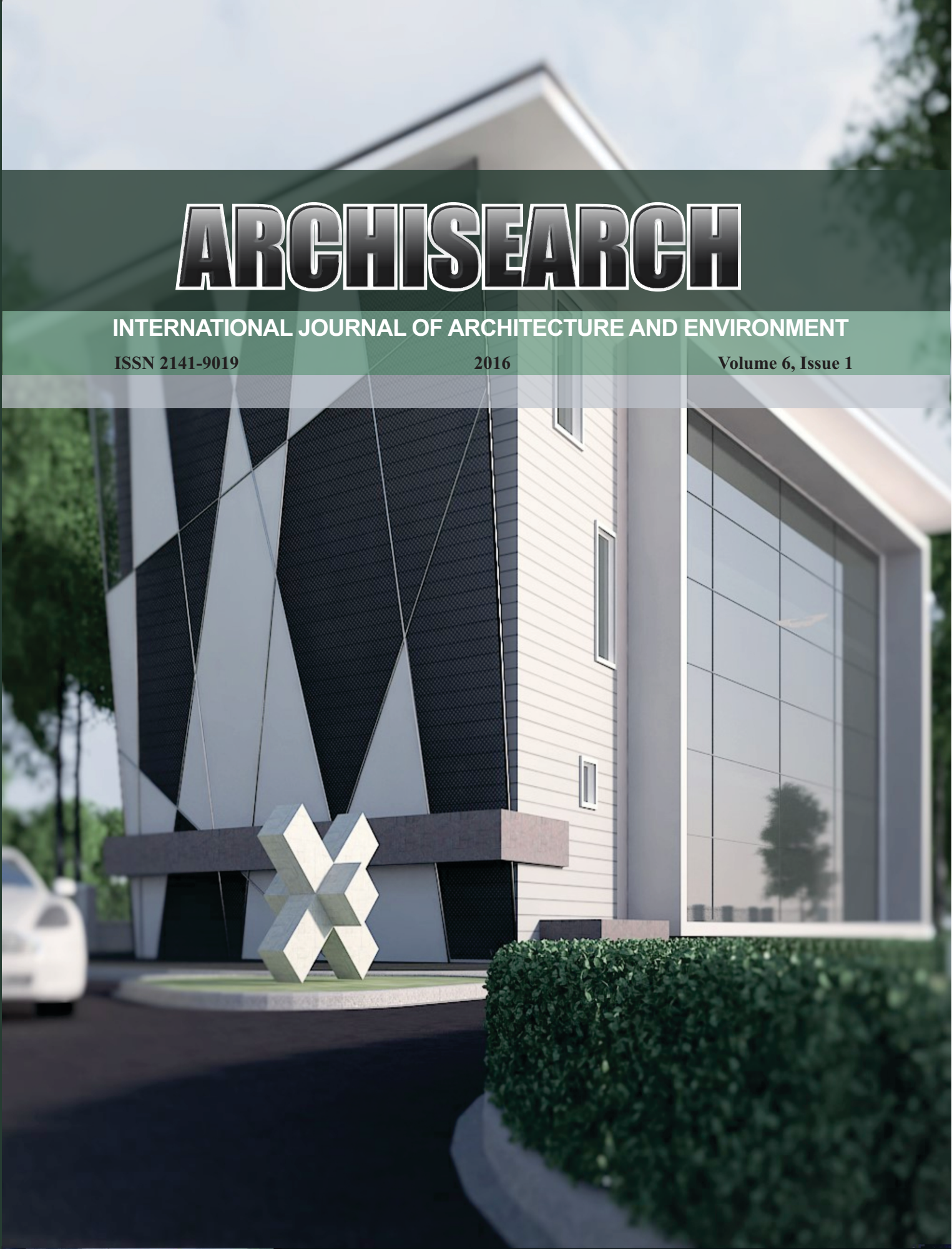


ARCHISEARCH

INTERNATIONAL JOURNAL OF ARCHITECTURE AND ENVIRONMENT

ISSN 2141-9019 2016 Volume 6, Issue 1

ARCHISEARCH

International Journal of Architecture and Environment

Volume 6 Issue 1



Published by The Department of Architecture, Ahmadu Bello University
Zaria-Nigeria
© 2016

Editorial Board
Dr. Abdullahi Abubakar (Chairman, Editor-in-Chief)
Dr. J. J. Maina (Secretary, Associate Editor)
Dr. R. B. Tukur (Associate Editor)

Volume 6 Issue 1 (2016)
ISSN 2141-9019

Cover image: *Exterior render by Haggai Stephen (stephen.haggai@yahoo.com, 0816 868 2711)*
Cover design and journal layout: *J. J. Maina*

This publication is typeset in Times New Roman font size 12 at the Department of Architecture, Ahmadu Bello University, Zaria. Articles published in this journal represent neither the views of the Editor-In-Chief nor the Department of Architecture, Ahmadu Bello University. Responsibility of opinions expressed and accuracy of facts rests solely with individual authors.

Copyright© 2016
All rights reserved. No part of this publication maybe reproduced, stored in a retrieval system or transmitted in any form or by any means electronic, mechanical or otherwise without the written permission of the publishers.

ARCHISEARCH is an international peer reviewed journal dedicated to the publication of high quality original research towards the advancement of theoretical and practical aspects of the built and natural environment. The journal disseminates academic research findings on issues that deal with architectural research and development, environmental problems, planning, design, management and construction regarding architectural science, education and technology. The journal provides a forum for discourse and scholarship between teachers and researchers in Architecture and the Built Environment.

Papers addressing the following themes are particularly invited:

- Innovative trends in Architecture, Planning, Construction and Design
- Student, Staff and Practice related perspectives on Design, Planning and Construction education
- Innovative learning environments
- Sustainable Architecture
- Interdisciplinary studies and collaborations in the Built Environment
- Sustainable technologies application and energy related studies in design
- Landscape and Urban studies
- Culture, Design and Architecture
- Entrepreneurship and Business opportunities in Design, Planning, Construction and Architecture
- BIM, Construction and Project Management

GUIDE FOR AUTHORS

Manuscripts must be written in British English, typed double-spaced on one side of A4 (230 x 210mm) sheets with 250mm margins. Papers must not exceed 6000 words or 15 pages inclusive of references. Papers should contain:

- Title, author's name(s), institutional affiliation, and corresponding author's email
- An Abstract not exceeding 250 words providing the purpose, methodology, significant results and conclusion of the research/study. The abstract should clearly state why the research is important particularly to those not necessarily in that field. Also provide at least 5 keywords in alphabetical order.
- Introduction outlining the Background to the study; Problem statement; Aim, objectives, hypothesis, premise or research question(s) as well as Organization of paper
- Literature review
- Methodology/research instruments
- Results/Findings and Discussion
- Conclusion, Acknowledgements and/or Appendices
- References according to the latest APA style

SUBMISSION INSTRUCTIONS

Authors should submit papers electronically to the **Editor-in-Chief** and Secretariat via the journal email address provided below:

archisearchjabu@gmail.com

Submissions should be accompanied by a scanned proof of payment/teller(s) of **N6,000** non-refundable assessment fee payable to the Journal account number provided below:

Account name: ARCHISEARCH Journal
Account number: 310 5096 516 (First Bank Plc.)

EDITORIAL ADVISORY TEAM

Professor H. T. Sa'ad
Department of Architecture
Ahmadu Bello University, Zaria Nigeria

Professor E. A. Adeyemi
Department of Architecture
Covenant University, Otta

Professor S. Zubairu
Department of Architecture
Federal University of Technology
Minna

Professor M. M. Garba
Department of Building
Ahmadu Bello University, Zaria
Nigeria

Professor K. Bala
Department of Building
Ahmadu Bello University, Zaria Nigeria

Professor W. B. Qurix
Kaduna State University
Kaduna

Professor U. A. Zanzan
Department of Architecture
University of Jos, Nigeria

Professor O. A. Olotuah
Department of Architecture
Federal University of Technology,
Akure, Nigeria

Professor J. B. Kaltho
Department of Urban and Regional
Planning
Abubakar Tafawa Balewa University,
Bauchi

Dr. A. S. Salisu
Department of Architecture,
Ahmadu Bello University, Zaria

Dr. M. D. Ahmed
Department of Architecture
Ahmadu Bello University, Zaria Nigeria

Professor M. L. Sagada
Department of Architecture,
Ahmadu Bello University, Zaria

Dr. J. O. Popoola
Department of Architecture
Ahmadu Bello University, Zaria
Nigeria

Professor A. Adamu
Department of Urban and Regional
Planning
Ahmadu Bello University, Zaria

Professor A. D. Ibrahim
Department of Quantity Surveying
Ahmadu Bello University, Zaria Nigeria

Dr. H. T. Kimeng
Department of Architecture
Ahmadu Bello University, Zaria

Dr. S. N. Oluigbo
Department of Architecture
Ahmadu Bello University, Zaria

Dr. S. B. Garba
Departemnt of Architecture
University of Qatar, Doha
UAE

Professor T. Arayela
Department of Architecture
Federal University of Technology,
Akure
Nigeria

Dr. Y. M. Ibrahim
Department of Quantity Surveying
Ahmadu Bello University, Zaria

Professor O. O. Ogunsote
Department of Architecture,
Federal University of Technology,
Akure, Nigeria

Dr. I. U. Hussain
Department of Architecture
Abubakar Tafawa Balewa University,
Bauchi

Professor M. O. Ogunrayewa
Department of Architecture
University of Jos, Nigeria

Dr. D. Ayeni
Department of Architecture
Federal University of Technology,
Akure, Nigeria

Dr. N. E. Suleiman
Department of Architecture
Kaduna State University
Kafanchan Campus, Kaduna State

Professor J. A. Fadamiro
Department of Architecture
Federal University of Technology,
Akure, Nigeria

TABLE OF CONTENTS

IMPERATIVES OF ALIGNING MEASUREMENT STANDARD WITH INFORMATION CLASSIFICATION SYSTEMS
Ganiyu Amuda-Yusuf, Taibat Ranti Adebiyi, Ibrahim Babatunde Oladapo & Soliu Idris..... 1

AN IMPROVED ASSESSMENT TOOL FOR REGENERATIVE ARCHITECTURE IN ECO-RESORTS
Sumayyah A. Kabir, Amina Batagarawa & M. H. Mukhtar 18

MARKETING STRATEGIES OF QUANTITY SURVEYING FIRMS IN KADUNA STATE IN THE 21ST CENTURY
Chioma Precious Ekweani, Kulomri Jaule Adogbo & Peter Gangas Chindo..... 28

ASSESSING RISK FACTORS IMPACTING THE ADOPTION OF BUILDIING INFORMATION MODELLING (BIM) BY BUILDING DESIGN FIRMS IN KADUNA AND ABUJA, NIGERIA
Mustapha Abdulrazaq, Mohammed Abdullahi & Amina Sani Bello..... 38

GENDER AND ACADEMIC PERFORMANCE IN ARCHITECTURAL EDUCATION: A CASE STUDY OF AHMADU BELLO UNIVERSITY ZARIA FROM 2011/2012 TO 2014/2015 SESSIONS
Muhammad Aminu Musa & Hassan Ozovehe Saliu..... 46

A FRAMEWORK FOR INTEGRATING BIOPHILIC DESIGN PATTERNS FOR IMPROVING PATIENTS' BIOLOGICAL RESPONSES OF CANCER CENTRES IN NIGERIA
Muawiya Maikudi, Amina Batagarawa & Mas'ud Abdulkarim..... 61

EFFECT OF VEGETATION ON THERMAL PERFORMANCE OF CLASSROOMS IN A HOT-DRY CLIMATE OF YOLA, NIGERIA
Sa'adatu Aminu, Olusegun Moses Idowu & Sumadanda Humphrey 72

PERCEPTIONS AND RELEVANCE OF ENVIRONMENTAL AND SOCIO-ECONOMIC LIFE QUALITY INDICATORS AMONG RESIDENTS OF KANO CITY, NORTHERN NIGERIA
Babangida Hamza & Binta Fatima Yahaya..... 83

FACTORS THAT INFLUENCE THE MOTIVATION OF NON-CONSTRUCTION PROFESSIONALS WORKING IN CONSTRUCTION COMPANIES IN ABUJA, NIGERIA
Abubakar Dardau AbdulAzeez, Shehu Ahmed Mohammed & Dauda Dahiru..... 99

BIM-BASED COST ESTIMATING USING THE NIGERIAN BUILDING AND ENGINEERING STANDARD METHOD OF MEASUREMENT (BESMM): INFORMATION REQUIREMENTS IDENTIFICATION
M. Abdullahi, M. Abubakar, Peter Gangas Chindo, U. Musa & A. Aminu 110

ARCHISEARCH

IMPERATIVES OF ALIGNING MEASUREMENT STANDARD WITH INFORMATION CLASSIFICATION SYSTEMS

Ganiyu Amuda-Yusuf[1], Taibat Ranti Adebiyi[2], Ibrahim Babatunde Oladapo[3] & Soliu Idris[4]

[1,2,3,4]Department of Quantity Surveying, Faculty of Environmental Sciences, University of Ilorin, Ilorin, Kwara State.

Corresponding author: *amuda.g@unilorin.edu.ng*

Abstract

The automation of Quantity Surveyors (QS) traditional quantity extraction and estimating process is practicable in Building Information Modelling (BIM). However, the existing measurement standards used by Nigerian Quantity Surveyors (NQS) will not facilitate electronic information exchange among project team because it is not aligned with any local industry classification systems. This paper examined the need for the measurement standard used in Nigeria to follow local information classification system which could enable it coordinate with other local product information and naming conventions. The research method adopted is literature synthesis, cross-country comparison and analysis of the classification systems that were adopted as basis for developing measurement standards in selected countries. This was followed by open ended interviews to experienced QS working in clients, contracting and consulting organisations. Content analysis was used to analyse the interview questions. The study reveals that different countries adopted different classification approaches based on their country specific classification systems in developing their local measurement standards, which in turn aids electronic information coordination among project participants. It was also found that, NQS can develop a measurement standard that could provide basis for the development of local information classification systems. Such standards will promote electronic information exchange among practitioners, facilitate speedy comparative evaluation of alternative design solution; assist in ICT adoption by QS, promote the use of e-procurement of construction project, reduce pre-construction documentation period, promote transparency in tender evaluation and promote QS ability to work with other project team members. The research suggests that the construction industry practitioners should collaborate and establish an industry-wide information classification systems that could provide basis for a common ICT platform for project team. Such standard should then form basis for measurement standard development by QS and specification documents by architect and engineers.

Keywords: *Building Information Modeling, Classification Systems, Collaboration, Electronic Measurement Standard, Quantity Surveyors*

INTRODUCTION

The wide use of information and communication technology (ICT) in the construction industry is changing the traditional method of project delivery while creating new opportunities for collaboration, coordination as well as information exchange among project participants Arayici, Egbu, & Coates, 2012). Previous studies have shown that

integration of project objectives and coordination of project participants is only achievable with the adoption and implementation of a common ICT platform that keeps track of all construction stages and collaboration under a common ICT platform. A need therefore arises to standardise the process for measurement and specify the procedure for procurement through electronic means for seamless collaboration and integration of cost information (Teo, Seah, & Chioh, 2006).

Following the advancement in ICT application in construction industry, QS in more developed countries are embarking on strategies to electronically integrate cost management processes with design and construction, through the development of measurement standards that aligns with construction industry classification systems. A measurement standard which promotes BIM-based quantity extraction and estimating process is required to allow QS to collaborate with other project team in performing their traditional functions (Teo and Heng, 2007; Cartlidge, 2011; Boon and Prigg, 2012; RICS, 2014).

Classification systems constitute the backbone of effective model–based information exchange among construction project participants (Eastman, Teicholz, Sacks, & Liston, 2011). Interoperability issues in the construction industry cannot be easily resolved without a set of rules and principles for classification of information requirements into data exchange specifications (Boon and Prigg 2012; Abdulahi, Abdullahi, & Musa, 2016). These classification systems differ greatly from country to country such as MASTERFORMAT and UNIFORMAT (now in Omniclass) in the US and Canada (Dell'lsola, 2002 Goedert and Meadati, 2008); Unified Classification for the Construction Industry (Uniclass) in UK (Boon and Prigg, 2012; Gelder, 2013); and Building 2000 in Finland because it supports BIM (Firat, et al., 2010).

However, Building and Engineering Standard Method of Measurement (BESMM4) published by the Nigerian Institute of Quantity Surveyors (NIQS) is the measurement standard currently used by the Nigerian Quantity Surveyors (NQS). The structure and term of set-out of BESMM4 is based on RICS New Rules of Measurement (NRM2) without reflecting the philosophy behind implementation of NRM2 in the UK. BESMM4 is not coordinated with any local classification and specification standards used by other built environment professionals. There is a dearth of industry classification and specification standards that links the activities of these professionals for effective information exchange. This is completely different from the practices in other countries where measurement standard is used to organise cost information. For instance, the seventh edition of Standard Method of Measurement (SMM&) was aligned with Uniclass (Cartlidge, 2011; Finch, 2012). While the NRM2 which serves as source document for BESMM4 was align with UK Standard Form of Cost Analysis (SFCA) a document that could also map into Uniclass Gelder (2013). Similarly, the Construction Electronic Measurement Standards (CEMS) in Singapore is aligned with Singapore Standard Code of Practice for Classification of Construction Cost Information (SS CP80:1999) (Boon and Prigg, 2012).

However, the Nigerian Quantity Surveyors (NQS) lags in efforts to ensure

that design and procurement information could be electronically shared on a common platform with other project stakeholders (Abdulahi, et al., 2016). Currently, little use is made by NQS of the numerous benefits that BIM offers in terms of capacity to collaborate to receive and share design and cost information with other project team members. According to Abdulahi et al.(2016), the slow pace of BIM adoption by QS is because of lack of conformance of BIM software to local standards such as measurement standards. The authors also observed that the data schema in Industry Foundation Classes (IFC) need to be extended to capture various local standards such as measurement standard and the information requirements establishing the local standards and provisions must be established prior to extension of IFC schema. However, the work of these authors ignored the importance of ensuring that BESMM3 be based on a classification system that reflects local practices in the construction industry before such extension could serve as basis for QS collaboration. Although the adoption of the model could facilitate BIM adoption at project and organisation levels but not at industry level because mere extension of IFC schema as proposed will not still provide good basis for collaboration among industry professionals.

Arguably, IFC's provide a designer-focused product model that explicitly represents components' and openings as an attribute of components (Staub-French, Fischer, Kunz, Paulson, & Ishi, 2002). However, QS have different preferences for describing these different design conditions and the impacts on the construction costs (Towey, 2013). But IFC do not provide a way to filter the component features connections in a way that are defined in the trade-based measurement standard used by Quantity Surveyors (Olatunji, Sher, Gu, & Ogunsemi, 2010; Boon & Prigg, 2012). This is because of the dearth of standard to support systematic data exchange between software applications and BIM models (Sabol, 2008). RICS (2014) considered the need to align BIM-based cost estimating and planning process with measurement standard so as to enhance QS collaboration in BIM environment. RICS explained that project team must agree on a set of requirements which is defined from the viewpoint of cost estimating and planning to enable the QS use BIM more effectively. This paper is an extension to the conference paper by (Amuda, Olowa, & Lateef, 2015) and the focus of this study is to investigate how Nigerian Measurement standard could align with Construction Information Classification System to facilitate electronic information exchange between QS and other project stakeholders on a common ICT platform. This standpoint is based on the supposition that interoperability issues in the construction industry cannot be easily resolved without a set of rules and principles for classification of information requirements into data exchange specifications (Yang and Zhang, 2006; Sabol, 2008; RICS, 2014). The use of classification system as basis for measurement standard development will enable sharing of complex cost information and ensure consistency in a project and from project to project.

This paper is structured as follows: The first section provides information on the relationship between information classification and measurement standards; the second section analyses the basis for

BIM pulled classification of construction information and alignment with measurement standard; the conceptualisation of the need to align BESMM4 with Construction Information Classification Systems, is presented in the third section. This is followed by research methodology and discussion of results. Lastly, conclusion and recommendations are made to industry stakeholders.

RELATIONSHIPS BETWEEN INFORMATION CLASSIFICATION AND MEASUREMENT STANDARDS

The information classification standards created by the Architectural Engineering and Construction Industry (AEC) are called Construction Information Classification Systems (CICS) and often defined as standard representation of construction project information (Carlos & Soibelman, 2003). The classification structure in CICS according to Klang and Paulson (2000) provided a common framework for improving organisation and coordination of information in construction projects. As the CICS codes serves as key fields for transferring information among project teams and facilitates access and management among project organisations. A CICS must consist of both a Work Breakdown Structure (WBS) for classifying information that comes from actual construction phases and an information management system for classifying materials such as construction product literature, procurement documents, and technical standards (Maritz, Klopper, & Sigle 2005)

It is important to note that, the standardised national classification systems started in the 1950s and 60s, in the Scandinavian countries, and some of the national information classification systems used in other countries include; the Swedish Classification System (SfB), the UK Common Arrangement of Work Sections (CAWS) and Unified Classification Systems (Uniclass); the Singapore's Code of Practice for Classification of Construction Cost Information (SS CP80: 1999) and Code of practice for Classification of Construction Resource Information – SS CP 93:2002, The Australian National Specification Systems (NATSPEC) (Winch, 2010). The use of CICS as basis for electronic measurement standards in selected countries is discussed in the next sections.

The Swedish Building Classification Systems

The Swedish building classification system (SfB) is one of the most important classification systems in use. The system originated from Sweden and had been in use since 1945 and is still the basis for many existing national knowledge classification systems such as CI/SfB used in the UK (Winch, 2010). The committee that was responsible for the establishment of SfB was called Samarbetskommitten for Byggnadsfragor, from which the acronym SfB was formed. The SfB was centrally adopted in Sweden as the national method for organising official and national construction industry specifications, price books and building product sheets (Maritz, et al., 2005). The SfB system set-out information in such a way that it can be easily stored and retrieved for quick reuse.

The weaknesses in CI/SFB as identified by Winch (2010) are: it applies only to building and not civil engineering; it does not contain classifications for process elements; its coding system is inappropriate for computerisation; new facility types have developed which are

not included. The limitations associated with this classification system leads to the publication and adoption of globally recognised classification principles known as Unified Classification for the Construction Industry (Uniclass) in the UK published in 1997 (Winch, 2010). UniClass is the UK implementation of BS ISO 12006-2. The new code of practice, BS 1192:2007 referred to as collaborative production of architectural, engineering and construction information, published in January 2008, recommends the use of Uniclass (Gelder, 2010). Uniclass was adopted as basis for the classification of the revised SMM7 in the UK as explained in ensuing sections.

The UK CAWS, UNICLASS and Measurement Standards

The CAWS first published in UK in 1987 purposely to promote standardisation and coordination between Bills of Quantities (BoQ) and specifications. It is the document used to set–out the National Engineering Specification (NES), the National Building Specification (NBS), and the seventh edition of the UK standard method of measurement (SMM7) (Seeley and Winfield, 1998). The CAWS comprise of 24 levels "1" group headings and about 300 work sections divided between building fabric and services; section numbers are kept short and cross reference are made to the specification to facilitate consistencies between various documents used on building project (Finch, 2012). Project specifications often prepared by designers and arranged on the basis of the CAWS; this is similarly applicable to the library of clauses in both the NBS and the NES for services installations (Gelder, 2010; Gelder, 2013). The lists of items in each work section are coded to allow for completion of specifications and advice on specification preparation by reference to British Standards (Co-ordinated Project Information, 1987). The overall aim of this is that, if the descriptions in the BoQ are cross referenced to clause numbers in the specification, then the co–ordination of drawings, specifications and BoQ will be improved and the risk of inconsistent information will be reduced (Seeley 1989; Seeley and Winfield 1998; Ashworth 2004; Brook 2008). The major shortcoming of CAWS is that, it does not easily adaptable to computerised applications. The alphanumeric order in CAWS is not ordered in elemental format; therefore, it is not suitable for object naming in the software models. This constitutes one of the reasons for the development and implementation of Uniclass in the UK.

However, Uniclass is a more current classification system published in UK in 1997 for the UK construction Industry (Finch 2012). The Uniclass was made of a new work section classification which incorporates CAWS in Table J and replaces the conventional CAWS published in 1987. Uniclass also incorporates the Electronic Product Information Co-operation (EPIC) which is a new European standard for structuring product data and product literature. The elemental classification of building products is incorporated in Section G of Uniclass (Gelder, 2010; Gelder, 2013). One of the main reasons for this development is the need for classification systems and specification of designs to accommodate civil engineering and process engineering, as well as architecture and landscape. Another reason for the development of Uniclass is the requirement for the classification of works to include a description of all anticipated works that a contractor may

carry out on a project. The CAWS cannot accommodate these requirements. The main function of Uniclass system was to unify all available classification systems developed in UK; Uniclass was based on CI/SfB, CAWS, CESMM3 and EPIC and the tables are arranged to represent the different facet of construction information unified with sub-titles and coding system. This approach according to Gelder (2010) and Finch (2012) laid an efficient basis for computer applications and can be used in: establishing product literature; organise project information; developing technical and cost information; structuring frame of reference for databases; set-up Libraries.

The Singaporean SS CP80: 1999 and SSCP 93:2002

The SS CP80:1999 was developed to serve the key purpose of allowing the exchange of data and information to guarantee effective communication of design, construction and contractual matters relating to cost through a uniform and accepted classification format. The main components of the standard are: an elemental classification; a work-section classification; a mapping dictionary for elements and work sections and a set of guidance notes. The standard was developed in 1999 by reviewing relevant international standards and an adaptation of a few international standards to suit local use (Productivity and Standard Board (PSB), 1999). Users of this standard in Singapore are property developers, architects, mechanical and electrical engineers, civil and structural engineers, quantity surveyors and contractors. The long-term benefits for users include an efficient information exchange between different parties, reduction in duplication of work between the different disciplines, increased familiarity with a uniform standard leading to an overall increase in productivity for the company as well as the industry. In Singapore, the Construction Industry IT Standards Technical Committee (CITC) formed in 1993 and the Construction and Real Estate Network (CORENET) formed in 1998 for ensuring that national standards are aligned with international standards as well as other industry de facto standards; leading to the publication of Singapore standards (Goh & Chu, 2002):

The Singapore Standard Code of Practice for Classification of Construction Cost Information is to ensure that construction cost information is structured and stored in a way that is consistent and reliable within and between the different disciplines to reduce any duplication of work. In addition, the Code of Practice for the Classification of Construction Resources Information will present a uniform system for classifying information relating to construction products, materials, services and machinery. The main purpose of the standard is to develop and provide a standardised format to facilitate procurement activities in the construction industry as construction projects are used for a broad range of products and services, there is a greater need for a classification standard to ensure a consistent and structured way of information exchange and storage (Goh & Chu, 2002). The Singapore industry appears to have made the most progress in agreeing a coding system to facilitate exchanges of information between computers based design models and costing systems. According to Boon & Prigg (2012) the Singapore Standard CP97: Parts 1 & 2 2002 “Code of Practice for Construction electronic standards” is

aligned with Singapore Standards CP 93:2002 classification of construction resources information and CP 83: 2000 construction computer-aided design, to ensure a common classification and coding system is adopted across the industry.

The Australian NATSPEC

The Australian NATSPEC was developed and published by the Construction Information Systems Australia (CISA). CISA established in 1975 with the primary responsibility to develop, produce and maintain the national building specification in Australia. NATSPEC is arranged around work sections that are broken down into subsections, clauses and then sub-clauses (Nani & Adjei-Kumi, 2008). NATSPEC also covers tendering procedures, preliminaries, quality assurance and contract issues. The fifth edition of the Australian Standard Method of Measurement is linked to the structure of NATSPEC. These basic classifications provide a comprehensive classification system for knowledge of the construction process and constructed product which can be used for the storage of both physical media such as catalogues and drawings, and digital media in databases (Winch, 2010). International standards for the layering of CAD models covered by the ISO 13567 series also rely on ISO 12006. Uniclass incorporates the UK classification standards for the construction process CAWS and is, therefore, compatible with both SMM7 and CESMM3 (Eastman & Liston, 2008).

The classification, terms of set–out, terminology and sections of the fifth edition of Australian Standard Method of Measurement (ASMM5) were aligned with the classification systems in NATSPEC. NATSPEC also covers tendering procedures, preliminaries, quality assurance and contract issues. These basic classifications provide a comprehensive classification system for knowledge of the construction process and constructed product which can be used for the storage of both physical media such as catalogues and drawings, and digital media in databases (Winch, 2010). Therefore, BoQ based on ASMM5 are readily aligned with NATSPEC sub–contract sections. NATSPEC was jointly developed by all key stakeholders in the Australian construction industry. Rationalisation of the rules of measurement in the previous edition (ASMM4) resulted in the deletion of measurement rules for a number of less common items and the introduction of rules of some sections of works that were not contained in the previous editions (Australian Institute of Quantity Surveyors, 1990).

Conceptualisation of the need to align measurement standard with classification standard

Recent advances in ICT adoption in construction industry have shown that QS need to collaborate with other project team members to perform their cost management roles and functions. Achieving this will require a measurement standard that could facilitate electronic exchange of construction information on a common ICT platform. The implication of this is that, the traditional standard method of measurement will need to be developed in such a way that it will take cognisance of the method used by other construction professionals to classify and name construction elements. This is referred to as Construction Information Classification Systems.

Classification is described as a means to facilitate communication among actors in a field of practice. In the construction sector, classification plays a significant role in structuring information in specifications, structuring of documents and calculation of costs (Ekholm, 1996). Goh and Chu (2002) opined that there is a need for a common language if the benefits of IT are to be optimised in the construction industry. Mainly because unorganised information is difficult if not impossible to access and therefore as good as lost. On the other hand, if information is properly organised using a common language, it will guarantee timely access for users and speedier transmission and exchange. This will optimise the deployment of scarce manpower for increased productivity and help to make the highly diversified and fragmented construction industry more efficient (Lee, et al.,1989).

Developing acceptable National standards requires engaging key stakeholders and making them understand that standard development is a means and not an end in itself. This is capable of supporting communication between man and man, man and machine and machine and machine(Lee, Leong, Nee, & Chan, 1989). One of the main concerns of industry standard developers (especially SMMs) is the conservative nature of the construction industry. It is quite difficult for the industry to let go of existing practices for new methods, even improved ones. Clients have been identified as the main driver of change in the construction industry (Bourne and Walker, 2006). Consultants and constructors also have considerable influence, but software developers can also be prominent drivers of change. Therefore, in developing and adopting an SMM, it is necessary to evaluate the influence of the various industry players, while keeping in mind Goh and Chu's (2002) recommendations.

However, an examination of BESMM4 showed that the document was not coordinated with any local information classification systems. Rather, the document possessed similar rules of measurement as in NRM2 and the 4th edition of CESMM4. Measurement rules are presented in a tabulated format and are classified under classification table; measurement rules; definition rules; coverage rules; and supplementary information (Amuda-Yusuf, 2016). The implication of this is that, it will be difficult for QS to use the document to collaborate with other project team members to exchange electronic information for automated quantity extraction and estimating process on a common ICT platform (Teo & Heng, 2007; RICS, 2014). For example, proponents of BIM considered that it has the capability for automated quantity extraction and estimating but the rules of measurement would be required to provide the basis for codified framework for cost planning (Matipa, Cunningham, & Naik, 2010). This will enhance the involvement of quantity surveyors in the provision of early cost management services to the project team, resulting to a more reliable and consistent approach in the allocation of cost resources (Arayici, et al., 2012).

However, Boon & Prigg (2012), said that there is a significant non- alignment between the object in BIM models and the traditional trade items in standard method of measurement because the objects in BIM 3D model represent components of the finished product whereas the SMM

calls for quantification of the work to create that component. A need arises, for QS to consolidate the BIM Schema with the information from the rules of measurement to improve the consistency and efficiency of BIM based measurement and estimating approaches (Matipa et al. 2010; Abdulahi, et al., 2016)). These reasons underscore the need for the review of the rules of the conventional Standard Method of Measurement in more developed economies like the UK where the use of SMM7 is now outdated (Gelder, 2010; RICS, 2014); The Australian ASMM6 was also rationalised by the Australian Institute of Quantity Surveyors to align with Australian NATSPEC (AIQS, 2016) and Singapore Construction Electronic Measurement Standard (CEMS) (Goh & Chu, 2002).

The structure and term of set-out of the Nigerian BESMM4 is based on RICS NRM2 and is not aligned with any local classification systems. This may make it difficult to provide basis for EMS. This approach may not facilitate the adoption of ICT tools by local industry practitioners as observed by Ofori (2000) that the procurement and contract administrative procedures used in developing countries are those passed on by the western countries. The author considered that Western countries have evolved with different history, culture, collective experience and level of construction expertise. However, the inherited procedures are adopted for contract documentation, procedures, and practices in the construction sector of the various developing countries. Ofori (2000) further considered that, the practices in the countries of origins of these standards and codes have changed to reflect the current technological development. For instance, findings from this study shows that, the first edition of UK SMM7 published in 1988 was based on common arrangement of work sections (CAWS-UK specific classification systems) while the second edition published in 1998 was based Uniclass-also a UK specific classification system). However, the need to meet up with BIM requirements has made SMM7 to be out of date in UK and has been replaced with the NRM2. The classification in NRM2 is based on SFCA systems, but the classification in the NRM2 could still map into both CAWS and Uniclass (Finch, 2012).

Similarly, the Singapore CEMS already made provisions for referencing to IFC under the measurement rules (Yong, et al., 2004). Therefore, the format of the BESMM must lay foundation for this by ensuring that there is provision to expand the measurement rules and coding systems to accommodate the industry classification systems. The use of software in the construction industry has global applications. Software vendors often based the classification in their applications on international standard for specific industry applications. Example of this is Uniclass in UK, NATSPEC in Australia and Omniclass in USA. At this stage, reference must be made to other international standards that other countries have tried to align the rules of their local SMM with. At the same time, provisions will be made to ensure that the standards available and used in other country comply with local preferences in the country. This will ensure that, when Nigerian classification system is fully developed, the classification and coding systems in the BESMM4 will be adaptable to its provisions.

Although, the classification systems in the UK (CAWS and Uniclass) were first developed in the UK before aligning UK SMM7. However, in Singapore, the contents of the standard method of measurement of building works published in 1986 was adopted to provide the local terminology and vocabulary, while UK SMM7 and Uniclass Section J was adopted to provide the framework for the work section classification (Goh, 2002). Therefore, in developing measurement standard the NQS could modify the traditional approach used for SMM development by taking cognisance of the approaches used in other countries.

RESEARCH METHODOLOGY

The study started with a comprehensive review of literature on SMM development and Information Classification Systems (ICS). The relationship between ICS and measurement standard development were then examined in detail. The review process was supplemented by the personal observations and experiences as well as interaction with experienced industry players. The methodology used for collecting practitioners' opinion was by interview. The targeted respondents are QS working in clients, contracting and consulting organisations. The interview was limited to QS because measurement of construction work is primarily the work of QS and other professionals were neither involved nor interviewed. Snowballing sampling approach was adopted to ensure that respondents have sufficient experience in the use of measurement standard. A number of questions were asked by email and face-to-face interview regarding the structure, development process and the classifications systems used in developing measurement standards. Respondents were told that their views would be reported anonymously and that the outcome of the study will be made available to them. A total of 27 interviews were conducted and the breakdown is shown in Table 1. A total of 30% of the respondents are form-contracting organisation, 26% from clients' organisation and the remaining 44% are from consulting organisation.

Table 1: *Organisations of Interviewees*

Organisation Type	Interviews Conducted	Percentage
Contracting	8	30%
Client	7	26%
Consulting	12	44%
Total	27	100

Table 2: *Positions of Respondents*

Designation	Number	Percentage
Principal Partner	5	18%
Managing Partner/Directors	8	30%
Contract managers/Estimators	8	30%
Managing Directors	6	22%
Total	27	100

As can be seen in Table 2, 18% of the respondents are principal partners, 30% are managing partners/Directors, 30% contract managers/estimators and the remaining 22% are managing directors. The positions of the respondents show

that the interviewees are highly experienced and that the information obtained from them is reliable. The interviews were conducted at the interviewees' own offices and the timescale for the interview ranged between thirty minutes to one and half hour. The interviews were undertaken over a period from February 2016 to July 2016. These questions included asking about the experience of the interviewees' regarding the use of the traditional measurement standards. The reasons for asking these questions were to ensure the interviewee has enough experience to comment on the EMS. After asking the background information, an explanation of what is meant by information classification system was offered before the ''Open-ended'' questions regarding the need for aligning measurement standards with information classification systems in Nigeria. The author explained how such measurement standard can facilitate automated quantity extraction and estimating process, the structure and development process. After the explanations, interviewees were requested to comment on the following points raised:

i. Is it possible for Quantity Surveyors to align measurement standard with information classification systems in Nigeria?
ii. How should information classification system be developed to meet the requirements of local practitioners?
iii. What benefits will result from aligning measurement standards with information classification systems?

Their responses were grouped according to the questions posed and a content analysis was adopted to analyse their responses. Research findings are discussed in the next section.

RESULTS AND DISCUSSIONS

Aligning Measurement Standards with Information Classification Systems by NQS

On whether it is possible for QS to align measurement standard with information classification systems in Nigeria, predictably, all the responses were qualified and about 52% of the interviewees fell into the "Yes with comments" while the remaining 48% fell into the "No with comments" categories. The views of the "YES" categories of respondents were that it is possible and that the use of computer applications in measurement is not new by the NQS. The reservations here were mostly about the lack of generally accepted classification system adopted by all professionals as is the case in more developed countries. It was felt that, if developed, the traditional ways of working by Architects, Engineers, Quantity Surveyors and other project team members must be reflected before it can support a seamless information exchange among project participants. One of the respondents felt that the development should be by QS with other experts from the construction industry and implementation should include software companies. Three (3) of the "No" categories of respondents believe that useful standards do not exist and any new development should start from a common local industry practices. About 75% of the respondents agreed that major changes were necessary to make the current BESMM4 match the local industry practices. The need for integration of design, specification and costing as basis for collaborative working was also proposed to the industry.

Development of information classification systems

On how information classification systems should be developed, respondents to this question all believed on the need for Construction Industry Classification Standards to be the basis for measurement standard that could aid electronic transfer of information. However, they differed on what should be classified or to adopt classification approaches from other countries. For wide recognition, some felt that such classification should be formalised to follow international standard such as ISO which has been used as basis for classifying products information. Another opinion was on the need to use a classification standard developed locally and possibly align with other international standards because classification systems in Europe may be different from that of US. The main issue highlighted by one of the respondents in the "No." category is whether the industry professionals supported the development of such classification standard. The respondent further stressed that, since the importance of such classification systems is not well known, it may not be supported. Another important observation was the issue of adaptability of such measurement standard for BIM model quantity extraction in line with QS practices. This may need consideration to ensure that it is useable in BIM environment to perform the traditional QS roles. Another point raised during the interview was that useful classification standards that can directly meet local requirements do not exist and any new development should start from industry practice and ideas. More classification and data definition work is required locally for such measurement standard to facilitate collaboration among practitioners. These findings also corroborate the work of Gelder (2013) that standard is required to promote efficient collaboration among project participants, and suggested that a single all-embracing national classification system with one structure and philosophy is needed and such classification systems must be able to serve the whole project timeline, all disciplines and all sectors.

