the study.

**Attribute of Sustainable Construction**

| Attribute | Respondent | Min. | Max | Mean | Std Deviation |
|---|---|---|---|---|---|
| Social | 82 | 1.00 | 2.00 | 1.6483 | 0.48105 |
| Bio – physical | 82 | 1.00 | 3.00 | 1.9024 | 0.89732 |
| Technical | 82 | 1.00 | 4.00 | 2.5854 | 1.01776 |
| Economic | 82 | 2.00 | 4.00 | 3.5122 | 0.67117 |

**Source: field survey, 2017**

The above table shows the level of attribute of sustainable construction in Nigeria. The table shows that the economic attribute have the highest mean of 3.51, this indicated that that the respondent were in the attitude of sustaining the continuity of affordable infrastructure project and sustained efficient use of resources and materials as which made it to be ranked first followed by the technical attribute having the second highest mean of 2.58. From the research work, it is clear that to achieve a technical indicator in Nigeria, the technological base has to be enhanced.

**Challenges of Sustainable Construction**

| Challenges | Respondents | Min. | Max. | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Government Enforcement | 82 | 1.00 | 2.00 | 1.4512 | 0.50068 |
| Government Intervention | 82 | 1.00 | 3.00 | 1.7439 | 0.76676 |
| Cost factor | 82 | 1.00 | 3.00 | 2.4146 | 0.66576 |
| Pointing fingers | 82 | 2.00 | 4.00 | 2.5854 | 0.66576 |
| Education Vs Experience 82 | 82 | 2.00 | 4.00 | 3.5122 | 0.67117 |

**Source: field survey, 2017**

The table shows the challenges of sustainable construction. Education and experience are the key challenges having the highest mean of 3.51. This implies that the level of education and experience have been regarded as utmost factor responsible for the level of implementation of sustainable construction at the moment. Other factors as highlighted include: lack of government intervention which may be in the area of not promoting sustainable construction through appropriate policies and incentives: lack of government intervention which may be in the area of not promoting construction through appropriate policies and incentives having the lowest means of 1.45.cost factor is next to this as developers' financial position determined whether or not the concept would be implemented as it may be perceived to increase their budget. This findings no doubt poses a challenge and opportunity for academia in introducing sustainability concept in the curriculum of Nigeria universities and other institutions of higher learning for all construction related courses.

**Current status of Sustainable construction**

| Status | Respondents | Min. | Max. | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Embracing sustainability | 82 | 1.00 | 2.00 | 1.6220 | 0.48788 |
| Starting to embrace | 82 | 2.00 | 3.00 | 2.8049 | 0.39873 |
| Inexperience but interested | 82 | 2.00 | 4.00 | 3.3780 | 0.67842 |

**Source: field survey, 2017**

The table shows current status of sustainable construction .inexperience but interested is having the highest means of 3.38. This imposed that the respondent were interested in the concept of sustainability but lack the require experience and expertise to practice it. Some respondents were beginning to put into action from the findings, these group of respondents are having mean of 2.80 while very few confirmed embracing the concept whole heartedly with mean of 1.62.

**Level of Awareness of Nigeria practitioners**

| Practitioners | Respondents | Min. | Max. | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Land surveyor | 82 | 1.00 | 3.00 | 1.6829 | 0.64556 |
| Quantity surveyor | 82 | 1.00 | 3.00 | 1.7073 | 0.63805 |
| Planner | 82 | 1.00 | 3.00 | 2.2195 | 0.75399 |
| Engineers | 82 | 1.00 | 4.00 | 2.7073 | 0.89564 |
| Architect | 82 | 2.00 | 4.00 | 3.5122 | 0.67117 |
| Builder | 82 | 3.00 | 5.00 | 4.5122 | 0.67117 |

**Source: field survey, 2017**

From the above table, it was conspicuous that the level of awareness of the builders with mean of 4.51 is much higher than the other professionals in Nigeria followed by Architect ranking 3.51. In addition, the least of all professionals mentioned above, who's its level of awareness were very low was the land surveyor.

**Means of Improving Sustainable construction**

| Means | Respondent | Min. | Max. | Mean | Std. Deviation |
|---|---|---|---|---|---|
| In-house learning | 82 | 1.00 | 3.00 | 1.4878 | 0.67117 |
| Journal,newspaper,website etc | 82 | 1.00 | 2.00 | 1.8049 | 0.39873 |
| Seminars and conference | 82 | 1.00 | 3.00 | 1.9024 | 0.69584 |
| Education and Higher learning | 82 | 2.00 | 4.00 | 3.4146 | 0.66576 |

**Source: field survey, 2017**

From the table above, majority of the respondent rely on education and higher learning to improve their knowledge about sustainable construction being ranked first. Seminars and conference were being ranked second. Other sources of knowledge are through journal proceedings, Newspaper, website, etc and in- house learning; they are ranked third and fourth respectively. As depicted in the table, the level of implementation of sustainable practices is very poor in Nigeria.

