JCBM

ISSN 2521-0165

Volume 1, Number 2, December 2017

JOURNAL OF CONSTRUCTION BUSINESS & MANAGEMENT

http://journals.uct.ac.za/index.php/jcbm/index

JCBM

Table of Contents
Volume 1, Number 2, December 2017

ABOUT JCBM

The **Journal of Construction Business and Management (JCBM)** is an open access journal published bi-annually by the University of Cape Town Libraries, South Africa. The Journal is hosted by the Construction Business and Management Research Group of the University of Cape Town. The journal aims to explore the experience of construction industry stakeholders and trends in the global system. It aims to publish peer reviewed and highly quality papers emanating from original theoretical based research, rigorous review of literature, conceptual papers and development of theories, case studies and practical notes. The journal also welcomes papers with diverse methodological research approaches including qualitative, quantitative and mixed methods. Contributions are expected from academia, public administrators, professionals in the public sector and private practice (such as contracting organizations and consulting firms) and other related bodies and institutions (such as financial, legal and NGOs).

The scope of **Journal of Construction Business and Management (JCBM)** covers, but is not limited to construction management and project delivery, strategic management, decision making, skills development, organizational practices and procedures in construction business. The specific areas in construction management, sustainability in construction and project delivery include project planning/feasibility studies, procurement, resource management, international construction, ethical issues, industrial relations, legislative requirements and regulations, construction education, information and communication technologies, housing policies, and urban design and development. Strategic management in construction covers risk management, quality management, resilience and disaster management, cultural and societal management, project life cycle management, and knowledge creation and management. Among issues in construction organizational practices and procedures covered are business development strategies, human resources and career development, continuous professional development, leadership systems, marketing strategies, gender issues and corporate social responsibility.

Journal of Construction Business and Management (JCBM) is a peer reviewed journal. All research articles in this journal undergo rigorous peer review, based on initial editor and anonymised refereeing by at least two anonymous referees.

Journal of Construction Business and Management (JCBM) Partners:

University of Cape Town

Obafemi Awolowo University

The UCT Library takes no responsibility for the content published within journals that are hosted on OpenUCT: open journals, and does not accept any liability arising out of the use of or the inability to use the information contained herein. The library, on behalf of itself and the University, assumes no responsibility, and shall not be liable for any breaches of agreement with other publishes/hosts.

Editorial

Welcome to the second issue of the Journal of Construction Business and Management (JCBM) in 2017. The issue contains six articles that were written by authors based in the United Kingdom, South African and Nigerian universities. Altogether, twelve authors produced these papers aimed at strengthening the discourse in and enhancing construction business and management research. The themes covered are varied and related to management theory and practice in the construction industry. These papers fill critical gaps in the knowledge and practice of construction businesses and project management by exposing the reader to innovative technologies, safety interventions, human resource management strategies and advances in housing development.

The first paper by Onugwa and Uduma-Olugu examines how Building Information Modelling (BIM) is improving collaboration among stakeholders in the construction industry. The paper establishes that a country has to adopt BIM to develop an internationally competitive construction sector. Paper two by Dosumu et al. seeks to understand the issue of continual poor project performance in the construction industry by investigating the frequent causes of errors in construction contract documents and suggests that all designs should go through a quality assurance process to prevent errors prevalent on construction contract documents and thereby improve project performance. Ogbu's paper highlights the need for low-income housing end-users to make inputs at the design and planning stages of their buildings based on the findings that the perception of a building by its occupants, rather than the physical features of the building is the main driver of maintenance cost. Paper four by Oladokun and Komolafe establishes that rural factors were the primary drivers of the housing choice by rural dwellers and recommends the inclusion of cultural values of the people such as kinship and social relations into integrated approaches to rural housing development. Housing development is a National strategy of most African countries needs to be improved in rural areas. The paper by Ameh and Daniel suggests that although the due process is followed in recruitment processes, the selection of suitable candidates is often hampered by interferences and competitive work conditions. The authors propose different methods through which human resource management can be improved in Nigerian construction firms. The final paper by Okoro and Musonda establishes the underlying structures of safety performance measures related to construction workers' unhealthy and unsafe eating behaviour and provides useful evidence for the psychometric evaluation of construction workers' safety and behaviours on construction sites.