Benefits of aligning Measurement Standards with Information Classification Systems

A key question was "what benefit will result from aligning measurement standards with information classification systems?" Under this question, highlights of the benefits of measurement standards that aligned with information standards were suggested to the respondents. This is to ensure that respondents actually understand and agree with the benefits associated with measurement standards that can support information sharing with other professionals on a common ICT platform. Almost no one questioned that benefits from the use of such measurement standard were achievable and to all involved in the procurement process. The main beneficiary would be the client because of efficiency resulting from collaboration by project team members to work and share information on a common platform. It will also lead to efficient information communication between the project team and the contractors including the project participants at the downstream of the supply chain.

Other benefits as supported by the respondents include:

i. It will ensure that local industry practitioners' views are effectively considered in the preparation of the document since the mode of practices used by other team members will

need to be captured and reflected for ease of information sharing.
ii. Promote electronic exchange of information by practitioners.
iii. Development of EMS will facilitate speedy comparative evaluation of alternative design solution.
iv. Development of EMS will greatly assist in ICT adoption by QS.
v. Promote the use of e-procurement of construction project.
vi. Reduce pre-construction documentation period.
vii. Promote transparency in tender evaluation and reporting.
viii. Promote QS ability to work with other project team members

CONCLUSION

This study has examined the need to align the Nigerian BESMM4 with construction industry information classification system to facilitate QS collaboration in model-based quantity extraction and estimating process. The nature of the construction industry classification systems used in some selected countries were identified and the relationships between their measurement standards highlighted. The study shows that the current BESMM4 would need to align with local industry classification systems to be acceptable to other project team members and possibly be used as basis for developing the local classification systems. Although the Nigerian project delivery model is based on UK practices and the use of standard method of measurement by Quantity Surveyors as basis for bills of quantities is a common practice. However, adoption of the classification systems in UK construction industry or any part of the world may not meet the requirements by Nigerian Quantity Surveyors to collaborate with other project team members at local level. Therefore, for BESMM to define basis for adoption of emerging ICT applications, the layout must be able to map onto a local classification systems agreed by the practitioners (Architects, Engineers, Quantity Surveyors and contractors). Findings shows that development of such measurement standard by Nigerian Quantity Surveyors is feasible. If developed, the benefits of implementing it at industry wide level include involvement of local practitioners, promote electronic exchange of information by practitioners, facilitate speedy comparative evaluation of alternative design solution; assist in ICT adoption by QS, promote the use of e-procurement of construction project, reduce pre-construction documentation period, promote transparency in tender evaluation and reporting and promote QS ability to work with other project team members.

Aligning BESMM4 with classification systems cannot be achieved solely by the Nigerian Institute of Quantity Surveyors. There is need for a collaborative synergy between all the construction industry professionals and they must take a lead in defining the structure of the classification standard. This effort must also involve software vendors to give direction with respect to integration with ICT tools, while Government should provide a policy framework that will facilitate standard development and adoption by the professionals in the industry. The entire industry stakeholders must be involved to reduce barriers to the adoption of the classification standard and the role players must: identify public and private sectors to be involved; determine resources required; select international standards to be revised; and target win-win results among industry stakeholders.

Although this research falls short of developing measurement standards that align with classification system, it clearly provides indicators to industry practitioners on step to take in aligning classification system with measurement standards. The study suggests that the NQS should abandon the idea of merely reviewing RICS measurement standard that is based on UK practice and address the issue of collaborative working with local industry practitioners. This will encourage local-centred and context-sensitive approaches to measurement standard development.

REFERENCES

Abdulahi, A., Abdullahi, M., & Musa, U. (2016). Developing Information Requirement Model for BIM-Based Quantity Take-off Using Building and Engineering Standard Method of Measurement 3 (BESMM3). Nigerian Building and Road Research Institute. Abuja: NBRRI. Pp. 1-16.

Amuda, G., Olowa, T. O., & Lateef, S. (2015). Classification of the Nigerian Building and Engineering Standard Method of Measurement for Electronic Measurement. In Ogunsemi. D.R., Aje. O.A, & Awodele. O.E (Ed.), NIQS RECON 2: Confluence of Research, Theory and Practice in Quantity Surveying Profession for a Sustainable Built Environment (pp. 122-132). Akure: The Nigerian Institute of Quantity Surveyors.

Amuda-Yusuf, G. (2016). BIM Interoperability and Information Standardisation. The Nigerian Institute of Quantity Surveyors 3- Day National Workshop/2016 Annual General Meeting on Building Information Modelling (Bim): The Concept, Applications and Benefits in Project Development; Date: 8th – 10th November 2016. Port Harcourt. pp. 1-22.

Ashworth, A. (2004). Cost Studies of Buildings (4th ed.). London: Pearson Prentice Hall.

Ashworth, A., Hogg, K., & Higgs, C. (2013). Willis's Practice and Procedure for the Quantity Surveyor (13th ed.). Chichester: Willey-Blackwell.

Arayici, Y., Egbu, C. and Coates, P., (2012). Building Information Modelling (Bim) Implementation and Remote Construction Projects: Issues, Challenges, and Critiques. Journal of Information Technology in Construction (ITcon), Volume 17, pp. 75 - 59.

Ashworth, A., (2011). Book Review- The Impact of Building Information Modelling: Transforming Construction by Ray Crotty. pp. 1-6

Australian Institute of Quantity Surveyors, (1990). Australian Standard Method of Measurement of Building Works. 5th ed. Brisbane, Australia: Clarke & Mackay.

Boon, J. and Prigg, C., (2011). Releasing the Potentials of Bim In Construction Education. Amterdam, Management and Innovation for a Sustainable Built Environment 20–23 June 2011, Amsterdam. Retrieved November 12, 2014 from http://misbe2011.fyper.com/proceedings/documents/130.pdf,

Boon, J. and Prigg, C., (2012). Evolution of Quantity Surveying Practice in the use of BIM - the New Zealand Experience. Montreal, Canada, CIB, pp. 84-98.

Boon, J., Prigg, C. and Mohammad, I., (2011). Cost Modelling in a BIM Environment. In Proceedings of 15th PAQS Congress. Pacific Asian Quantity Surveyors. pp 33-40, held on 25th and 26th July 2011 at Cinnamon Grand Hotel, Colombo, Sri Lanka.

Carlos, H. C., & Soibelman, L. (2003). Automating Hierarchical Document classification for Construction Management Information Systems. Automation in Construction, (12), 395-406.

Cartlidge, D., (2011). New Aspect of Quantity Surveying Practice. 2nd ed. Oxford: Elsevier.

Cartlidge, D., (2013). Quantity Surveyor's Pocket Book. 2nd ed. Oxon: Routledge.

Dell'lsola, M. (2002). Architect's Essentials of Cost Management. New York: John Wiley & Sons.

Eastman, C., & Liston, K. (2008). BIM Handbook: A Guide to Building Information Modeling (1st ed.). Hoboken: Wiley.

Eastman, C., Teicholz, P., Sacks, R. and Liston, K., (2011). BIM Handbook: A Guide to Building Information Modeling for Owners, Managers Designers, Engineers, and Contractors. Second ed. New Jersy: John Wiley & Sons.

Ekholm, A. (1996). A Conceptual Framework for Classification of Construction Works. ITcon, (1), pp. 1-25.

Finch, R. (2012). Coordinating Common Arrangement, Uniclass, NBS and Rules of Measurement. Retrieved April 19, 2013, from http://www.thenbs.com/topics/practicemanagement/articles/coordinatingCommonArrangement-Uniclass-NBS-RulesofMeasurement.asp

Firat, C. D., Arditi, J., Hamalainen, J., Stenstrand, J., & Kiiras, J. (2010). Quantity Take-Off in Model-Based Systems. Proceedings of the CIB W78: 16-18 November. Cairo, Egypt: CIB Retrieved October 15, 2016 from http://itc.scix.net/data/works/att/w78-2010-112.pdf

Forgues, D., Iordanova, I., Valdivesio, F., & Staub - French, S. (2012). Rethinking the Cost Estimating Process through 5D BIM: a Case Study. Construction Research Congress, pp. 778 - 786.

Gelder, J. (2010). The new Uniclass Work sections table. Retrieved October 18, 2016, from http://www.thenbs.com/topics/DesignSpecification/articles/CPICandUniclass.asp

Gelder, J., (2013). Removing Barriers to Collaboration in the Built Environment, ICIS News-letter. [Online] Available at: www.icis.org [Accessed 16th March 2015].

Goedert, J. and Meadati, P., (2008). Integrating Construction Process Documentation into Building Information Modeling. Journal of Construction Engineering and Management, Volume 134, pp. 509 - 516.

Goh, B. and Chu, Y. L., (2002). Developing National Standards for the Classification of Construction Information in Singapore. Aarhus School of Architecture, CIB W78 Conference.

Kang, L. and Paulson, B., 1997. Adoptability of Information Classification Systems for Civil Works. Construction Engineering and Management, Volume 123, pp. 419 - 425.

Kang, L. and Paulson, B., (2000). Information Classification for Civil

Engineering Products by Uniclass. Construction Engineering and Management, Volume 126, pp. 158 - 166.

Keat, Q., (2012). Strategies and Frameworks for Adopting Building Information Modelling (BIM) for Quantity Surveyors. Applied Mechanics and Materials, Volume 174 - 177, pp. 3404 -3419.

Kori, S., & Kiviniemi, A. (2015). Towards Adoption of BIM in the Nigerian AEC Industry: Context Framing, Data Collecting and Paradigm for Interpretation. 9th BIM Academic Symposium & Job Task Analysis Review, NIBS 7-8 April 2015. Washington DC, USA.pp 34-41

Lee, B., Leong, C., Nee, Y., & Chan, W. (1989). A unified Information System for the Construction Industry. In proceedings of First IES Information Technology Conference. The Construction Industry, Singapore, 25-27 May. pp. 16-32.

Maritz, M. and Du Rand, R., (2009). Standard Method of Measurement for Underground Development Works. s.l., 13th Pacific Association of Quantity Surveyors Congress (PAQS 2009), pp. p2-103.

Maritz, T., Klopper, C. and Sigle, T., (2005). Developing National/Code of Practice for the Classification of Construction Information in South Africa. Building and Environment, Volume 40, pp. 1003-1009.

Matipa, W. M., Cunningham, P., & Naik, B. (2010). Assessing the Impact of New Rules of Cost Planning on Building Information Model (BIM) Schema Pertinent to Quantity Surveying Practice. In E. C. (Ed.), 26th Annual ARCOM Conference (pp. 625 - 632). Leeds,UK: Association of Reserchers in Construction Management.

Nani, G. E., & Adjei-Kumi, J. (2008). Customisation and Desirable Characteristics of Standard Method for Building Works in Ghana. Australia Journal of Construction Economic and Building, Vol 8, (2). pp.30-40.

Ofori, G. (2000). Globalisation and Construction Industry Development: Research Opportunities. Construction Management and Economics, 18, 257-262.

Olatunji, O., Sher, W., Gu, N. and Ogunsemi, D., (2010). Building Information Modelling Processes: Benefits for Construction Industry. Salford, CIB, pp. 137 - 151.

RICS, (2014). How can Building Iformation Modelling (BIM) Support the New Rules of Measurement (NRM) Report for Royal Institution of Chattered Surveyors, London: RICS.

Teo, A. L., Seah, K. and Chioh, J., (2006). CEMS - A Better Standard for Measurement of building Works.. Singapore, Singapore Institute of Surveyors and Valuers.

Teo, E. A. L. and Heng, P. S.-N., (2007). Deployment Framework to Promote the Adoption of Automated Quantities Taking-Off System, The CRIOCM International Symposium on "Advanced of Construction Management and Real Estate. Sydney, CRIOCM, pp. 8-13.

Sabol, L. (2008). Challenges in Cost Estimating with Building Information Modeling. (Design Construction Strategy) Retrieved September 29th, 2016, from The Power of Process in the Built Environment: http://www.dcstrategies.net/files/2_sabol_cost_estimating.pdf

Seeley, I. (1989). Advanced Building Measurement (2nd ed.). London: Macmillan.

Staub-French, S., Fischer, M., Kunz, J., Paulson, B., & Ishii, K. (2002, October 11). A Feature Ontology To Support Construction Cost Estimating. Retrieved 14th July,2012, From Center For Integrated Facility Engineering: http://www.stanford.edu/group/CIFE/online.publications/WP069.pdf

Towey, D., (2012). Construction Quantity Surveying:A Practical Guide for the Contractor's QS. Chichester: Wiley Blackwell.

Towey, D. (2013). Cost Management of Construction Projects. Chichester: Wiley Blackwell.

Winch, G. M., (2010). Managing Construction Projects: An Information Processing Approach. 2nd ed. Chichester: Wiley-Blackwell.

'Yang, Q. Z., & Zhang, Y. (2006, October 10). Semantic Interoperability in Building Design: Methods and Tools' ScienceDirect, 1099-1112, Retrieved 5th October 2016, from http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6TYR-4KJ0SV8

Yong, K., Seah, E., & Sun, H. (2004). Construction Electronic Measurement Standards-Re-thinking Quantity Surveying. Singapore: Synthesis.

Yong, S., Seah, E., H.W., Sun K. (2004). Construction Electronic Standard Part 2 – Standard Method of Measurement for Mechanical and Electrical Building Services, Retrieved August 18, 2011, from http://www.itsc.org.sg/pdf/Journal%202004/Section_Five_04/Five_Earthb.pdf, acc

ARCHISEARCH

AN IMPROVED ASSESSMENT TOOL FOR REGENERATIVE ARCHITECTURE IN ECO-RESORTS

Sumayyah A. Kabir[1], Amina Batagarawa[2] & M. H. Mukhtar[3]
[1,2 & 3]Department of Architecture, Ahmadu Bello University Zaria.
Correspondence email: sumykay@gmail.com

Abstract

This paper develops an assessment tool for regenerative architecture in eco-resorts. Establishing an effective regenerative architectural assessment tool becomes necessary due to social, environmental and economic problems. Regenerative architecture lacks assessment tool that includes relevant aspects of eco-resort design. Regenerative architecture is the practice of engaging the natural world as the medium for, and generator of architecture while eco-resort design makes minimal impact on the environment without compromising guests' comfort and safety. Four studies are reviewed by: Wells, Society of Building Science Educators (SBSE), Littman, and Bromberek within 1982-2009, because they present a relationship between Regenerative Architecture and Eco-resort designs. The methodology includes: a review of indicators of regenerative architecture from Well and SBSE; correlating the indicators of regenerative architecture with principles of regenerative architecture and, correlating the principles of regenerative architecture with eco-resort design considerations. The result generates a checklist titled 'Regenerative based checklist for design and construction of eco-resorts'. The checklist presents six principles; integration into the landscape; intelligent limits; intelligent construction; bold ecology; experience of place; and culture. Each of the principle has indicators used for evaluation. Each indicator can attain a score ranging from +100 to -100. The total number of indicators is 25, making the highest total score after evaluation to be +2500 and -2500 the lowest. Contributions of the study includes; applying 'Regenerative based checklist for design and construction in Eco-resort' as a measuring tool at design stage and as an evaluation tool at post occupancy stage.

Keywords: *Assessment tool, Construction, Design, Eco-resorts, Regenerative Architecture*

INTRODUCTION

Establishing effective green building assessment methodology is becoming necessary in the developing world because of the considerable environmental, social and economic problems (Hikmat and Saba, 2009). There are many available assessment methodologies on the market, yet from a comparative analysis performed by Yaunon (2011), each assessment methodology is accommodated to suite the environment for which it was designed for. An example is Leadership in Energy and Environmental Design (LEED) , which is mainly concerned with energy use and gives lower importance to water while Building Research Establishment Environmental Assessment Method (BREEAM) Gulf does exactly

the opposite thing. BREEAM Gulf gives a high weight on pollution. Estidama Pearl rating system does not give water use a higher weight than energy, despite the nature of the environment in existence. While Indoor environmental quality got low weight in all the rating systems except in Green Globes.

Sustainable Architecture offers LEED or BREEAM rating systems as assessment methodologies however; Sustainable Architecture is limited towards balancing economics, the environment and society (Singer, 2010). It focuses on causing "lesser harm"; that is reducing the usage of natural resources, energy consumption and, as a consequence, CO_2 emissions whereas Regenerative Architecture goes a step further and concentrate on creating, combining and improving natural and artificial systems (David, 2013). Regenerative Architecture is also geared towards the built and natural environment co-evolving as a single entity. This establishes that Regenerative Architecture is an improvement on Sustainable Architecture as illustrated in Figure 1.

Regenerative Architecture on another hand does not declare any assessment tool (Cole, 2011). Wells (1982) and SBSE, (1999) have proposed checklist for Regenerative Architecture, however these sources have failed to cover some principles of Regenerative Architecture as proposed by Littman (2009) that relate to Eco-resort design. Hence the need to explore and develop an assessment tool for Regenerative Architecture specific to Eco-resorts is necessary.

The aim of this paper is therefore to develop an assessment tool that evaluates the level of Regenerative Architecture principles reflected in Eco-resorts.

LITERATURE REVIEW

Wilderness Based Checklist For Design And Construction

A 'Wilderness-Based Checklist for Design and Construction' was proposed by Malcolm Wells (1982). Wells takes a naturally cultivated land, which he describes as a 'wilderness' as a model for regeneration, he also suggests that 'wilderness' gets a positive and perfect score while a sub-urban research lab gets a negative score.

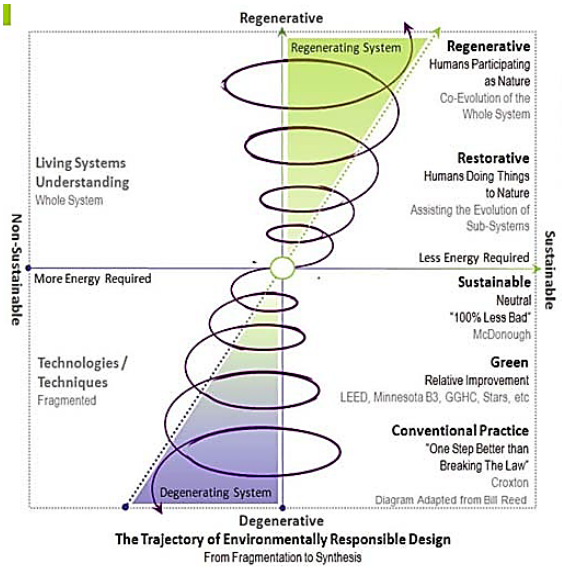


***Figure 1**: Steps towards Regeneration*
Source: (Doug Pierce after Bill Reed et al. 2006)

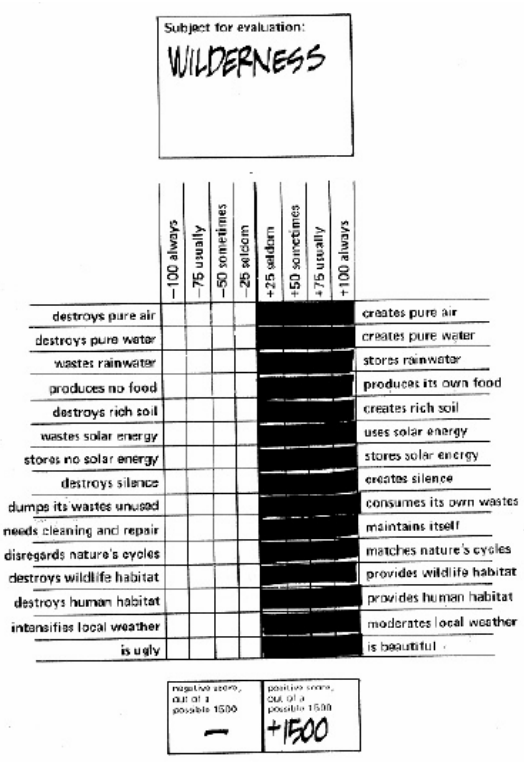
The Wilderness-Based checklist for Design and Construction includes 15 indicators used for evaluation; placing the worst aspect on the left side while the best on the right hand side this is illustrated in Table 1 and Table 2.

Based on Wells' checklist, the total highest score that can be achieved is +1500 while the lowest is -1500. A wilderness scores +1500 being the total highest score as illustrated in Table 1 while a suburban research lab scores -750 as illustrated in Table 2. Wells' checklist incorporates a rating system that starts

with +100 being the highest, +75, +50, +25, -25, -50, -75 and -100 being the lowest. This rating system allows each indicator to be evaluated based on its application on a building/site. The following are the scores and their explanation:

i. -100 means; always degenerating
ii. -75 means; usually degenerating
iii. -50means; sometimes degenerating
iv. -25 means; seldom degenerating
v. +25 means; seldom regenerating
vi. +50means; sometimes regenerating
vii. +75 means; usually regenerating
viii. +100 means; always regenerating

***Table 1**: Wilderness checklist (Regenerating score).)*

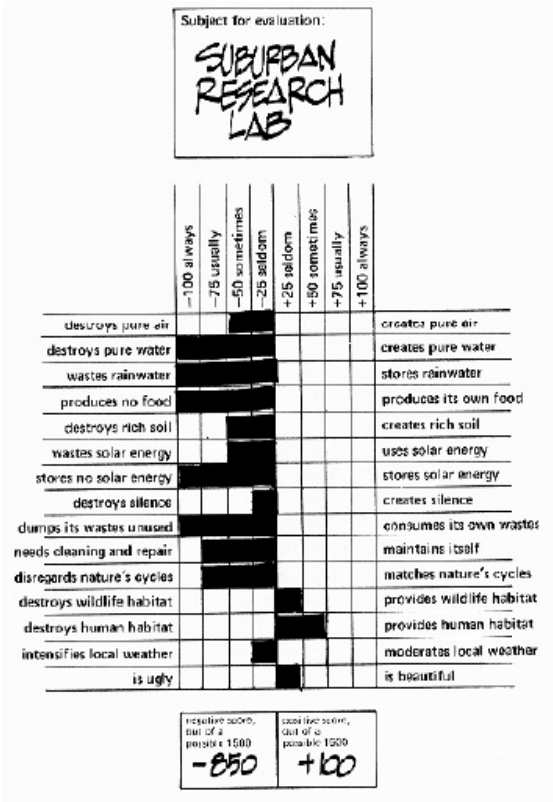


Source: (Wells, 1982

Regenerative Based Checklist For Design And Construction

Regenerative based checklist for design and construction' was proposed by Society of Building Science Educators (SBSE, 1999). SBSE studied Wells' checklist and revised it to reflect the four changes in thinking that have affected sustainable design.

***Figure 2**: Wilderness checklist (Degenerating score).*



Source: (Wells, 1982)

These changes include; proposing new indicators; categorising the indicators into building and site; introducing a '0' value to mean sustainable; and, providing explanations and considerations for indicators.

i. Proposing new indicators- 11 indicators are proposed, 8 indicators are adopted, while 3 indicators are renamed as illustrated in Table 3.
ii. Categorising the indicators into site and building- Table 4 illustrates the site and its indicators highlighted in

red, while the building and its indicators are highlighted blue. This technique is adopted for ease of assessing cases studied and acknowledging John Tillman Lyle's idea that sustainable design is merely breaking even, while regenerative design renews earth resources.

iii. Introduction of a '0' value to mean sustainable- This value is highlighted in green colour as illustrated in Table 4. The '0' value is neutral; meaning neither a positive nor a negative effect is practiced.

iv. Providing explanations and proposing considerations- SBSE went further to provide explanations and propose considerations for each indicator which are as follows;

- Pollutes air/ cleans air: Considers exterior air pollution via combustion, ventilation, and off-gassing.
- Pollutes Water/ Cleans Water: Considers water pollution by on-site toxic wastes, pesticides, insecticides, fertilizers, and petroleum products.
- Imports Energy/ Exports Energy: Considers the energy required to heat and cool the building, to maintain the site, and to provide electricity for lights and equipment.
- Requires Fuel-Powered Transportation/ Requires Human-Powered Transportation: Considers the building's accessibility by automobile, transit, bicycle, and foot.
- Intensifies Local Weather/ Moderates Local Weather: Considers the microclimatic effects caused by the building and site development.
- Excludes Natural Light/ Uses Natural Light: Considers the use of daylight for ambient and task lighting in the building.
- Uses Mechanical Heating/ Uses Passive Heating: Considers the systems used to provide heat to the building.
- Uses Mechanical Cooling/ Uses Passive Cooling: Considers the systems used to provide shade, ventilation, humidity control, and cooling for the building.
- Needs Cleaning and Repair/ Maintains its self: Considers durability of the materials and systems used in the building.
- Produces Human Discomfort/ Provides Human Comfort: Considers thermal, luminous, and psychological comfort.
- Pollutes Indoor Air/ Creates Pure Indoor Air: Considers the building materials, furnishings, and maintenance requirements as sources of indoor air pollution.
- Consumes Food/ Produces Food: Considers food produced for humans and other species.
- Destroys Rich Soil/ Creates Rich Soil: Considers soil destruction through hard landscape creation (the roof and pavement) and pollution.
- Dumps Wastes Unused/ Consumes Wastes: Considers the fate of all wastes created on-site (waste water, trash, pollutants) while the building was being constructed and during its lifetime.
- Is a Bad Neighbour/ Is a Good Neighbour: Considers the building and site's relation with its neighbours.

- Is Ugly/ Is Beautiful: Considers organic rightness, appropriateness will repair the broken connection between architecture and its roots.
- Built of Recycled Materials/ Built of Virgin Materials: Considers materials used for paving, structure, finish, and furnishing.
- Cannot Be Recycled/ Can Be Recycled: Considers the materials used and the construction techniques employed as well as the suitability of the structure for new uses in the future.
- Serves as an Icon for the Apocalypse/ Serves as an Icon for Regeneration: Consider the symbolic nature of the building.

Principles Of Regenerative Architecture

Regenerative architecture is defined as the practice of engaging the natural world as the medium for, and generator of the architecture. Littman (2009) develops principles of Regenerative Architecture, stating that the criteria developed were using the scale of permanence method of permaculture. For example, the first and most permanent system on the site is Climate. The climate is systems in which we have very little control over, thus we perform the place analysis starting with climate. The last to be processed in the place analysis step is Aesthetics and Experience of Place, because this has been determined to be the most malleable site system in which we are concerned with in RA. These principles are; integration into the landscape; intelligent limits; intelligent construction; bold ecology; experience of place; and culture.

Eco-Resort Design Planning Considerations

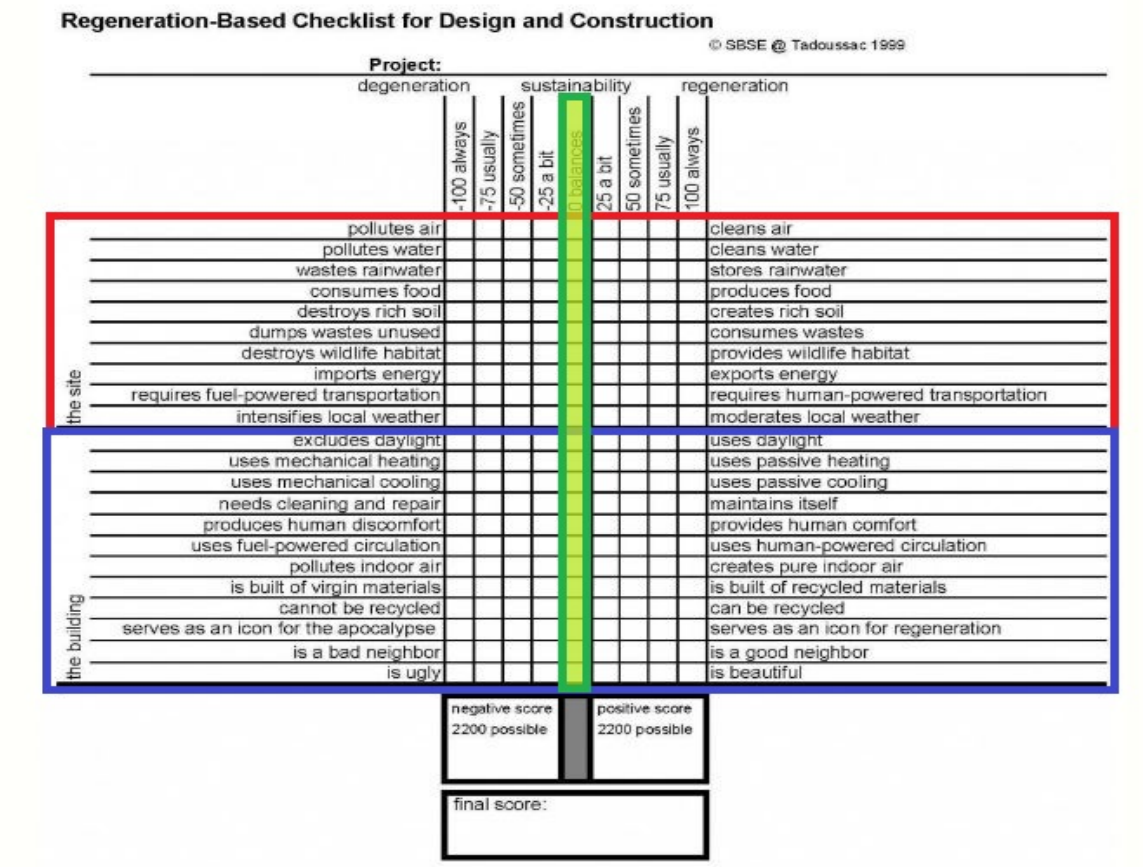
Eco-resorts are also defined as resorts making minimal impact on the environment without compromising guests' comfort and safety (Bromberek, 2009). Eco-resorts minimise use of energy through passive solar design and, where additional energy inputs are required, they also utilise the renewable resources of sun, water and wind making minimal impact on the environment by limiting waste, emissions, pollution and other undesirable effects of the operation. Bromberek (2009) discusses that design and planning consideration include; energy management; water management; waste and pollution management; impact of building materials and construction technologies; and relationship between tourist and the site.

Table 3: Status quo of Indicators on SBSE Regenerative based checklist for design and construction

INDICATORS	STATUS
Pollute air/ cleans air	Renamed
Pollutes water/ cleans water	Renamed
Wastes rainwater/ stores rainwater	Adopted
Consumes food/ produces food	Adopted
Destroys rich soil/ creates rich soil	Adopted
Dumps waste unused/ consumes wastes	Adopted
Destroys wildlife habitat/ provides wildlife habitat	Adopted
Imports energy/ exports energy	Renamed
Requires fuel-powered transportation/ requires human-powered transportation	Proposed
Intensifies local weather/ moderates local weather	Adopted
Excludes daylight/ includes daylight	Proposed
Uses mechanical heating/ passive heating	Proposed

Uses mechanical cooling/ passive cooling	Proposed
Needs cleaning and repair/ maintains itself	Adopted
Produces human comfort/ discomfort	Proposed
Uses fuel-powered circulation/ human powered circulation	Proposed
Pollutes/ creates pure indoor air	Proposed
Is built of virgin materials/ recycled materials	Proposed
Cannot/ can be recycled	Proposed
Serves as an icon for apocalypse/ regeneration	Proposed
Is a bad/ good neighbour	Proposed
Is ugly/ beautiful	Adopted

Table 4: Classification of Regeneration based checklist into building and site and Introduction of '0' scale.



Source: (Author, 2016 based on SBSE, 1999)

METHODOLOGY

Four studies are selected because they present a link between Regenerative Architecure and Eco-resort designs. The studies include: Wells (1982), SBSE (1999), Littman (2009) and Bromberek (2009). These studies are reviewed, and improved upon to form the proposed checklist titled 'Regenerative based checklist for design and construction in Eco-resort'. The methodology includes: a review of indicators of regenerative architecture from Wells (1982) and SBSE (1999); correlating the indicators of regenerative architecture with principles of regenerative architecture; and, correlating the principles of regenerative architecture with eco-resort design considerations.

1. Reviewing Wells (1982) and SBSE (1999); The first study which is Wells' (1982) checklist includes 15 indicators that are used for evaluation as shown in Table 1 and 2. These 15 indicators are reviewed by SBSE (1999), the second study. SBSE (1999) adopts the 15 indicators by making 4 significant changes to the checklist.
2. Correlating Indicators and principles: Indicators from SBSE (1999), the second study relate directly with 5 of 6 principles of regenerative architecture highlighted by the third study, Littman (2009) as illustrated in Table 5. The indicators are further categorised under the principles.
3. Correlating principle of regenerative architecture with eco-resort design considerations: The fourth study provides consideration for Eco-resort design. It provides indicators that relate with the principle (Intelligent Limit) not covered. The indicators include; abandons/changes use of spaces**,** replaces/restores materials and components**,** space design based on function it serves**,** and neglects/adopts standard measurement.

RESULTS

The result generates a checklist titled 'Regenerative based checklist for design and construction of eco-resorts'. The result is illustrated in Table 6. Six principles are presented; they include integration into the landscape; intelligent limits; intelligent construction; bold ecology; experience of place; and culture. Each of the principle has indicators used for evaluation. The total no of indicator is 25, making the highest total score +2500 and -2500 the lowest total score. The proposed checklist incorporates SBSE's (1999) rating system. Each indicator can attain a score ranging from +100, being the highest (regenerative), to -100 being the lowest (degenerative). 0 is an average score meaning sustainable and neutral.

Table 5: Categorising 'Indicators of regenerative based checklist' under 'principles of Regenerative Architecture'

S/N	**Principles Of Regenerative Architecture**	**Indicators Of Regenerative Based Checklist**
1	Integration to Landscape	Pollutes air/ cleans air; Pollutes Water/ Cleans Water; Wastes Rainwater/ Stores Rainwater; Consumes Food/ Produces Food; Destroys Rich Soil/ Creates Rich Soil, Dumps Wastes Unused/ Consumes Wastes, Destroys/ Provides wildlife habitat and Intensifies Local Weather/ Moderates Local Weather.
2	Intelligent Construction	Excludes Natural Light/ Uses Natural Light; Uses Mechanical Heating/ Uses Passive Heating; Uses Mechanical Cooling/ Uses Passive Cooling; Needs Cleaning and Repair/ Maintains its self; Produces Human Discomfort/ Provides Human Comfort; Pollutes Indoor Air/ Creates Pure Indoor Air; Built of Recycled Materials/ Built of Virgin Materials; and Cannot Be Recycled/ Can Be Recycled.
3	Bold Ecology	Imports Energy/ Exports Energy; Requires Fuel-Powered Transportation/ Requires Human-Powered Transportation and Requires fuel/human powered circulation.
4	Place	Is Ugly/ Is beautiful
5	Culture	Serves as an icon for apocalypse/ regeneration; Is a bad/good neighbour

CONCLUSION

The aim is to develop an assessment tool for regenerative architecture in eco-resorts. Establishing an effective regenerative architectural assessment tool becomes necessary due to social, environmental and economic problems. Regenerative architecture lacks assessment tool that includes relevant aspects of eco-resort design. Regenerative architecture is the practice of engaging the natural world as the medium for, and generator of architecture while eco-resorts designs make minimal impact on the environment without compromising guests' comfort and safety.

Table 6: Regenerative Based checklist for Design and Construction of Eco-resorts

	Degeneration										Regeneration
		always (-100)	ususally (-75)	sometimes (-50)	a bit (-25)	Sustainable (0)	a bit (+25)	sometimes (+50)	usually (+75)	always (+100)	
	INTEGRATION TO LANDSCAPE										
	pollutes air										cleans air
	Pollutes water										cleans water
	wastes rain water										stores rain water
	Consumes food										poduces food
	Destroys rich soil										produces rich soil
	Dumps wastes										Consumes waste
	Destroys wildlife habitat										Provides wildlife habitat
	Intensifies local weather										moderates Local Weather
	BOLD ECOLOGY										
	Imports Energy										Exports Energy
	Requires fuel powered transportation										Requires human powered transportation
	Requires fuel powered circulation										Requires human powered circulation
	INTELLIGENT CONSTRUCTION										
	Excludes daylight										Includes daylight
	Uses mechanical cooling										Uses passive cooling
	Needs cleaning and repair										Maintains itself
	Produces human discomfort										Produces human comfort
	Pollutes indoor air quality										Creates pure indoor air quality
	Is made of virgin materials										Is made of recycled materials
	Cannot be recycled										Can be recycled
	CULTURE										
	Serves as an icon for apocalypse										Serves as an icon for regeneration
	Is a bad neighbour										Is a good neighbour
	INTELLIGENT LIMIT										
	Abandons spaces										Changes use of spaces
	Replaces materials and components										Restores materials and components
	Space is not designed										Space is designed
	Neglects standard space requirements										Adopts standard space requirements
	PLACE										
	Is ugly										Is beautiful

Four studies are reviewed by: Wells, Society of Building Science Educators (SBSE), Littman, and Bromberek within 1982-2009, because they present a relationship between Regenerative Architecture and Eco-resort designs. The methodology includes: a review of indicators of regenerative architecture from Wells and SBSE; correlating the indicators of regenerative architecture with principles of regenerative architecture and, correlating the

principles of regenerative architecture with eco-resort design considerations. The result generates a checklist titled 'Regenerative based checklist for design and construction of eco-resorts'. The checklist presents six principles; integration into the landscape; intelligent limits; intelligent construction; bold ecology; experience of place; and culture. Each of the principle has indicators used for evaluation. Each indicator can attain a score ranging from +100 to -100. The total number of indicators is 25, making the highest total score after evaluation to be +2500 and -2500 the lowest. Contributions of the study includes; applying 'Regenerative based checklist for design and construction in Eco-resort' as a measuring tool at design stage and as an evaluation tool at post occupancy stage.

Contribution To Knowledge

The study makes two contributions;

1. This study highlights the importance of 'Regenerative based checklist for design and construction in Eco-resort' as a measuring tool. At the conceptual and design stages, the checklist is used in planning to achieve a regenerative eco-resort by considering: integration to landscape; intelligent construction; intelligent limit; bold ecology; place; and culture.
2. The study establishes the importance of 'Regenerative based checklist for design and construction in Eco-resort' as an evaluation tool. At post occupancy stage, the checklist is used in evaluating the performance of eco-resorts by scoring: integration to landscape; intelligent construction; intelligent limit; bold ecology; place; and culture. The scoring illustrates the regenerative quality of eco-resorts by: indicating principles that are neglected (degenerative) and principles that need improvement (regenerative).

REFERENCES

Bromberek, Z. (2009). *Eco-Resorts-Planning and Design for the Tropics.* Burlington, USA: Elsevier Ltd.

Cole, R. J. (2011). Regenerative Design and development: current theory and practice. *Building Research & Information*, 1-6.

David, L. (2013). Beyond LEED: Regenerative Design. *Landscape Journal*, 229.

Gifford, H. (2009). *A better way to rate green buildings- LEED sets the standard for green buildings, but do green buildings actually save energy?* Northeast Sun.

Globe, G. (2012). *green globe*. Retrieved august 27, 2014, from greenglobe.com: http://www.greenglobe.org

Hikmat, H and Saba, F. (2009). Developing a green building assessment tool for developing countries – Case of Jordan. *Elseveir: Building and Environment*, 1053-1064.

Hodges, N. A. (2006). *Regenerative Design Theory and Practice:Demonstration of the Integrated Framework in a Resort Development at Mountain Lake, VA.* Blacksburg, V.A: Virginia Polytechnic Institute And State University.

Iain C., Eneida F., Hannah M., and Louise T. (2013). *Tourism in Africa: Harnessing Tourism for growth and Improved Livelihoods.* Washington: Intrenational Bank for Reconstruction and Development, The World Bank.