**Concept of Sustainable construction**

| Concept | Respondent | Min. | Max. | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Enhancement of quality of life | 82 | 1.00 | 2.00 | 1.1951 | 0.39873 |
| Effective planning | 82 | 1.00 | 3.00 | 1.9024 | 0.53541 |
| Effective management & control | 82 | 1.00 | 3.00 | 2.0976 | 0.69584 |
| Social progress | 82 | 1.00 | 3.00 | 2.1220 | 0.70955 |
| Improve Clients satisfaction | 82 | 1.00 | 3.00 | 2.1220 | 0.70955 |
| Effective protection of environment | 82 | 2.00 | 4.00 | 3.5122 | 0.67117 |

**Source: field survey, 2017**

To examine further what the respondents understand about the concept of sustainable construction, they were asked to select issues that match their understanding about the concept of sustainable construction. Issues that are related to environmental aspect of sustainability also received highest rank. Followed by social progress and improve client satisfaction being ranked 2.12 respectively. From this results, it is deduced that the majority of respondent understand that sustainability is about protecting the environment but many are still unaware that sustainability is also about enhancement of quality of life thus it is ranked low.

## 3. Conclusion and Recommendation

This research demonstrates how sustainability can be viewed in the context of Nigeria. It points to the importance of process in any efforts at sustainable construction. Sustainable construction requires a process that looks at sustainability comprehensively, exploring each of its component dimensions to discern its fit and relevance to a given context. The prioritization of social needs clearly shows that to achieve social sustainability in Nigeria, emphasis is on quality of working life, education and training as well as knowledge management .the ranking of economic indicators of sustainable construction in Nigeria indicates that strengthening of existing laws, efficient use of resources, appointment of environmentally responsible contractors and local material protection are essential factors necessary for attainment of economic sustainability in construction.

The application of efficient waste management system, the use of renewable construction materials and effective use of project design facilities will facilitate the attainment of biophysical sustainability in Nigeria. Design for flexibility, durability adaptability and quality are essential factors necessary for the attainment of technical sustainability in construction. Compliance with relevant legislations, ability to carry out preliminary assessment of purposes and activities as well as utilize a life cycle framework and manage activities through the setting of targets are essential factors necessary for attainment of sustainable construction.

In the light of research findings and conclusions, the following recommendations are made in order to motivate the application of sustainable construction in Nigeria.

Government should improve existing laws in this area of research paradigm so as to improve quality of working life, education, training as well as knowledge management for all stakeholders in sustainable construction. A clause should be introduced in the conditions of contract that will address environment issues of sustainable construction as this will facilitate the appointment of responsible contractors and suppliers. Seminars, workshops and lectures should be

organized for all stakeholders in sustainable construction to address issues on efficient waste management, environmental management systems and design for flexibility, durability, adaptability and the use of renewable construction materials.

**REFERENCES**

(1) M.A. Abdellatif, and A.A. Othman, (2006) Improving the sustainability of low-income housing projects: The case of residential buildings in Musa¦ah commercial city in Abu Dhabi. Emirates Journal for Engineering Research, 11(2), 47-58

(2) Z,Acuff, A., Harris, L. Larissa, , M. Beyan, and Allyson, P. (2005) Building Green for the Future: Case Studies of Sustainable Development in Michigan.

(3) G. K Babawale,. (2004). Sustainable Urban Infrastructure Delivery in Nigeria: The Role of the Private Sector and Community Based Organisations, being a Paper presented at the 31st annual conference of Nigeria Institute of Estate Surveyors and Valuers at Nicon Hilton Abuja.

(4) S. M. Beheiry, W. K Chong,. and C. T. Haas, (2006). Examining the Business Impact of Owner Commitment to Sustainability. Journal of Construction Engineering and Management, 132(4), 384-392.

(5) U. Bogenstätter, (2000). Prediction and optimization of life-cycle costs in early design. Building Research Information 28(5), 376-386.

(6) Chattered Institute of Building (CIOB) (2004). Sustainability and Construction. UK Publication, www.ciob.uk/filegrab/sustainability.pdf, Retrieved (04/04/2017).

(7) C. Choi, (2009). Removing Market Barriers to Green Development: Principles and Action Projects to Promote Widespread Adoption of Green Development Practices. JOSRE, 1(1), 107-138.