I wish to thank all authors who submitted papers for consideration, members of the Editorial Board and Panel of Reviewers for their assistance, timeous feedback and comments that helped shape and improve the quality of the submitted manuscripts. Finally, we welcome your feedback and suggestions that will help improve the quality of the journal and maintain the integrity of our published findings.

Abimbola Windapo *PhD*
Editor-in-chief

JCBM (2017) 1 (2). 1-10

University of Cape Town

Journal of Construction Business and Management

http://journals.uct.ac.za/index.php/jcbm

Building Information Modelling and Collaboration in the Nigerian Construction Industry

I. O. Onungwa[1], N. Uduma-Olugu[2]

Department of Architecture., University of Lagos, Nigeria [1, 2]

Received 30 October 2016; received in revised form 6 December 2016, 31 January 2017and 1 March 2017; accepted 15 March 2017

Abstract

Building Information Modelling (BIM) is a concept that is transforming the way construction is done internationally. Nigeria is lagging regarding the adopting BIM as a collaborative tool amongst professionals in Architecture, Engineering, and Construction (AEC) industry. The thesis of this paper is to investigate how BIM has been adopted in Nigeria and determine to what extent it has helped in improving collaboration among stakeholders in Nigerian construction industry. The method adopted is that of the structured questionnaire. The questionnaires which were organized to capture the central thesis of this study were distributed among 30 AEC firms selected through the simple random sampling method. The responses derived from the responses of respondents were carefully analysed and showed that BIM has significant impacts in areas such as client satisfaction, time for completion, quality and presentation of different concepts in schematic design. The responses also showed a high impact on conflict resolution, supervision, construction programming and quality of completed jobs during the post-contract stage. Major challenges militating against the adoption of BIM were identified to include inadequate infrastructure, lack of skilled workers and insufficient awareness of BIM technology. For Nigeria to compete internationally in the construction industry, BIM should be adopted; hence, there is a need for a more sustained study in this area. The study identified several recommendations which, when applied, can engender a more improved management in the construction industry in Nigeria. Some of the recommendations include: first: developing a curriculum that will incorporate the study of BIM in courses relating to construction. Second: establishment of learning centres that deal with studies in new trends in technology should be developed for private practitioners. Third: relevant professional bodies should create awareness or publicity about the effectiveness of BIM and; fourth, incentives should be made available to AEC firms so as to encourage the use of BIM and collaboration among stakeholders.

Keywords: Adoption; Building information modelling; Collaboration; Construction lifecycle.

1. Introduction

BIM is a product of the general improvement in technology that is created to encourage teamwork and collaboration during the design and construction period. Lucas (2015) averred that BIM is a process that acutely increases the ability to collaborate and exchange information throughout a project's lifecycle from its conception through design, construction, facility management, and decommissioning. BIM technologies have been developed primarily as a solution to information and co-ordination problems (Baddeley and Chang, 2015). According to Holness (2008), BIM is the assembly of a single database of fully integrated and interoperable information that can be used seamlessly and sequentially by all members of the design and construction team and ultimately, by owners/operators throughout a facility's life cycle.

Efforts at adopting BIM in Nigeria's private and public sector and amongst different building professionals (Architects, Quantity Surveyors, Civil Engineers, etc.) have been very slow. Architects have adopted BIM, but they have done so mainly for enhancing the visual quality of their presentation (Alufohai, 2012). Other professionals continue to produce their drawings with 2D Auto Cad. As a result, collaboration on BIM-based projects is not

[1] Corresponding Author. Tel: +234 803 6767760
Email address: digitdesign@yahoo.com
[2] Email address: nnezi.udumaolugu@gmail.com

effective. BIM allows for collaboration in design at the early stage of a project. Usually, this enables consultants to take their decisions at a project's early stage and reduce changes that may occur at a later stage in the design process.