Littman, J. A. (2009). *Regenerative Architecture: A Pathway Beyond.*

Massachusetts: University of Massachusetts.

McMinn S. (1997). The Challenge of Sustainable Tourism. *The Environmentalist*, 135-141.

SBSE. (1999). A Regeneratio- Based Checklist for Design and Construction. In S. o. Educators, *A Regeneratio-Based Checklist for Design and Construction.*

SBSE. (1999). A Regeneration Based Checklist for Design and Construction. In S. o. Educators.

Singer, M. (2010). Eco-nomics: Are the Planet-Unfriendly features of Capitalism Barriers to Sustainability? *Sustainability: An impossible Future?*, 127-144.

TIES. (2015). *What is Ecotourism*. Retrieved November 18, 2015, from The International Ecotourism Society: tps://www.ecotourism.org

Wells M. (1982). *Gentle Architecture.* Mc Graw Hill

Younan, V. A. (2011). *Developing a green building rating system for Egypt.* Cairo: American University Cairo.

ARCHISEARCH

MARKETING STRATEGIES OF QUANTITY SURVEYING FIRMS IN KADUNA STATE IN THE 21ST CENTURY

Chioma Precious Ekweani[1], Kulomri Jaule Adogbo[2] & Peter Gangas Chindo[3]
[1,2 & 3]Department of Quantity Surveying, Ahmadu Bello University, Zaria
[1]Correspondence email: *ekweanichioma@gmail.com*

Abstract
Previous studies indicated that there is a need for improvement of marketing performance of consultancy firms in the Nigerian construction industry. Quantity Surveying (QS) firms have been surmised to have the lowest firm survival rates than other professions in the industry because of the attitude of its professionals towards marketing. This paper assessed the barriers mitigating against the adoption of marketing strategies in QS firms with a view to develop indirect marketing strategies accommodated within the professional code of conduct. The research adopted the use of questionnaires and interviews. A total of 34 questionnaires were distributed and used in the analysis. Further, interviews were conducted with 12 owners of registered QS firms, which have been in practice for 10 years and above to explore the strategies the firms adopted for survival. The results revealed that QS professionals are reluctant to pursue effective marketing strategies because they do not want to be portrayed as "business men" and to avoid falling short of the professional code of ethics. The indirect marketing strategies developed at the course of the study are: 1) Dealing honestly with clients and maintaining a cordial relationship with them, 2) Insuring clients on projects, 3) Employing good staff and 4) Identifying potential client in casual meetings. It was concluded that the adoption of these marketing strategies in QS firms will be of paramount importance to QS professionals and would-be consultants for firm's survival purposes. Training of professionals on how to maximise digitalization and the social media for marketing purposes within the professional code of ethics was recommended for further study.

***Keywords**: Barriers, Marketing Strategies, Quantity Surveying Firms*

INTRODUCTION

Marketing is perhaps the most essential tool every business needs for survival. Gerland Stanley in Perreault and McCarthy (2005, p.403) said "A man's success in business today turns upon his power of getting people to believe he has something they want". Marketing mainly deals with customers and aims to manage profitable customer relationships (Yankah & Dadzie, 2015).

Kotler and Armstrong (2009) in Yankah, and Dadzie (2015) opined that the ability to attract new customers by promising a superior value than competitors and keeping/growing current customers by delivering satisfaction are the main goals of marketing. Preece, Haron, Abdullah, and Suhaimi (2009) stressed that marketing is not only about selling and advertising anymore but shared the opinion of Macnamara (2003) that marketing is about activities that are

involved in obtaining future work, from strategic analysis and planning, to staff enthusiasm and performance, service delivery and customer feedback.

Marketing within the professional sector has been considered at worst as an alien concept, and at best as a new development that is viewed with scepticism (Morgan & Morgan, 1991; Bowen & Rwelamila, 1995). But the constant change in construction business environment, new trends of service deliveries, proliferation of cost management and other QS related services, increasing number of professionals, complex client's requirements, intense competition in the profession and possible survival of their firms through marketing has made it become more pertinent for adoption in Quantity Surveying (QS) firms. This assertion was justified by the opinion of Yankah et al., (2015) that marketing is indispensable for the QS consultancy firm's survival and profitability in a highly competitive business environment.

Unfortunately, marketing in QS firms is still in infancy despite increasing awareness of competitive demands from clients and have been rated as relatively poor in Nigeria (Preece et al., 2009; Ogbu, 2015; Yankah, 2015a). One of the recommendations made by Ogbu (2015) is the adoption of marketing strategies by QS firms for better performance in Nigeria. The study found that an assessment of the external and internal environment of a firm's operations must be carried out first to know which marketing strategy the firm can adopt. To further stress this point, Yankah et al., (2015) emphasised that it is inappropriate to assume that marketing strategies used in other professional services such as medicine and accounting will work for QS firms because they have different business environment.

Other observations by Yankah (2015), are that QS firms conduct marketing in an ad-hoc manner (few firms have their own marketing departments or specific individuals responsible for marketing) and that marketing is often viewed as less important to the management and survival of firms than finance and personnel issues which explained why practitioners are still struggling to understand and implement effective marketing programmes that would enable them achieve sustainable growth.

Preece et al., (2009) found that the reasons why 100% of the QS firms they surveyed do not have a dedicated marketing department are: 1) 56% view marketing as a senior management role 2) 26% perceived that their firms are too small to warrant a specific function 3) 14% use the services of external marketing consultancies and 4) the remaining 4% felt it was pointless to have external consultations because of budget constraints and the belief that the marketing consultants do not possess the knowledge on QS services and construction industry as a whole.

Ojo (2011) also reported a low level of awareness of marketing strategy among construction professionals despite the fact that they believe marketing is essential in improving the productivity of their firms. So far, little effort is expended on analysis of markets and competitors as well as the creation of websites which is an important element of marketing (Preece et al., 2009). It was also reported that majority of QS firms are still relying on the use of traditional company

brochure and previous working relationships for marketing purposes.
Yankah (2015) reiterated that the marketing performance of QS firms could be improved through the firm's marketing planning (effective allocation of the firm's resources to marketing programmes), organisation of marketing functions (the way marketing function is managed through to its success) and the allocation of marketing resources.

Ene (1995) and Adegbile (2008) also posited the need for awareness on the importance of marketing as a tool to withstand the stiff competition in the Nigerian construction business environment. An appeal has also been made to the QS professional bodies to amend some of the regulations to allow QS firms to market their professional services (Preece et al., 2009; Ogbu, 2015).

The study therefore set out to assess the barriers to the adoption of marketing strategies of QS firms, keeping in mind the existing rules of professional conducts required of practicing Quantity Surveyors with the view to develop adoptable marketing strategies for QS firm's survival.

SERVICES OF QS FIRMS

A Quantity Surveying (QS) firm is one that provides cost management and quantity surveying services on a vast range of construction projects, including building, civil-engineering, industrial, infrastructure and major highway projects with the help of its professionals (Jaafar, Aziz, & Wai, 2008).

According to Preece et al., (2009, p.2), "there has been a decline in use of the traditional method of procurement which presented a number of challenges for the QS profession and the profession has moved towards developing new services with a focus on risk management, value management, legal and environmental services".

These new services and competition from within and outside the profession in the opinion of Mui and Keong (2001) demand a more effective approach to marketing for the firms. Similarly, Kotler, (2002) in Preece et al., (2009) saw the need for consultants to recognise that the client base is changing and is likely to continue to change. He also stated that firms more likely to succeed will be those that add value to clients' through excellence of performance and innovation. Preece et al., (2009) added that as clients continue to focus on established business relationships with compatible firms, effective marketing is important, with significant emphasis required on the considerations of the needs of the client.

Ogbu (2015), posited that the performance and survival of Quantity Surveying firms in Nigeria are linked to the firm owners' (mostly sole proprietors) characteristics which bear heavily on the organisation's strategies. He equally stated that QS firms' performance (which have been tagged as poor in Nigeria), could be possibly improved if they can adopt marketing strategies. However, some factors such as stringent code of ethics, ignorance of the significance of marketing to professional practice, lack of marketing know-how, difficulty in the measurement of marketing performance among others, have deterred the adoption of marketing strategies by QS firms in Nigeria.

In the same vein, Yankah (2015b) stated that the confusion over the true meaning of marketing coupled with lack of a single universally accepted definition for marketing in the consulting industry might have caused its poor adoption. He identified some factors responsible for the low utilisation of marketing by professional service firms (QS firms) which are: disdain of commercialism, professional code of ethics, equating marketing with selling, lack of in-house marketing expertise, professional limitation, lack of partner level acceptance of marketing as a legitimate business function, resource constraint, and engineer's paradigm.

Barriers to marketing of QS services

Jaafar et al., (2008), Ogbu (2015), and Yankah (2015b) investigated the underlying barriers to the adoption of marketing in QS firms. The barriers were classified as external environmental factors and internal generated factors. The internal factors are "resource-associated" which occurs as a result of the firm's limitations to acquire them whereas the external factors are those beyond the firm's control.

External Barriers

i. Stringent Code of Ethics

According to Ogbu (2015), stringent code of ethics was identified as one of the factors hindering the adoption of marketing strategies by QS firms in Nigeria. The attitude of the early professionals that "we are not in business but simply responding to our 'peers request' for services" has been passed down to generations of construction professionals and has affected marketing in practice more than those actually set by the professional code of conduct. Ogbu (2015) argued that marketing is meted out with levity in the Nigerian QS firms because members of NIQS are expected to be modest about their personal achievements in all publications and avoid direct solicitation of interest and other activities calculated at getting jobs illegally, and finally recommended a re-examination of marketing-related NIQS code of conducts in order to alleviate possible ethical impediments to marketing by its members. Jaafar et al. (2008) also opined that the action of some professional associations of banning the use of marketing activities such as advertising, direct solicitation and referral commission has led to the limited use of effective marketing strategies.

ii. Disdain of Commercialism

Yankah (2015b) found that although there is a growing need for greater commercialization of professional services as a result of the stiff competition in the market, professional service firms are reluctant to pursue effective marketing programmes because they prefer to portray that they are motivated by service to their clients than the money they receive for providing services.

iii. Engineer's Paradigm

Richardson (1996) observed that engineer's paradigm is a hurdle that needs to be overcome for effective adoption and implementation of marketing and other skills in the construction industry. The dominance of management by the engineers has resulted in the limited use of strategic management by other professionals (Seymour & Rooke, 1995).

iv. Professional Limitation

Yankah (2015b) found that the professional education and training of

construction professionals does not include marketing and consequently limited their marketing management techniques. Yisa, Ndekugri, and Ambrose (1995) also observed this shortcoming that marketing in the construction industry lacks adequate literature compared to the industry's core areas like estimating and construction management. As a result, the professional's abilities to adopt marketing management strategies and other business strategies that could possibly enhance their firms growth are being limited.

Internal Barriers

i. Insufficient Skill/Know-how

Some construction professionals cannot appraise their business skills because attending to client's needs and meeting project's deadlines are given more priority than the skills needed to grow the business which is usually a long-term process (Abd-Hamid, Azizan, & Sorooshian, 2015).

ii. Resource Constraint

Yankah (2015a) noted that resource constraint was a major barrier to the adoption of marketing because it compelled the construction professionals to concentrate on their production efficiency than on marketing. Jaafar et al. (2008) opined that because of the low consultation fees charged by construction professionals, the firms are not able to allocate adequate funds to support entrepreneurial activities nor are they able to employ external experts for consultations. This was confirmed by the findings of Yankah (2015a) that majority of the QS firms used their technical employees to manage their marketing functions in addition to their core functions because the firms were not able to employ marketing professionals due to their limited budget.

iii. Difficulty in Measurement of Skill Performance

Since skill performance is not a core competency of construction professionals, there is need for external professionals to be employed to conduct skill performance measurements in the firms routinely which should assist the construction professionals to pay more attention to adopting the needed skill to enhance the survival of their firms.

RESEARCH METHOD

A self-administered questionnaire survey was conducted to establish the level of adoption of marketing and the marketing strategies used for survival within Quantity Surveying firms in Nigeria.

The choice for questionnaire survey was informed by the fact that previous studies on construction marketing adopted same research instrument. Some of which are the works of (Morgan 1990; Morgan & Morgan 1991; Namo & Fellows 1993; Bowen & Rwelamila, 1995; Yisa et al., 1995; Arditi et al., 2008; Preece et al., 2009; Ojo, 2011; Ogbu, 2015; Yankah et al., 2015). Hence, a questionnaire was designed as the research instrument and administered to the respondents as done in similar previous studies.

However, to get an in-depth view of issues being addressed in the study and gather other useful information, which was not well articulated in the questionnaire, a second phase of data collection was done by an interview session conducted with some of the respondents who are older in the profession. This is justified by Yeasmin and Rahman's (2012) observation that the adoption of a qualitative approach is

important to compensate for the limitations of using a quantitative approach to study human behaviour.

To reach the target respondents, the study adopted a purposive/expert sampling technique for the questionnaire and interview respectively. These selective sampling methods were chosen because they are suitable when studying a particular group of respondents and when an expert opinion is desired (Kumar, 1996). By adopting these techniques, a list of registered QS firms was obtained from Quantity Surveying Registration Board of Nigeria (QSRBN) which showed that Kaduna State had the highest number of registered QS firms in Nigeria that are above ten years in practice. This informed the selection of Kaduna State as study area. The questionnaires were sent to all the individuals (owners/partners ONLY) of the registered QS firms in the QSRBN list and a total of 34 completed questionnaires were retrieved for subsequent analysis. Also, 12 principal partners/owners of the QS firms participated in the interview session at the second phase of data collection. These constituted a high response rate which is considered acceptable for a survey of this nature (Kumar, 1999). The instructions accompanying the questionnaires and interviews provided the aim of the study and guaranteed anonymity in the published results. Respondents were also promised a feedback on completion of study.

Questionnaires were delivered to the respondents by the researcher and collected in the same manner. It was envisaged that the questionnaire would be completed by partners/owners of the firms to whom the questionnaires were sent.

The questionnaire was divided into 5 main sections which dealt with: the personal information of the respondents, company information, level of adoption of marketing in the firms, barriers to the adoption of marketing and the marketing strategies adopted by the firms. The conventional five-point rating scale was adopted to help elicit the appropriate ratings according to the extent of adoption. Likert rating scale of 1-5 were used, where 5= Great extent, 4= Fair extent, 3= little extent, 2= Negligible, 1= Not sure.Analysis of the responses was done by using descriptive statistics such as percentages to identify, summarize, and synthesize the views of respondents to understand trends in their marketing practices and importance that is attached to marketing by the firms.

The interview questions were structured to get first-hand information from owners/principal partners of the firms on the strategies they have adopted to survive beyond the 10years "glass-ceiling" business failure years common to the construction industry (Mcintyre, 2007). Other relevant information such as "how they seek for/get clients despite of the professional code of ethics", "do they set marketing strategies and how often they realize them" and the impact of marketing to the growth of their firms" were sourced.

RESULTS AND DISCUSSION

A total of thirty-four (34) completed questionnaires were used for data analysis. On a scale of five, with 5 being Great extent, 4 fair extent, 3 little extent, 2 negligible and 1 not sure, respondents were asked to indicate the extent to which they adopt marketing strategies in their firms. The result revealed that 12 (35.3%) of the respondents adopted marketing to a

great extent, 16 (47.1%) fairly adopted marketing, 5 (14.7%) adopted to a little extent, 2 (5.9%) adopted to a negligible extent while 1 (2.9%) of the respondent was not sure. This shows that marketing strategies is fairly adopted in majority of QS firms. This finding agrees with the reports of previous research that "marketing" which is an important management strategy for construction professionals has not been fully understood in the context of the construction industry especially in quantity surveying consultancy firms (Jaafar et al., 2008; Ogbu, 2015; Yankah, 2015a).

In assessing the barriers to the adoption of marketing in QS firms, a five-point likert type question was used as shown in table 1. 5 represents great extent, 4 fair extent, 3 little extent, 2 Negligible, and 1 No influence.

Assessment of Barriers to the Adoption of Marketing Strategies

The barriers identified from literature as seen in Ogbu, (2015) and Yankah, (2015b) were subjected to investigation and used as the basis for the questionnaire survey. The internal barrier which the respondents in this survey identified as having the highest degree of influence is resource constraint with particular interest to the hiring of external marketing consultants. This also justified the findings of Jaafer et al., (2008) and Yankah, (2015a) that resource constraint has been a major barrier to the adoption of marketing in QS firms.

Table 1: Ranking of barriers by respondents

Barriers to the adoption of Marketing strategies	5	4	3	2	1	Mean	SD	Rank
Resource restraint	16	8	5	2	3	3.94	1.301	1
Disdain of Commercialization	4	12	11	3	4	3.88	1.094	2
Stringent code of ethics	10	10	7	5	2	3.62	1.231	3
Difficulty in measurement of skill performance	9	8	8	5	4	3.38	1.349	4
Professional limitation	8	8	6	7	5	3.26	1.163	5
Insufficient skill know-how	11	14	4	4	1	3.24	1.208	6
Engineer's paradigm	4	13	8	5	4	3.21	1.409	7

On the external barriers, respondents indicated that disdain of commercialism and stringent code of ethics imposed by the professional body posed the greatest challenge. This revealed that the QS professionals are reluctant to pursue effective marketing strategies because they do not want to be portrayed as "business men" and to avoid falling short of the professional code of conducts. This finding affirms the positions from literature on the poor attitude of construction professionals towards marketing despite the growing need for greater commercialization of construction professional services (Jaafar et al., 2008; Ogbu, 2015; Yankah, 2015).

RESULTS AND DISCUSSION

Some of the issues raised in the questionnaire survey were further investigated to get an in-depth and gain more clarity to understand some of the strategies employed in the firms for survival. About 12 principal partners/owners of QS firms participated in the interview.

The Strategies Adopted by the Respondents

1. Dealing honestly with clients: In describing the marketing strategies which helped their firms to survive, majority of the interviewees said they maintained previous working relationships by dealing honestly with their clients. This strategy also elevated the reputation of their firms.
2. Insuring clients: Some of the respondents said they boosted their clients/customer satisfaction by insuring their clients on every project. This strategy helps to cover the clients in case of project failure. Once the clients are satisfied with their services, they keep coming back or making recommendations to them.
3. Employing good staff: majority also reported that employing good staff creates a good name for their firm and increases patronage from clients.
4. Identifying potential clients: Some of the interviewees stated that while mingling and relating casually with people at sport centres, parties, clubs or even the market place, they are always looking out for potential clients/customers.

Barriers Identified by Interviewees

Major Barriers

100% of the respondents believe that getting clients without strong political connection in Nigeria was difficult. In Preece et al., (2009), political connection and contacts was also identified as a hurdle for reaching clients. This reveals that the public sector is still the highest employer of labour in the construction industry. Another major barrier identified is the lack of awareness of the profession by the public which resulted in poor patronage by the private sectors.

External Barrier

On the external barriers to the adoption of marketing strategies, majority of the respondents reported that stringent code of ethics by the professional body was regarded as the most common barrier. The interviewees opined that the professional code of conduct of the NIQS & QSRBN does not allow for seeking clients as they would have desired.

Internal Barrier

The internal barrier indicated by the interviewees is resource constraint which was a result of ineffective management and allocation of resources.

All these findings are indicates the nature of marketing within the construction industry and the barriers may deter construction professionals from adopting marketing strategies.

Marketing Strategies Adopted by QS Firms

The study established that the following strategies are being adopted by QS firms that survived the glass-ceiling failure years. These strategies also form a basis for would-be QS consultants on how to adopt marketing strategies without going against the professional code of ethics. They were developed based on the opinions of the respondents in the survey.

The strategies are:

1. Deal honestly with your clients and maintain a cordial relationship with them
2. Insure your client on every project
3. Employ good staff and keep training them
4. Easily identify potential customers (clients) when interacting with people

CONCLUSION

The adoption of the above marketing strategies in QS firms is of paramount importance in the light of the stiff competition in the profession. While some of the barriers such as stringent professional regulations and resource constraints may continue to pose as a challenge to marketing, some realistic, tested and adoptable strategies accommodated within the code of ethics have been outlined in this study and recommended for adoption by QS professionals and would-be consultants.

Further Study

Future research should focus on training would-be professionals on how to maximise digitalization and the social media for marketing purposes within the professional code of ethics. Also similar studies should be conducted nationwide to obtain and compare results from other States.

REFERENCES

Abd-Hamid, Z., Azizan, N. A., & Sorooshian, S. (2015). Predictors for the Success and Survival of Entrepreneurs in the Construction Industry. *International Journal of Engineering Business Management, 7*(12), 1-11. doi: 10.5772/60530

Adegbile, M. B. O. (2008). Prominence of Marketing among Nigerian Construction firms. *Journal of Quantity Surveyors, 55*(1), 6-10.

Bowen, P.A., Rwelamila, P.D. (1995). Marketing of Professional Service by Quantity Surveying Consultancy Practices in South Africa. London: *The Royal Institution of Chartered Surveyors (RICS) Research*.

Ene, G. U. (1995). A Case for more Effective Marketing by Construction Contractors in Nigeria. *Journal of Quantity Surveyors, 1*(1), 11-21.

Jaafar, M., Aziz, A. R. A., & Wai, A. L. S. (2008). Marketing Practices of Professional Engineering Consulting Firms: Implement or not to Implement? *Journal of Civil Engineering and Management, 14*(3), 199-206.

Kotari, C. R. (2004). *Research Methodology, Methods and Techniques*: New age International Publishers.

Kotler, P. (2002). Marketing Professional Services. United States of America: Prentice Hall.

Kotler P, Armstrong G (2005). Marketing: An Introduction, New Jersey: Pearson Education Inc.

Kumar, R. (1999), Research Methodology: A step-by-step Guide for Beginners. Sage, London, England.

Liubarets, T. (2016). Expert views on top 5 Marketing Skills. Retrieved 21-09-2016, 2016, from http://writent.com/blog/top-5-marketingskills-to-be-successful-as-a-marketer/

Macnamara, P. (2003). Marketing of Civil Engineering Consultancies in the United Kingdom. In Preece, C., Moodley, K., Smith, P. (eds.) *Construction Business Development: Meeting New Challenges, Seeking Opportunity*. Oxford: Butterworth-Heinemann.

Mcintyre, M. (2007). Why do Contractors Fail. On *May 2007 issue*. Washington DC: Insurance.

Morgan, R. E. and Morgan, N. A (1991). An Appraisal of the Marketing Development in Engineering Consultancy Firms, *Construction Management and Economics*, *9* (1), 355-368.

Morgan, R. E. and Morgan, N. A, (1990), Marketing Consulting Engineering Services, *Civil Engineering Surveyor*, June, 20-21

Morgan, R. E., Foreman, S. K. and Poh, T. C. C. (1994), Assessing the Status of Marketing in Architectural Service Firms, *Management Decision*, *32* (4), 36-42

Namo, F. and Fellows, R. F. (1993) The Role of Advertising in Marketing Civil / Structural Engineering Consultancy Firms, *Construction Management and Economics*, *11* (1), 431 – 411.

Ogbu, C. P. (2015). Application of Marketing Strategies in Nigerian Quantity Surveying Firms. *Journal of Economics and Sustainable Development, 6* (16), 30-43.

Ojo, G. (2011). Effective Marketing Strategies and the Nigerian Construction Professionals. *Afrcan Journal of Marketing Management, 3* (12), 303-311.

Perreault, W. D., & McCarthy, E. J. (2005). Basic Marketing: A Global Managerial Approach

Preece, C. N., Haron, R. C., Abdullah, H., Suhaimi, M. S. N. M. (2009). The Challenges and Opportunities in Marketing the Quantity Surveying Practice in Malaysia. *International Islamic University, Malaysia, Malaysia.*

Richardson, B. (1996). Marketing for Architects and Engineers: a New Approach. London: Chapman & Hall.

Seymour, D., & Rooke, J. (1995). The Culture of the Industry and the Culture of Research. *Construction Management and Economics, 13* (6), 511-523.

Yankah, J. E. (2015a). Marketing Performance of Quantity Surveying Consultancy Firms. *International Journal of Construction Engineering and Management, 4* (6), 230-237.

Yankah, J. E. (2015b). Principal Barriers to Marketing Performance of Quantity Surveying Consultancy Firms. *African journal of applied research, 2* (2), 126-139.

Yankah, J. E. & Dadzie, D. K. (2015). The Status of Marketing in Quantity Surveying Consultancy Firms. *European Journal of Business Manangement, 7* (22), 197-204.

Yeasmin, S. & Rahman, K. F. (2012). 'Triangulation' Research Method as the Tool of Social Science Research. *BUP JOURNAL*, *1* (1), 154-163.

Yisa, S. B., Ndekugri, I. E., & Ambrose, B. (1995). Marketing Function in UK Construction Contracting and Professional Firms. *Journal of Management in Engineering, 11* (4), 27-33.

ARCHISEARCH

ASSESSING RISK FACTORS IMPACTING THE ADOPTION OF BUILDIING INFORMATION MODELLING (BIM) BY BUILDING DESIGN FIRMS IN KADUNA AND ABUJA, NIGERIA

Mustapha Abdulrazaq[1], Mohammed Abdullahi [2] & Amina Sani Bello[3]
[1,2 & 3]Department of Quantity Surveying, Ahmadu Bello University, Zaria
[1]Correspondence email: *musteephd@gmail.com*

Abstract

Studies have shown that Building information Modelling (BIM) is still a novel concept in the construction industry. Accepting novel concepts involves numerous challenges ranging from implementation and adoption issues, legal issues, application issues, and barriers to implementation. The performance of new concepts can be impaired when unidentified risk factors are present during implementation. Hence, a complete understanding of the risk factors likely to affect the successful implementation of BIM becomes quite necessary by all stakeholders involved in the construction industry. This study assessed risk factors affecting the adoption of BIM in building design firms. A questionnaire survey of 48 building design firms within Abuja and Kaduna was undertaken. Purposive sampling method was strategically employed in selecting all the construction firms. Thirty (30) risk factors related to technical, financial, management and legal aspects of BIM were identified from literature and used for designing the questionnaire. Based on the results of a questionnaire distributed to building design firms in Nigeria, the risk factors with the highest levels of occurrence and impact were identified using mean value analysis. The research identified the three BIM factors with highest occurrence as: Proliferation of software (with a mean value of 3.52), Lack of available skilled personnel (3.42) and High level of technical complexity (3.35), and those with highest impact as: Lack of software compatibility, Model management difficulties and Insufficient data interoperability. The study concludes that BIM practitioners should take note of these factors and develop appropriate risk response strategies for these factors.

Keywords: *BIM, Risk Factors, Construction Industry, Nigeria*

INTRODUCTION

Building Information Modeling (BIM) is a reliable information data base in form of 3D digital prototype graphics that accurately represents the total life cycle of a facility in details (Ibrahim and Bishir, 2012). BIM has been defined as an object based 'digital representation of physical and functional characteristics of a facility' (NIBS, 2012). The concept exhibits a strong potential to become the core technology used in the construction industry. In the last decades, several researches have been carried out on BIM ranging from implementation and adoption issues (Smith, 2014; Song. 2014), to Legal issues (Olatunji, 2011; Fansworth, 2014; Kuo-Feng, 2014). Also, Cost estimating issues (Ma, 2013, Laakso & Kiviniemi, 2012; Isa, 2014) and other more technical issues that centrally focus on extending the functionalities of BIM

in the various construction management domain (Ibrahim and Bishir, 2012; Dim. 2015) have received attention. The successful implementation of BIM has been recorded in the United States of America where over 75% of the industry had adopted BIM (Clifton. 2014). Similarly, in UK, the implementation of BIM is also improving significantly, with the UK government mandating the application of BIM in public projects in the year 2016 (Arayici, 2011; Kuo-Feng, 2014; Eadie, 2013). According to Kuo-feng *et al.* (2014) most of the successes were recorded due to quick embrace of the BIM concept by users in executing early responses to clients' expectations.

BIM is rapidly gaining acceptance in the construction industry. Although most construction organizations are highly experienced in managing construction projects using traditional methods, BIM based projects may involve new challenges and risk factors that must be managed differently from those of traditional construction projects (Dim, 2015). Kuo-Feng *et al.* 2014 identified and assessed critical risk factors impacting on BIM-reliant projects in Taiwanese contractor organisations. The authors further asserted that the performance of new managers can be impaired when unidentified risk factors are present during the implementation of the BIM concept. However, the assessment of risk factors impacting on the successful adoption of BIM in design firms at organizational level is yet to be investigated. The aim of this study is to assess the risk factors impacting on the successful adoption of BIM by building design firms in Nigeria.

LITERATURE REVIEW

BIM implementation and usage comes with many advantages for the digital design of buildings. Yet with BIM comes issues and risks that a design professional must consider. Enhanced usage of electronic design and construction processes holds promises for saving time and money, reducing claims and increasing the quality of performance, especially on complex projects. However, one must consider and recognize the individual risks associated with this new process (Song, 2014).

Several groups have defined risk in different ways. Each definition is dependent on the background of the group and the reason for assessing risks. The Advanced Learners dictionary defines risk as "The chance of failure or the possibility of meeting danger or suffering from harm or loss" (p. 1264). In construction, project risk may be defined as the likelihood of a detrimental event occurring to projects (Laakson and Kiviniemi, 2012). Since the objectives of a project are usually the targets established for function, cost, time and quality. The most important risk in construction is the failure to meet these targets. Risks are not always associated with negative outcomes. Risks may represent opportunities as well, but the fact that most risks usually have negative outcomes has led individuals to consider only the negative sides. Lichtenberg (2000) defined risk as a possible event that would have a negative or positive impact. Odeyinka (2008) defined risk as the exposure to loss/gain, or the probability of occurrence of loss/gain multiplied by its respective magnitude. For the purpose of this study the definition by Lichtenberg (2000) which states that risk is a possible event that

would have a negative or positive impact would be adopted.

According to Thompson (2007), the first legal risk to determine is the ownership of the BIM data and how to protect it through copyright and other laws. For example, if the owner is paying for the design, then the owner may feel entitled to own it, but if team members are providing proprietary information for use on the project, their propriety information needs to be protected as well. Thus, there is no simple answer to the question of data ownership; it requires a unique response to every project depending on the participants' needs. The goal is to avoid inhibitions or disincentives that discourage participants from fully realizing the model's potential.

Schmidth, Lyyntinen, Keil, and Cule, (2015) found that risk factors associated with IT or software projects include lack of top management support, weak project managers, and lack of stakeholder involvement. Other factors include weak commitment of the project team, lack of requisite knowledge by team members, lack of documented requirements and success criteria, communication breakdown among stakeholders, etc.

Peter (2014) conducted a research on the risk associated with the use of Quantity Surveying software and found that the following risk factors were prevalent: Proliferation of Software Application, Virus Attacks, Project Information Discouragement, Lack of First-Hand Software Expertise, Incompatibility in Software Packages, Lack of Management Desire and Appreciation of Software, and High rate of Obsolescence of Software.

Abdullahi (2015) found that work break down structure of the BIM based Quantity takeoff does not conform to Nigerian standard (BESMM) for generating quantities. This was highlighted as a risk negating the essence of the use of the BIM concept. The research results showed that the respondents who use the Autodesk quantity take-off as a tool were running the risk of confusing both client and contractors as it was difficult to amalgamate the available standard (BESMM3), with the BIM software. It was recommended that the Industry Foundation Classes (IFC) should be extended in order to direct data exchange with relevant application software when used in Nigeria.

Saidu (2015) pointed out that quantity surveyors in the Nigerian construction industry have a limited knowledge on the practical application of BIM**.** The research stated that in order to understand the future role of a Quantity Surveyor in BIM implementation, a thorough study on what specific information will be available from BIM at different stages of project and what information the QS has to contribute at each stage is required. The results showed that BIM professional training and education is important in order to improve BIM awareness and implementation.

RESEARCH METHOD

The quantitative approach was adopted in order to reach as many of the respondents as possible; furthermore, the targeted respondents are literate and are spread across a wide geographical location. The numerical nature of the data sought also informed the decision to employ the quantitative approach. Also the nature of the research problem, which seeks to

answer the question "How much of impact and how often do certain risk factors affect BIM implementation in the Nigerian construction industry?"

The population for this study is building design firms within the Nigerian construction industry. There are 1,370 building design firms within Abuja and Kaduna (VConnect, 2016). A non-probability sampling method known as *purposive sampling* was strategically employed in selecting the construction firms approached as respondents.

Questionnaires were used to seek the perception of 69 organisations on BIM risk factors. Forty-eight (48) of the questionnaires administered were returned which amounted to a response rate of 70%. The data collected was analysed using mean, standard deviation, frequencies and ranking. Measurement of the level of occurrence and impact of risk factors on the implementation of building information modeling (BIM) by building design firms in Nigerian construction industry (NCI) was carried out. Mean Value Analysis (MVA) was used to analyse the level of impact of risk factors on BIM adoption. MVA has been the preferred tool for analysing data collected through questionnaires. This is because it enables appropriate considerations of the relative importance of each indicator.

RESULTS AND DISCUSSIONS

Table 1 shows the percentage distribution of types of services provided by the various respondents. The Architectural firms constituted about 52%, Quantity Surveying constituted 27%, Mechanical and Electrical engineering firms constituted about 4%. The contributions of other firms to the research instrument were the consortium organisations with about 16%. The frequency distribution indicates that Mechanical and Electrical engineering firms constitute the least respondents to the research instrument while Architectural services firms constituted the majority of the respondents.

Table 1: Job Description of the Surveyed organisations

Category	Freq.	%	Cum. %
Architectural services	25	51.0	52.1
Quantity Surveying services	13	26.5	79.2
M & E Services	2	4.0	81.3
Consortium	8	16.3	97.9
Total	48	100.0	

Table 2 shows the mean, standard deviation and ranking of the risk factors based on their occurrence. *Proliferation of software* ranked 1st with a mean of 3.52. This is followed by *Lack of available skilled personnel* with a mean of 3.42. *High level of technical complexity* ranked 3rd with a mean of 3.35, while *cost of purchasing, and additional expenditure* both ranked 4th with the same mean of 3.33 each respectively.

The result obtained on Table 2 agrees with findings by previous researches. Proliferation of software also ranked 1st in the research conducted by Peter (2014). Also, Lack of available skilled personnel and additional expenditure are top ranking BIM risk factors in the research conducted by Kuo-Feng et al. (2014). This shows that the risk factors occur most at both project and organisational levels.

Table 2: Likelihood of occurrence of BIM Risk Factors

S/No	Risk Factors	Mean	Std. Dev.	Rank
1	Proliferation of software	3.52	1.148	1
2	Lack of available skilled personnel	3.42	1.334	2
3	High level of technical complexity	3.35	1.041	3
4	Cost of purchasing	3.33	1.209	4
5	Additional Expenditure	3.33	1.078	4
6	Conflict among users	3.21	1.184	6
7	Cost of training	3.21	1.010	7
8	Lack of technical specifications	3.21	1.271	8
9	Lack of software compatibility	3.21	1.071	9
10	Lack of top management commitment	3.21	1.220	10
11	Excessive workload on BIM experts	3.19	1.161	11
12	Insufficient data interoperability	3.17	1.277	12
13	No stakeholder involvement & participation	3.13	1.282	13
14	Unclear legal liability	3.08	1.069	14
15	Project information discouragement	3.06	1.060	15
16	Too much requirements	3.00	1.130	16
17	Lack of BIM standards	2.96	1.129	17
18	Change in organisational management	2.96	1.220	18
19	Model management difficulties	2.96	1.071	19
20	Unclear system requirements	2.92	1.069	20
21	Changing requirements	2.88	1.248	21
22	Corporate politics that negatively affect project	2.85	1.185	22
23	Increase in short term cost	2.83	1.155	23
24	Workflow transition difficulties	2.79	1.071	24
25	Lack of documented project plan	2.77	1.096	25
26	Increase in short term workload	2.69	.993	26
27	Management process change difficulties	2.67	1.173	27
28	Virus attacks	2.54	1.237	28
29	Intellectual property	2.52	1.072	29
30	Health risks	2.35	1.139	30

Table 3 shows the mean, standard deviation and ranking of the risk factors based on their impact if they occur. *High level of technical complexity* has mean of 3.65, ranking first, followed by *lack of top management commitment* with a mean of 3.58. The factor with the 3rd ranking is *No stakeholder involvement and participation* also with a mean of 3.58 followed by *proliferation of software* with a mean of 3.56. The 5th ranking factor is *unclear legal liability* with a mean of 3.54.

The result on Table 3 shows that three of the top five BIM risk factors assessed are the same in terms of both occurrence and impact, just as in the research conducted by Kuo-Feng *et al.* (2014). These are: Lack of top management commitment, High level of technical complexity and proliferation of software. This shows that the respondents' have similar perceptions on the level of occurrence and impact of the BIM risk factors.

Table 3: Impact of BIM Risk Factors

S/no	RISK FACTORS	Level of Impact		
		Mean	Std. Dev.	Rank
1	High level of technical complexity	3.65	1.021	1
2	Lack of top management commitment	3.58	1.164	2
3	No stakeholder involvement & participation	3.58	1.182	3
4	Proliferation of software	3.56	1.128	4
5	Unclear legal liability	3.54	1.110	5
6	Excessive workload on BIM experts	3.52	1.111	6
7	Change in organisational management	3.52	1.031	7
8	Cost of training	3.50	0.945	8
9	Insufficient data interoperability	3.40	1.333	9
10	Cost of purchasing	3.40	1.198	10
11	Conflict among users	3.38	1.299	11
12	Lack of available skilled personnel	3.33	1.404	12
13	Additional Expenditure	3.33	1.059	13
14	Lack of software compatibility	3.27	1.086	14
15	Lack of BIM standards	3.25	1.329	15
16	Corporate politics that negatively affect project	3.23	1.096	16
17	Increase in short term cost	3.23	1.096	17
18	Model management difficulties	3.21	1.288	18
19	Changing requirements	3.08	1.285	19
20	Lack of documented project plan	3.08	1.269	20
21	Increase in short term workload	3.06	1.192	21
22	Lack of technical specifications	3.04	1.352	22
23	Management process change difficulties	3.02	1.158	23
24	Unclear system requirements	3.00	1.072	24
25	Workflow transition difficulties	2.96	1.110	25
26	Too much requirements	2.94	1.227	26
27	Virus attacks	2.94	1.245	27
28	Project information discouragement	2.92	1.252	28
29	Intellectual property	2.71	1.166	29
30	Health risks	2.65	1.082	30

CONCLUSION

This paper has attempted to look into the risk factors involved in the adoption of Building Information Modelling (BIM) by building design firms in Nigeria. The study sought the likelihood of occurrence of the risk factors and the impact if they do occur. The findings from the study suggest that the risk factors with the highest likelihood of occurrence are Proliferation of software, Lack of available skilled personnel, high level of technical complexity and cost of purchasing software. High level of technical complexity, lack of top management commitment, no stakeholder involvement and participation, proliferation of software and unclear legal liability.

RECOMMENDATIONS

The following recommendations can be drawn from the study:

i. Design firms in the Nigerian construction industry should develop strategies to overcome the risk factors with the highest likelihood of occurrence
ii. Strategies should also be developed to overcome the impact of the risk factors when they occur.
iii. A study to suggest these strategies and/or reduce the risks to a manageable size should be conducted.