(8) S.O Chrisna, (2006). Environmental Degradation and its Consequences. National Population Prevention Centre for Higher Education, University of Michigan.

(9) R. Cole, (2003). Building Environmental Assessment Methods: A Measure of Success. The Future of Sustainable Construction.

(10) G. K Ding,. (2008). Sustainable construction, the role of environmental assessment tools. Journal of Environmental Management, 86 (3), 451-464.

(11) J. T.Doyle, R. B.Brown, D. P. De Leon, and L. Ludwig, (2009). Building Green-Potential Impacts to the Project Schedule. International Transactions, PS.08.01-PS.08.11

(12) F. Figge and T. Hahn, (2012). Is green and profitable sustainable? Assessing the trade-off between economic and environmental aspects. Int. J. Production Economics, 140, 92-102.

(13) C. George, (2002). Basic Principles and Methods of Urban and Regional Planning. Lagos: Librogem Book.

(14) S. Halliday, (2008). Sustainable Construction. Stoneham, Mass: Butterworth-Heinemann.

(15) A. Hardy, (2007). Environmental Design of Buildings. Ekistics 23 (136):181 – 187.

(16) A.Horsley, (2003). Delivering Energy Efficient Buildings; A Design Procedure to Demonstrate Environmental and Economic Benefits, Journal of Construction Management and Economics 21: 345-356.

(17) N. Howard, (2000). Data for Sustainable Construction. Center for Sustainable Construction, UK.http://projects.bre.co.uk/sustainable/SusConstructionData.pdf, Retrieved (03/02/ 2017)

(18) N. K Isa, A Alias,and Z. A. Samad, (2014). Towards Developing a Sustainability Integration Framework for Building Project. Journal of Building Performance, 5(1), 22-33.

(19) H. Kerzner, (2003). Project Management: a systems approach to planning, scheduling and controlling (Eight Edition Ed.). New York: Wiley.

(20) C. J. Kibert, (2005). "Sustainable construction: green building design and delivery". Hoboken, New Jersey: John Wiley and Sons, Inc.

(21) H. Koleosho, and A. Adeyinka, (2006). Impact of Environmental Degradation on Growth and Development: Case Study of Iwaya Community, Lagos, paper presented at International Conference on Environmental Economics and Conflict Resolution, University of Lagos.

(22) C. A. Langston, and G. K. Ding, (Eds.) (2001). Sustainable practices in the built environment". Butterworth-Heinemann: Oxford.

(23) A. R Lapinski,. M. J Horman,. and D. R. Riley, (2006). Lean Processes for Sustainable Project Delivery. Journal of Construction Engineering and Management, 132(10), 1083-1091.

(24) M. Majumdar, (2006). Energy Efficiency in Green Buildings- An Integrated Approach to Building Design. Green Business Directory; CII-Godrej GBC. The Energy and Resource Institute, Habitat Place, New Delhi, 110 003.

(25) M.A. Khalfan. (2002). "Sustainable Development and Sustainable Construction": A Literature Review on C-San D Project. Department of Civil Engineering, Loughborough University.

(26) T . Mochal and A. Krasnoff, (2010). Green Project Management: Supporting ISO 14000 Standard Through Project Management Process [Electronic Version]. Retrieved 10th January 2017, from http://greeneconomypost.com/green-project-management-greenpm-iso-14000-11040.htm

(27) S. R. Muldavin, (2010). Value Beyond Cost Savings, How to Underwrite Sustainable Properties. USA: Muldavin Company Inc.
(28) S. Parkin, (2000)." Context and Drivers for Operationalizing Sustainable Development".
(29) D. Prowler, (2011). Whole Building Design [Electronic Version]. Retrieved 7th February 2017, from http://www.wbdg.org/wbdg_approach.php
(30) B. Reed, (2007). Shifting from 'sustainability' to regeneration. Building Research & Information, 35 (6), 674-680.
(31) W. G. Reed, and E. B. Gordon, (2000). Integrated design and building process: What research and methodologies are needed? Building Research and Information, 28(5-6), 325-337.
(32) E.S. Rubin, and C.T. Davidson, (2001). Introduction to Engineering and Environment. New York: McGraw-Hill Inc.
(33) R. Sappe, (2007). Project management solutions for building owners and developers. Building, 101(4), 22-22.
(34) M. William and Partners (2000). "The Hannover Principles, Design for Sustainability". Expo 2000. The World's Fair, Hannover. Germany.
(35) O. Zwikael, (2009). Critical Planning Processes in Construction Projects. Construction Innovation 9(4), 372-387

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