BIM is fast dictating the pace of professionals in the construction industry and changing the process of design and construction of buildings. Hassan and Yolles, (2009) stated that the 3D modelling process extends to scheduling and sequencing (4D), cost estimating (5D), sustainable design also termed Green Design (6D) and facility management (7D). BIM is a new approach to design, depending on the extent of collaboration between Architects, clients, Engineers, building services, manufacturers, contractors and other consultants. It is a team approach in which inputs of all professionals in the design are captured in the same model. "It is a unique opportunity for the building industry to have a shared model that incorporates various building components, including the building's geometry, its spatial relationships, and indeed, its material properties and quantities" (Hassan and Yolles, (2009). The most common programs for BIM are Autodesk Revit, Microstation, ArchiCAD, CBIM, and Ruska.

Baddeley and Chang (2015) noted that collaboration is inherently about harnessing social influences – the tendency humans have to co-operate with others. Therefore, developing collaborative interaction across professions has become a key issue for both academics and practitioners in recent times (Lu, Zhang, and Rowlinson, 2013). Some studies have expressed poor productivity and fragmentation in construction industry (see Lu et al., 2013). For Nigeria to compete globally in construction, the full potentials and opportunities provided by BIM as a collaboration tool have to be utilized. Using BIM as a mechanism during a project's lifecycle will greatly bolster efficiency in the construction of buildings and reduce the problems that are likely to occur during construction.

Among professional bodies interested in construction in Nigeria, there is limited use of BIM due mainly to their inability to keep pace with the modern advancement in technology, their level of awareness about BIM is low. It is in this light that the major factors that impede the adoption of BIM are identified and discussed here. In highlighting the factors impeding the utilization of BIM, it is the hope of this study that the relationship between stakeholders in the construction industry will be strengthened and values that can be derived from this model will be identified. Few studies have been done focusing on the adoption of BIM in the Nigerian construction market. In the same vein, other studies have emphasized the benefits that can be derived from BIM in the industry. Equally, elsewhere in the world, the capacity of BIM to foster collaboration in technology has been explored. Abubakir, Ibrahim, and Kado (2014) explored contractor's perception of factors affecting BIM in the Nigerian construction industry. Zhang and Rowlinson (2013) focused on BIM collaboration: A conceptual model and its characteristics. However, studies that centralize BIM as a powerful tool that ensures collaboration during the life cycle of the project is yet to be conducted in Nigeria. It is assumed that the use of BIM will improve the design process and enhance collaboration amongst professionals during schematic design and post-contract stage of design. Important as well is that studies have not been done to determine if indeed BIM promotes collaboration. Also, there has been no effort at discussing why there has not been any significant collaboration among professionals and disciplines within the construction industry in Lagos, Nigeria. If there has not been any collaboration among professionals in the construction industry in ensuring innovations in their field, then a study that will show that interoperation is needed becomes necessary.

Collaboration and improvement in communication and efficiency during construction is one of the major advantages of BIM. This also accounts for one of the problems militating against innovations in the Nigerian construction industry. Therefore, the present paper investigates the factors impeding the utilization of BIM in Nigeria. In doing this, it advocates for an interdisciplinary collaboration among professionals in the construction industry with a view to identifying measures that will make for its improvement.

2. Literature review

The present paper aims at exploring how the Building Information Modelling (BIM) can provide a framework for collaboration among key stakeholders in the construction industry. Although several kinds of literature on the Building Information Modelling is available, few have been done in relation to the Nigerian context. Therefore, the reviews that will be done here will highlight the studies that have been undertaken so far and show its relevance to the Nigerian situation. To do this, the review will give a historical survey of the development of the BIM to demonstrate the innovations that have been introduced to it at different stages. Since the model is useful in enabling technological and interdisciplinary collaboration among professionals in the construction industry, its relevance will also be highlighted. The review will also highlight the challenges that exist in the adoption of BIM. Equally relevant is the way in which the review will show how BIM occupies a central mechanism for architectural design management and, indeed, an effective collaborative tool.