REFERENCES

Abullahi, A. (2015). *Modeling the Information Requirement for Building Information Modeling (BIM) - based Quantity Takeoff.* Unpublished BSc Project, Department of Quantity Surveying, Ahmadu Bello University, Zaria, Nigeria.

Arayici, Y. C. (2011). BIM Adoption and Implementation for Architectural Practices. *Journal of Structural Survey, 1* (29), 1-3.

Clifton, B. F. (2014). Application, Advantages and Methods Associated with Using BIM in Commercial Construction. *International Journal of Construction Education and Research Publication, 2* (1), 2.

Dim, U. E. (2015). Managing the Change Process Associated with BIM Implementation by Public and Private Investors in the Nigerian Construction Industry. *Donnish Journal of Engineering and Manufacturing Technology, 2* (1), 1-6.

Eadie. R. (2013). BIM Implementation throughout the UK Construction Project Life-cycle. *Automation In Construction, 36* (1), 145-151.

Ibrahim, M. & Bishir, S. (2012). Review of using Building Information Modeling (BIM) in Nigerian Construction Industry. *Journal of Environmental Sciences and Policy Evaluation, 2* (2), 54-55.

Isa, M. (2014). Developing a Roadmap for Implementation of Building Information Modelling (BIM) in the Nigerian Construction Industry. Unpublished MSc Dissertation, Department of Quantity Surveying, Ahmadu Bello University, Zaria, Nigeria.

Kuo-feng, C., Lin, K., Wu, L., & Yu, P. (2014). Identifying and Assessing Critical Risk Factors for BIM Projects: Empirical study. *Automation in Construction*, 1-5.

Laakson, M. & Kiviniemi, A. (2012). The IFC Standard-A review of history, development and standardisation, Journal of Information Technology in Construction, *17*, 134-161.

NIBS (2012). *National Building Information Modeling Standard: Overview, Principles and Methodologies. 1* (1), 5-9.

Odeyinka, H. L. (2008). An evaluation of risk factors impacting construction cash flow forecast. *Journal of Financial Management, Property and Construction, 13* (1), 5-7.

Olatunji, O. (2011). Perspectives on modelling BIM-E nabled estimating practices. *Austrialian Journal of Construction Economics and Building, 14* (4), 32-53.

Peter, A. (2014). Assessment of Risks Associated with the Usage of Quantity Surveying Softwares in Nigeria: The Case Lagos State. *Economy, 1* (2), 55-58..

Saidu, M. (2015). An Assessment of BIM Competency Requirement for Quantity Surveying Professionals. Unpublished BSc Project, Department of Quantity Surveying, Ahmadu Bello University, Zaria-Nigeria.

Schmidth, R., Lyyntinen, K., Keil, M., & Cule, P. (2015). Identifying Software Project Risks: An International Delphi Study. *Journal of Management Information Systems*, 17 (4), 5-36.

Smith, P. (2014). BIM Implementation-Global Strategies. *Creative Construction Conference*, 482-492.

Song, W. G. (2014). A Technical Review Of Bim Based Cost Estimating In Uk Quantity Surveying Practice, Standards And Tools. *Journal of Information Technology in Constuction, 19*, 534-538.

Thompson, D. (2007). *Building Information Modeling - BIM: Contractual Risks are Changing with Technology*. Retrieved from http://www.aepronet.org/ge/no35.html

ARCHISEARCH

GENDER AND ACADEMIC PERFORMANCE IN ARCHITECTURAL EDUCATION: A CASE STUDY OF AHMADU BELLO UNIVERSITY ZARIA FROM 2011/2012 TO 2014/2015 SESSIONS

Muhammad Aminu Musa[1] & Hassan Ozovehe Saliu[2]
[1 & 2] Department of Architecture, Ahmadu Bello University, Zaria
Correspondence email[1]: ammusa@abu.edu.ng; mamzayopmo@gmail.com; mamzayopmo@yahoo.com

Abstract

There has been so much controversy as to whether gender affects academic performance of architecture students or not. This study is aimed at investigating gender performance in architectural education in Nigeria, using Ahmadu Bello University as a case study. It was achieved by exploring students' performances in three major architecture core courses, namely: Architectural Design; Building Structures and Building Construction. The study used quantitative approach with 929 students as sample size with data obtained from the archive of the Department of Architecture ABU Zaria. Data generated was then analysed using statistical tools such as Pearson Product Moment Correlation technique using significance threshold of 0.05, bar charts, column charts, graphs, etc. The results show that female students outperform their male counterparts in Building Structures while male students are better in Building construction and their performance in Architectural Design are the same. Furthermore, a regular pattern was observed in the performance of male students based on mode of entry while irregular pattern was observed on the part of their female counterparts. It was also found out that if a student passes Architectural Design there is strong tendency to also pass Building Construction and Building Structures, the reverse is also true. The study concludes that, gender has impacts on the performance of students in architectural education. It further recommended that admission policy into schools of architecture should be gender sensitive.

Keywords: *Architecture, Core Course, Gender, Grade, Performance*

INTRODUCTION

So many differences exists between male and female human beings especially on their biological and anatomical variances. Wood (2005) observed that, the differences include genetic materials and hormonal alterations, such as height with men being taller on average than women (Samaras, 2007). Gender differences are also apparent in bodily strength and physical structure (Maughan, Watson, & Weir 1983; Frontera, Hughes, Lutz & Evans, 1991). Scientists also believe that, apart from physical structure, there are fundamental differences in the way men and women's brains process language, information, emotion, cognition, etcetera (Renato, 1997). A typical example is that women are generally better in memorization of texts than men (Kimura, 1999; Adegoke,1998; Aliyu, 2000). Moreover, Wilson (1992) believes that females incline more than males in sympathy, oral talents and social skills, among other things, while men tend to be higher in independence, governance,

spatial and mathematical skills. In addition to that, Sukhnandan, (2000) observed gender differences in response to schooling and learning environments. Females place a high value on the demonstration of their work; they devote more time trying to improve what they produce (McDonald, 1999) they care more about the opinion of their teachers more than their male counterparts (Bray, 1997), and develop more pleasure from their school life (Arnot, 1998), in contrast to males' attitudes.

Sex dissimilarities have developed on the main list of serious concerns around the globe. A study by Hausmann, Tyson and Zahidi (2009) reveals that, there is no nation that has achieved gender equality especially in critical matters such as education, politics or even economic participation. For example, Lian (2014) observed that 40% of architecture students are women in the United States of America, but only about 12% were estimated to be working as registered architects (Garry, 2016). Moreover, Evelyne (2015) concluded that, the number of women studying architecture is almost the same as men in Kenya. However, most women "drift off" somewhere after graduation and fail to make the transition to practice. Even though is the right of every child in Nigeria to access education regardless of gender and physical deformation (Abdulkareem & Muraina, 2014), the disparity appears to be apparent in the country if one considers at gender participation in Nigerian university based on faculty enrolments. The highest proportion of female enrolment are 42.13% in the faculty of education, followed by faculty of arts with 36.2% while the lowest was in the faculty of environmental design and engineering (Adeyemi & Akpotu, 2004).

There has been so much controversy as to whether gender affects academic performance of architecture students or not. Some believed that male students outperform female students in architectural education (Anagbogu, 2002) while others have the contrary view. For instance; a study conducted by Opoko, Oluwatayo, Ezema and Ediae (2015) concluded that, individual characteristics like gender, were the key dynamics that affect academic performance of students in architectural education, so also scientists such as Eze and Ezen (2015) confirmed that gender effects academic success of university Vocational Skill Education. Furthermore, Lili (2015) found out that gender had some effect on the correlation between academic performance and educational attainment. In addition to that, Opoko, Alagbe, Aderonmu, Ezema, and Oluwatayo (2014) observed that in Building Structures' course, female students overtook their male counterparts in all the semesters. Whereas on the other hand, Ozlem (2013) opined that student's sex has no consequence on passing Building Construction in Architectural education. So also Bart, Hokanson, Sahin, and Abdelsamea, (2015) disclosed that, there were no statistically substantial disagreements in the articulacy and creativity subtests between male and female students' intellectual ability. Ayla and Ömür (2009) showed that, there were no major gender-centered dissimilarities in original thinking capacity. These arguments of which sex performs better in architectural education motivated the researcher to investigate gender performance in architectural education in Nigeria, using Ahmadu Bello University

(ABU) as a case study. This goal is achieved by exploring students' performance in 3 major architecture core courses, namely: Architectural design; Building Structures and Building construction. The following questions were raised: What are the impacts of gender on academic performance of architecture students in 3 core courses; how does gender affect academic performance of architecture students in the 3 core courses based on students' mode of entry? Is there correlation among the students' performance in 3 core courses based on gender?

To justify the choice of 3 architecture core courses in this research, it was recorded in the Department of Architecture ABU Zaria (2012) that, courses in Architectural education are classified into 3: Core; Cognate; and Elective Courses. Core courses are those that provide students the foundational knowledge and skills they need in their course of study (Glossary of Education Reform, 2016). While a Cognate Course is the one from a related discipline deemed to complement the chosen area of study and to encompass knowledge and skills relevant to that area. The two are compulsory in Architectural education while Elective courses are optional as observed in the Department of Architecture ABU Zaria (2012). It is important to know that, the contents of Architectural Design, Building Construction and Building Structure carry more than 70% of the National Universities Commission's (NUC) minimum standard curriculum of architecture in Nigeria (Olotuah & Adesiji, 2005; Masaruf & Muhammad, 2016). Moreover, Olotuah and Adesiji (2005) also observed that, architectural education in Nigeria is aligned on seven concentrations: Architectural Design; Arts and Drawing; Historical and Theoretical Studies; Building Systems Technology; Humanities and Social Studies; Environmental Control System and Physical Sciences. Therefore Architectural Design, Building Construction and Building Structure represent more than two third of National Universities Commission's (NUC) minimum standard of architectural curriculum in Nigeria (Masaruf and Muhammad, 2016).

The Course Credit System has been in operation in ABU using Admission through University Matriculation Examination (UME), where by candidate who passes the senior secondary school certificates examinations (SSCE) or its equivalent with credit in English language, Mathematics, Physics and any other two science subjects is given admission to 100 level after getting acceptable pass at the entrance examination, organized by Joint Admission and Matriculation Examination Board (JAMB); the next mode of entry is through A-Level admission, candidate who passes SSCE as well as A-level programs such as IJMB, higher national diploma (HND) architecture with lower class, are admitted to 200level after filling a direct entry (DE) form; the third mode of entry is when a student has HND with Upper class, and admitted into 300 level.

LITERATURE REVIEW

Gender and academic performance

Gender differences in degree performance could be for a number of reasons (Hoskins; Rudd, 1984). It may arise in the categories of subject that male and female students study or sex dissimilarities in peoples' exact qualities

that are interrelated with fulfillment, such as family background, age and marital status (Robert, Smarmstha & Peter, 2002). Other ways may be due to the differences in the kinds and quality of the institutions male and female student attend (Mellandy et al 2000). Another direction is by scientific findings such as the discovery of a region in a human brain by Frederikse, Lu, Aylward, Barta and Pearlson, (1999) known as inferior-parietal lobule (IPL) which is bigger in men than women. It was observed that, the size of IPL is highly related to conceptual mathematical skills. Investigation on gender performance by Wilson & Hart (2001, as cited by Arigbabu & Mji, 2004) in mathematics showed that males are better than females.

Gender and thinking style

Some researchers established that women are more innovative than men (Chia, Koh & Pragasm, 2008; Fleenor & Toylor, 1994), while others reported that males are more inventive than females (Jellen & Urban, 1989; Jan-Erik & James, 1985). But recent research conducted by Chua, (2014) discovered that, gender and intellectual style were important issues of creative thinking skill. Nevertheless, no substantial interface consequence of the two factors on total creative thinking capacity was instituted. Chua (2014) further concluded that gender was considerably associated with creative thinking ability. Moreover, Sternberg and Grigorenko (1995); Masafi, Rezaei, Najafi, Hoseynzade and Tehranchi (2014) revealed that males were more toward left-brain thinking style than females and females were more towards right-brain thinking style than males. A Study conducted by Marshal, Faust, Hendler and Jung-Beeman, (2007); Denny and O' Sullivan (2007) discovered that, right brain thinking style is positively associated with imaginative intellectual capability. These findings support the split-brain theory that creativity is a function of the right brain (Sperry, 1975). On the other hand, Riegel (1979); Torrance and Ball (1984) described that creative thinking ability is positively linked with the left brain elegance. Moreover, Bart, Hokanson, Sahin, and Abdelsamea, (2015) discovered that there were weighty variances where the right brain fashioned students did better than the left brain styled students in all the five modules of original intelligent capacity. A research conducted by Zalizan, Khadijah, Hazadiah and Ma'rof (2002) resolved that male and female students who have different thinking and learning styles take assorted angles on the teaching style of teachers. These scholars appealed that one of the causes for high failure rate of male students from schools is female teachers' coaching approaches are very much counter to the male students learning style.

METHODOLOGY

It is a case study research using a quantitative approach and was conducted by means of a review of literature from secondary materials such as journals, books, newspapers, internet, and thesis. As a result, a list of variables was developed. Data was collected from the archive of the (pioneer school of Architecture in Nigeria) department of architecture Ahmadu Bello University Zaria as students' academic performance measured by their performances in 3 core course: Architectural Design; Building Structures and Building Construction. The study focused on records of 929

registered architecture students in 2011/2012, 2012/2013, 2013/2014 and 2014/2015 sessions which covered the last 4 Sets of Course-Credit System, including all their first and second semester results. Scores were then tabulated based on gender and students' mode of entry and then compared. The results were graded in maximum percentage of 0-100%, for each class was converted into a letter grade A, B, C, D, E or F with each represented 70-100, 60-69, 50-59, 45-49, 40-44 and 0-39 cuts respectively. Data generated was then analysed using statistical tools such as Pearson Product Moment Correlation technique using significance threshold of 0.05, bar charts, column charts, graphs and tables to find out the impacts of gender on the academic performance of architecture students, in Ahmadu Bello University Zaria Nigeria.

RESULTS AND DATA ANALYSIS

The following results were obtained from the archive of the department of architecture, ABU Zaria based on students' performances in 3 major core courses.

Table 1: Academic Performance of Architecture students on 3 core courses by percentage based on gender, from 2011/2012 to 2014/2015 Sessions

Grade	Architectural Design		Building Construction		Building Structures	
	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)
A	3.7	2.6	10.3	9.4	6	4
B	13.4	11.3	25.8	23	14.5	14.9
C	37.5	39	33.8	30.8	33.3	37.2
D	19.4	24	12.5	16.8	14.7	16.1
E	18.8	19.6	11.5	13.4	23.4	21.2
F	7.2	3.5	6.1	6.6	8.1	6.6
TOTAL	100	100	100	100	100	100

Source: Archives of the Department of Architecture, A.B.U. Zaria

The research was analysed based on the research questions raised earlier in this paper. The first question is that:

i. What is the impact of gender on academic performance of architecture students in the 3 core courses?

In this part, descriptive analysis as well as the inferential techniques was used to compare the academic performance between male and female students using bar-charts, tables, column bars and t-test (to calculate if the difference is statistically significant or not). For the purpose of this research the significance threshold (p-value) was set as 0.05.

From table 1 above, it could be observed that gender has little impact in Architectural design, and male students are slightly better than their counterparts in all grades except in grade C as shown in figure 1.

Male students have more A and B-grades than females, however 54.9% of males scored credits and above while 52.9% of female have 50 and above. This shows that there is no significant difference between the performances of male and female students in Architectural Design having p value of .33. In Building construction, male students outperformed their female counterparts in all grades as shown in figure 2

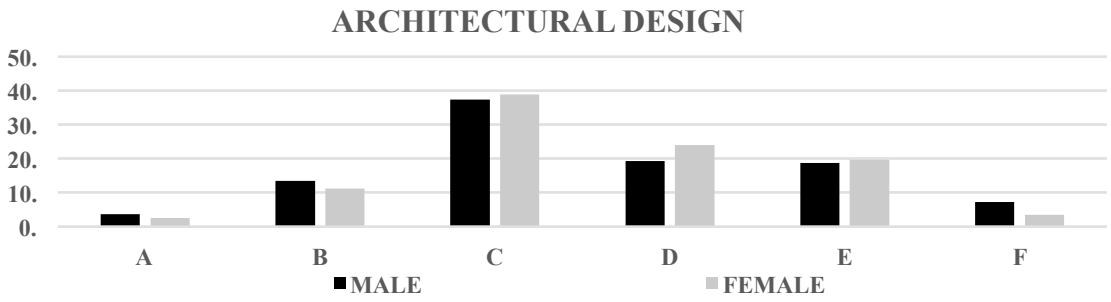


Figure 1: Influence of Gender on academic performance in Architectural Design (2011/2012 to 2014/2015 Sessions).

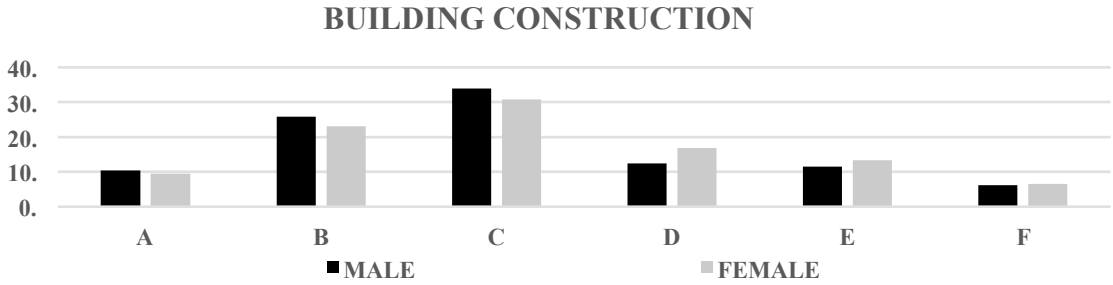


Figure 2: Influence of Gender on the academic performance in Building Construction (2011/2012 to 2014/2015 Sessions).

A total of 69.9% of male students recorded credits and above while 63.2% of female students have credits and beyond. The difference is statistically significant having p value of .04. The result shows that, gender has impact on the academic performance of architecture students in Building Construction. The effect of students' gender on academic performance in Building Structures has revealed that, female outperform males in all grades with the exception of grade-A as shown in figure 3.

In figure 3, 56.1% of females recorded 50 and above while 53.8% of males scored 50 and above, however the difference is not statistically significant having p value of 0.35.

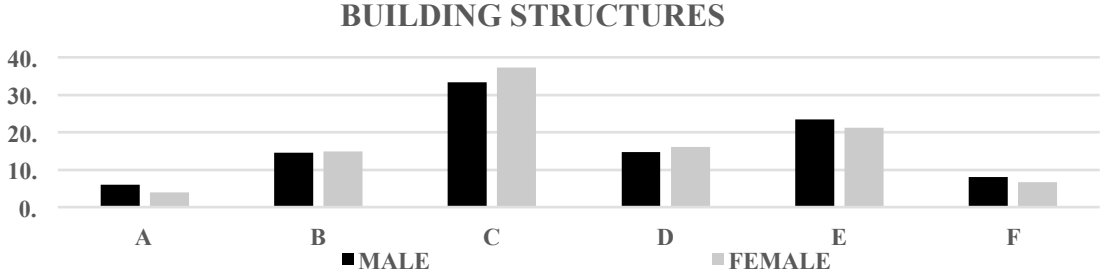


Figure 3: Influence of Students' gender on the academic performance in Building Structures (2011/2012 to 2014/2015 Sessions).

The second research question is:

ii. How does gender affect academic performance of architecture students (in 3 core courses) based on students' mode of entry?

Department of Architecture ABU Zaria has 3 modes of entry: Admission through UME; DE into 200 level; and DE into 300 level for upper credit students with HND architecture. Table 2 shows the performance of Architecture students by gender based on mode of Entry:

Table 2: Performance of Architecture students by gender based on mode of Entry from 2011/2012 to 2014/2015 Sessions

Mode of entrance	Grade	Architectural design		Building construction		Building structures	
		Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)
Admission into 100L through UME	**A**	2.8	2.1	10.2	8.7	6.3	4.1
	B	12.6	11.2	25.3	23.6	14.8	15.2
	C	38.5	39	34.4	31.2	34	37.1
	D	20.3	24.3	12.5	16.3	15.2	15.8
	E	18.4	19.8	11.7	13.4	22	21.3
	F	7.4	3.6	5.9	6.7	7.7	6.4
A-Level Admission into 200L	**A**	6.5	14.3	4.8	28.6	3.3	
	B	13	14.3	23.4		6.6	
	C	30.9	42.8	33.9	14.3	26.2	50
	D	17.1	14.3	13.7	42.8	9.8	33.3
	E	24.4	14.3	13.7		38.5	
	F	8.1		10.5		15.6	16.7
Admission into 300L (HND with Upper class)	**A**	20.4	100	27.1	100	6.3	
	B	34.7		47.9		25	
	C	28.6		16.7		33.3	
	D	4.1		8.3		12.5	
	E	12.2				22.9	100
	F						

Source: Archives of the Department of Architecture, A.B.U. Zaria

Figure 4 shows that male DE students into 300 level outperform the other 2 modes with 83.7% of them scoring credits and above, followed by male UME students of which 53.9% scored credits and above while lastly are male DE students into 200 level of which 50.4% scored credits and above.

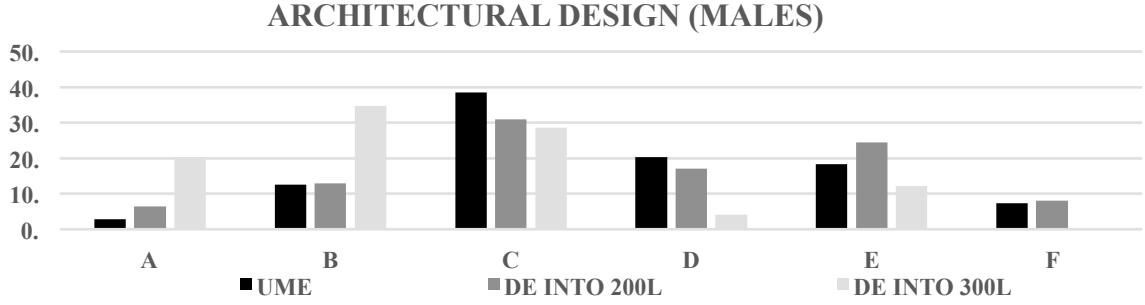


Figure 4: Academic performance of male students in Architectural Design course based on their mode of entry (2011/2012 to 2014/2015 Sessions).

On the other hand, performance of females mode of entry pattern is in such a way that female DE students into 300 level overtake the other 2 modes of which 100% got credits and above, followed by female DE students into 200 level of which 71.4% scored credit and above and lastly the female UME students of which 52.4% counted credits and above as shown in figure 5. Furthermore, in Building Construction, male students' pattern is similar to that of Architectural Design as shown in figure 6. Here 91.7% of male DE students have credits and above, followed by male UME students of which 69.9% scored credit and above and lastly male DE students into 200 level of which 62.1% scored credits and above. This is also the same in female's pattern as shown on figure 7.

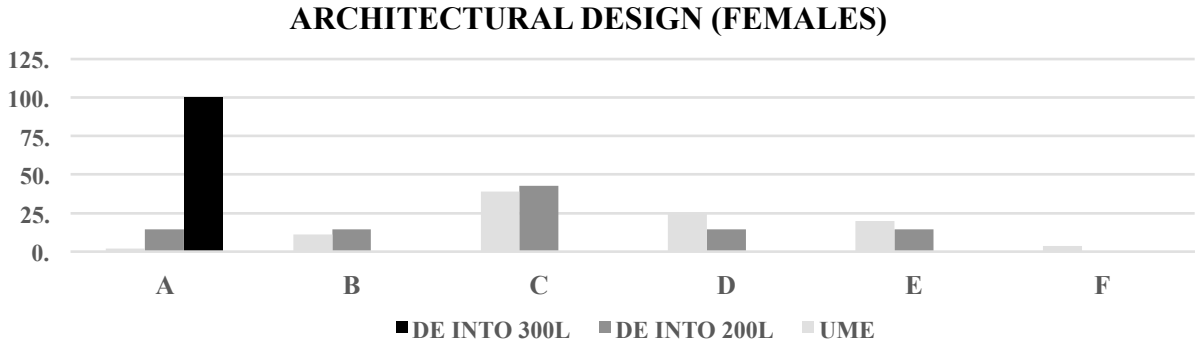


Figure 5: Academic performance of female students in Architectural Design course based on their mode of entry (2011/2012 to 2014/2015 Sessions).

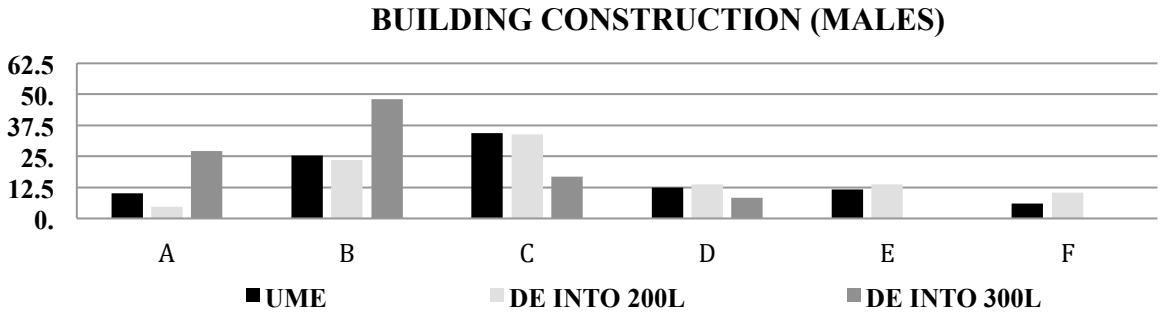


Figure 6: Academic performance of male students in Building Construction course based on their mode of entry (2011/2012 to 2014/2015 Sessions).

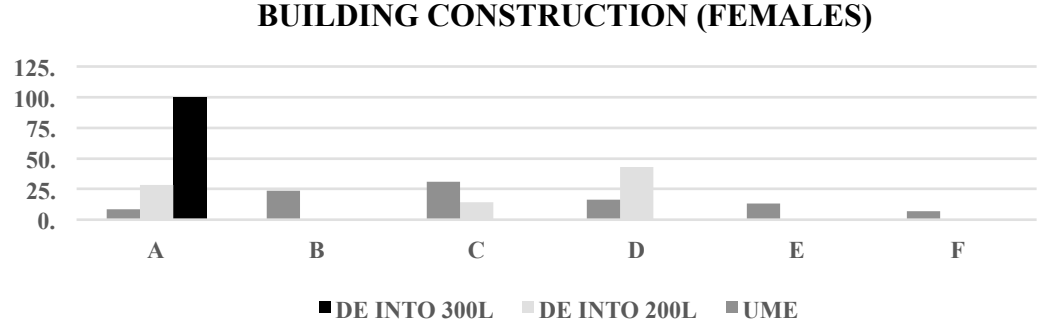


Figure 7: Academic performance of female students in Building Construction course based on their mode of entry (2011/2012 to 2014/2015 Sessions).

In Building Structure, males' performance pattern does not change as in architectural design and Building Construction. The pattern still maintains that DE students into 300 level outperformed the other 2 modes of which 64.6% scored credits and above, followed by UME students of which 55.1% got credit and above and lastly DE students of which 36.1% scored credits and above as seen in figure 8.

On the other hand, females' performance pattern changed again different from architectural design as well as building construction. Here UME students outperformed the other 2 modes, followed by DE students into 200 level and lastly DE students into 300 level. The 56.4% of UME students scored credit and above, while 50% of DE students into 200 level recorded credit and above and none of DE students into 300 level scored credit and above as shown in figure 9.

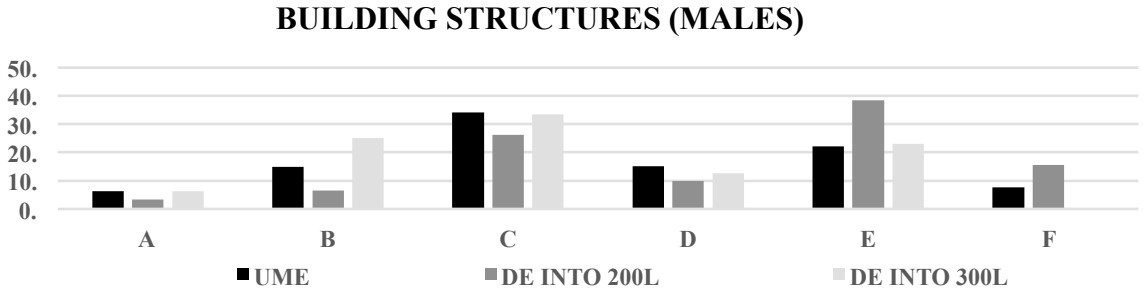


Figure 8: Academic performance of male students in Building Structure course based on their mode of entry (2011/2012 to 2014/2015 Sessions).

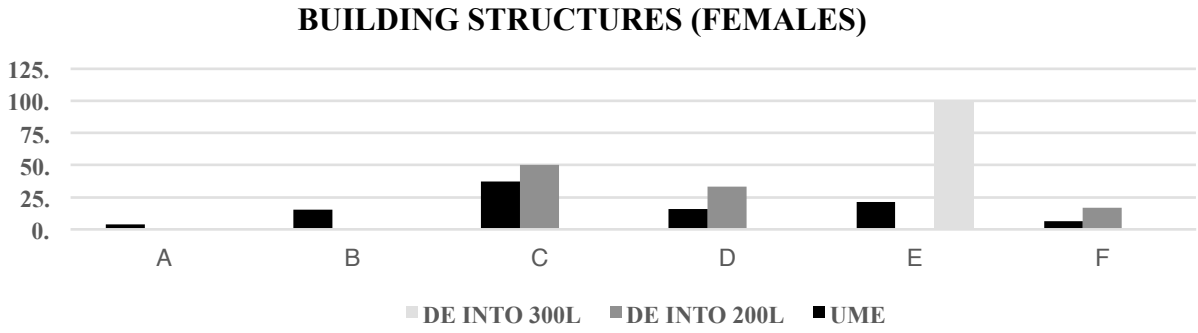


Figure 9: Academic performance of female students in Building Structure course based on their mode of entry (2011/2012 to 2014/2015 Sessions).

The third research question is:

iii. Is there correlation among the 3 core courses of students' performance based on gender?

This is aimed at finding out if a student passes one of the core courses will he/she also pass or fail any or the rest of the remaining 2 core courses? Microsoft Excel Data Analysis Pack was used to analyse data from the archive of the Department of Architecture ABU Zaria to find out the performance correlation values (*r)* and value of statistical significant (*p*-value) among the 3 architecture core courses. For the purpose of this research the significance threshold was set as 0.05, while the values of correlation were categorised as strong

positive correlation with values of r ≥ 0.65 and strong negative correlation with values of r ≥ -0.65. Then medium correlation was set as 0.3 < r < 0.65 followed by weak correlation with 0 < r ≤ 0.3 and lastly no correlation when r=0. Table 3 shows the results obtained from the archive of the department of architecture ABU Zaria based on the Performance of Architecture students in 3 core courses based on gender.

Table 3: Academic Performance of Architecture students in 3 core courses based on gender from 2011/2012 to 2014/2015 Sessions

Grade	Architectural Design		Building Construction		Building Structures	
	Male (no)	Female (no)	Male (no)	Female (no)	Male (no)	Female (no)
A	53	9	155	33	90	14
B	192	39	390	81	216	52
C	539	135	509	108	497	130
D	279	83	188	59	219	56
E	269	68	173	47	349	74
F	104	12	92	23	121	23
TOTAL	1436	346	1507	351	1492	349

Source: Archives of the Department of Architecture, A.B.U. Zaria

The research discovered that, all performance correlations of male students among the 3 core courses have strong positive correlations but only one is statistically significant. The strongest positive correlation is obtained between the performance of male students in Architectural Design and Building Structures with r=0.96 and is statistically significant having p value of .003. This follows by the strong positive correlation between their performance in Architectural Design and in Building Construction with correlation coefficient of 0.76 yet no statistically significant having *p* value of .08 as shown on table 4.

Table 4: Pearson product moment correlation table testing the correlation between the Performance of Male Students and 3 architecture core courses.

S/No		Architectural Design	Building Construction	Building Structures
1	**Architectural Design**	1		
2	**Building Construction**	R=0.76, p=.08	1	
3	**Building Structures**	R=0.96, p=.003	R=0.73, p=.102	1

Furthermore, the last is the performance of male students in Building Construction, which has strong positive correlation with Building Structures having correlation coefficient of 0.73 and is not statistically significant with p value of .102. However, all the performance correlations of female students among the 3 core courses have strong positive correlations and all are statistically significant as shown on table 5.

Table 5: Pearson product moment correlation table testing the correlation between the Performance of Female Students and 3 architecture core courses.

S/No		Architectural Design	Building Construction	Building Structures
1	**Architectural Design**	1		
2	**Building Construction**	R=0.81, p=.05	1	
3	**Building Structures**	R=0.96, p=0.003	0.85, p=.03	1

The performance of female students in Architectural Design has strong positive correlation with that of Building Structures having r =0.96 and is statistically significant having *p* value of .003. This followed by the strong positive correlation between their performance in Building Construction and that of Building Structures with correlation coefficient of 0.85 and is statistically significant having *p* value of .03. Moreover, their performance in Architectural Design has strong positive correlation with that in Building Construction having correlation coefficient of 0.81 and is also statistically significant with p value of .025.

The above results on table 4 and 5 show that, if a student passes Architectural Design there is strong tendency to also pass Building Construction and Building Structures, the reverse is also true.

DISCUSSION AND CONCLUSION

The study investigated gender performance in Architectural Education: a case study of ABU Zaria from 2011/2012 to 2014/2015 sessions. It was established that, males are better in Building Construction while females are better in Building Structures and their performance in Architectural Design are the same. The research therefore concludes that, gender has substantial impact on the performance of students in architectural studies.

On the impact of gender on academic performance of architecture students in 3 core courses it was observed that, female students are better than their male counterparts in Building Structures. This is not in consonance with Wilson & Hart (2001) as cited by Arigbabu and Mji, (2004) but is in total agreement with the Opoko, Alagbe, Aderonmu, Ezema, and Oluwatayo (2014) who stated that in Building Structures' course, female students outperformed their male counterparts in all the semesters. In Building construction, male students outperformed their female counterparts in all grades and therefore is not in agreement with the findings of Ozlem (2013) who noted that, student's gender has no influence on passing Building Construction in architectural education. The performance of male and female students are almost equal in Architectural Design which is in agreement with the findings of Ayla and Ömür (2009) who noted that there were no major gender-centered differences in original thinking capacity.

However on the effects of gender on academic performance of architecture students in 3 architecture core courses based on students' mode of entry, it was revealed that performance of female students follows irregular pattern while that of male students follows a regular pattern with the DE students into 300 level having the most outstanding performance, followed by UME students and lastly DE students into 200 level. These patterns replicated in all the 3 architecture core courses.

On the correlation among the students' performance in 3 core courses based on gender, the result shows that, gender has influence on the performance correlation among the 3 core courses in architecture. This is because performance correlations of females among those courses are all strong positive and statistically significant which differ from male students whose performance correlations are also strong and positive but only one is statistically significant. However, the most outstanding performance correlation in both male and female students is between Architectural Design and Building structures which are all strong positive and statistically significant. This may be unconnected to the fact that mathematics and physics are prerequisites to admission into architecture while Technical drawing is simply an option. Another thing to observe is that, the second most outstanding coefficient in male students is their performance correlation between Building Construction and Architectural Design while for female students is between Building Construction and Structures. This is confirming the discussion on the first research question.

Implications and recommendations

The popular notion that males perform better than females in architecture education has been disproved in the findings of this study and therefore should be helpful to all stakeholders in the university education including the students' parents who should support their children to study the subjects of their choice. This will also influence admission policy into department of architecture and other related courses to a gender sensitive admission criteria. The Study further recommends the following:

1. The number of female students should be increased in admission policy of Nigerian schools of architecture. The proportion of students enrolment should be gender sensitive, male and female students should be in equal proportion.

2. Subjects such as Technical Drawing and Fine Art should be part of prerequisite entry requirements for UME students into schools of Architecture so as they will have a background knowledge of Architectural Design and Building Construction. Another option is to introduce a course in the first year that will give UME students a background to Building construction and Design.

3. Information provided in the research will encourage women architects to practice after graduation since males are not better than them.

REFERENCES

Abdulkareem, A. Y. & Muraina, M. B., (2014). Issues and challenges of access and management of admission to universities in Nigeria. *International Journal of Education and Research*, *2* (6), 449-460.

Adegoke, K.A. (1998*). The Challenges of Quality Public Education in the 21st Century, with Particular Reference to Nigeria*. World Teachers Day Document by Nigeria Union of Teachers.

Adeyemi, K. & Akpotu, N. (2004). Gender Analysis of students' enrolment in Nigerian Universities. *Higher Education*, *48* (3), 361—378.

Anagbogu, M.A. (2002). Educating the girl child. *Psychology News*, (3), 17-18.

Aliyu, M.S. (2000). Towards a better understanding of the Almajiri system

of education in Nigeria, The Nigeria Teacher Today. *A Journal of Teacher Education*, *8* (1), 1-2.

Arigbabu, A.A. & Mji, A. (2004). Is Gender a Factor in Mathematics Performance among Nigerian Pre-service Teachers? *Sex Role, Nigeria, 51*(11), 749–753.

Arnot, M., Gray, J., James, M., Rudduck, J & Duveen, G. (1998). *Recent Research on Gender and Educational Performance: Ofsted Reviews of Research.* London: The Stationery Press.

Ayla, A.P. & Ömür, B. (2009). Gender and creative thinking in education: A theoretical and experimental overview. *ITU Journal of the Faculty of Architecture,* 6 (2), 44-57.

Bart, W. M., Hokanson, B., Sahin, I., & Abdelsamea, M. A. (2015). An investigation of the gender differences in creative thinking abilities among 8th and 11th grade students. *Thinking Skills and Creativity,* 17, 17-24. http://dx.doi: 10.1016/j.tsc.2015.03.003

Bray, R., Gardner, C. & Parsons, N. (1997). *Can Boys Do Better?* Leicester: Secondary Heads Association.

Chua, Y. P. (2014). Effects of Gender and Thinking Style on Student's Creative Thinking Ability. *Procedia - Social and Behavioral Sciences, 116*, 5135-5139.

Chia, Y.M., Koh, H.C. & Pragasam, J. (2008). An International Study of Career Drivers of Accounting Students in Singapore, Australia and Hong Kong. *Journal of Education and Work*, *21*(1), 41-60.

Denny, K. & O'Sullivan, V. (2007). The Economic Consequences of Being Left-Handed: Some Sinister Results. *Journal of Human Resources*, *42* (2): 353-374.

Department of Architecture ABU Zaria. (2012). *Student's Hand book.* Zaria: ABU Press.

Evelyne W. (2015, October 29). Maybe it is time women started designing buildings. *Daily Nation, Nigeria*.

Eze, I.T., Ezenwafor, J.I., & Obi, M.N. (2015). Effects of Age and Gender on Academic Achievement of vocational and technical education students of a Nigerian university. *Journal of Emerging trends in Educational Research and Policy studies, 6*(1), 96-101.

Fleenor, J.W. & Taylor, S. (1994). Construct validity of three self-report measures of creativity. *Educational and Psychological Measurement, 54*(2), 464-470.

Frederikse, M.E., Lu, A., Aylward, E., Barta, P. & Pearlson, G.(1999). Sex differences in the inferior parietal lobule. *Cerebral Cortex, l 9* (8), 896 - 901.

Frontera, W.R., Hughes, V.A., Lutz, K.J., & Evans, W.J. (1991). A cross-sectional study of muscle strength and mass in 45-78 year old men and women. *Journal of Applied Physiology, 71* (2), 644–50.

Garry S. (n.d). *Women in Architecture*. Retrieved December 17, 2016, from http://www.archsoc.com/

Great Britain, Department for Education and skills. (2007). *Gender and Education: the evidence on pupils in England*. UK.

Great Schools Partnership(n.d.). *The Glossary of Education Reform; Core Course of Study*. rettrieved from March 21, 2017, http://edglossary.org/core-course-of-study/

Hausmann, R., Tyson, L. & Zahidi, S. (2009). *The global gender gap report.* A report published by the World Economic Forum, Geneva, Switzerland. Retrieved December 28, 2016, from http://www.weforum.org/pdf/gendergap/report2009.pdf

Hoskins, S., Newstead, S., & Dennis, I. (1997). Degree performance as a function of Age, Gender, Prior Qualifications and Discipline studied. *Assessment and Evaluation in Higher Education, l.22*, 317-328

Jellen, H.G. and Urban, K.K. (1989). Assessing creative potential world-wide: the first cross-cultural application of the test for creative thinking- drawing production. *Gifted Education International, 6, 78-86.*

Kimura, D. (1999). *Sex and Cognition*. UK: MIT Press.

Lian C.C. (2014). *Measuring Progress on Gender in Architecture: Association of Collegiate Schools of Architecture*. USA : Matrix Group International Inc.

Lyon, N., Barnes, M. & Sweiry, D. (2006). *Families with Children in Britain: Findings from the 2004 Families and Children Survey* (FACS), DWP RR339.

Lili S.M.K (2015). *The Impact Of Academic Procrastination and Academic Performance on*

Academic Achievement Amongst Undergraduate Students at a Local University of Malaysia. Unpublished M.Sc thesis Submitted to Othman Yeop Abdullah Graduate School of Business Universiti Utara Malaysia.

MacDonald, A., Saunders, L. & Benefield, P. (1999). *Boys' Achievement, Progress, Motivationand Participation: Issues Raised by Recent Literature.* Retrieved March 17, 2017, from https://books.google.com.ng/books/about/Boys_Achievement_Progress_Motivation_and.html?id=miCWAAAACAAJ&redir_esc=y

Masafi S., Rezaei O., Najafi N., Hoseynzade H. & Tehranchi K. (2014). The Relationship between Thinking Style and Gender in High School Students. *International Research Journal of Biological Sciences, 3*(12), 1-4.

Mashal, N., Faust, M., Hendler, T., & Jung-Beeman, M. (2007). An fMRI Investigation of the Neural Correlates Underlying the Processing of Novel Metaphoric Expressions. *Brain and Language*, *100*(2), 115-126.

Masaruf M., & Muhammad S. I. (2016). The Architectural Education Curriculum in the Nigerian Schools of Architecture. *Journal of Research & Method in Education, 6* (6), 13 – 17.

Maughan R.J, Watson J.S., & Weir J. (1983). Strength and cross-sectional area of human skeletal muscle. *The Journal of Physiology, 338* (1): 37–49.

Mellandy, J., Martin, M., & O'Doherty, J. (2000). The Gender Gap in final Examination results at oxford university. *British Journal of psychology*, *91*, 377-390.

Olugbile, S. (2010 January, 4). Varsity Enrolment: Females Improve in Male-Dominated Courses. *The Punch Daily Newspaper.*

Olotuah A.O. & Adesiji O. S. (2005). An Appraisal of Architectural Education in Nigeria. *Online Proceedings of The Built Environment Education Conference, Centre for Education in the Built Environment.* Retrieved October 17, 2012, from

www.cebe.heacademy.ac.uk/ news/ past_events/bee/files/C2.doc

Education. *Procedia - Social and Behavioral Sciences*, *106*(4), 1636-1647.

Opoko, P. A., Alagbe, O. A., Aderonmu, P. A & Ezema, I. C. (2014). *Entry Qualifications and Academic Performance of Architecture Students in Building Structures.* In: Proceedings of EDULEARN14 Conference, 7th-9th July 2014, Barcelona, Spain. 1637-1641.

Opoko A., Oluwatayo A., Ezema I. & Ediae O. (2015). *Factors that affect academic outcomes of Architecture students: Evidence from selected Nigerian Schools of Architecture*. Proceedings of 8th International Conference of Education, Research and Innovation, 18th-20th November 2015, Seville, Spain. 2340-1095.

Renato M.E. S. (1997). Are There Differences between the Brains of Males and Females *Brain & Mind Magazine*, *17*, 39-40.

Riegel, T.R. (1979). Laterality of high school students and its relation to convergent and divergent abilities. (Doctoral Dissertation, The University of Georgia, 1979) *Dissertation Abstracts International 40* (11).

Robert M, Sarmistha P. & Peter S. (2002). Gender Differences in Educational attainment: the case of University students in England and Wales. *Economica, 69* (275), 481-503.

Rudd, E. (1984). A Comparison between the results achieved by women and men studying for first degree in British Universities. *Studies in Higher Education*, *9* (1), 47-93

Ozlem P.B.Z. (2013). Is Gender Important on Understanding Construction Course in Architectural

Jan-Erik R., & James E. B. (1985). Creativity in adulthood and age: Relations to intelligence, sex and mode of testing. *International* Journal of Behavioral Development, *8* (1), 99-109.

Samaras, T. (2007). *Human body size and the laws of scaling*. New York: Nova Science. Sperry, R.W. (1975, August 9). Left-Brain, Right-Brain. *Saturday Review*, p. 30-33.

Sternberg, R.J. & Grigorenko, E.L. (1995). Styles of thinking in school. *European Journal for High Ability, 6*(2), 1-18.

Torrance, E. P., & Ball, O. E. (1984*).The Torrance Tests of Creative Thinking Streamlined (revised) manual, Figural A and B*. Bensenville, IL: Scholastic Testing Service, Inc

Wilson, E.O. (1992). *Sociobiology*. USA: Harvard University Press.

Women in Science, Technology and Engineering, WISE (2015). *Women in Science, Technology, Engineering and Mathematics: The Talent Pipeline from Classroom to Boardroom*. Retrieved February 20, 2017, from https://www.wisecampaign.org.uk/uploads/wise/files/ WISE_UK_Statistics_ 2014.pdf.

Wood, J. T. (Ed.). (2005). *Gendered lives: communication, gender, and culture (*6th ed.). Belmont, CA: Wadsworth/Thomson Learning, Australia.

Zalizan, M.J., Khadijah, R.M. Y., Hazadiah, M.D. & Ma'rof, R. (2003 August, 31). Girls out performed boys in most subjects. *The New Strait Time* p.12.

ARCHISEARCH

A FRAMEWORK FOR INTEGRATING BIOPHILIC DESIGN PATTERNS FOR IMPROVING PATIENTS' BIOLOGICAL RESPONSES IN CANCER CENTRES IN NIGERIA

Muawiya Maikudi[1], Amina Batagarawa[2] & Mas'ud Abdulkarim[3]
[1,2 & 3]Department of Architecture, Faculty of Environmental Design,
Ahmadu Bello University, Zaria, Nigeria.
Corresponding email: *mmuawiya@ymail*

Abstract
Biophilic design is an innovative approach to design that accentuates the importance of maintaining a connection with the natural world through the built environment. This paper aims to design a framework for integrating biophilic design biophilic design patterns to improve biological responses of patients resident in cancer centres. Previous designs of cancer centres devoid patients the necessary connection with natural to meet the psychosocial needs. Based on existing literature correlating biophilic design biophilic design patterns and biological responses, strategies for the integration of biophilic design biophilic design patterns are developed through a review of six studies; Wilson (1984) Ulrich (2008), Heerwagen (2008), Kahn (1997), Keller (2008) and Hilderbrand, 2000). There are thirteen biophilic design patterns under three broad categories; Nature in the space biophilic design patterns, Nature of the space biophilic design patterns and Natural analogues biophilic design patterns. The result shows that 'Nature in the space' has seven biophilic design patterns with fifteen proposed biophilic architectural strategies while 'Natural analogues' and 'Nature in the space' have three biophilic design patterns with six proposed biophilic architectural strategies each. Theses architectural strategies present a holistic approach to enable researchers and practitioners with a pragmatic approach for incorporating biophilic architecture in the built environment.

***Keywords**: Biophilia, Biophilic design biophilic design patterns, Nature, Cancer*

BACKGROUND TO THE STUDY

Biophilia is the essential human inclination to affiliate with natural systems and processes, especially life and life-like features of the nonhuman environment (Heerwagen & Mador, 2009). Biophilic design is an innovative approach to design that accentuates the importance of maintaining a connection with the natural world through the built environment (Kellert, 2008). Because of its remarkable influence on human psychology, biophilia based design plays a vital role in healthcare delivery (Heerwagen & Orians, 2011) for hospitals, clinics, and offices are high-stress environments for patients, visitors and families, and healthcare professionals alike. Integrating nature into healthcare facilities has abundant benefits for many groups.

The projection for several forms of cancer have upgraded over the last decade in developed countries, mostly due to vast technological and scientific

advancements, the viewpoint remains grim in Nigeria (Lakeshore cancer centre, 2014). The available statistics bear this out, 150,000 new cancer cases were recorded in Nigeria in 2014 with mortality rate of about 80,000 (World Health Organization, 2014). Regardless of this, there are only 11 cancer registries which are located in various tertiary teaching hospitals in different parts of the country (Fatima, 2009).

Clinical practices in these cancer registries focus mainly on "cure over care" phenomena while often neglecting the patients' psychological and spiritual needs. And since their design is not cancer specific, they lack the required provision of natural elements fused in their design, which aids in connecting the patients with natural environments and for the purpose of meeting their psychosocial needs. Moreover, they were design when patients were not considered as focus of the design and thus were subsequently not considered in planning of the facilities.

Nonetheless, treating cancer is not the same as treating the patient (Holland & Rolland, 1990). This is due to the fact that cancer is not restricted to physical effects; it also evokes emotional chaos that influences personal relationship and patient's ability to live and work (Holland & Rolland, 1990). These additional impacts are referred to as one's psychosocial health. Problems resulting from untreated psychosocial needs have been shown to bring antagonistic effects within the body's cardiovascular, immune, and endocrine systems, contributing to the drop in health associated with cancer and its treatment (Sagerstom & Miller, 2004). Two of the most reported psychosocial effects in persons with cancer are anxiety and emotional distress (Stark, Smith, Velikova, House, & Selby, 2002).

The concept of biophilia has been approached by (Kaplan & Kaplan, 2006) based on the attention & restoration theory, stress reduction and cognitive functioning. These are the evidence for biophilia linked to research in one or more of three overarching mind-body systems–cognitive, psychological and physiological responses.

Building upon the work of Kellert (2008) on biophilic design principles, Terrapin (2014) come up with biophilic design biophilic design patterns that articulate the relationship between nature, science and the built environment so as to experience the human benefits of biophilia in design applications. These biophilic design biophilic design patterns focus on the elements of nature-health relationship which are important in the built environment, especially those that are known to enhance human lives through a connection with nature.

However, these biophilic design biophilic design patterns lack a clear defined framework for their integration into the built environment. The aim of this paper is to present a framework for integrating biophilic design biophilic design patterns through the provision of strategies to improve biological responses in patients resident in cancer centres.

While informed by science, biophilic design biophilic design patterns are not formulas; they are meant to inform, guide and assist in the design process and should be thought of as another tool in the designer's toolkit. The purpose of defining these biophilic design patterns is to articulate connections between aspects

of the built and natural environments and how people react to and benefit from them.

METHODOLOGY

To integrate biophilic design biophilic design patterns to improve biological responses in patients resident in cancer centres, biophilic architectural strategies are extracted from a literature review and designed in a framework. The studies are reviewed based on the three categories of biophilic design which have fourteen biophilic design patterns based on the research conducted by Terrapin (2014). The first category is 'nature in the space'. The biophilic design patterns under this category are; visual connection with nature, non-visual connection with nature, non-rhythmic sensory stimuli, thermal and airflow variability, dynamic and diffuse light, presence of water and connection with natural systems. The second category is 'natural analogues' which have three biophilic design patterns: biomorphic forms and biophilic design patterns, material connections with nature and complexity and order. The last category is 'nature of the space' and the biophilic design patterns under this are: prospect, mystery and refuge. A tabular analysis using frequency of adoption in studies by (Wilson, 1984; Ulrich, 2008; Heerwagen, 2006; Kahn, 1991; Kellert, 2008; Hilderbrand, 2000) is used to extract proposed biophilic architectural strategies required to evaluate and integrate biophilic architecture into the design of a cancer centre.

RESULTS & DISCUSSION

Biophilic architectural strategies from literature

After a review of related literature on biophilic design (Wilson, 1984; Ulrich, 2008; Heerwagen, 2010; Kahn, 1997; Kellert, 2008; and Hilderbrand, 2001), biophilic architectural strategies are extracted and proposed for each biophilic design biophilic design pattern (as shown in Table 1) under the three broad categories of biophilic design; nature in the space, natural analogues and nature of the space. These strategies paved a way of how the biophilic design patterns can be incorporated in the built environment.

Table I: Biophilic design biophilic design patterns and biological responses on the human body

	Biophilic design patterns (Terrapin, 2014)	**Biological Responses** (Terrapin, 2014)	**Biophilic Response Strategies in Architecture** (Wilson, 1984; Ulrich, 2008; Heerwagen, 2006; Kahn, 1991; Kellert, 2008; Hilderbrand, 2000)
	'Nature in the Space' Biophilic design patterns		
1.	Visual connection with nature.	- Lowered blood pressure and heart rate. - Improve mental engagement/attentiveness. -Positively impacted attitude and overall happiness	- Provision of varied landscaping and vegetation -Unrestricted views of nature and vistas from the interior -Provision of healing gardens

2.	Non-visual connection with nature.	-Reduce systolic blood pressure. -Positively impacted cognitive performance. -Perceived improvements in mental health & tranquillity	-Access to nature sound over urban sounds -Integration of natural ventilation and presence of water
3.	Non-rhythmic sensory stimuli.	-Positively impacted heart rate and sympathetic nervous system activity -observed & quantified behavioural measures of attention & exploration.	-Use of warm colours for sensory stimulations -Provision of indoor landscape that will attract birds and butterfly
4.	Thermal airflow & variability.	-Positively impacted comfort, wellbeing & productivity. -Positively impacted concentration. -Improve perception of temporal and spatial pleasure.	-Design with respect to sun and wind orientation -Placement of windows to allow natural ventilation
5.	Presence of water	-Enhanced perception & psychological responsiveness. -Reduce stress, increase feelings of tranquillity, lower heart rate.	-Use of water as a landscape element
6.	Dynamic & diffuse light	-Increase visual comfort. -Positively impacted circadian system functioning	-Placement of windows to capture dynamic and diffuse light within the interior of the building. -Use of reflective surface to enhance lighting and mitigates glare.
7.	Connection with natural system	-Enhance positive health responses. -Shift perception of environment.	-Provision of visual to existing natural system within the site.
	'Natural Analogues' Biophilic design patterns		
8.	Biomorphic forms & biophilic design patterns	-Observed view preference	-Use of botanical interior motifs -Applications of organic shapes in building exterior
9.	Material connection with nature	-Decrease diastolic blood pressure. -Improve comfort. -Improve creative performance.	-Use of sustainable building materials. -Use of natural colour pallet like green within the interior spaces
10.	Complexity & Order	-Positively impacted perceptual & physiological stress responses.	-Complex architectural expression and landscape planning.
	'Natural in the Space' Biophilic design patterns		
11.	Prospect	-Reduce stress, boredom, irritation & fatigue -Improve comfort and perception of safety	-Orienting building, fenestration or corridor to optimise visual access to outdoor vistas -Designing around existing or planned savannah-like ecosystem.

12.	Refuge	-Improved concentration, attention & perception of safety	-Change in light levels within the interior.
13.	Mystery	-Induce strong pleasure response. -Resulted in strong dopamine or pleasure responses.	-provision of low maintenance garden with winding path -Preference of curve edges than sharp corners within the interior spaces

The biophilic design biophilic design patterns under 'nature in the space' category are; visual connection with nature, non-visual connection with nature, non-rhythmic sensory stimuli, thermal and airflow variability, dynamic and diffuse light, presence of water and connection with natural systems. Table II shows the frequency that the biophilic design biophilic design patterns are used in the six studies reviewed. Visual connection scores in three studies (Wilson, 1984; Kahn, 1991; and Kellert, 2008) and also has three biophilic architectural strategies that were adopted from the literature; Provision of varied landscaping and vegetation, unrestricted views of nature and vistas from the interior and Provision of healing gardens. Non-visual with nature connection scores in three studies (Ulrich, 2008; Heerwagen, 2006; and Kahn, 1991.) and have two biophilic architectural strategies; Access to nature sound over urban sounds and integration of natural ventilation and presence of water (see Table 2). Non-rhythmic sensory stimuli scores in three studies (Wilson, 1984; Heerwagen, 2006; and Hildebrand, 2000) and have two biophilic architectural strategies; Use of warm colours for sensory stimulations and provision of indoor landscape. Thermal and airflow variability scores in three studies (Wilson, 1984; Ulrich, 2008; and Kahn, 1991) and have two biophilic architecture strategies; design with respect to sun and wind orientation and placement of windows to allow natural ventilation. Dynamic and diffuse light scores in three studies (Ulrich, 2008; Heerwagen, 2006; and Hilderbrand, 2000) and has three biophilic architectural strategies that were adopted from the literature; Placement of windows to capture dynamic and diffuse light within the interior of the building and the use of reflective surface to enhance lighting and mitigates glare. Presence of water scores in all the studies provided in table 2 except in (Ulrich, 2008) has only one biophilic architecture strategy that was adopted from literature; which is the use of water as a landscape element. Last but not the least, connection with natural systems scores in two studies (Kellert, 2008 and Hilderbrand, 2000) and have one biophilic architecture strategy which is the provision of visual to existing natural system within the site (see Table 2).

Table 2: Relating 'Nature in the Space' patterns with architectural design strategies

Biophilic design patterns of Biophilic Design	**Biophilic Architectural Strategies**	Wilson (1984)	Ulrich (2008)	Heerwagen (2006)	Kahn (1991)	Kellert (2008)	Hilderbrand (2000)
	'Nature in the Space' Biophilic design patterns						
Visual connection with nature	• Provision of varied landscaping and vegetation • Unrestricted views of nature and vistas from the interior • Provision of healing gardens	■			■	■	
Non-visual connection with nature.	• Access to nature sound over urban sounds • Integration of natural ventilation and presence of water		■	■	■		
Non-rhythmic sensory stimuli.	• Use of warm colors for sensory stimulations • Provision of indoor landscape.	■		■			■
Presence of water.	• Use of water as a landscape element • (Fountain & aquarium).	■		■	■	■	■
Dynamic & diffuse light	• Placement of windows to capture dynamic and diffuse light within the interior of the building • Use of reflective surface to enhance lighting and mitigates glare		■	■			■
Thermal airflow & variability.	• Design with respect to sun and wind orientation • Placement of windows to allow natural ventilation	■	■		■		
Connection with natural system.	• Provision of visual to existing natural system within the site.				■		■

Source: Author, (2015)

The second category is 'natural analogues' which have three biophilic design patterns: biomorphic forms and biophilic design patterns, material connections with nature and complexity and order (See Table 2). Biomorphic forms and biophilic design patterns scores in three studies (Ulrich, 2008; Kahn, 1991 and Kellert, 2008) and has two biophilic architectural strategies that were adopted from the literature; Use of botanical interior motifs and applications of organic shapes in building exterior (see Table 3).

Materials connection with nature scores in three studies (Wilson, 1984; Heerwagen, 2006 and Hilderbrand, 2000), and has two biophilic architectural strategies that were adopted from the literature; Use of sustainable building materials and use of natural colour pallet like green within the interior spaces. Complexity and order scores in four studies (Ulrich, 2008; Heerwagen, 2006; Kahn, 1991; and Hilderbrand, 2000) and has two response strategies; Complex architectural expression and landscape planning, and integration of buildings parts into whole (see Table 3).

Table 3: Relating 'Natural Analogues' patterns with architectural design strategies

Biophilic design patterns Of Biophilic Design	**Biophilic Architectural Strategies**	Wilson (1984)	Ulrich (2008)	Heerwagen (2006)	Kahn (1991)	Kellert (2008)	Hilderbrand (2000)
'Natural Analogues' Biophilic design patterns							
Biomorphic forms & biophilic design patterns.	• Use of botanical interior motifs • Applications of organic shapes in building exterior						
Material connection with nature.	• Use of sustainable building materials • Use of natural colour pallet like green within the interior spaces						
Complexity & order	• Complex architectural expression and landscape planning • Integration of buildings parts into whole						

Source: Author, (2015).

The last category is 'nature of the space' and the biophilic design patterns under this are: prospect, mystery and refuge. Prospect scores in three studies (Ulrich, 2008; Kahn, 1991 and Kellert, 2008) and has two biophilic architecture strategies established from literature; Orienting building, fenestration or corridor to optimise visual access to outdoor vistas and designing around existing or planned

savannah-like ecosystem. Refuge scores in three studies (Wilson, 1984; Heerwagen, 2006 and Kellert, 2008) and the only strategy for its incorporation in the built environment in creating a change in level within the interior spaces. Mystery scores in five out of the six studies (all except Heerwagen, 2006) and has two biophilic architecture strategies established from literature; Provision of low maintenance garden and preference of curve edges than sharp corners within the interior spaces (See Table 4).

The most cited strategies are found under 'presence of water' and 'mystery' as they are cited in five out of the six literature reviewed. Strategies of visual connection with nature is the least cited in the literature reviewed with two mentions only (See Table 4).

Table 4: Relating 'Nature of the Space' patterns with architectural design strategies

Biophilic design patterns Of Biophilic Design	**Biophilic Architectural Strategies**	Wilson (1984)	Ulrich (2008)	Heerwagen (2006)	Kahn (1991)	Kellert (2008)	Hilderbrand (2000)
'Nature in the Space' Biophilic design patterns							
Prospect	• Orienting building, fenestration or corridor to optimize visual access to outdoor vistas • Designing around existing or planned savannah-like ecosystem		■		■		
Refuge	• Change in light levels within the interior	■		■		■	
Mystery	• Provision of low maintenance garden. • Preference of curve edges than sharp corners within the interior spaces	■	■		■	■	

Source: Author (2015)

The result obtained from Table 2-4 is further demonstrated in Figure I to show the development of the framework for integration of these biophilic design patterns in the built environment.

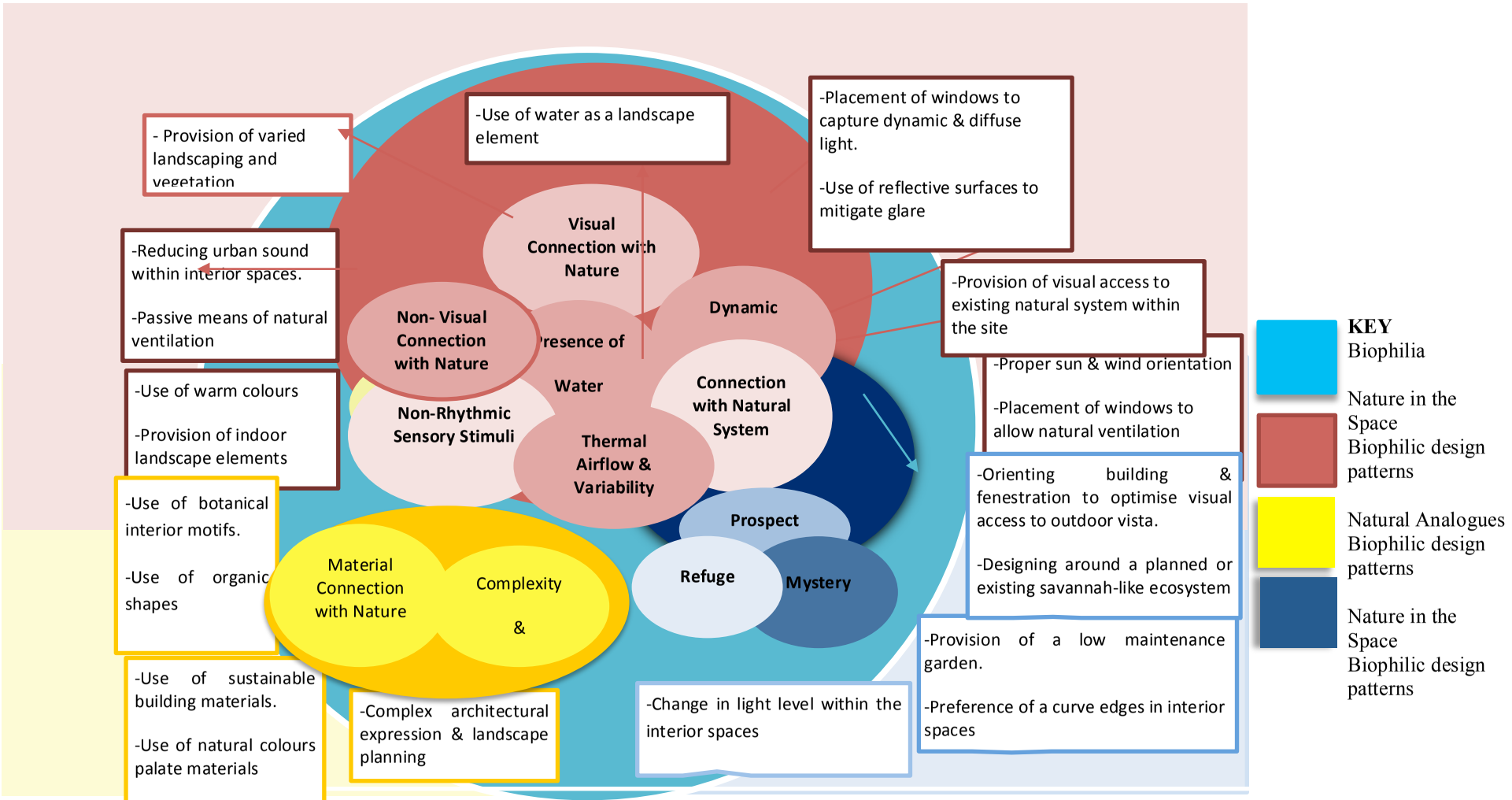


Figure I: A framework for the integration of biophilic design biophilic design patterns

CONCLUSION

To integrate biophilic design biophilic design patterns to improve biological responses in patients resident in cancer centres, biophilic architectural strategies are extracted from a literature review and designed in a framework. The studies are reviewed based on the three categories of biophilic design which have thirteen biophilic design patterns according to Terrapin, (2014). The first category is 'nature in the space'. The biophilic design patterns under this category are; visual connection with nature, non-visual connection with nature, non-rhythmic sensory stimuli, thermal and airflow variability, dynamic and diffuse light, presence of water and connection with natural systems. The second category is 'natural analogues' which have three biophilic design patterns: biomorphic forms and biophilic design patterns, material connections with nature and complexity and order. The last category is 'nature of the space' and the biophilic design patterns under this are: prospect, mystery and refuge. Out of 14 biophilic design patterns of biophilic design, however the last biophilic design pattern (risk/peril) is omitted because it is beyond the scope and aim of this work. The most cited strategies are found under 'presence of water' and 'mystery' as they are cited in five out of the six literature reviewed. Strategies of visual connection with nature is the least cited in the literature reviewed with two mentions only.

This analysis adds methodologically to the process of integrating or evaluating biophilic design patterns in the design of cancer centres as each pattern is proven to have direct physiological or psychological medical benefit to the patients. Previous works approached biophilic design patterns without clear strategies on how to incorporate them into the built environment as opposed to the strategies highlighted in this work. This analysis highlights biophilic architectural strategies and presents them holistically to enable researchers and practitioners with a pragmatic approach to achieving biophilic architecture.

REFERENCES

Fatima, A. (2009). Epidemiology & incidences of common cancer in Nigeria. Cancer registration workshop.

Heerwagen, J. (2010). *Biophilia, Health Nad wellebeing.* Resorative commons.

Heerwagen, J. H., & Mador, M. (2009). *Biophilic design: The theory, science and practice of bringing building to life.* New Jersey: John Willet & Sons Inc.

Heerwagen, J. H., & Orians, G. H. (2011). Humans Habitat and Aesthetics. In *Biophilia Hypothesis* (pp. 142-146). Washington DC: Island Press.

Hilderbrand, G. (2001). *Origins of architectural pleasure.* California: University of California press.

Holland, J. C., & Rolland, J. H. (1990). *Handbook of pscho-oncology: Psychological care with cancer patients.* NewYork: Oxford University Press.

Kahn, P. H. (1997). Developmental psychology and the biophilia hypothesis: Children's afilliation with nature. *A journal of nueral science, Delopmental review 17*, 1-61.

Kaplan, S., & Kaplan, R. (2006). *The experiance of nature: A psychological perspective.* Cambridge, UK: Cambridge University press.

Kellert, S. (2008). *Biophilia, Children and restoring connection to nature in*

the modern built environemnt. Unpublished.

Kellert, S. (2008). Dimensions, Elements and attributes of biophilic design. In J. Kellert, & M. Mador, *Biophilic design: The theory, science and practice of bringing building to life* (pp. 3-20). New Jersey, USA: John Wiley & Sons, Inc.

Lakeshore cancer centre. (2014). Retrieved August 12, 2015, from www.lakeshore.org: www.lakeshorecancer.org

Sagerstom, S. C., & Miller, G. E. (2004). Psychological stress and the human immune sytem: a meta-analytic study of 30 years of inquiry. *Psychological Bulletin, 130*(4), 601-630.

Stark, D., Smith, M., Velikova, G., House, A., & Selby, P. (2002). Anxiety and dis-orders in cancer patients: Their nature, association and realtion to quality of life. *Journal of clinical oncology, 20*, 3137-3148.

Terrapin, B. G. (2014). *14 Biophilic design patterns of biophilic design.* New York: Banes Foundation.

Ulrich, R. S. (2008). *Biophilic Theory and research for health design.* NewYork: John Milley.

Wilson, E. O. (1984). *Biophilia hypothesis.* Harvard university press.

ARCHISEARCH

EFFECT OF VEGETATION ON THERMAL PERFORMANCE OF CLASSROOMS IN A HOT-DRY CLIMATE OF YOLA, NIGERIA

Sa'adatu Aminu[1], Olusegun Moses Idowu[2] & Sumadanda Humphrey[3]
Department of Architecture, Modibbo Adama University of Technology, Yola
Correspondence email[2]: idowumosegun@gmail.com

Abstract
Thermal performance of buildings is aimed at providing the most comfortable environment for occupants, thus minimizing demand for cooling and heating. Studies in hot-humid climates suggest that vegetation has influence on local temperature, and may be effective in reducing air temperature and creating different air flow patterns in buildings. There is however paucity of knowledge on similar influence in hot-dry climates. Hence this study sought to ascertain the extent to which vegetation affect thermal performance of classrooms in the study area. The ex post-facto case study investigated three classrooms with varying incidence and proximity of vegetation in a College in Adamawa State Polytechnic, Yola, selected on convenience. Architectural characteristics (building form, orientation, building height, floor to ceiling height, floor area, opening sizes and type, position of openings, window/floor ratio, window/wall ratio etc.)of the studied spaces were measured and environmental variables (wind speed, air temperature and relative humidity) were recorded using pocket-sized thermal anemometers with telescopic velocity stick, and kestrel 3000 pocket weather meter. Mean of the environmental variables were compared using ANOVA to establish any significant difference (at 0.05 level of significance) among the three classrooms. A significant difference in temperature in the classrooms and outdoor spaces under study was found. Cooling extent ranging from 4.62 to 5.90^{o}C with corresponding cooling difference up to 1.23^{o}C were observed among the classrooms. The effect of trees on wind speed and direction could not be determined because wind directions could not be measured. Among the recommendations made to enhance interior thermal performance in the study area include planting of evergreen trees with clear trunk height above window levels, at distances between three and 12 metres away from buildings.

Keywords: *Thermal performance, Classrooms, Vegetation, Passive cooling, Hot-dry climate*

INTRODUCTION

In the hot climates characterized by air temperatures and relative humidity beyond desirable comfort zone, buildings are expected to provide cooler interiors for occupants' thermal comfort (ASHRAE, 2003; Nadel, 2006; Oral, Yenal and Bayazit, 2003; Muncey, 2011). Odim, Okonkwo and Idowu (2012) revealed this can passively be achieved by design strategies aimed at solar protection, heat dissipation and heat modulation. The level at which it is achieved could be an indicator of the thermal performance of the building. Vegetation can be employed to provide not only solar protection to building fabrics, but also to aid heat dissipation

from the building (Odim et al, 2012). The extent to which vegetation may affect thermal performance of buildings is dependent on a number of factors including type and size of vegetation, position of vegetation relative to building elements concerned (Misni, 2012). Trees, shrubs, hedges, and grasses could be placed adjacent to building walls, windows, and roofs to directly protect these elements from direct solar radiation. Roofs could also be designed as gardens to act as thermal mass capable of modulating heat flow into space below (Huang, Ruey-Lung & Kuo-Tsang, 2014).

Teaching and learning performance in naturally ventilated classrooms has been directly related to thermal comfort level of occupants (Akande and Adebamowo, 2010; Huang et al, 2014). Considering the economic and environmental challenges associated with mechanical cooling, Abanomi and Jones (2005) have advocated that passive cooling and other energy conservation strategies be explored in school buildings in hot and arid regions. This study is aimed at enhancing thermal performance of classrooms in hot-dry climate by vegetation. A review of literature on some theory of vegetative cooling, and related empirical studies is considered appropriate here.

Vegetation and Urban/ buildings' Heat

Vegetation includes all the plant life such as trees, shrubs, hedges, and grasses (Misni, 2012). Boutet (1987) implied that vegetation can influence solar radiation, air temperature, humidity and air flow magnitude and direction. While there are a number of landscape strategies that can be implemented to modify the microclimate, the three main functions of vegetation used to do this are shade, evapotranspiration (the process of transferring moisture from the earth to the atmosphere by evaporation of water and transpiration from plants), and wind control (Hiroaka, 2002; Skudo and Nikolopoulou, 2004; Misni, 2012).

Misni (2012) also posits that using strategically placed shade trees of the right species and form around a building can potentially modify its microclimate and the building's energy use. The shading they provide can reduce the amount of radiant energy absorbed and stored by buildings and other built surfaces. According to Simpson (2002), evaporation and transpiration through vegetation contributes to lowering urban temperatures. In this process, the plant draws moisture from the ground, uses what it needs to grow, moderates its own temperature and transpires the excess. Plants, trees and shrubs cool the environment when they absorb radiation for photosynthesis, releasing moisture thereby raising the humidity level.

The re-radiation effect of concrete surfaces, according to Huang (2008), increases the surrounding air temperature in the urban area. In hot climates, this is a negative effect that can be mitigated by replacement of hard concrete surfaces with soft vegetative coverings like hedges and grasses. In general, increase of wind velocity provides more comfort to pedestrians in urban open spaces. Air movement has proved to incorporate lower air masses which have the tendency to provide refreshing sensation for pedestrians in the urban areas. Part of the design strategies is to direct winds to necessary areas where they are required, and this could be achieved with trees and shrubs. Vegetation creates different air

flow patterns by causing minor pressure differences, and thus can be useful in directing or diverting the prevailing wind to advantage (Boutet, 1987; Corbella & Magathael, 2008).

Givoni (2001), cited in Girei (2010), also implied that vegetation affects the internal temperature and cooling load of buildings in various ways. Cooling can be provided by trees and pergolas close to walls and windows without significant reduction in ventilation. A significant reduction in ventilation may however accompany cooling with vines on walls and high shrubs close to walls. Hedges and grasses around a building reduces reflected solar radiation emitted toward the walls from the surrounding area, thus, lowering the solar and long wave heat gain. Trees on the eastern and western sides of a building can effectively shield from rising and setting solar radiation. Kamal (2012) also agreed that landscaping can be one of the important factors for energy conservation in buildings. Vegetation and trees in particular, very effectively shade and reduce heat gain. Trees can be used with advantage to shade roof, walls and windows. Different types of plants (trees, shrubs, vines) can be selected on the basis of their growth habit (tall, low, dense, light permeable) to provide the desired degree of shading for various window orientations and situations (Kamal, 2012).

Some Previous studies

Cooling or themal effects of vegetation had been recorded by researchers such as Zahoor (1997), Saxena(2001), Hiraoka (2002), Kamal (2012), Obi (2014), Huang et al, (2014), and Morakinyo, Adegun and Balogun (2014).

Zahoor (1997), from an experiment in Pakistan, found out that vegetation has significant influence to local temperature and was effective in reducing air temperature by about 6-7^{0}F. Saxena (2001), by computer simulation also observed that temperature in residential neighborhoods surrounded by considerable number of trees was 1.34 ^{0}F lower than without vegetation. In the same vein, Hiroaka (2002) observed through computer simulation the air temperature distribution of around 10m height single tree and obtained the range of maximum reduced air temperature at about 25 meter away from the tree, though this was partially influenced by wind velocity and direction. Obi (2014) observed temperatures under different trees and adjacent open spaces, and discovered that extent of cooling depends on type of trees in the hot dry season of February and March in Enugu, Nigeria. He reported that coconut trees produced a cooling of 4.4^{o}C, palm trees 5.4 ^{o}C, while cashew produced 7.4 ^{o}C.

Perhaps more related to building interiors is the work of Huang et al (2014) where cooling of naturally ventilated classrooms under conventional aluminum roof, and roof garden in a hot and humid climate were studied. It was reported that thermal comfort and learning performance in the classroom with roof garden were significantly higher than obtained in that with the aluminum roof (Huang et al, 2014). It was a demonstration of passive cooling by heat modulation as espoused in Odim et al (2012). Interior heat dissipation effects of trees around buildings in warm humid climate of Akure, Nigeria were reported by Morakinyo et al (2014). The causal-comparative study found that occupants of residential buildings close to trees were significantly more thermally comfortable than those of buildings not close to trees.

The Study Area

The climate of an area helps in understanding thermal behavior of buildings. Hence apprehending the climate of Yola, the study area is apt. Yola is located on the north eastern part of Nigeria between latitude 7^0 and 11^0 North of the equator, and longitude 11^0 and 14^0 of the Greenwich meridian. Based on analysis of climatic data of temperature, rainfall and relative humidity, Yola has been classified, as espoused in Idowu (2012), as a hot-dry zone. It is characterized by mean daily maximum dry bulb temperature during the dry season not less than 35^{o}C, daily diurnal temperature range up to 20 ^{o}C, relative humidity not exceeding 40%, and the mean yearly rainfall below 1000mm. The dry season lasts about five months from November to March when there is usually no rain, with maximum temperature up to 45 ^{o}C, and relative humidity as low as 15%. Wind speeds during this period range from 0.16 to 1.36m/s (Idowu, 2012; Abdurrahman, 2015). Thermal comfort is ordinary difficult to attain under the climatic conditions during the hot dry season in the study area.