2.1 Historical account of BIM

In the 1950s, The United States Military pioneered the development of the first graphic system called SAGE (Semi Auto Ground Environment.) The system was developed in partnership with the Lincoln Laboratory of Massachusetts Institute of Technology (MIT). In the 1960s, Ivan Sutherland, a researcher at MIT developed the sketchpad. "From the roots of the SAGE graphical interface and Ivan Sutherland's Sketchpad program in 1963, solid modelling programs began to appear building on developments in the computational representation of geometry." (http://www.archdaily.com/302490/a-brief-history-of-bim).

One of the first projects to successfully create a building database was the Building Description System

(BDS) which was the first software to describe individual library elements which can be retrieved and added to a model. This project was created by Charles Eastman. In 1977, Eastman created GLIDE (Graphical Language for Interactive Design) which has most of the characteristics of current BIM." In the 1970s and 1980s, several developments continued around the world. "The BDS approach tended to be described as "Building Product Models" in the USA, and "Product Information Models" in Europe. These phrases then merged to become "Building Information Model".

2.2 The relevance of BIM in the construction industry

There have been many discussions on BIM; however, there has arguably been no attempt to relate the discussions of the model to the Nigerian context. BIM has been in use for many years in Nigeria. However, its effectiveness and indeed its potentials have hardly been maximized. The benefits involved in engaging in the use of BIM as a collaborative tool include: leveraging on the value of good, reliable information, enabling better co-ordination, synchronization, and sequencing of projects, by allowing all project participants to access and interrogate project information. At a higher level, BIM enables better clash detection (Baddeley and Chang, 2015). Collaboration is often difficult to achieve because the degree of adoption of BIM among the different stakeholders in the construction industry is not the same.

According to Eastman et al. (2011), BIM can potentially increase the efficiency, quality, and productivity of construction projects by reducing the number of mistakes and incompatibilities, providing more accurate and up-to-date information, and by giving a more illustrative and accessible exposition of a building. There are many benefits of BIM and key among others is the ability to reuse information stored in a database (Egbu and Sidawi, 2012). Automation through BIM also improves time and cost management. It streamlines the design process across the company and facilitates automation of emails via knowledge database.

Other benefits include an ability to visualize what is to be built in a simulated environment, higher reliability of expected field conditions, and allowing for an opportunity to do more prefabrication of materials off-site (Rajedran and Clarke, 2011). According to Gordon and Holness (2008), the building design development can continue with the provision of bills of material and generation of shop drawings automatically for everything ranging from structural steel to sheet metal duct fabrication, to fire protection and piping fabrication, to electrical cabling and bus duct layouts.

2.3 Challenges and barriers to BIM adoption in Nigeria

Oladapo (2006) studied the adoption of ICT in the Nigerian construction industry and concluded that the most important obstacle is the poor state of electricity and other infrastructures. Lack of constant electricity and lack of internet connectivity affect the output of work in offices (Abubakir et al., 2014). Constant use of generators increases the cost of running the offices. Moreover, Internet connection is necessary for adequate use of the BIM. Internet should be available to get drawings from a vendor site. BIM systems create big files, implying that the management and transfer of these records will be difficult to do in Nigeria, given the slow internet speed and electricity supply problems. This is in addition to the fact that the use of internet facilities in Nigeria certainly increases the cost of production.

Key of the challenges posed by the adoption of BIM in Nigeria is the interoperability risks between different programs used. (Azhar et al., 2012). This affects the collaboration of construction working drawings and limits the use of BIM, especially during the post-contract stage. A survey by AEC bytes showed that despite each discipline working in 3D environment, collaboration is still primarily based on the exchange of 2D drawings (Khemlani, 2007).