Statement of the Problem

Anecdotal evidence and information in tropical built environment suggest that vegetation has appreciable cooling effect on temperature within and around buildings. Odim et al (2012) cited ample literature also suggesting the thermal protection effect of vegetation around architectural spaces. Some empirical studies in hot-humid climates of Nigeria have been reported ascertaining significant heat-mitigating effect of varieties of trees. For instance, Obi's (2014) work in Enugu revealed that temperature in spaces under different trees (coconut, palm, cashew etc) are different but significantly lower than in adjacent open spaces. Morakinyo et al (2014) also reported appreciable cooling of vegetation on building interiors in Akure.

In the hot-dry climate of Nigeria, however, empirical evidence on the thermal effect of vegetation is virtually non-existent, or hardly reported. Trees are often sited at varying distances from buildings without an informed knowledge of their effects on the buildings' thermal environments. Part of this knowledge-gap is intended to be filled by this study.

Aim and Objectives of the Study

The aim of this study is to proffer strategies that could improve thermal performance of building indoor spaces through vegetation in the study area.

This will be achieved through the following objectives:

i. To determine the extent to which distance between vegetation (tree) and building affect the thermal performance of building indoor spaces.
ii. To determine the extent to which trunk height of the vegetation (tree) affects the thermal performance of building indoor spaces.

METHODOLOGY

Research Design

The Case study is an ex-post facto (causal-comparative) research design. It is a contextual study of independent variables as they inherently exist without manipulation (Koleoso, 1999).The presence and distance of vegetation to some existing architectural spaces are the independent variables under study. The dependent variables, on the other hand, are the thermal comfort parameters of

temperature, relative humidity and wind speed.

The Study Subjects

Three classrooms (labeled A, B, and C) in two blocks of buildings (see figure 1) in the College of Environmental Sciences, Adamawa State Polytechnic are subjects of the study. Classroom A has no vegetation (tree) on both sides; B has one vegetation (Neem tree) 12.5m away from the external wall it also has a trunk height of 3.00m with small foliage size on the southern side. Classroom C has vegetation (Neem trees) on both sides 3.0m away to the north and 12.5m away to the south with trunk heights of 2.60m and 3.00m respectively and small foliage size as well. The architectural characteristics of the classrooms are indicated in table 1.

Data and Data Collection Technique

Two pocket-sized thermal anemometers with telescopic velocity stick ('Testo 405-v1'), and pocket weather meter ('kestrel 3000') were used for measuring thermal performance variables of wind speed, temperature, and relative humidity indoors and outdoors. These variables were measured two times on each of a classroom's 22 desk-tops of 0.8m height, at time intervals of about 10 seconds, with corresponding outdoor simultaneous observations. Measurements were done in turn in class rooms A, B and C with all windows and doors opened.

Data analysis technique

Thermal performance of was calculated as outdoor-indoor differentials of the measured variables by subtracting the indoor readings from those of the corresponding outdoor. Descriptive statistics of mean and standard deviation were employed in analyzing the generated data. Analysis of Variance (ANOVA) was deployed to compare means, and draw inference on their difference at 0.05 level of significance. The results were presented in tabular forms.

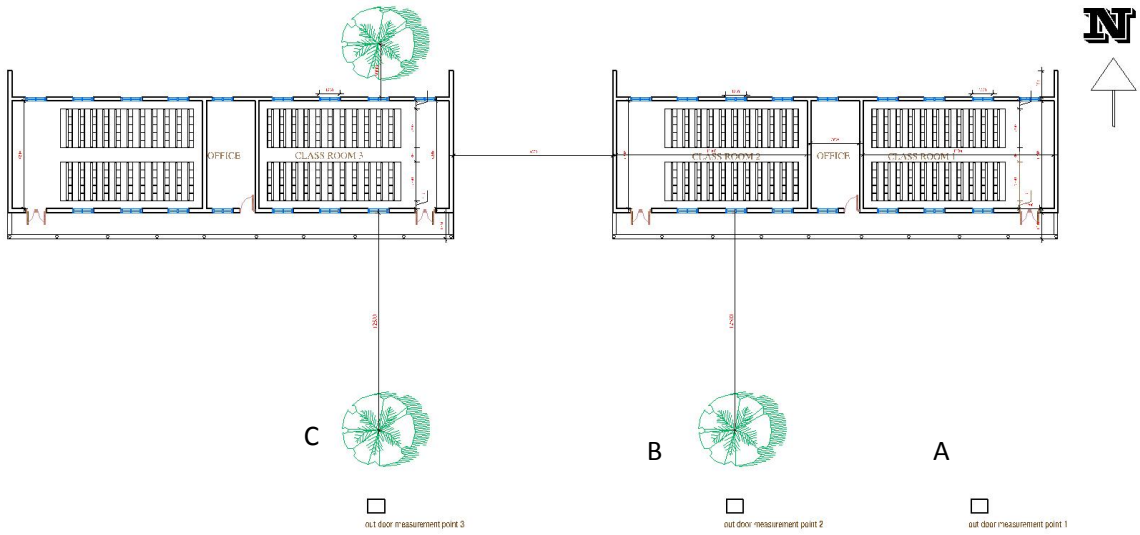


Figure 1: Floor plan of the observed classrooms. Source: Author's field work (2015)

Table 1: Architectural Characteristics of the studied building/spaces

S/N	Variables	Class room A	Class room B	Class room C
1	Building name	CR of CES, Jambutu. Adamawa State polytechnic, Yola.	CR of CES, Jambutu. Adamawa State polytechnic, Yola.	CR of CES, Jambutu. Adamawa State polytechnic, Yola.
2	Building form	Rectangular shape in plan	Rectangular shape in plan	Rectangular shape in plan
3	Building height	3.35m	3.35m	3.35m
4	Orientation of building	The longest side is oriented in north- south with corridor on southern side and northern wall recessed.	The longest side is oriented in north-south with corridor on southern side and northern wall recessed.	The longest side is oriented in north-south with corridor on southern side and northern wall recessed.
5	Roof form and slope	Gable roof with slope less than 30^o.	Gable roof with slope less than 30^o	Gable roof with slope less than 30^o
6	Floor level	On ground floor.	On ground floor.	On ground floor.
7	Size of the floor	11.0m by 6.2m	11.0m by 6.2m	11.0m by 6.2m
8	Height of floor to ceiling	3.10m	3.10m	3.10m
9	Floor area	$68.2m^2$	$68.2m^2$	$68.2m^2$
10	Size of door	1.2m by 2.1m	1.2m by 2.1m	1.2m by 2.1m
11	Window type	Louver type, which is ninety five percent operable.	Louver type, which is ninety five percent operable.	Louver type, which is ninety five percent operable.
12	Window sill height above ground	0.9m	0.9m	0.9m
13	Size of the window	1.2m by 1.2m	1.2m by 1.2m	1.2m by 1.2m
14	Position of the window	All windows are on the longer sides of the wall, none on the adjacent, located at work-plane.	All windows are on the longer sides of the wall, none on the adjacent, located at work-plane.	All windows are on the longer sides of the wall, none on the adjacent, located at work-plane.
15	Number of the window	**7**	**7**	**7**
16	Orientation of the window	North-South(four on north and three on south)	North-South(four on north and three on south)	North-South(four on north and three on south)
17	Security of the window	Bounded with burglary bars 8mm diameter to the outside, design to cross each other.	Bounded with burglary bars 8mm diameter to the outside, design to cross each other.	Bounded with burglary bars 8mm diameter to the outside, design to cross each other.
18	Floor finish	Sand screed floor finish	Sand screed floor finish	Sand screed floor finish
19	Wall finish	Cement-Sand plaster	Cement-Sand plaster	Cement-Sand plaster
20	Window/floor ratio (%)	2.11%	2.11%	2.11%
21	Window/wall ratio (%)	4.22%	4.22%	4.22%

CR= Class Room, CES= College of Environmental Sciences Source: Author's fieldwork (2015)

RESULTS AND DISCUSSION

Results

Table 2 indicates the effect of vegetation parameters on the thermal performance variables of the spaces under study. The Analyses of variance (ANOVA) of the mean temperatures among the spaces under study are shown in tables 3, 4, and 5.While table 3 indicates the ANOVA of outdoor air temperatures, tables 4 and 5 indicate those of indoor air, and outdoor-indoor temperature differentials respectively. While there is no tree adjacent to classroom A, classroom B has one adjacent tree, and two trees are adjacent to classroom C. The trees are located at distances and directions to the classrooms as shown in figure 1 and table 2.The mean outdoor wind speeds are 0.4m/s at (with Standard Deviation, SD of 0.33), 0.5m/s at (S.D of 0.35) and 0.41m/s (SD of 0.20) for classrooms A, B, and C respectively, the mean indoor wind speed are 0.13m/s (SD of 0.6), 0.13m/s (SD of 0.10) and 0.19m/s (SD of 0.18) for class rooms A, B, and C respectively furthermore, the ventilation coefficients are 0.44 (SD of 0.38), 0.37 (SD of 0.38) and 0.55 (SD of 0.51) for the three class rooms respectively. While the mean outdoor temperatures are 37.45^{o}C (SD of 0.74), 38.35^{o}c (SD of 1.00) and 38.03^{o}C (SD of 1.46) for classroom A, B, and C respectively. Also the mean indoor temperatures are found to be 32.83 ^{o}C (SD of 0.76), 32.68 ^{o}C (SD of 0.62) and 32.13 ^{o}C (SD of 1.00) for the three classrooms respectively. The outdoor-indoor temperature differences are 4.62 ^{o}C (SD of 0.86), 5.66 ^{o}C (SD of 1.16) and 5.90 ^{o}C (SD of 0.95) for the three classrooms respectively. The percentages for outdoor relative humidity are 29.40, 30.50 and 32.90 respectively. Finally, the percentages for indoor relative humidity are 32.80, 33.40 and 35.60 for the three classrooms respectively. The difference in mean outdoor temperatures measured around the classrooms is found to be significant (calculated value of F-ratio higher than critical value) at 0.95 level of confidence as shown in table 3. There is also a significant difference in the mean indoor temperatures of the classrooms as indicated in table 4. In the same vein, table 5 reveals that the mean outdoor-indoor temperature differentials are significantly different.

Table 2: Incidence of vegetation, Study Spaces, and Thermal performance variables

Measured attributes/variables	Class room A	Class room B	Class room C
Number of tree	None	1	2
Tree to building distance (m)	None	12.50	12.50 and 3.00
Location of tree	None	North	North and south
Trunk height (m)	None	3.00	2.60 and 3.00
Mean outdoor wind speed (m/s) and S.D	0.41 (0.33)	0.51 (0.35)	0.41 (0.20)
Mean indoor wind speed (m/s) and S.D	0.13 (0.06)	0.13 (0.10)	0.19 (0.18)
Ventilation coefficient and S.D	0.44 (0.38)	0.37 (0.38)	0.55 (0.51)
Mean outdoor temperature (^{o}C) and S.D	37.45 (0.74)	38.35 (1.00)	38.03 (1.46)
Mean indoor temperature (^{o}C) and S.D	32.83 (0.76)	32.68 (0.62)	32.13 (1.00)
Temperature difference (^{o}C) and S.D	4.62 (0.86)	5.66 (1.16)	5.90 (0.95)
Outdoor relative humidity (%)	29.40	30.50	32.90
Indoor relative humidity (%)	32.80	33.40	35.60

S.D = Standard Deviation

Table 3: Analysis of Variance Summary of Mean outdoor air temperature among the Classrooms

Source of variance	Sum of squares	d.f.	Mean square	F_{cal}	Sig.	F_{crit}	Remark: Difference in mean
Between groups	12.232	2	8.960	7.275	0.001	3.07	Significant
Within groups	84.297	129	1.232				
Total	96.529	131					

Table 4: Analysis of Variance Summary of Mean indoor air temperature among the classrooms

Source of variance	Sum of squares	d.f.	Mean square	F_{cal}	Sig.	F_{crit}	Remark: Difference in mean
Between groups	12.232	2	6.116	9.359	0.000	3.07	Significant
Within groups	84.297	129	0.653				
Total	96.529	131					

Table 5: Analysis of Variance Summary of Mean air temperature difference among the classrooms

Source of variance	Sum of squares	d.f.	Mean square	F_{cal}	Sig.	F_{crit}	Remark: Difference in mean
Between groups	40.585	2	20.292	20.428	0.000	3.07	Significant
Within groups	128.142	129	0.993				
Total	168.726	131					

Discussion

There is a significant difference in temperature in the classrooms and outdoor spaces under study. Cooling extent ranging from 4.62 to 5.90^{o}C with corresponding cooling difference up to 1.23^{o}C were observed among the classrooms. These classrooms and spaces are adjoined by trees of varying numbers (classroom A by none, B by one, and C by two trees) and distances (from three to 12.5m). The clear trunk heights of the trees (2.6 to three metres) seem not significantly different. These data suggests that number and distance of adjoining trees have significant effect on temperature of classroom spaces under study. It is also indicative of a significant effect of vegetation on temperature of outdoor spaces. The study reinforces the position espoused in Odim et al (2012), Kamal (2012), and Obi (2014) to the effect that trees around buildings can produce significant interior cooling.

The position of Misni (2012) seems different from that revealed by this study. The study suggests that trees beyond three to five metres from buildings could produce significant interior cooling, whereas Misni (2012) reported that significant interior cooling is attainable

only if trees are located three to five metres away from buildings.

The effect of clear trunk height could not be ascertained in the study since the difference in the clear trunk height of the studied trees seems insignificant.
Wind directions were not measured in the study, making it difficult to ascertain whether wind was blowing from the trees into the classrooms or from the classrooms to tree-covered spaces. Thus the effect of vegetation on wind speed could not be ascertained in this study, even though earlier works (such as Boutet, 1987; Idowu, 2012) showed that vegetation and other site features affect wind direction and speed.

There is also a difference in the relative humidity as observed in the classrooms and outdoor spaces under study. This suggests, and reinforces the position espoused in Misni (2012) that vegetation around buildings has effect on relative humidity of interior spaces. The extent to which vegetation density affect both temperature and relative humidity could not be ascertained, because this was not measured. Number of trees may not necessarily be a measure of density of vegetation cover.

CONCLUSION AND RECOMMENDATIONS

The study sought to know the extent to which vegetation affects thermal performance of building indoor spaces with the aim of improving thermal performance of building indoor spaces in a hot dry climate. It has revealed among other things that vegetation around the studied classrooms have significant interior cooling effects. It is also established in the study that vegetation cooling capacity varies with number of trees. Effect of clear tree-trunk height could not be ascertained because all the subject trees have virtually same trunk architecture with vegetation above classroom window levels. The effect of trees on wind speed and direction could not be determined in the study because wind directions could not be measured. Consequently, the following recommendations may enhance thermal performance of classrooms and other interior spaces in the study area: (i) planting of evergreen trees with clear trunk height above window levels, at distances between three and 12 metres away from buildings; (ii) explore use of vegetation to enhance heat dissipation cooling through further research into effect of vegetation on wind speed and direction in the study area.

REFERENCES

Abanomi, W. & Jones, P. (2005). Passive Cooling and Energy conservation strategies of School buildings in hot-arid region of Riyadh, Saudi Arabia. *Proceedings of International conference: 'Passive and low Energy Cooling for the Built Environment', May, Santorini, Greece.*

Abdurrahman, A. B. (2015). *Application of Mahoney tables for Bioclimatic residential buildings in Yola*. A seminar paper in The Department of Architecture, Modibbo Adama University Technology, Yola. 7/01/2015. 1-21.

Akande, O. K. & Adebamowo, M. A. (2010). Indoor Thermal comfort for Residential buildings in hot-dry climate of Nigeria. *Proceedings of Conference: Adapting to Change: New thinking on Comfort. Cumberland Lodge, Windsor,* UK, 9-11 April 2010. London: Network for Comfort and

Energy use in buildings: Retrieved from http://nceub.org.uk 11/07/2015.

ASHRAE (2003). Green guide: The Design, Construction, and Operation of Sustainable Buildings. *American Society of Heating, Refrigerating and Air-Conditioning Engineers.* New York: ASHRAE Press.

ASHRAE (2005). *Fundamentals (SI ed.).* Atlanta American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc.

Boutet, T. S. (1987): *Controlling Air Movement: A manual for architects and builders.* New York: Mc-Graw Hill Book Company.

Corbella, O.D. & Magathael, M. N. (2008). Conceptual Differences between the bioclimatic urbanism for Europe and for the Tropical humid climate. *Renewable Energy 33* (2008) 1019-1023.

Escobedo F. Seitz, J.A, & Zipper W, (2011). *The Effects of Grainesville's urban trees on Energy use of residential buildings*. University of Florida, IFAS extension For 2011, 1-3.

Girei, M. B. (2010). *A study on passive cooling techniques in hot humid climate.* Unpublished M.Sc Thesis. Department of Architecture, Ahmadu Bello University Zaria, Nigeria.

Givoni, B. (2001). *Passive and low Energy cooling of buildings*. New York: John Wiley& sons.

Gomez-Monoz, V. P., Porta-Garidara, M. A., Fernandez, J. I, (2010). Effect of Tree shades in Urban planning in hot-arid climatic regions. *Landscape and Urban planning 94*. 149-151.

Hiroaka, H. (2002). Simulating the Microclimate produced by a Single tree. Ecole d' Architecture de Nantes (CERMA). *Proceedings of International Workshop on Architecture and Urban Ambient Environment, Nantes*, 6-8 February 2002. 1-11.

Huang, L. (2008). A fieldwork study on the Diurnal changes of Urban microclimate in four types of Ground cover and Urban heat Island of Nanjing, China. *Building and Environment 43.* 7-17.

Huang, W., Ruey-Lung, H. and Kuo-Tsang, H.(2014). The Effect of Green roof on Thermal comfort and Learning performance in a naturally ventilated classroom in a hot and humid climate. *Conference Proceedings for World SB 14. 6*. Reviewed by the Scientific Committee of World SB14 Barcelona. World Sustainable Buildings, Barcelona, 28-3 October, 2014. 9-15.

Idowu, O. M. (2012). *Towards Enhancing the Effectiveness of Classroom-designs for Natural Ventilation in Hot dry climate: Case study of some Primary schools in Yola*. Unpubished Ph.D thesis, Abia State University, Uturu, Nigeria.

I.P.C.C. (2013). The physical science basis. In: Stocker T.F., Qin, D., Plattner,G.K., Tignor, M., Allen, S.K., Boschung, J., Nauels, A., Xia, Y., Bex, V. and Midgley, P.M. (eds) *Contribution of working group I to the fifth assessment report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press. 2-27.

Kamal, M. A. (2012). An overview of Passive Cooling techniques in buildings: Design Concepts and architectural interventions Acta Technica Napocensis: *Civil Engineering & Architecture. 55*. 1. 84-97 (16 September, 2012). http://constructii.utcluj.ro/ActaCivilEng.

Koleoso, A.(1999). *Research methods and statistics*. Ondo: Alex Publishers.

Lechner, N. (2000): *HEATING, Cooling, Lighting design methods for Architects (second ed.).*New York: John Wiley & Sons, Inc.

Misni, A. (2012). *Effect of surrounding vegetation, building construction and thermalperformance of housing in a tropical environment*. Unpublished Ph.D Thesis, Victoria University of Wellington, New Zealand.

Morakinyo, T. E., Adegun, O. B., and Balogun, A. A. (2014). The effect of vegetation on indoor and outdoor thermal comfort conditions: Evidence from a micro-scale study of two similar urban building in Akure, Nigeria. *Journal of Indoor and Built environment. 25*. (4, 2016). http://www.sage publications.com

Muncey, R. W. (2011). Thermal performance of Buildings. *Architectural Science Review, 7* (2). 45 – 47.

Nadel, B. A. (2006). 21st century building envelope systems: Merging Innovation with Technology, Sustainability, and Function. *Architectural Record:* Continuing Education Centre, 1-10.

Nervis, R.G & Hardy, J.D (2007). *Humidity effects on Comfort and well-being of People in humidity and moisture. 2*, 3-11.

Obi, N. I. (2014). The influence of vegetation on microclimate in hot humid tropical Environment: A case of Enugu urban. *International Journal of Energy and Environmental Research, 2((2),* 28-38, June. European Centre for Research Training and Development UK (www.eajournals.org).

Oral, G. K., Yener, A. K., & Bayazit, N. T. (2003). Building Envelope Design with the objective to ensure Thermal, Visual, and Acoustic comfort conditions. *Building and Environment*. *39,* 281-287.

Pandit, R. & Laband, D.N, (2010). Energy saving from Tree shade. *Ecological Economics*, *69*, 1324-1329.

Radhi, H. A. (2009): Comparison of accuracy of building energy analysis in Bahrain using data from different weather periods. *Renew Energy 34*, 869-875.

Saxena, M. (2001): *Microclimate Modification: Calculating the effects of trees on air Temperature*: website.www.sbse.org/awards/docs. 09/07/2015.

Scudo, G. & Nikolopoulou, M. (2004). Evaluation of radiation conditions in Urban Spaces in Designing Open Spaces in Urban Environment: A Bioclimatic Approach. *Journal of Applied Sciences Research, 8* (11), www.aensiweb.com/old/jasr/jasr/2012/ 5306-5310.

Simpson, J. R. (2002). Improved estimates of tree-shade effects on residential energy use. *Energy and Buildings 34*, 1067-1076.

Yoshida, S., Ooka, R., Moshida, A., Murakami, S., & Tominaga, Y. (2006). The influence of urban design on outdoor thermal comfort in the hot, humid city of Colombo, Sri Lanka. Development of three dimensional plant canopy models for numerical simulation of outdoor thermal environment. *Int J Biometeorol.* 2006 Nov; *51*(2):119-33. Epub 2006 Jul 20.

Zahoor, A. (1997): *Effects of Trees in ameliorating air temperature in Urban setting in Pakistan,* Unpublished Dissertation, University of Idaho.

ARCHISEARCH

PERCEPTIONS AND RELEVANCE OF ENVIRONMENTAL AND SOCIO-ECONOMIC LIFE QUALITY INDICATORS AMONG RESIDENTS OF KANO CITY, NORTHERN NIGERIA

Babangida Hamza[1] & Binta Fatima Yahaya[2]
[1]Department of Architecture, Ahmadu Bello University, Zaria
[2]Department of Architecture, Kano University of Science and Technology, Wudil
[1]Correspondence email: babanhamza@gmail.com

Abstract

The concept of quality of life relates the quality of living conditions of human populations with reference to how well they live their lives. It is presented as the characteristic of people's lifecycle that reveals life-sustaining activities, as well as life necessities. Indicators of life quality cover various aspects of the human life such as health, education, employment and quality of working life, income and wealth distribution, social attachments, personal safety and justice, and indicators which affect their living conditions around their physical environment. The aim of this study is to measure the Kano resident's perceptions and relevance of Life Quality Indicators, specifically on the aspect of their socioeconomic and environmental issues. In undertaking this study, a stratified questionnaire based on the Likert scale and rated on a five-point scale of 1-5, where 5 represent the highest score and 1 the lowest was used. As a first step to the analysis, descriptive and inferential statistics were used to summarize and describe the demographic attributes of the respondents using the SPSS software (version 20), followed by second method whereby a mathematical formulae was used for the calculation of the measures of level of importance of LQ indicators, LQ index and Habitability Index based on respondents questionnaire scores. Findings based on the analysis reveals indicators of Educational /capacity building and social interactions as the highest contributor to the respondents LQ while sanitation was the least contributor which indicate very low level of sanitation in the downtown city. The findings primarily imply the urgent need for intervention in the environmental life quality such as provision of infrastructural elements such as drainages and sewer systems where they do not exist, and regular clearing, expansion and upgrading existing ones.

Keywords: *Life Quality, Socio-economic indicators, Environmental indicators, Perception, Kano*

INTRODUCTION

The concept of quality of life (LQI) was proposed by the UN in the 1960s as a tool to measure developments in countries. This was due in part, to the inability of many governments to accurately measure the true development of their societies using indicators such as the Gross National Product (GNP) and the Gross Domestic Product (GDP) (Mansoor, 2004). The report of later studies such as those conducted on normative tools of measuring development by Stiglitz, Sena & Fittoussi (2009) suggests limitations

for evaluation of the success of economic growth of human populations. The successful use of LQ in selected cities and in different countries by the UN such as the UK and Australia in 1970 encourages other countries to adopt same (Mansoor, 2004). The LQ as a measuring tool was also found to be an alternative means of expanding ways to measure other aspects of developments of countries not covered by GDP and GNP such as the environmental assets, social and human values and happiness (Flanagan 1978, Brownson, Hoehner, Day, Forsyth, Sallis, 2009, Marans, 2012; 2003). According to Smitha (2015), the scope of life quality covers, at the global scale issues on environment and its impact, and at the individual human level it addresses socio-cultural and psychological aspects within the context of built environment. Similarly, Marans (2003) further argued that other measurable aspects of LQ such as physical health and health-promoting behaviours were useful in measuring environmental amenities and conditions, such as the provision and maintenance of human-made infrastructure. In general, LQ as a concept was found to be an excellent means to improve lives of human population without recourse to geographical or economic affiliations of nations (Zuzana, Pavol & Stela, 2014).

Attempts to define the concept of LQ by scholars have so far proven to be tasking, due in part to its complex nature as it cut across disciplines. The most common of the definitions were however, found to be synonymous with life importance and subjective well-being (Epley & Menon, 2008). A comprehensive review of definitions of LQ carried out by Lawrence (2001) suggests some level of dependence on the research question which guide the study and the level at which subject is studied (e.g., individuals, social or ethnic groups, and across local, regional, and national levels). For example, while the definitions offered by Fontinelle (2011) suggests that the most important indicators of quality of life were happiness, human rights and respect for human life, the works of Keles (2012) and Abdel-Hadi (2012) however, identified environmental quality as the most important indicator of the quality of life. Their arguments was informed based on outcomes of studies which suggests that improving environmental conditions of countries and surroundings of individuals increases the level of QL. In line with the objective of this paper, two definitions were found useful. The first one presented here was proposed by the Compendium of Key Well-Being Indicators, cited in Zuzana, Pavol & Stela (2014) which defines it as 'the set of non-financial, non-monetary attributes of individuals, which co-determines their life chances and opportunities in life and have value in different cultures and contexts'. The second definition however, found relevant here was by provided by World Health Organizatio (WHO) as the "individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns'. As seen from the last definition it captures four domains of LQ; physical health, psychological health, social relationships and immediate environment, the last being the focus of this paper.

Indicators of living or of life quality identified through extant literature covered both subjective and objective indicators. Examples of latter include health, social attachments personal safety

and justice, social opportunity and participation (Shabalina, 2015) while the former include education, employment and quality of working life, income and wealth distribution (McGranahan, 1972). To measure LQ of various societies among nations, strategies were evolved which largely depend upon peculiarities of affected nations. In the United States for example, health and wellness, interpersonal relationship, personal growth, dignity and self-esteem were considered by citizens as key life quality indicators (Mansur, 2004). This study focusses on measuring the perception of Kano residents on both the subjective (socioeconomic) and objective (physical environment) identified indicators within the context of traditional Kano city.

Environmental and Socio-economic LQ Indicators: theoretical framework

The significance of environmental life quality indicators have over the years been highlighted by various scholars and across disciplines. Many examples of extant works have suggested in particular that the quality of the urban environmental indicators when considered with other indicators such as socio-economic and cultural, affect the overall quality of life of urban residents (Van Liere & Dunlap, 1980, Holman & Coan, 2008, Dalia, 2015) and strongly influenced the way and manner people conduct their lives within the environment (Diener & Suh, 1997). They also contribute to people's well-being as it affects the health of the physical environment which reflect what people value (Brajša-Žganec, Merkaš, & Šverko, 2011). There is also the issue of benefits derivable directly from the use of environmental assets and services, such as clean water, pollution free air, open land, maintained forests and easy access to green areas (Balestra & Sultan, 2012). Similarly, the works of Kahn & Matsusaka (1997) as cited in Dalia (2015) reveals that people attach importance to the beauty and health of the environment where they live, due in part to the care they have about the degradation of the planet and the depletion of natural resources. From the health perspective of the quality of life indicators of the physical environment, Karen et al. (2016) suggest that an improved understanding of built environments was a critical factor to the health of the population who live in that environment. For example, the works of Koplan, Liverman, & Krakk (2005) which relates status of the environment to health behaviors of residents with respect to obesity and other chronic diseases.

On the other hand, the Socio-economic indicators generally relate to, in part, the Maslow model (2003) cited in Anett & Károly (2015) in which a hierarchy of needs was developed at three levels which include subjective indicators as *"Having, loving, and being"*. Socio economic indicators presents themselves as utility indicators used for subjective wellbeing and for achieving individuals' benefits (Kahneman, 1999). The relevance of the socio economic indicators to the human populations are quite varied. For example, the study of Mabogunje (1974) signifies their relevance with respect to eveloping new residential settings. Similarly, according to Shabalina, Fakhrutdinova, Mustafin & Shakirova (2015) the socio economic indicators provides opportunities for self-realization, income and influences the standard of living of human populations, which results in the development of human social circle such as education and medical care. Although, the works of Parris & Kates (2003) suggest absence of

socio economic indicator sets that are universally accepted, many scholars have however, identified aspects of both subjective and objective aspects of social and economic indicators that affects the life quality of human populations. The works of Mabogunje (1974) for example, identified four each of subjective and objective socioeconomic life quality indicators as employment, livability, manageability (of the environment) and serviceability (of the social services and amenities) on one hand and earnings, labour-market status, the availability of consumer goods and other similar material indicators respectively on the other. Other subjective 'context-specific' socioeconomic indicators of life quality were identified as consumption, schools status and commuting (Diener & Seligman 2004). Similarly, the woks of Stiglitz, Sen, & Fittoussi (2009) suggest non-market activities, income distribution and overall functioning of private households as indicators of socio-economic life quality indicators.

In this paper, the environmental indicators of life quality here considered include access to sources of clean water, management mechanisms of waste (soild and liquid) generated in the city, availability and adequacy of drainages, sewer system, waste disposal system and status of burrow pits. Others include electricity supply, sustainable electricity systems, adequacy of road network and width sufficiency of footpaths in the built areas. The choice of these environmental indicators as focus of this study is predicated on their importance as determinants of life quality at global level. Clean portable water for example is fundamental for human well-being, yet many people suffer from an inadequate quantity and quality. Availability of road network within the city and width sufficiency of footpaths within the traditional city indicates level of mobility among populace which are indicators that affect life quality of city's residents (Anett & Károly, 2015). The socioeconomic indicators identified include those that promote sociocultural cohesion among residents, economic activities and educational or capacity building of residents in the study area. The indicators that promote sociocultural cohesion among residents selected include community halls used for social gatherings, informal meetings and other community engagements. The socio economic indicators that promote economic activities considered here include shopping areas, trade training centers and cooperative societies which serve as avenues for promoting income among community members. Lastly, the life quality indicators on educational/capacity building considered here include formal schools, non-formal schools provided through self-help community efforts (Tsangaya/Islamiyya), clinics, trade training centers and cooperative societies. A closer look at the indicators shows a close relationship with life standard and local economy of individuals as well as the community.

Aim of the research

The overall aim of this study is to measure environmental and other socio economic life quality indicators of residents of Kano specifically, the traditional city city. To achieve the stated aim, the following objectives are targeted:

i. To establish through literature sources the environmental and socio economic indicators which affect life quality of human populations, in general and for Kano residents in particular.

ii. Measure the level of importance of LQ indicators, LQ index and LQ Habitability index (LQHI) as perceived by Kano residents through questionnaire response analysis, and
iii. Suggest areas for intervention to policy makers and other stakeholders concerned with improving quality of life of citizens within the traditional city of Kano.

Brief about the study area

The city of Kano is the capital of Kano State in northern Nigeria. With a population of over 7000 persons per sq. km in 1990, it has the highest population density in Africa south of the Sahara (Oumar, 1997). Its metropolitan population makes it the second largest city in Nigeria. Geographically located at 481 meters (or about 1580 feet) above sea level. The city lies to the north of the Jos Plateau, in the Sudanian Savanna region that stretches across the south of the Sahel. The region features savanna vegetation and a hot, semi-arid climate. Kano sees on average about 690 mm (27.2 in) of precipitation per year, the bulk of which falls from June through September. Kano is typically very hot throughout the year, though from December through February, the city is noticeably cooler. The city which the traditional city city of Kano qualifies consists of indicators and places built or designed by humans, including buildings, grounds around buildings, layout of communities, transportation infrastructure, parks and trails (Sallis, Floyd, Rodriguez, & Saelens, 2012). The urban territory according to Oumar (1997), is constituted by two main areas; *birni*, and *waje* consisting of about 2500 hectares of residential area. The *waje* is the outside of the traditional city housing areas where most government buildings are located. The *birni* is the traditional city historically inhabited by indigenous people of the city placed in four sectors meant for administrative purposes and surrounded by historical city gates. These include *Fuskar Arewa, Fuskar Gabas, Fuskar Yamma and Fuskar Kudu*. The *fuskar* arewa according to scholars such as Palmer (1928) cited in Oumar (1997) was the initial settlement where the city of Kano was founded and the cultural center of Kano (Liman, 1990). The *Fuskar gabas* on the other hand consists of the oldest parts of the city and presently serves as the commercial center of the city (Perchonock, 1976, 1979). The south sector (*Fuskar Kudu*) is the smallest and also the most recent (Barkindo, 1983). The *Fuskar Yamma* (west sector) is the largest in terms of area and accommodates some of oldest wards as well as the most recent ones.

RESEARCH METHODOLOGY

The research methodology adopted combines the use of multidimensional approach (measures of both the environmental and socio-economic indicators) as means to determine the perception of respondents (Zuzana, Pavol & Stela 2014). This was achieved through the use of questionnaire since it is related to measuring people's perception due to its acceptability globally (Dokmeci & Berkoz, 2000; Gbakeji & Magnus, 2007; Oduwaye, 2008; Sanni & Akinyemi, 2009). questionnaire consists of written questions (Descombe, 1998) developed from initial interviews for coding into pre-determined options based on the Likert scale rated on a five-point scale of 1-4 with corresponding options of least important (1) and most important (4). Recent studies have similarly, proven that this approach has dual advantages when measuring and predicting quality of life

(Bramston, Chipuer & Pretty, 2005; Matarrita-Cascante, 2010). Various models for measuring LQI at local and global levels exist. It could be measured using regression analysis model such as a study conducted for World Bank by Cheney & Syrquin (1975), Cluster analysis (Khan, 1979), Scatter diagram model (McGranahan, 1972). And the use of a mathematical formulae (Ogu, 2002; Awotona, 1990; Hanga, 2009, Hamza, 2013) which the authors considered as more versatile, hence was adopted. This approach respects institutional models such as one developed by the International Labour Organization ILO, (1976), as it essentially aims to determine the basic needs of the population in terms of minimum requirements of goods and services.

Data analyses include the use of descriptive statistics (SPSS Software) to summarize and describe demographic attributes of respondents, and the level of importance of indicators as perceived by respondents based on percentages. The respondent's attributes include age, location, and education level, length of stay, origin, and trade/profession A mathematical formulae was used to calculate the Life quality Index (LQI) and Life quality Habitability indexes (LQHI) of selected environmental and socioeconomic life quality indicators. To determine the LQI, the mathematical formulae adds up all the scores that each respondent has given to all the indicators, the score is then divided by the maximum possible score and the sum was multiplied by 100 to obtain the result as percentage. As shown in the formulae below LQI is the importance index derivable for each of the environmental and socio-cultural aspects, where *s* is any of the two aspects. *N* is the number of the indicators rated by the respondents under the Likert scale. *y1* is the actual score by respondents on all indicators, (*Ith*) YI is the maximum score that could be scored by a respondent on all indicators. Using this formula, therefore, a respondent could score a maximum of 100% and minimum of 20%. The higher the score to 100%, the higher is the importance, while the closer the respondents score to 20% the lower the degree of importance.

$$\mathrm{LQI}s = \left(\sum_{I=1}^{N} yI \div \sum_{I=1}^{N} YI\right) \mathrm{X}\ 100$$

Similarly, to compute the Life Quality Habitability Index (LQHI) of a particular variable, all the scores that respondents gave to a particular indicator are added up, the total score is then divided by the maximum possible score for that variable which is then obtained as a percentage by multiplying by 100. In the formulae below, LQHIe is the habitability index of the indicators. N is the number of respondents in this case 450. *aye* is the actual score of all respondents (*y*th) on one variable (*e*th). *Aye* is the maximum possible scores that respondents (*y*) could give to one variable (*e*) on the five point Likert scale.

$$\mathrm{LQHI}e = \left(\sum_{I=1}^{N} aye \div \sum_{I=1}^{N} Aye\right) \mathrm{X}\ 100$$

RESULTS OF ANALYSIS AND DISCUSSION

In the analysis, after the demographic characteristics of respondents, the results of the analysis were presented at three levels; Level of Importance of measured Life Quality Indicators as perceived by respondents, Life Quality Index (LQI) for grouped indicators and Life Quality Habitability Index (LQHI) of measured indicators. The respondent's LQ index represents scores given by respondents

and presented under a group indicators. It shows the level of contribution any group indicator made to the overall importance. The LQHI which refers to the degree at which each indicator under the group indicators contribute to the degree of importance was similarly measured. The environmental indicators include sanitation and waste disposal and physical infrastructure which relate to social amenities, while indicators of sociocultural cohesion, economic activities and institutional indicators for educational /capacity building of residents represent the socioeconomic indicators respectively.

Demographic attributes of respondents

The number of male respondents in the survey dominates with a percentage of about ninety per cent responses as shown in Table 1. The highest number of respondents falls within the age bracket of 31 to 40 and 41-50 years of age. In the survey, degree and Higher National Diploma (HND) holders constitutes the highest number of respondents. Education level of respondents is a function of LQ, whereby the higher the education level, the higher the economic power and hence the higher LQ. Majority of respondents were married (76.3%) followed by single respondents with a percentage of about 24 per cent. In relation to this, the number of people including children and dependents found in respondent's houses varies, such that, the number of people in respondent's house was found to be between 1-10 people with a total of above seventy percent. This was followed by those with 11-15 people (14.3%). There are also respondents who accommodate at least twenty people in their houses as found during the survey (14.8%).

Civil servants at the federal with 39.8% and state 49.7% constitutes the highest number of respondents, followed by those engaged in trade or business with a percentage of 4.7%. This result negates the general assumption that those living in traditional city areas were generally engaged in trade or other types of business. It shows that even civil servants still live in these areas. The type of work of an individual has been found to affect his or her quality of life where the higher the income the higher quality of life of individuals. Respondents have been found to have lived in the areas for different lengths of time, some, were actually born in these areas (24%) and have not moved to another place since birth. Majority of respondents (39.8%) were found to have lived for between 10-20 years, followed by those who lived for between 20-30 years (25.1%). The longer the length of stay in a place the higher the sense of place attachment, which in turn affect one's LQ. The family type of majority of respondents have been found to be single nuclear family (68.4%), followed by those who were in an extended family (27.8%). On house ownership type of respondents, owner occupiers constitute nearly 70% followed by tenants (23.4%), free users (13.3%) including adolescent children and servants living in separate houses.