The ownership of BIM data has not yet been determined. It is not yet clear if the BIM belongs to the client who paid for it to be done or the Architect who developed the model. This can create conflict if the client decides to get inputs from other consultants by himself. In most instances, the Architect has to bear the cost of changes in the model during construction, as the client is usually not willing to pay for extra expenses. "BIM entails a high setup cost in both software investment and training, potentially hindering the initial rate of conversion. The nebulous benefit of BIM perceived by individual users also intensifies the resistance to this new technology. In the short run, a proper incentive system can help lift most of the barriers" (Baddeley and Chang, 2015). Most BIMs in use do not have object libraries that are utilized in the Nigerian Market. Even so, the standards for drawing presentation have not been developed.

The Integrated concept of BIM increases risk and liabilities to different parties involved (Azhar et al., 2011). This creates problems when vendors and other consultants make an input to the BIM. There are also various barriers to the adoption of BIM. One of them is the lack of skilled personnel (Abubakir et al., 2014). There are not enough trained personnel in the industry. Most architects train themselves or learn on the job. Therefore, they are usually not aware of all innovations in technologies in the software. Additionally, the reluctance of other stakeholders in using BIM makes it difficult for architects who must transform their drawings to AutoCAD to allow other consultants do their jobs.

Another barrier to the adoption of BIM is the "fear of change" (Hassan and Yolles, 2009). Most people are comfortable with the software they use and, as a result, find it difficult to change or switch to another one, even though it may be more advanced. Using BIM means a shift in mindset from developing drawings with lines to developing drawings in three dimensions putting in walls, windows, doors and other building components (Hassan and Yolles, 2009).

According to Farley (2011), "lack of BIM object libraries" affects the production of drawings because some products are not available in the software. Many professionals in the construction industry are still not aware of the technology. If BIM innovations can be designed to enable inter-disciplinary learning and promote collaboration throughout a project supply chain,

then the efficiency savings are likely to be large (Baddeley and Chang, 2015).

Most of the countries that have successfully adopted BIM have government participation. Alufohai (2012) also stressed the necessity for government involvement; Government has helped to achieve progress in most countries. The General Services Administration (GSA) in the U.S.A made the use of BIM a requirement on all major projects receiving significant public funding in 2007. In Finland, the Senate Properties, a government owned organization implemented BIM Requirements in October 2007. Such a role has been played by governments in Northern Europe. In Singapore, the CORENET e-PLAN Check system (Construction Real Estate Network), launched by Singapore's Ministry of National Development) provides automated compliance checking against building codes for schemes designed using BIM. Lack of Government encouragement or incentive is one of the factors affecting adoption of BIM.

2.4. The relevance of BIM as an architectural design management

It is believed that the implementation of BIM may lead to significant improvement in architectural design team performance. According to Emmitt (2010), the management of architectural design is essential for delivering design intent and maximizing value to a wide range of stakeholders. Birx (2008) posited that the Geometrical CAD did not significantly affect the way architects work, but only computerized the drawing practice which was in the past done with boards. His studies also showed that with the increase in the use of BIM in the construction industry, there would be cultural changes in several design aspects, constructive processes, services offered, and organizational structure of the companies.

Ballard and Koskela (1998) noted that one major reason for the poor level of design management is the lack of solid conceptual foundation. The use of BIM enables input of all professionals in the design process at the conceptual stage. The principal partner and other Architects in the Architectural practice can make inputs at the conceptual stage. The client can also easily visualize the project.

The use of the BIM allows design improvement with a reduction of errors, as it anticipates the design definitions. In this way, it avoids problems in future stages, where the modifications usually generate huge consequences. According to Souza et al., (2009), the ease of visualization through countless cross-sections, views, and perspectives also contributed to the generation of more intelligent design solutions. The automatic generation of views and cross-sections leads to the possible reduction of the work. Offices can meet delivery deadlines with the reduction of the workload spent on each project.

2.5. Use of BIM as a collaboration tool

Collaboration is essential for success in the management of any construction project. However, the construction industry has problems of fragmentation and non-collaboration amongst stakeholders. Collaboration in BIM addresses collaboration amongst the different disciplines involved in the construction project during the various stages of the project's life cycle. The potential of any collaboration depends on cognitive perception, trust, and planning (Lu et al., 2013). A cross-profession collaboration theory claims three determinants of successful collaboration: Collaborative team characteristics, collaboration environment characteristics, and collaborative processes (Lu et al., 2013).