Table 1: Demographic Attributes of Respondents

S/No.	Demographic Attributes	Frequency	Missing values	Valid (%)	Cum (%)
1.	**Gender**				
	Male	162	5	87.1	87.1
	Female	24		12.9	100
2.	**Age of Respondent**				
	20-30 years	47	1	24.7	24.7
	31-40 years	76		40.0	64.7
	41-50 years	46		24.2	88.9
	51-60 years	20		10.5	99.5
	Above 60 years	1		0.5	11
3.	**Level of formal Education**				
	Primary School	1	1	0.5	0.5
	Secondary School	9		4.7	5.3
	Diploma or NCE	38		20.0	25.3
	HND or Degree	97		51.1	76.3
	Master Degree	39		20.5	96.8
	PhD	6		3.2	100
4.	**Marital status of Respondent**				
	Married	145	1	76.3	76.3
	Separated or divorced	2		1.1	77.4
	Single, not yet married	42		22.1	99.5
	Widowed	1		0.5	100
5.	**Number of People in the house**				
	1-5 people	65	2	34.4	34.4
	6-10 people	69		36.5	70.9
	11-15 people	27		14.3	85.2
	16-20 people	13		6.9	92.1
	Above 20	15		7.9	100
6.	**Work type of Respondents**				
	Federal civil service	76		39.8	39.8
	State civil service	95		49.7	89.5
	Corporate organization	5		2.6	92.1
	Business/trading	9		4.7	96.6
	Others	5		2.6	99.5
7.	**Length of stay in Traditional areas**				
	10-20 years	52	8	39.8	39.8
	21-30 years	46		25.1	53.6
	31-40 years	26		14.2	67.8
	Above 40 years	15		8.2	76.0
	Born here	44		24	100
8.	**Respondents Family type**				
	Single nuclear family	128	3	68.4	68.4
	Extended family	52		27.8	96.3
	Unrelated tenants	6		3.2	99.5
	Others	1		0.5	100
9.	**House ownership type of Respondent**				
	Owner occupies	102	3	68.4	68.4
	Tenancy	44		23.4	77.7
	Owner and tenant	17		9.0	86.7
	Free user	25		13.3	100

Level of Importance of measured Life Quality Indicators (LQI) as perceived by respondents according to base data

To measure the level of importance of the environmental and socioeconomic indicators, nineteen indicators were identified and categorized into five indicator groups as shown in Table 2 below. The level of importance was rated from the Likert scale rated 1-4, in which 1 represents (not Important) the least value and 4 (very Important) the highest value. The result was presented in frequency and percentage in relation to the overall responses. Responses on indicators for social cohesion, shows that the highest number of respondents consider the community hall as either important (45.6%) or very important (33%). Similarly, the highest number of respondents who consider open spaces for children play as important constitutes 37.4% while the least was only 6.0%. On the indicators that promote educational and capacity building, the results shows that respondents appear to consider all indicators that fall within this group as very important. For example, formal schools 64.6%, clinic/dispensaries 58.3%, Tsangaya/Islamiyya schools 57% and cooperative societies 37.6%. Respondents that considered drainages within the housing areas, sewer system, waste disposal system and status of burrow pits as very important were in the majority (53.1%, 42.7%, 56.4%, and 43.3% respectively). Similarly, the least number of respondents who consider these as not important to their life quality constitute only 10.1%, 7.9%, 9.4%, and 11.0% respectively. Respondents who considered the indicators of social amenities as very important were also in the majority with the highest number who considered electricity supply as very important (65.2%) and road network (60.9%). In terms of the number of respondents, majority of respondents selected electricity supply as the most important indicator (65.2%) which affect their LQ followed by formal schools with 64.6%.

Table 2 Derived Level of Importance of measured LQ Indicators as perceived by respondents

S/No.	LQ Indicators	N. Important Frq. (%)	Neural Frq. (%)		Important Frq. (%)	V. Import. Freq. (%)
1.	**Socio-cultural Cohesion**					
	Community hall for social gatherings	16	20		82	60
		8.9	11.1		45.6	33.3
	Open spaces for children play	11	28		68	74
		6.0	15.4		37.4	40.7
2.	**Economic Activities**					
	Shopping areas	14	14	7.9	72	76
		7.9			40.7	42.9
	Trade training centers	11	25		70	71
		6.2	14.0		39.3	39.9
	Cooperative societies	14	27		75	65
		7.7	14.8		41.2	35.7
3.	**Educational/Capacity building**					
	Formal Schools/Primary/Secondary	12	13	7.3	36	115
		6.7			20.2	64.6
	Tsangaya/Islamiyya schools	15	20		41	102

		8.4	11.2		22.9	57.0
	Clinics/Dispensaries	11	18		44	105
		6.1	10.0		24.4	58.3
	Trade/Skill acquisition centers	15	15	8.3	68	82
		8.3			37.6	45.3
	Cooperative societies	19	27		66	68
		10.5	14.9		36.5	37.6
4.	**Sanitation/Waste disposal**					
	Drainages within housing clusters	18	20		45	95
		10.1	11.2		25.1	53.1
	Sewer systems	14	28		59	76
		7.9	15.7		33.1	42.7
	Waste disposal system	17	15	8.3	46	102
		9.4			25.4	56.4
	Status of Burrow pits	21	29		51	78
		11.0	16.1		28.3	43.3
5.	**Social Amenities**					
	Pipe born water	17	14	7.9	40	106
		9.6			22.5	59.6
	Community borehole	13	24		49	92
		7.3	13.4		27.4	51.4
	Electricity supply	17	13	7.2	32	118
		9.4			17.7	65.2
	Sustainable Electricity (solar/wind)	18	24		53	86
		9.9	13.2		29.1	47.3
	Road Network	11	21		37	109
		6.1	11.7		20.7	60.9
	Width sufficiency of Footpaths	13	25		69	74
		7.1	13.7		37.9	40.7

Key: N. Import. (Not Important), Neutral, Import. (Important), V. Important Frq. (Frequency)

Life Quality Index (LQI) for group indicators

The respondent's Life Quality Index (LQI) are classified into percentage score-groups; 20-39% (very low), 40-59%, (low), 60-79% (moderate) and 80-100% (high) score-groups. Bearing in mind the score of 60% as a mean score on the Likert scale as used in the analysis. In the group indicators for the promotion of socio-cultural cohesion among residents none of the respondents fall under very low score group. However, majority of respondents (57%) fall under low score region followed by moderate score group/region (42.8%). This trend was repeated for indicators which promote economic activities with responses under low score group (61.3%) and the rest fall under moderate region of score with 38.7%. In the group for educational/capacity building, majority (51.8%) fall under high contribution score group/region followed by those that made moderate contribution with a score of 35.6%. Note here that none of the respondents fall under very low score group. For indicators of sanitation and waste disposal, majority of the respondent's responses fall under moderate contribution score with a percentage of 45%. The implication is an indication of how respondents respond to questions as a group rather than at individual level. This is a significant aspect of measuring Index.

Table 3 Derived Life Quality Index (LQI) for grouped Variables as perceived by respondents

LQ Index (%)	Score Group	A-A Frq. (%)	B-B Frq.	(%)	C-C Frq.	(%)	D-D Frq. (%)		E-E Frq.	(%)
20-39	Very Low									
40-59	Low	110 57.5	117	61.3	4	12.5	31 16.2		31	16.2
60-79	Moderate	81 42.8	74	38.7	68	35.6	86 45.0		86	45.0
80-100	High				99	51.8	74 38.7		74	38.7
Total No. **N**		191 100	191	100	191	100	191	100	191	100

***KEY**: **A-A** (LQ indicators which promote socio-cultural cohesion among residents), **B-B** (LQ indicators which promote economic activities within traditional areas), **C-C** (LQ indicators for educational /capacity building of residents), **D-D** (LQ indicators for Sanitation and Waste Disposal), **E-E** (LQ indicators of Social amenities).*

Life Quality Habitability Index (LQHI)

The Life Quality Habitability Index (LQHI) was similarly measured using the mathematical formulae based on results obtained from the questionnaire responses. The habitability index refers to the degree at which each indicator under the group indicator contributes to the level of importance or otherwise. The higher the score recorded by any of the indicator the higher its contribution to respondents LQ. As shown in Table 4, the results of the survey for the various indicators were duly stratified based on scores and presented in percentage. With reference to the Table 4, the most significant indicator for respondent's life quality were the number of formal schools (primary and secondary schools) under the educational/capacity building indicators with a score of 81.2% and closely followed by electricity supply and road network both under the social amenities indicators with scores of 80.6% and 80.1% respectively. The least contributor to respondents' life quality according to the analysis results was the community hall for social gatherings under the socio-cultural indicators with a score of 65%. This was followed by status of burrow pits within the traditional city areas under the indicators of sanitation and waste disposal with a score of 70.8%. Another least contributor to respondent's life quality as measured was the cooperative societies which fall under educational/capacity building indicators. The rating of formal schools as the most significant indicator of life quality indicates the importance of education in the global context. It also shows the interdependency of other indicators to educational level.

Table 4: Life Quality Habitability Index (LQHI) for measured variables as perceived by respondents

S/No.	LQ Indicators	Indicators	LQHI (%)
1.	**Socio-cultural cohesion**	Community hall for social gatherings	65.0
		Open spaces for children play	74.8
2.	**Economic activities**	Shopping areas	73.1
		Trade training centers	73.0
		Cooperative societies	73.1
3.	**Educational/Cap. building**	Formal schools (Primary/Secondary)	81.2
		Tsangaya/Islamiyya schools	78.0
		Clinics/Dispensaries	79.9
		Trade/Skill acquisition centers	75.5
		Cooperative societies	71.5
4.	**Sanitation/Waste Disposal**	Drainages within housing clusters	76.0
		Sewer systems	72.0
		Waste disposal system	78.0
		Status of Burrow pits	70.8
5.	**Social amenities**	Pipe born water	78.0
		Electricity supply	80.6
		Sustainable Electricity (Solar/wind)	74.2
		Road network	80.1
		Width sufficiency of footpaths	74.3

Key: LQHI Index in percentage (%)

CONCLUSION AND POLICY IMPLICATIONS

As a result of the high importance shown by the respondents on environmental indicators such as drainages, sewer system, pipe born water supply and electricity, there is the urgent need for intervention to upgrade and develop a maintenance culture on existing infrastructure and to provide same where they do not exist. A way to achieve this among others requires the creation of sanitation markets for active private participation, construction of toilet facilities in public areas, incentivizing and training members of affected communities to engage in periodic maintenance of existing facilities and to also develop a robust institutional framework for waste management from domestic and industrial sources. Provision of adequate portable water in quality and quantity by periodically expanding water facilities in line with projected population growth. The government may also consider employing new technologies in the provision of portable water suitable for human consumption. In remote areas of the city, the use of more sustainable means of water provision such the use of manual operated boreholes has become necessary. Waste disposal in these areas is also a critical area that needs intervention. For example, advocacy efforts among communities to maintain the minimum sanitation standards within their surroundings, and to provide supports to communities through stakeholders, and traditional viziers. Engagement of facility management outfits in view of the significant roles they play at global level and lastly, employ a viable, affordable and adaptable technology to use in the treatment of domestic as well as industrial wastes.

Due to very low scores given to indicators of socio-cultural cohesion, there is the need for the government to

provide structures to accommodate functions at community levels. Private investors could be encouraged to erect commercial structures within the traditional city areas. The number of formal and Tsangaya/Islamiyya schools has been identified by respondents as the indicator that was most important. Hence, the government should ensure regular expansion and upgrading of such schools and to establish new ones in areas earmarked for future development to meet up with increasing student's population and the city's expansion. The road network, and width sufficiency of footpaths, within the study could only be enhanced through deliberate efforts to open up the areas. This will provide the opportunities needed for the provision of infrastructure such as pipe born water and electricity and especially adequate drainages.

Burrow pits in the built up areas are gradually disappearing through the community efforts. Many community members have over the years converted parts of it to residential houses. This calls for the need for the government to establish a body consisting of officials and community members to find a common ground on best way to address this issue to avert negative environmental inpact. Electricity supply services were the least important indicator, which means that the respondents do not seem to see much less use much of it. This call for efforts on the part of government to introduce other sustainable sources of electricity or atleast encourages residents to use them. Sustainable means of providing electricity such as the use of solar panels to light up critical areas and also look at the prospect of employing wind systems. Availability of electricity greatly affect income of individuals and nations. It is used in the operation of machineries in factories as well as for sustaining local businesses such as welding, fabrications and carpentry, which enhances the economic status of individuals and hence raise their quality of life.

REFERENCES

Abdel-Hadi, E. (2012). Culture, Quality of Life, Globalization and Beyond. *Procedia-Social and Behavioural Sciences 50,* 11 -19.

Anett S., & Károly P. (2015). Measuring of subjective Quality of Life. *Procedia Economics and Finance, 32* (2015), 809 – 816.

Awotona, A. (1990). Nigerian Government participation in housing: 1970-1980. P. Onibokun (Ed.). *Housing in Nigeria.* A Book of Reading (NISER), Ibadan

Hanga, N. (2009). *Socio-Cultural values in relation to residential satisfaction of low-cost housing in Kano State.* Unpublished MSc Thesis, IIU-Malaysia.

Balestra, C., & Sultan, J. (2012). Home sweet home: The determinants of residential importance and its relation with well-being. *OECD Statistics Directorate Working Papers, OECD*,

Barkindo, M.(1983). *The Gates of Kano: a historical survey*. B.Ed Thesis, Bayero University, Kano.

Brajša-Žganec, A., Merkaš, M., & Šverko, I. (2011). Quality of life and leisure activities: How do leisure activities contribute to subjective well-being. *Social Indicators Research, 102*(1), 80–97.

Bramston, P., Chipuer, H., & Pretty, G. (2005). Conceptual principles of quality of life: an empirical exploration. *Journal of Intellectual Disability Research, 49*(10), 728–733.

doi.org/10.1111/j.1365-2788.2005.00741.x

Brownson, R. C., Hoehner, C. M., Day, K., Forsyth, A., & Sallis, J. F. (2009). Measuring the built environment for physical activity: State of the science. *American Journal of Preventive Medicine, 36* (4 Suppl), S99–123.

Dalia, S. (2015). Environmental indicators for the assessment of quality of life. *Intellectual Economics, 9* (1), 67–79.

Descombe, M. (1998). *The good research guide for small-scale social research projects*. Buckingham: Open University Press.

Diener, E., & Seligman, M.E.P. (2004). Beyond money: toward an economy of well-being. *Psychological Science in the Public Interest*, *5* (1), 1–31.

Diener, E., & Suh, E. (1997): Measuring quality of life: economic, social, and subjective indicators. *Social Indicators Research, 40*, 189–216.

Dokmeci, V., & Berkoz, L. (2000). Residential-location preferences according to demographic characteristics in Istanbul. *Landscape and Urban Planning*, *48* (2000), 45-55.

Epley, D. & Menon, M. (2008). A method of assembling cross-sectional indicators into community quality of life. *Social Indicators Research*, *88* (2), 281–296. http://dx.doi.org/10.1007/s11205-007-9190-7

Flanagan, J. C. (1978). A research approach to improving our quality of life. *American Psychologist 33*, 138–147.

Fontinelle, A.(2011). Standard of living vs. Quality of life. In *Investopedia*. Retrieved October 19, 2013, from http://www.investopedia.com/articles/financial-theory/08/standardof-living-quality-of-life.asp

Gbakeji J. O., & Magnus, O. O. (2007). Aspects of Residential and Neighborhood Preferences in the Warri Metropolis, Delta State, Nigeria in Kamla-Raj 2007 Stud. *Home Comm. Sci., 1* (2), 121-126.

Hamza, B. (2013). Perceived Satisfaction Indicators for Urban Hausa Traditional House Residents In Katsina City. *Techno Science Africana Journal 8* (1), 19-25, Kano State University of Science and Technology, Wudil, Kano State.

Holman, M. R., & Coan, T. G. (2008). Voting Green. *Social Science Quarterly, 89*, 1121–1135.

Kahn, M. E., & Matsusaka, J. G. (1997). Demand for environmental goods: Evidence from voting patterns on California initiatives. *Journal of Law & Economics, 40* (1), 137–173.

Kahneman, D. (1999). Objective happiness. In D. Kahneman, E. Diener, N. Schwarz (Eds.), *Well-being: The Foundations of Hedonic Psychology* (p. 25). New York: Russell Sage Foundation.

Karen G. A., Susan, L., Handy, B., Kathryn, E., Henderson, C., Sandy, J. Lisa, M. (2016). Powell Built environment assessment: Multidisciplinary perspectives. *SSM - Population Health, 2*(2016), 24–31.

Keles, R. (2012). The Quality of Life and the Environment. *Procedia-Social and Behavioural Sciences, 35*, 23-32.

Khan, H. (1979). *International Comparison of Socioeconomic development.* Ph.D Thesis, University of New South Wales, Sydney.

Koplan, J. P., Liverman, C. T., & Kraak, V. I. (Eds.). (2005). *Preventing childhood obesity: Health in the*

balance. Washington, DC: Institute of Medicine of the National Academies.

Lawrence, R. (2001). Human ecology. In Tolba, M. K. (ed.). *Our fragile world: Challenges and opportunities for sustainable development*, 1, 675–693. Oxford: Eolss Publishers.

Liman, M. (1990). *A geographical Perspective of the evolution of Kano city*. Unpublished paper, Department of Geography, Bayero University, Kano.

Mabogunje, A. L. (1974). Towards an Urban Policy in Nigeria. *Nigerian Journal of Economics and Social Studies*, *16*(4), 121 – 133.

Mansoor, I. (Ed.). (2004). *Quality of Life Indicators in Sustainable Development Context: Concepts and Applications in Sustainable Built Environment through Management and Technology*. A Publication of the Kulliyya of Architecture and Envrionmental Design, IIU Malaysia: Platform DG Print SD Bhd.

Marans, R. (2003). Understanding environmental quality through quality of life studies: The 2001 DAS and its use of subjective and objective indicators. *Landscape and Urban Planning, 65,* 73–83.

Marans, R. (2012). Quality of Urban Life Studies: An Overview and Implications for Environment-Behaviour Research. Procedia-Social and Behavioural Sciences, 35, 9-22.

Maslow, A. (2003). A lét pszichológiája felé, Ursis Libris, Budapest.

Matarrita-Cascante, D. (2010). Changing communities, community importance, and quality of life: A view of multiple perceived indicators. *Social Indicators Research, 98*, 105–127. Retrieved from http://dx.doi.org/10.1007/s11205-009-9520z

McGranahan, D.V. (1972). *Contents and Measurement of Socioeconomic Development*. New York: Preager.

Oduwaye, L. (2008). Planning Implications of the Ethnic Structure of Residential Areas of Metropolitan Lagos. *Journal of Asian Social Science, 4*(8).

Ogu, V. I. (2002). Urban residential importance & the planning implications in a developing world context. *International Planning Studies, 7*(1), 37-53. Retrieved May 31, 2007 from EBSCO database.

Oumar, A. A. (1997). *Gidaje: the socio-Cultural Morphology of Hausa Living Spaces*. Unpublished PhD thesis, University College London, United Kingdom.

Parris, T.M., & Kates, R.W. (2003). Characterizing and measuring sustainable development. *Ann. Rev. Environ. Resour.*, *28,* 559–586.

Perchonock, N. (1976). Occupation and Residence in Kano city. *Paper presented at the seminar on the Economic History of the central Savannah of West Africa;* Kano, January 5-10, 1976.

Perchonock, N. (1979). The Territorial Principle and the Evolution of Social organization in Kasar Hausa Before 1500. *International Seminar on the History of Central Sudan Before 1805;*

Sallis, J. F., Floyd, M. F., Rodriguez, D. A., & Saelens, B. E. (2012). Role of built environments in physical activity, obesity, and cardiovascular disease. *Circulation, 125*(5), 729–737.

Sanni, L., & Akinyemi, F.O. (2009). Determinants of Households' Residential Districts' Preferences within Metropolitan City of Ibadan, Nigeria. *Kamla-Raj 2009 Journal of Human Ecology, 25*(2), 137-141.

Shabalina, S.A., Fakhrutdinova, L.R., Mustafin M.R., & Shakirova A.R. (2015). Factors that Affect the Quality of Life in Tatarstan. International Conference on Applied Economics, ICOAE; Kazan, Russia, July 2-4, 201 5. Retrieved from http://creativecommons.org/licenses/ by-nc-nd/4.0/

Stiglitz, J. E., Sen, E.A. & Fittoussi, J. P. (2009). *Report by the Commission on the Measurement of Economic Performance and Social progress*. Retrieved October 16, 2013, from http://www.stiglitz-sen-fitoussi.fr/documents/rapport_anglais.pdf

Van Liere, K. D., & Dunlap, R. E. (1980). The social bases of environmental concern: A review of hypotheses, explanations and empirical evidence. *Public Opinion Quarterly, 44*(2), 181–197.

Zuzana, H., Pavol, A., & Stela, B. (2014). Development of quality of life economic indicators with regard to the environment: Contemporary Issues in Business, Management and Education 2013. *Procedia - Social and Behavioral Sciences,* 110(2014) 747 – 754.

ARCHISEARCH

FACTORS THAT INFLUENCE THE MOTIVATION OF NON-CONSTRUCTION PROFESSIONALS WORKING IN CONSTRUCTION COMPANIES IN ABUJA, NIGERIA

Abubakar Dardau AbdulAzeez [1], Shehu Ahmed Mohammed[2] & Dauda Dahiru[3]
[1,2,3]Department of Building, Ahmadu Bello University, Zaria-Nigeria.
[1]Correspondence email: *engraazeez@gmail.com; aabdulazeez@abu.edu.ng*

Abstract
Construction Companies experience low performance of non-construction professionals (Accountant, Health and Safety Professionals, Store keepers and Information and Communication Technology (ICT) Professionals) as a result of inadequate motivation. The study assessed motivational factors of non-construction professionals working in construction companies in Abuja with a view to improving their performance. The quantitative research approach was adopted; the population size of non-construction professionals is 348. Stratified sampling technique was used to select a sample of 186 non-construction professionals. Structured questionnaire was administered to non-construction professionals. Relative Significance Index (RSI) was used for the various ranking on motivation. The findings of the study reveal the ranking of the first five motivational factors as outlined in order of their significance from the study: Job security (0.95), salary paid by the company (0.92), advancement and growth opportunities (0.91), training and development (0.88), rewards that are linked to performance (0.86). The study concluded that all the factors of motivation as it relates to motivation of non-construction professionals are significant, however their degree of significance varied. The study recommended that the construction companies should be concerned with these factors in order of their significance, for the continuous motivation of the non-construction professionals in order to improve their performance in the construction industry.

Keywords: *Construction industry, Motivation, Non-construction professionals, Construction companies.*

INTRODUCTION

The construction industry is strategic to the national economy providing infrastructure and shelter for other economic activities to take place (Benviolent & Tirivavi, 2014). Attar, Gupta, & Desai (2012) noted that construction is a key sector of the national economy for countries all around the world, as traditionally it takes up a big portion in the nation's total employment and its significant contribution to a nation's revenue as a whole. The importance of the construction industry can never be over emphasised. In Nigeria, the industry is responsible for 16.00% of the GDP (Ayangade, Wahab, & Alake, 2009) and employs approximately 25% of Nigeria's workforce and the largest in Africa (Ibrahim & Musa-Haddary, 2010).

In realizing its aim in project delivery, the construction industry involves many parties amongst which are: the owner or

client; the designers or consultants and; the construction contractors (Usman, Inuwa, Iro & Dantong, 2012). The contractor is undeniably one of the most important organizations in the construction project delivery system (Usman et al., 2012). In the construction industry, the function of the construction professionals is to deliver projects safely, within cost and time and to the client's requirement. This cannot be achieved successfully without the contribution of non-construction professionals such as the Accountant, Health and Safety officer, Store keeper, Information and Communication Technology (ICT) professionals and so on, particularly in medium-size and large construction companies where large volumes of work are being carried out. Therefore, for construction companies to be efficient and innovative in order to remain competitive and increase productivity, the non-construction professionals need to be highly motivated. These non-construction professionals contribute to the success of project delivery through increased quality and speed of work, financial and safety controls, and effective communication (Ikechukwu, Chinedu, & Onyegiri, 2011).

Every organisation is concerned with how to achieve sustained high levels of performance through its workforce. This means giving close attention to how individuals can best be motivated through means such as incentives, rewards, leadership, and the organization context within which they carry out the work (Offei-Nyako, Osei-Tutu, Fugar, & Adinyira, 2014; Armstrong, 2006). Motivation is thus essential to labour, as it gives site workers satisfaction such as achievement, sense of responsibility and pleasure of the work itself (Offei-Nyako et al., 2014; Enshassi, Mohammed, Mustapha & Mayer, 2007). Employee motivation is one of the policies of managers to increase effectual job management amongst employees in an organisation.

According to Lin (2007), motivation is the force that makes people choose a particular job, stay with that job and work hard in that Job. Work motivation has also been defined as "the willingness to exert high levels of effort toward organisational goals, conditioned by the effort's ability to satisfy some individual need". In this circumstance, a need is some internal state of being in which certain outcomes may appear more attractive than others. Furthermore, if the need remains unsatisfied, tension is created, which, in turn, stimulates a drive within the individual (Ramlall, 2004).

Non-Construction Professionals are the non-technical employees in the construction industry that do not possess technical skills in construction activities but are also professionals in their own fields of study. For the purpose of this study, the non-construction Professionals considered were Accountant, Health and Safety officer, Store keeper, and ICT Professionals. However, there is no national agency responsible for coordinating the activities of these professionals and hence there appears to be a lack of synergy. According to Olatunji, Oke & Owoeye (2014), professionals are valuable resources that may contribute in several different ways to construction companies' activities, provided such companies give them an appropriate chance.

As briefly discussed above, non-construction professionals are one of the key elements for the majority of

construction companies in achieving performance and competitive edge. In a preliminary survey conducted on 10 organisations (construction companies), 6 respondents indicated that management is not always happy with the performance of non-construction professionals on projects. Out of the 10 respondents, 8 found their current motivational level to be low or fair while the remaining 2 found it high. However, all respondents indicated that when the current motivational level is improved, it will improve their performance in the construction industry. Researches were conducted on the motivation of construction professionals such as Architects, Quantity Surveyors, Builders and Engineers in the construction industry. Adjei (2009) conducted research on 'Motivational Strategies to Improve Productivity in the Construction Industry in Ghana' where the respondents were Architects, Quantity Surveyors, Builders and Engineers. Osuji (2014) studied 'Motivational Factors of Employee Consultants in the Nigerian Construction Industry'. More so, Olatunji et al., (2014), assessed 'Factors Affecting the Performance of Construction Professionals in Nigeria'. However, studies on motivation of non-construction professionals are rare in literature. The aim of this study is therefore, to assess factors that influence the motivation of non-construction professionals working in construction companies in Abuja, with a view to improving their performance which will in turn provide construction companies the opportunity to be efficient and innovative so as to remain competitive and increase productivity.

Factors that Influence the Motivation of Non-Construction Professionals

Motivation is a factor that catalyses the success of an organisation. Human beings are motivated by satisfying their different kind of needs. Needs depend on many factors and vary by the person, situation, organisation, nature of work, educational background, skills and so forth (Lin, 2007). The factors affecting non-construction professionals' motivation might be different from the factors affecting the construction professionals' motivation. It is evident that these factors change from time to time depending on the circumstances. All employees therefore, have their own motivational factors that drive them to perform at their best, thus, the need to conduct future studies on the factors which motivate employees in an organisation. Uwakweh (2006); Lin (2007); Lai (2009); Venkatesan, Varghese & Ananthanarayanan (2009); and Osuji (2014) identified the following factors from the analysis of motivation theories which have impact on worker's motivation. These factors are:

i. Advancement and growth opportunities: This is the organizations' effort in seeing that an employee's personal education, skills and knowledge are improved upon and promotion is regular.
ii. Remuneration (salary): This is the basic requirement for meeting the employees' basic physical needs which include food, water and shelter. Salary is thought to be one of the key factors influencing career choices.
iii. Working conditions: Unsafe working conditions or a noisy work environment will cause workers to be dissatisfied.

iv. Interpersonal relationships: Cordial relationship with co-employees is a very important factor in motivating an employee at work. Workplace is all about people working together to achieve a uniform goal, so it is important that all the co-workers respect each other and never show disrespect toward each other.
v. Self-expression: An employee who is given an opportunity to participate in decision making on matters affecting his workplace will feel motivated.
vi. Job security: An employee will motivated if he knows that his safety needs have been overcome. In an organisational workplace, safety needs reflect the need for safe jobs, fringe benefits and sense of security about future within the organisation.
vii. Recognition and appreciation: Esteem needs reflect a motivation for recognition and credit for contributions to the organisation.
viii. Job characteristics: opportunity to undertake interesting and challenging task.
ix. Company policies: If the company policies match the needs of an employee, he/she is motivated. Unfavourable company policies cause dissatisfaction.
x. Goal setting: Hard goals are more motivating than easy ones. Highly ambitious but achievable goals ask people to stretch their abilities.
xi. Rewards: Administration of pleasant reward that are linked to performance and valued by employees is highly motivating.
xii. Performance feedback: accurate and timely feedback on the level of progress towards achieving organisations' goal or knowledge of results is usually associated with high performance.
xiii. Good leadership role at workplace: Leaders play a key role in maintaining a conducive work environment. The leader should understand how to deal with different employees. It is imperative on the leader that he should respect the employees and this would make others take a leaf out of his book.
xiv. Training of employees: Training given to employees to develop skills for challenging tasks is an important factor in employee motivation.

RESEARCH METHODOLOGY

According to Osuji (2014), Saunders, Lewis, & Thornhill (2003), the choice of research method influences the way in which the researcher collects data. Given the scale and complexity of the study, a number of methods are considered in order to capture the diversity of information and data across a number of source and together the richest picture of the prevailing condition. The quantitative research method was adopted for this study requiring the development and dissemination of a structured questionnaire. The questionnaire consists of two sections. The first section was used to generate data on the respondents' profile with emphasis on academic and professional qualifications, and years of experience. The second section was used to assess the factors influencing the motivation of non-construction professionals working in construction companies in Abuja.

The survey covers only four (4) non-construction professional individuals (Accountants, Health and Safety officers, Storekeepers, and Information and Communication Technology (ICT) professionals) due to their impact in the construction industry. This survey was

limited to persons working in various construction companies registered with the Federal Inland Revenue Services (FIRS) Abuja as company income tax payers (2015). They are made up of medium-size and large construction companies operating within the Federal Capital Territory (FCT) Abuja. There are a total of 14 medium and 24 large construction companies that met the criteria, which brought the total number of companies on which the study was undertaken to thirty-eight (38). This class of companies was chosen for the study because of the large projects they undertake, their large annual turnover and the great number of workers they employ. In addition, non-empirical evidence shows that these companies have better organisational set up that lend themselves to refined academic research work, than the lower class of companies. Based on the information obtained from the Human Resources Departments of these construction companies, there are 95 Accountants, 77 Health and Safety officers, 90 Store Keepers and 86 ICT professionals. Thus, the population of the non-construction professionals is 348. Stratified sampling technique was used to select the non-construction professionals for questionnaire administration. The required sample size for non-construction professionals was calculated using the formula given by Yamane (1967).

$$n = \frac{N}{1 + N\,(e)^2} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where
n = Sample size
N = Total Population
e = The level of precision taken as +/- 5%

Table 1: Population and Sample Size

Non-Construction Professionals	Population	Sample Size
Accountants	95	51
Health and Safety officer	77	41
Store keeper	90	48
ICT Professionals	86	46
Total	**348**	**186**

Source: Field survey (2015)

Thus, the sample size (n) for the non-construction professionals is 186. This implies that 186 questionnaires were administered to non-construction professionals of the said construction companies in Abuja. 112 were properly filled and returned. The responses of 32 Accountants, 24 Health and Safety officers, 30 Store keepers, and 26 ICT professionals were obtained. These represent 60.2% of the 186 questionnaires sent out for the survey. The tool used for data analysis is relative significance index to determine the premium placed on each variable of motivational factors. The Likert-type scale data was analysed using the formula employed by Mbamali and Okotie (2012), using the following steps:

i. Computation of the mean using the weighted average formula

X = …… (2)

Where:
X = mean
x = points on the Likert-type scale (1, 2, 3, 4, and 5)
f = frequency of respondents' choice of each point on the scale
∑fx = is the total weight given to each attributes by the respondents.
∑f = is the total number or respondents in the sample.

ii. Computation of the Relative Significance Index (RSI) for each item of interest, using the formula

RSI …… (3)

Where:

k = is the highest weight on the Likert-type scale.

iii. Ranking of the items under consideration based on their RSI values. The item with the highest RSI value is ranked first (1st) the next second (2nd) and so on.

And the guide to degree of significance rating is given in Table 2.

Table 2: Guide to degree of significance

Degree of significance	Rating
Very significant	0.76 above
Significant	0.67-0.75
Fairly significant	0.45-0.66
Not significant	0.44 below

Source: Vanduhe (2012*)*

RESULTS AND DISCUSSION

Demographic Data of the Respondents

The demographic data obtained from the non-construction professionals were age, profession, educational qualification, number of years working for their current company, and number of years working in the industry. Figure 1 shows a majority of respondents (42.9%) were between the age of 31 and 40 years old, 21.4% were in the age of 21 to 30 years of age while 23.2% were between 41 to 50 years of age. 12.5% of the respondents were over the age of 50 years. This shows that the workforce of the construction companies as regards to non-construction professionals were between the age of 31 and 40. This is an indication that majority of the respondents are still young and energetic.

A close look at the profession of the survey respondents from Figure 2 revealed that Accountants make up 28.6% of respondents, Health and Safety officer 21. 4%, Storekeepers 26.8%, and ICT professionals 23.2% of respondents.

Figure 3 below shows that only 3.6% of respondents were Ph.D. holders. A majority of respondents (46.4%) were B.Sc. holders while 12.5% were M.Sc. holders. The remaining 20.5% and 17.0% of the respondents were ND and HND holders respectively. The fact that only 3.6% and 12.5% were Ph.D. and M.Sc. holders respectively, is an indication that the non-construction professionals were not given the opportunity to advance their studies. Also from the results, 62.5% of the respondents had the minimum qualification of B.Sc. This shows that the respondents had the required academic qualifications that could assist to provide a meaningful data from which inferences could be drawn for the study.

According to the survey result, as Figure 4 shows 54.5% of respondents have been with their current company for anywhere between 3 to 10 years. Followed by 27.7% that have worked with the same company for 11 to 20 years, 2.7% have been with their current company for more than 20 years. The fact that only 15.2% have less than 3 years working experience is an indication that the respondents were not only professionals in their fields but also have work experience.

Figure 5 shows that 19.6% of respondents have been working in the industry for more than 20 years, followed by 31.3% that have worked in the industry for 11 to 20 years. Out of the remaining, 36.6% of respondents, have worked between 3 to 10 years while 12.5% have worked for less than 3 years.

The previous two figures reveal that about 20% of respondents have more than 20 years of work experiences in the industry, out of which at least one-seventh of them have not been by working under their current company. It is interesting to note that only 2.7% of the respondents have been with their current company for more than 20 years yet over one fifth of the respondents have worked in the industry for more than 20 years. Out of the 19.6% of respondents that have been working in the industry for more than 20 years, only 2.7% have spent at least 20 of those years working for their current company. That is a difference of 16.9% that have worked for at least more than one employer (company) up to this point in their career. The percentage gaps between those years working in the industry and those working for the current company give an insight into the employee turnover experienced in the construction companies of the sample surveyed.

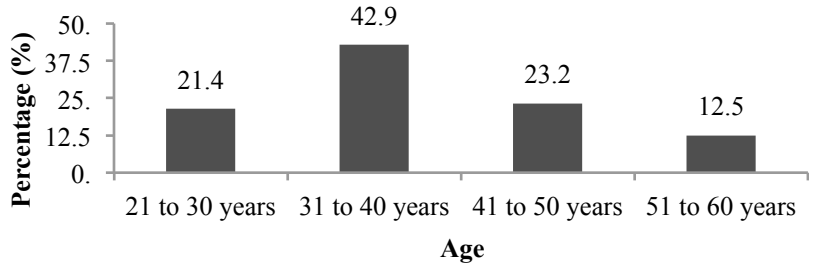


Figure 1: Age of respondents. Source: Field Survey (2015)



Figure 2: Profession of respondents. Source: Field Survey (2015)

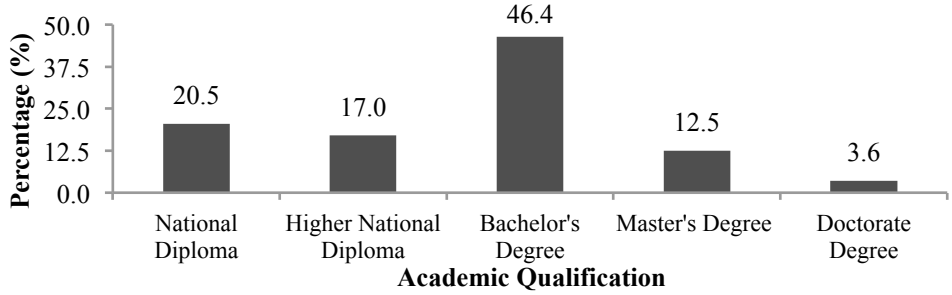


Figure 3: Academic qualification of respondents. Source: Field Survey (2015)

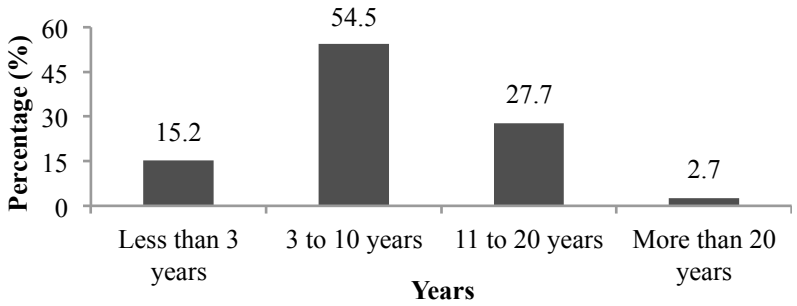


Figure 4: Years with company. Source: Field Survey (2015)

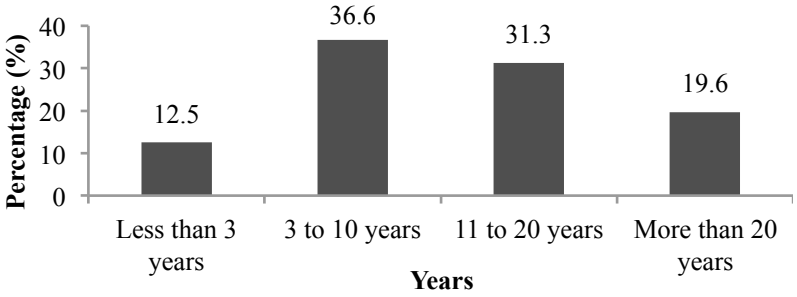


Figure 5: Years working in the industry. Source: Field Survey (2015)

Factors that Influence Motivation of Non-Construction Professionals

From Table 3, the most influencing factor on the motivation of non-construction professionals is 'Job security' with RSI of 0.95. It is a very significant factor because it ranked 0.76 and above on the relative significance index (RSI). 'Salary', 'Advancement and growth opportunities', 'Training and development', and 'Rewards for performance' ranked second, third, fourth, and fifth respectively with RSI between 0.86 and 0.92. This shows that they are all very significant factors. 'Working conditions', 'Interpersonal relationship with co-employees', 'Ability to participate in decision making', 'Good leadership', 'Recognition and appreciation' were ranked sixth, seventh, eighth, ninth, and tenth respectively with RSI between 0.76 and 0.85 and are all very significant factors. 'Goal-setting', and 'opportunity to undertake challenging task' both ranked twelfth while 'favourable company policies' ranked fourteenth with RSI between 0.72 and 0.73 and are all significant factors because their relative significance index is between 0.67 - 0.75.

Therefore, it is identified from the study that all the factors are significantly important, however their degree of significance varied. The first five factors are outlined in order of their significance on motivation of non-construction professionals as identified from the research: 'Job security', 'Salary', 'Advancement and growth opportunities', 'Training and development' and 'Reward for performance'. According to non-construction professionals, having a secured job is a very significant motivation. Uncertainty within the organisation lowers the morale of employees at work, therefore, they prefer to have confidence about their future within the organisation. This is then followed by other factors in the order stated above. The findings of this study corroborated the study of Osuji (2014)

which concluded that the six most influential factors of motivation of employee-consultants in the Nigerian construction industry includes: 'Job security', 'Salary', 'Working conditions', 'Reward', 'Training and development' and 'Leadership'.

Table 3: *Factors of motivation*

S/N	Factors of motivation	Frequency of responses					∑f	∑fx	Mean	RSI	Rank
		1	2	3	4	5					
1	Advancement and growth opportunities within the organisation	-	-	9	30	73	112	512	4.57	0.91	3
2	Salary paid by the company	-	-	8	28	76	112	516	4.61	0.92	2
3	Working conditions and conducive work environment	-	6	19	26	61	112	478	4.27	0.85	6
4	Leadership (a trustworthy and respectful leader)	1	10	34	34	33	112	424	3.79	0.76	9
5	Goal-setting (challenging but achievable)	7	12	20	47	26	112	409	3.65	0.73	12
6	Rewards that are linked to performance	-	10	12	27	63	112	479	4.28	0.86	5
7	Interpersonal relationship with co-employees	4	6	21	28	53	112	456	4.07	0.81	7
8	Recognition and appreciation of employees' performance	3	7	39	28	35	112	421	3.76	0.75	10
9	Opportunity to undertake challenging tasks	1	15	35	34	28	112	409	3.65	0.73	12
10	Ability to participate in decision making	7	9	19	27	50	112	440	3.93	0.79	8
11	Job security (having confidence about future within the organisation)	-	-	1	28	83	112	530	4.73	0.95	1
12	Timely feedback on employees performance and their level of progress	4	8	38	28	34	112	416	3.71	0.74	11
13	Training and development to enhance skills and ability to improve performance	1	6	11	26	68	112	490	4.38	0.88	4
14	Favourable company policies	8	9	33	31	29	112	394	3.58	0.72	14

(1= Insignificant, 2= Less Significant, 3= Average, 4= Significant, 5= Very Significant)
Source: Field survey (2015)

CONCLUSION AND RECOMMENDATION

This study focused on the assessment of motivational factors of non-construction professionals working in construction companies in Abuja, Nigeria, with a view to improving their performance. A review of literature was carried out, where motivational factors were identified and used for the assessment.

Based on the research findings, it can be concluded that all the factors of motivation as it relates to motivation of non-construction professionals are significant, however their degree of significance varied. The first five factors

are outlined in order of their significance as identified from the research: Job security, salary, career advancement and growth, training and development and reward for performance. Therefore, in light of the findings of this study, construction companies should be concerned with these factors in order of their significance, for the continuous motivation of the non-construction professionals in order to improve their performance in the construction industry.

REFERENCES

Adjei, E. A. (2009). Motivational Strategies to Improve Productivity in the Construction Industry in Ghana. M.Sc. Thesis, Kwame Nkruma University of Science and Technology, Kumasi, Ghana.

Armstrong, M. (2006). *Human Resource Management Practice.* Kogan 251-269.

Attar, A. A., Gupta, A. K., & Desai, D. B. (2012). A Study of Various Factors Affecting Labour Productivity and Methods to Improve it. *IOSR Journal of Mechanical and Civil Engineering - Second International Conference on emerging trends in engineering, 1(3),* 11–14.

Ayangade, J. A. I., Wahab, A. B. I., & Alake, O. I. (2009). An Investigation of the Performance of Due Process Mechanism in the Execution of Construction Projects in Nigeria. *Engineering Dimension, 11(1),* 1-7.

Benviolent, C. & Tirivavi, M. (2014). Factors Affecting Labour Productivity on Building Projects in ZImbabire. *International Journal of Architecture, Engineering and Construction, 3 (1),* 57-65.

Enshassi, A., Mohamed, S., Mustapha, Z. A., & Mayer, P. E., (2007). Factors Affecting Labour Productivity in Building Projects in the Gaza Strip. *Journal of Civil Engineering and Management, 13 (4)*. 245-254.

Ibrahim, A. D., & Musa-Haddary, Y. G. (2010). Concept of Value for Money in Public Infrastructure Development. A Paper Presented at a 3-day International Workshop on PPP Approach to Infrastructure Development in Nigeria. Organized by the NIQS, held on 13-15, July, 2010 at Shehu Musa Yar'Adua International Conference Centre Abuja, Nigeria. *Journal of Engineering and Applied Science, 4,* 2-3.

Ikechukwu, O., Chinedu, C. N., & Onyegiri, J. (2011). Information and Communication Technology in the Construction Industry. *American Journal of Scientific and Industrial Research, 2(3),* 461-468.

Lai, C. (2009). *Motivating Employees through Incentive Programmes.* Dissertation Thesis of Bachelor Degree, Jyvaskyla University of Applied Science. Retrieved from http://publications.thesis.filbitstream/handle/10024/17561/jamk_12374444888_5.pdf/ sequence=2 (accessed on: 11/09/2011).

Lin P. Y. (2007). *The Correlation Between Management and Employee Motivation in SASOL Polypropylene in Business, South Africa.* Dissertation Thesis of Master Degree, University of Pretoria, South Africa, retrieved from: https//upetd.up.ac.za/thesis/available/etd0804200892827/dissertation.pdf, (Accessed on: 10/09/2013).

Mbamali, I. & Okotie, A. J. (2012). An Assessment of the Threats and Opportunities of Globalisation on Building Practice in Nigeria.

American Journal of Contemporary Research, 2(4), 146.

Offei-Nyako, K., Osei-Tutu, E., Fugar, F. D. K., & Adinyira, E. (2014). Skilled Artisanal Availability in the Ghanaian Construction Industry. *Covenant Journal of Research in the Built Environment (CJRBE), 1 (1) (Maiden Edition),* 1-5.

Olatunji, S. O., Oke, A. E., & Owoeye, L. C. (2014). Factors Affecting Performance of Construction Professionals in Nigeria. *International Journal of Engineering and Advanced Technology (IJEAT) 39 (1),* 76 – 77. ISSN: 2249 – 8958

Osuji, E. O. (2014). *Evaluating the Motivational Factors of Employee Consultants in Nigerian Construction Industry.* Unpublished M.Sc. Thesis, Department of building, Ahmadu Bello University, Zaria, Nigeria.

Ramlall, S. (2004). A Review of Employee Motivation Theories and their Implications for Employee. *Journal of American Academy of Business, Cambridge, 5(1-2),* 52-63.

Saunders, M., Lewis, P. & Thornhill, A. (2003). *Research Methods for Business Students*, (3rd Ed.) London: Prentice Hall Financial Times.

Usman, N. D., Inuwa, I. I., Iro, A. I., & Dantong, J. S. (2012). Training of Contractor Craftsmen for Productivity Improvement in the Nigerian Construction Industry. *Journal of Engineering and Applied Science, 4,* 1-11.

Uwakweh, B. O. (2006). Motivational Climate of Construction Apprentice. *Journal of Construction Engineering and Management, 132(5),* 525-532.

Vanduhe, B. A. (2012). *An Investigation of Factors affecting Residential Building Maintenance.* Unpublished B.Eng. Project submitted to the Department of Civil and Water Resources Engineering, University of Maiduguri.

Venkatesan, R., Varghese, K., & Ananthanarayanan, R. (2009). Motivation and Demotivation 'Cause Factors' for Engineers in Construction Organisation *In*: Dainty, A.R.J. (Ed). *Procs 25th annual ARCOM Conference,* Nottingham, UK. Association of Researchers in Construction Management, *1(1),* 145-153.

Yamane, T. (1967). *Statistics: An Introductory Analysis*. (2nd Ed.), New York: Harper and Row.

ARCHISEARCH

BIM-BASED COST ESTIMATING USING THE NIGERIAN BUILDING AND ENGINEERING STANDARD METHOD OF MEASUREMENT (BESMM): INFORMATION REQUIREMENTS IDENTIFICATION

M. Abdullahi[1*], M. Abubakar[2], Peter Gangas Chindo[1], U. Musa[3] & A. Aminu[1]
[1]Department of Quantity Surveying, Ahmadu Bello University, Zaria-Nigeria
[2]Department of Building, Ahmadu Bello University, Zaria-Nigeria
[3]Due Process and Project Monitoring Bureau, Dutse, Jigawa State
*Correspondence email: bnabdallah02@gmail.com

Abstract

Conventionally, construction cost estimates are prepared manually using paper-based, CAD-based or semi-automated approaches. These methods have been criticised for being labour intensive and error prone. However, with the advent of Building Information Modeling (BIM), researchers have proposed BIM-based costing frameworks based on which several cost estimating software applications have been developed. Despite the proliferation of these software tools, studies have reported slow pace of adoption of these tools by Quantity Surveyors globally. One of the major challenges hindering the widespread of usage and application of BIM-based estimating systems is the differences in cost estimating practices and measurement standards which differ from one country to another. Most of the current BIM tools are based on standards that do not adequately capture local cost estimating requirements, hence making the full adoption of these BIM tools difficult and unrealistic. The Industry Foundation Classes (IFC) as the major BIM data standard being utilised by various software vendors has been reported to be inadequate and insufficientbecause it doesnot capture most local requirements. This paper therefore aims at identifying the information requirements that support BIM-based cost estimating using the Nigerian local standard for estimating. This is with the view to establishing information needs for software developers to improve their cost estimating software applications. Using a qualitative research approach, a total of five (5) experienced consultant Quantity Surveyors were interviewed and data collected was analysed using content analysis. The study identified six (6) categories of information required to support BIM-based cost estimating using the Nigerian BESMM as a local cost estimating standard. The study concludes that unless these local are comprehensively captured by the IFC schema, the full benefits and potentials of BIM-based cost estimating tools will not be achieved.

Key Words: *BIM-based estimating, IFC, BESMM, Information requirements, Quantity Surveyors*

INTRODUCTION

Several predictions suggest the extinction of Quantity Surveying profession with the emergence of BIM. This largely has been due to lack of BIM awareness and the conservative attitude to change exhibited by Quantity Surveyors (QS). However, this prediction turned out to be wrong as BIM's capability of automating measurements through extraction of

quantities has enhanced QS estimating processes and has shifted their attention to providing knowledge and expertise-intensive advice to the project team. QS Firms are now beginning to embrace BIM in their practices globally (McGraw-Hill Construction, 2014). For instance, Pittard and Sell (2016) reported widespread BIM practice by UK firms in the areas of cost planning; risk management; whole life cycle costing, procurement, contract administration and information management. "HC QS"; a major QS consultancy in UK engages its junior QSs in developing BIM models of highest level of detail for cost planning and estimating using simple BIM authoring tools (Pittard & Sell, 2016). This development is quite evident in the proliferation of BIM-based cost estimating frameworks and software application in recent times (Ma, Zhang, Wu, Wei, & Lou, 2010; Ma, Zhenhua, Wu, & Zhe, 2011; Wan, Chen, & Tiong, 2004).

To effectively leverage the potentials of these BIM-based cost estimating applications, software vendors have explored and adopted neutral file formats that facilitate interoperability among heterogeneous systems and applications with Industry Foundation Classes(IFC) considered as the most popular and widely adopted data model currently implemented in the industry. For example, Faraj, Alshawi, and Aouad (2002) developed a Web-based IFC Shared Project Environment (WISPER)that facilitates Web basedproject stakeholders'integration and sharing of the design, budget, schedule andother information in construction projects. Fu, Aouad, Lee, Mashall-Ponting, and Wu (2006) developed an IFC based life-cycle cost assessment that automatically generate cost data from 3D Models. Staub-French, Fischer, and Kunz (2003) developed IFC-based cost estimating system that supports the preparation of cost estimates from BIM models. Furthermore, using IFC standard and 4D model, Yabuki and Shitani (2005)developed a cost estimating prototype system that extracts quantities and generate cost estimates of construction projects .

Despite the significant contributions made by these research works towards the improvement of the accuracy and speedy production of estimates using BIM, studies (Ma et al., 2011; Madugu, Abdullahi, & Musa, 2016) observed that the IFC standard is inadequate, lacking the capacity to sufficiently capture local standards for cost estimating which varies from one country to the other (e.g. the BESMM in Nigeria; and the Quota/BOQ method in China). Ma et al. (2011) argued that, extending the IFC standard to accommodate the standards of each country so that all the relevant local information can be captured and shared efficiently by different application software through an IFC file presents a better solution than extracting applicable data fromthe IFC file and supplementing it in the application software as highlighted by existing research works (Faraj et al., 2002; Fu et al., 2006; Staub-French et al., 2003; Tanyer & Aouad, 2005; Yabuki & Shitani, 2005).

This paper therefore identifies the information requirements that support BIM-based cost estimating using the Nigerian local standard for estimating, specifically the BESMM. This is with the view to establishing information needs for software developers to improve the scope and capacity of their cost

estimating applications. The paper commenced by reviewing extant literature on current BIM-based cost estimating methods and the Nigerian Building and Engineering Standard Method of Measurement (BESMM). Subsequently, the research method adopted in the study; the results and discussions; and conclusions were finally presented. Results of this study provide software vendors with useful information for improving their products for wider acceptability and adoption.

LITERATURE REVIEW

Methods of BIM-based Cost Estimating

Although BIM platforms have the capacity of generating quantities automatically, they however lack capacity to produce cost estimate. To prepare estimates, the quantities generated from BIM models are assigned prices/rates and descriptions based on a standard format. Therefore, researchers suggest the following three approaches as methods of performing BIM-based cost estimating:

i. Exporting building object quantities to estimating software

In this approach, quantities generated from 3D BIM are exported into spread sheets where pricing and other estimating activities are carried out. Eastman, Teicholz, and Sacks (2011) reported that most BIM-based estimating tools are capable of exporting the quantities to a spreadsheet or external databases, where Quantity Surveyors could do their pricing work. Using the exported quantities, Quantity Surveyors can be able to prepare BOQs in any format they decide to. However, a major weakness of this approach is that there is lack of bi-directionality between the BIM model and the spreadsheet, which prevents changes made into the model to be directly reflected on the exported quantities. Even so, this approach still offers the simplicity and control that matches certain workflows. Example of BIM software capable of performing this approach are the Autodesk Quantity Take-off, and all BIM design authoring tools, such as Revit, ArchiCAD, Bentley systems, etc.

ii. Bridging the BIM Tool Directly with Estimating Software

This method involves the use of BIM estimating software plug-ins such as TocomaniLink which are linked to 3D Models in BIM design tools through application programming interfaces. With this approach, measurement rules are set by Quantity Surveyors using plug-ins and then quantities are automatically generated from the models. A typical example of this approach was demonstrated by Aiyeleso, Ibrahim, Abdulrazaq, and Kolo (2014) where an application was developed as an ad-on to Revit to automatically extract material quantities and specifications from a BIM. BIM objects can then subsequently be mapped to rates/prices in an external price database such as the RS-Means cost database. Using this approach, BIM design tools mainly serve to provide model visualisation to aid the cost estimating processes.

ii. Using BIM Quantity Take-off Tools

This involves the use of specialised quantity take-off (QTO) software, e.g. Autodesk QTO, Vico Office, ExactalCostX, and Innovaya. These software have the ability to transfer the BIM models and their embedded parameters from BIM design tools into their system, extract quantities from the models and then generate estimates.

These tools can support both the automated extraction and manual take-off features. They can generate visual take off diagrams while providing visualisation of models whereby the Quantity Surveyor can mark off the building components using colours, enabling the Quantity Surveyor to cross check the take-off lists and to see which components have or have not been included in the estimate (Eastman et al., 2011).

Challenges for BIM-based Cost Estimating

Despite the huge benefits derived in using BIM for estimating and cost planning purposes, a number of challenges continue to hinder its successful adoption by Quantity Surveyors. The following are some of the challenges acknowledged by researchers:

i. Substandard BIM Models and Inadequate Information

The accuracy of estimates depends on many factors among which are detailed information and specifications. BIM models of various categories of details known as Level of Developments (LODs) are developed by designers. However, models of LOD 500 provide adequate information that ensures accurate estimates are prepared. LOD 500 models contain details of size, shape, location, quantity and orientation that have been verified in the field (RICS, 2014). Therefore, where substandard models of lower level of details are prepared, the accuracy and reliability of estimates generated by the BIM models become questionable and unreliable.

ii. Interoperability Challenges (Issues Related to Data Exchange)

BIM-based estimating software currently do not provide bi-directional data exchange with other relevant applications. For example, estimates prepared now cannot capture later changes made to BIM models except if the updated models are imported into the BIM tool and new estimates are prepared(Eastman et al., 2011; Sabol, 2008).

iii. Lack of Standardisation and Inappropriate Pricing Format

As methods of estimating vary from one country to the other, there is lack of standard formats suitable for automated quantity take-off and pricing that is universally applicable. Standards currently in use in most BIM applications are the Uniformat, Uniclass, Omniclass classification systems which do not capture local in most cases (Ma et al., 2011). In Nigeria, the different versions of the BESMM are the standards used by Quantity Surveyors to prepare cost estimates. However, these standards do not support BIM based Quantity take-off in many aspects because they are not based on any classification standards (Uniformat, MasterFormat,Uniclass, and Omniclass). Madugu et al. (2016) developed information requirements that supports BIM-based QTO using BESMM 3.

iv. Legal & liability issues

Confusion as to whether or not the BIM model is a contract document needs resolution, particularly as sub-contractors are now beginning to price directly from BIM models (RICS, 2014).

v. Manual review of extracted quantities necessary:

Quantities extracted using some BIM software such as Autodesk Quantity Take-off need to be manually checked to ensure all items of works are completely captured (Eastman et al., 2011)

The Nigerian Building and Engineering Standard Method of Measurement (BESMM 4)

The first edition of the Nigerian Standard method was produced by the Nigerian Institute of Quantity Surveyors in 1988, and the document was titled Standard Method of Measurement of Building Works and Services (SMMBWS)(Nigerian Institute of Quantity Surveyors, 2015). In 2002, improvement were made to upgrade the SMMBWS to second edition which encompasses rules for the measurement in line with technological development of both building and engineering works. However, method of measurement of engineering was incorporated into the second edition and was titled Building and EngineeringStandard Method of Measurement 2 (BESMM2). Since then, the BESMM has gone through revisions and modification twice to produce the BESMM 3 and BESMM 4. Today, the current document that specifies the local standards for the measurement of building and engineering works in Nigeria is the BESMM 4.

The BESMM 4 is a holistic review of the BESMM3 along the principles of the New Rules of Measurement 2 (NRM2), Civil and Engineering Standard Method of Measurement 4 (CESMM4) and Industrial Standard Method of Measurement (ISMM) with adjustments intended to suit the main contracting culture in the Nigerian Construction Industry.

Unlike the BESMM3, the BESMM4 classification and coding system is different, in that the manner of classification of components/items is not as complex as in the former. Components/items of similar work characteristics are grouped under one section(Nigerian Institute of Quantity Surveyors, 2015). The section is no longer tagged with alphabets as in BESMM3, but with numerals. At the beginning of every work section, some major components/items are mentioned just to indicate the type/nature of work measured under such section.

Measurement rules in the BESMM4 are set out in tables with a view to enhancing comprehensive description without difficulties. Each section of the rules comprises of Information (to be) provided, classification tables and supplementary rules. Information (to be) provided ensures that details about the work at hand which the tenderer requires for preparing accurate estimates are provided either in drawings, specifications or any other form that will allow the extraction of the necessary information. The classification tables have five columns similar to that in the BESMM3. The second column from the left which contains units of measurement is usually not referred to when cross-referencing. For this reason, the classification table is in some texts said to have four columns. Unlike in the BESMM3.

The classifications tables are classified in the BESMM4 as: Item listing column, list building components/items commonly encountered in building works. Example of such items include disposal, painting, excavations. The unit column, specifies the unit of measurement appropriate for each item or work to be measured. Column 3 (level 1) lists the information, including any dimension , that shall be included in the description of the building components/items. Column 4 (level 2) lists the supporting information, including any additional dimension , which shall be

included in the description of the building components/item. Column 5 (level 3)lists the further supporting information,including any additional dimension , which shall be included in the description of the building components/item. Column 6 (notes, comments and glossary) gives explanations on what work is deemed to be included in specific building components/items, clarifies the approach to quantification and description of building components/items, and contains definitions of specific terms and phrases used in connection with the building components/items.

Table 1 shows classification for Support to face(s) of excavation where not at the discretion of the contractor. The building components/items listed in the BESMM4 tables comprises those commonly encountered in building, civil engineering and industrial works; the lists are designed not to be too exhaustive.In addition to the classification tables for works there is also supplementary rules which aremeant to guide the user of the BESSM4 to properly measure the physical quantities and to compose and phrase the work item descriptions appropriately.The section on supplementary rules is made up of a further four columns namely: Measurement rules, definition rules, coverage rules and **s**upplementary information. Column 5 - Measurement Rules these set out when work is to be measured and how the quantities are to be calculated. It states for instance the voids in quantities that are to be deducted and those to be ignored, when to measure an item separately or when to treat as part of some other item, etc. Column 6 - Definition rules define the extent and limits of the work represented by a word or expression used in the rules and in the bills prepared in accordance with the rules. Column 7 – Coverage Rules draw attentions to incidental work which shall be deemed to be included in the appropriate items in a bill of quantities to the extent that such work is included in the tender documents. Where the coverage includes materials, they shall be measured in the item description.Column 8 – Supplementary rules contain rules governing the information which shall be given in addition to the information guiding the composition of bill of quantities.

Table 1: Classification for Support to face(s) of excavation where not at the discretion of the contractor

Item or work to be measured	**Unit**	**First division**	**Second division**	**Third division**
Support to face(s) of excavation where not at the discretion of the contractor	m^2	Max. depth stated	Location Stated	Method of forming support where not left to the discretion of the contractor

Information Requirements for Cost Estimating

Studies have identified various information needs that support quantity take-off and cost estimating of building works. Some of the information required to leverage BIM models for cost estimating and QTO are as follows (Eastman et al., 2011; Ma et al., 2010; Ma et al., 2011; Madugu et al., 2016; Pittard & Sell, 2016):

Building Product information: This refers to the various components of the design based on which the different elements to be considered in the estimate are derived. It varies from one project to the other. In a BIM-based estimating system,

quantities of work items are usually extracted from objects which are the major components of the building products. These products contain virtually all the semantic and geometric information required for developing cost estimates.

Work items information: This represents individual work items that constitute each building element (Product). The general structure of estimates in the form of work break down structure (WBS) are derived from the various work sections where these work items are defined in the standard methods of measurements they use. The provision of local standard method of measurement in most cases are captured by this category of information.

Quantity information: This information is obtained from the geometric properties extracted from the building products. Using the geometric properties of the BIM components from the product information, computations are done based on geometry calculation rules to obtain the quantities used in preparing estimates. The quantity information provides the item units, geometry and brief descriptions.

Resource information: This constitutes the materials, labour and plants consumption required for the execution of construction projects. It is obtained from the quantity information and specifications embedded in the building products.

Price information: This provides prices to the various resources identified in the market. Unit rates used in developing bill of quantities solely rely on current market prices as prices fluctuate sporadically in most developing economies.

Cost information: This corresponds to the costs of all the building elements estimated, including the cost of the temporary components, and provisions that eventually make up the total cost of the project.

RESEARCH METHODS

A qualitative research approach using structured in-depth interview technique was chosen as the preferred method of this research. In-depth interview is a qualitative research technique that involves conducting intensive face-to-face interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation(Boyce & Neale, 2016). Qualitative method was employed basically on the premise that similar studies (Ma et al., 2011; Madugu et al., 2016) adopted same approach and also consideringthe natureof the research problem that seeks to investigate how cost estimating is practiced in the Nigerian construction industry (NCI).

The study commenced with an extensive literature review basically to provide an overview of the concept of BIM and construction cost estimating practices in the NCI. The review also identified information requirements that support BIM-based cost estimating generally. The outcome of the review guided the development of an interview guide used for data collection. The main purpose of the interviews was to identify the prevalent cost estimating methods practiced with their associated information needs; the challenges faced by Quantity surveyors using BIM for cost estimating; and lastly to validate the established information requirements identified in literature.

The interview was comprised of three (3) broad components. The first component basically appraised the prevalent cost estimating practices adopted by Quantity surveyors in Nigeria, while the second component was undertaken to validate the information requirements necessary for the estimating practice identified. A total number of nine (9) interview request letters were distributed to Quantity Surveyors (interviewees) purposively selected from different Quantity Surveying firms in Nigeria. The selection was based on a pre-defined criteria that the prospective interviewee must have practiced Quantity Surveying for over ten years, used any QS based software before and is aware and relatively familiar with the concept of BIM. Data collected was analysed using constant comparison content analysis technique. However, the interview involved only five experienced Consultant Quantity Surveyors who were eventually available to participate in the study. Only registered QS who have BIM knowledge or considerable amount of experience in some of the BIM-based estimating tools were chosen for the survey. Consultant QS working with QS firms were considered as the preferred respondents because they more often prepare cost estimates than their contractor QS counterpart. Also, Olatunji and Sher (2014) observed that cost estimating practices between estimators who work in client organizations, contracting organizations, consulting practices and those who work in specialist project organizations differ subtly in terms of procedure, not on the requisite information needed for the estimating.

RESULTS AND DISCUSSIONS

The interviews were conducted by the researcher and the length of time taken on each respondent varied from one hour to two and half hours. The interview themes are as follows:

1. Background information of the interviewees and their firms
2. Cost estimating practices of the surveyed firms;
   a. *Cost estimating methods/approaches adopted by the Firms;*
   b. *Challenges encountered with the use of estimating software; especially the BIM tools*
   c. *Standard Method of Measurement adopted by the firms*
   d. *Quantity Surveyors perception of the current measurement standards (BESMM).*
3. The information requirements for the cost estimating methods adopted by the firms

Characteristics of the surveyed Respondents and their firms

As shown in Table 2, a total number of five (5) respondents representing 55.55% response rate were interviewed. All the interviewees are registered QSs with at least a Bachelor of Science/Technology degree in Quantity Surveying and have worked on virtually all types of construction projects. Their years of experience in Quantity Surveying practice ranged between 8 to 18 years, and are in the middle and top management levels in their respective organizations. Similarly, the firms have adequate experience in construction business and undertake both building and civil engineering works for both public and private sector institutions in Nigeria (Table 3).

Table 2: Background information of the respondents

Firm	Academic Qualification	Professional qualification	Position	Years of experience
PJR 1	BSc. Qs, MSc. Project Management	MNIQS	Director	8 years
PJR 2	BSc. Qs, MSc. Project Management	MNIQS	Senior Quantity Surveyor	10 years
PJR 3	B.Tech. Qs	MNIQS	Quantity Surveyor	5 years
PJR 4	BSc. Qs, MSc. Project Management	FNIQS	Partner	18 years
PJR 5	BSc. Qs	MNIQS	Senior Quantity Surveyor	8 years

* PJR refers to Interviewee

Table 3: Background information of surveyed firms

Firm	Nature of Works	Years of Experience	Major Client
PJR 1	Building and Civil Engineering	15	Both Public and Private
PJR 2	Building and Civil Engineering	12	Both Public and Private
PJR 3	Building and Civil Engineering	10	Both Public and Private
PJR 4	Building and Civil Engineering	25	Both Public and Private
PJR 5	Building and Civil Engineering	23	Both Public and Private

* PJR refers to Interviewee

Cost estimating practices

Cost estimating methods/approaches adopted by the Surveyed Firms

All the respondents agreed that the manual based estimating methods are still the predominant approaches they use in preparing cost estimates. Estimating in these firms is largely paper-based, and where CAD designs and models are available, they are only used to extract dimensions, in some cases quantities. According to the interviewees, their firms' choice of a particular type of estimating method for a project always depends on various factors such as; the level of information available, project type, the time available to prepare estimate and sometimes the type of estimate required, and the type of client/employer. Availability of information and period of time to prepare the estimate were identified as the most important factors that determine the most suitable estimating method applied in most cases. However, the 'elemental approach' to analytical estimating was found to be the most predominant method used by Quantity Surveyors, especially on public client projects. Elemental estimating method as defined by the interviewee involves the breaking down of projects into elements, by categorizing associated work items together.

Furthermore, the interview confirmed that the firms surveyed have not fully incorporated BIM into their service delivery processes. Although all the firms use one software tool or the other, only three (3) of them use BIM tool in some aspects of their estimating process. The respondents acknowledged the use of estimating software applications such as spreadsheets, AQTO (Autodesk Quantity Take-off), CATO (Computer Aided Take-Off), CAD measure, and Vector-X. Some of these software are BIM-based applications.

Also, regarding the procedure followed in preparing Bills of Quantities (BoQ), results from the interview describes the procedure as getting the design (2D CAD or BIM) in electronic or hard form; reading and understanding the design to ensure that all necessary information and specifications are provided; taking off quantities; squaring; building-up unit

rates using current market prices; and the final BoQ preparation as the case may be.

Challenges encountered with the use of estimating software

The interviewees were asked about the challenges and difficulties they encounter when using both the BIM-based and non-BIM-based software in their estimating process. The interviewees' all reported that the estimating packages they adopt had improved the accuracy of their estimates. However, for those using BIM-based applications, their major challenge was lack of alignment of the BIM models with the standard method of measurement they adopt and the immaturity of the models, mostly of Level of Development (LOD 200). Another major concern was that most of the tools available do not have information and object libraries that suit local users' requirements. The existing libraries have to go through some rigorous process of adjustment before the desired results are obtained. More so, interoperability challenge was also highlighted as a major hindrance to the successful adoption of the tools. This is because some of the BIM-based tools do not interoperate seamlessly with the BIM authoring tools used in creating the 3D BIM. This necessitates the need for an improved data model that eases data exchange among the diverse stakeholders in the construction industry.

Standard Method of Measurement adopted by Quantity Surveying Consultancies Surveyed

Majority of the firms adopt the RICS Standard Method of Measurement 7 (SMM7) and rarely make reference to Building and Engineering and Standard Method of Measurement (BESMM). Their major argument was that the BESMM are direct replications of the UK standards of measurements (mostly the SMM7, and the NRM; new rules of measurement) and therefore using the RICS SMM 7 still amounts to the use of the BESMM. The respondents claimed that a lot of omissions were made in the process of preparing the BESMM just to make it look different from the foreign SMMs. Some of the respondents opined that some additions in the document (BESMM4) are not worthy and necessary. The respondents believed that unless major clients in the industry such as Government establishments demand and legislate the use of these documents the rate of adoption of these new standards will continue to be slow and insignificant.

Identification of Cost Estimating Information Requirements

The major purpose of this study is to appraise the estimating approaches used by Quantity Surveying firms' visa-vis identifying the information requirements of the most widely adopted method. The interviewees were requested to validate the information requirements for all the stages they undergo in preparing cost estimates. During the interview session, a list of information requirements for BIM-based cost estimating identified by researchers (Ma et al., 2011; Madugu et al., 2016; Ombugadu, 2016) was put forward to the respondents for critical evaluation and validation. A total number of six (6) information requirements were confirmed by the interviewees as thenecessary information they always require to prepare cost estimates. The information according to the interviewee are as follows:

1. **Building Product information:** All the interviewees confirmed product information as a major information requirements they rely on in

preparing cost estimates. This corroborates Ma et al. (2011) findings that product information is a major information requirements for BIM-based cost estimating using the Chinese standard. Similarly, Ombugadu (2016) in his effort to assess IFC's capabilities to support Quantity take-off using BESMM4, identified twenty eight (28) building products in the Nigerian BESMM and observed that the current IFC4 Add 1 Data Schema still doesn't cover all the items of work as required by the BESMM 4 for the purpose of quantity take-off of building works in Nigeria. The study reported that only 24 IFC entities correspond with the identified building products. This clearly confirms building product as a major information requirements for cost estimating.

2. **Work items information:** The interviewees opined that the work items of each element are generated from designs/models and the various sections of the BESMM. However, building products in BIM are structured and arranged based on standard classifications such as MasterFormat, Omniclass and Uniclass which do not directly align with the BESMM standard used by QSs in Nigeria (Amuda-Yusuf & Mohamed, 2015). This further explains why the direct adoption of existing BIM-based estimating software for estimating purposes by Nigerian QSs cannot be fully achieved.

3. **Quantity information:** The interviewees all mentioned quantity information as a fundamental requirements for preparing cost estimates. Geometric information which form the basis of all quantities are extracted from BIM models. However, the conventional BIM-based estimating applications do not fully generate quantities in all the formats and rules defined by the BESMM; the local standard for cost estimating of building works used by Quantity surveyors in Nigeria. Ma et al. (2011) made similar observation in their attempt to extend the IFC schema to capture local estimating requirements in the Chinese construction industry.

4. **Resource information:** Resource information was also identified as a requirement for cost estimating by the respondents. The computation of resources is done using productivity rates which are obtained from price books and other cost databases such as the BCIS. Although industry wide standard cost databases are not available in Nigeria Construction Industry, price books such as the CONSOLS and the cost books by Newpro Quants Consultants that document price information and productivity rates relevant to the industry need to be explicitly captured by BIM models to ensure effective adoption and utilization of BIM-based cost estimating by Quantity surveying firms. Most BIM-based cost estimating software are linked to external cost databases such as the RS-means, and BCIS databases (Eastman et al., 2011).

5. **Price information:** The respondents identified prices of material, labour, plants, and subcontractors among the key information they always need to

prepare estimates. These prices could be obtained directly from the market or through online cost databases and construction price books. Ma et al. (2011), Madugu et al. (2016) and (Eastman et al. (2011)) identified price information as a major requirements for all BIM-based cost estimating applications.

6. **Cost information:** Cost information depicted as cost centres in the BoQ are collected as summaries, which give the estimated total cost of projects.

CONCLUSION

This paper has appraised cost estimating practices in the Nigerian Construction industry and in the process the information requirements for cost estimating using BIM was identified. The study identified six (6) categories of information required to support BIM-based cost estimating of which current BIM-based tools do not fully support. The elemental cost estimating approach which is currently the widely adopted estimating format can only be supported by the existing BIM applications if the six information entities; Product information, Works item information, Quantity information, Resource information, Price information, and Cost information are fully integrated into the BIM tools. The study concludes that unless these local information are comprehensively captured, the full benefits and potentials of BIM-based cost estimating will not be achieved. Furthermore, to support the application of BIM estimating tools, it is recommended software vendors should develop applications that incorporate all the information entities that support local estimating standards.

REFERENCES

Aiyeleso, A. K., Ibrahim, Y. M., Abdulrazaq, M., & Kolo, B. A. (2014). Development of an Automated Program for Extracting Materials' Quantities from Building Information Models. *Journal of Environmental Studies (ENVIRON). Faculty of Environmental Design, A.B.U., Zaria, Nigeria, 3*(7 and 8), 63-75.

Amuda-Yusuf, G., & Mohamed, S. F. (2015). Essential features of a building services standard method of measurement in Malaysia. *Engineering, Construction and Architectural Management, 22* (6), 749-770.

Boyce, C., & Neale, P. (Producer). (2016, May 3). Pathfinder International. *Conducting In-Depth Interviews: A Guide for Designing and Conducting In-Depth Interviews for Evaluation Input*. Retrieved from http://www.pathfind.org/site/DocServer/m_e_tool_series_indepth_interview

Eastman, C., Teicholz, P., & Sacks, R. (2011). *BIM Handbook; A Guide to Building Information Modeling to Owners, Designers, Engineers and Contractors* (2nd ed.). Canada: Wiley & Sons Inc.

Faraj, I., Alshawi, M., & Aouad, G. (2002). An industry foundation classes Web-based collaborative construction computer environment : WISPER *Automation in Construction, 10* (1), 79-99.

Fu, C., Aouad, G., Lee, A., Mashall-Ponting, A., & Wu, S. (2006). IFC model viewer to support nD model application. *Automation in Construction, 15*, 178-185.

Ma, Z., Zhang, X., Wu, S., Wei, Z., & Lou, Z. (2010). *Framework Design*

for BIM-based Construction Cost Estimating Software. Paper presented at the CIB W78 , International Conference 16-18 November, Cairo, Egypt.

Ma, Z., Zhenhua, W., Wu, S., & Zhe, L. (2011). Application and Extension of the IFC Standard in Construction Cost EStimating for Tendering in China. *Automation in Construction, 20*, 196-204.

Madugu, A. A., Abdullahi, M., & Musa, U. (2016). *Developing Information Requirements Model for BIM-Based Quatity Take-off Using Building and Engineering Standard Method of Measurement 3(BESMM 3)*. Paper presented at the International Conference of Nigeriaan Building and Road Research Institute, Abuja, Nigeria.

McGraw-Hill Construction. (2014). The business value of BIM for construction in major global markets: How contractors around the world are driving innovation with building information modelling. New York.

Nigerian Institute of Quantity Surveyors. (2015). Building and Engineering Standard Method of Measurement (BESMM 4) Fourth Edition. Abuja, Nigeria: Emirati Innovative Services.

Olatunji, O. A., & Sher, W. (2014). Perspectives on modelling BIM-enabled estimating practices. *Australasian Journal of Construction Economics and Building, 14*(4), 32-53.

Ombugadu, J. T. (2016). *Assessing Industry Foundation Classes (IFC) Capabilities for Supporting Quantity Take-off of Building Works Using BESMM4.* (Undergraduate), Ahmadu Bello University, Zaria.

Pittard, S., & Sell, P. (2016). *BIM and Quantity Surveying*. New York: Routledge.

RICS. (2014). International BIM Implementation Guide (First ed.). Parliament Square, London.

Sabol, L. (2008). Challenges in Cost Estimating with Building Information Modelling. Retrieved 18th October, 2016, 2016, from http://www.dcstrategies.net/files/2_sabol_cost_estimating.pdf

Staub-French, S., Fischer, M., & Kunz, J. (2003). A Generic Feature-driven Activity-based Cost Estimation Process. *Advanced Engineering Informatics, 17*(1), 23-39.

Tanyer, A. M., & Aouad, G. (2005). Moving Beyond the fourth dimension with an IFC-based single project database. *Automation in Construction, 14*(1), 15-32.

Wan, C., Chen, P.-H., & Tiong, R. L. K. (2004). Assessment of IFCs for Structural Analysis Doamian. *Journal of Information Technology in Construction, 4*, 75-95.

Yabuki, N., & Shitani, T. (2005). *A management system for cut and fill earthworks based on 4D CAD and EVMS, Computing in Civil Engineering,*. Paper presented at the ASCE International Conference on Computing in Civil Engineering.

6|1

ARCHISEARCH International Journal of Architecture and Environment

2016

Department of Architecture, Ahmadu Bello University, Zaria-Nigeria