The collaborative team involves relevant knowledge, skills, and attitude to work. Collaborative environment denotes institutional support, while collaborative processes are effective communication, clarity and conflict resolution processes (Lu et al., 2013). BIM is a collaborative approach to construction concerned with integrating the various disciplines to build a structure in a virtual and visual environment (Lu et al., 2013).

Given the studies reviewed, there must be a collaborative team, institutional support and efficient communication for BIM to work effectively. On its part, effective communication allows stakeholders from different disciplines to exchange detailed and accurate information. BIM focuses on series of activities, high levels of data input and highly skilled personnel. For BIM to work effectively, the environment for collaboration has to be in place. There must be institutional support from Architects and Engineers. Without this support, the fragmentation which currently exists in the industry will continue, despite the advent of new technology. In Europe and America, Architects and Engineers have been able to integrate their works in the same BIM model.

In Nigeria, "due to non-integration between the architect, M&E, structural engineer, and the general contractor, it is observed that there are clashes between the M&E design and that of the architect such as a sewage pipe hitting or passing through a beam which is only found out on site during the construction exercise" (Dim et al., 2015).

2.6 Measures of collaboration

Collaboration in BIM is a requirement. Different parties share their knowledge and expertise in a single model. BIM supports integrated project delivery by providing platform and tools for collaborative design and project management (Hamid and Pardis, 2014). For collaboration to be monitored, there must be measures for collaboration. In construction management, several key performance indicators (KPI's) have been identified. These include cost, time, and quality, team performance, communication, stake-holder and human resource management. Brewer and Mendelson (2013) identified traits in an effective team that can result in collaboration. These include creativity, productivity, co-location, commitment, multidisciplinary work, decision authority, productive environment, training, accountability, consensus leader selection, aligned people and organization, aligned process and practices. Hamid and Pardis (2014) developed a collaboration assessment tool to monitor collaboration. Factors to be considered in their assessment tool include personal and team characteristics, training, human-human interactions, human – computer

interactions, communication channels and physical location of team members.

To measure collaboration in BIM, its effect on productivity in the construction industry must be considered. "Coates et al. (2010), developed some KPIs from a case study, focusing on the business impact of BIM, including speed of development, improvement in skills and knowledge, reduction of costs, travel, printing, document shipping, and better architecture and deliverables."

To determine challenges to BIM adoption and lack of collaboration amongst professionals and disciplines within the construction industry, measures of collaboration in BIM need to be developed. Measurement of collaboration in BIM will include: personal and team characteristics, human interactions within the BIM model, channels of communication for team members as well as physical locations of team members. We will also examine the impact of BIM in construction life-cycle in Nigeria. These include the impact on the speed of development, quality, time of completion, reduction in changes and reduction in cost.

3. Research Methodology

3.1 Aim and objectives

The central purpose of this study is to explore the use of Building Information Modelling in Nigeria and evaluate the factors that affect its adoption within the context of AEC (Architecture Engineering Construction) projects in Lagos, Nigeria. Other subsidiary objectives are to: assess how BIM is adopted amongst stakeholders in the Nigerian construction market; identify and discuss barriers to BIM adoption in Lagos, Nigeria, during schematic and post-contract stages of design; and determine and analyse the factors which enhance the use of BIM as a tool for collaboration among stakeholders in the Nigerian construction industry. The study is limited to construction projects. Architects and other consultants within the AEC industry are the main focus of study.

3.1 Methodology

The method used in the study were got through a literature review of research subject matter, the literature review of various methodologies that have been used in practice and review of existing theories in practice. Abubakar et al. (2015) used structural questionnaires as a tool for collecting data in their research on factors affecting BIM in Nigerian construction industry. Dim et al. (2015) studied case studies of different projects for their research on managing change process with BIM implementation by public and private investors in Nigeria. Oladapo (2006) used questionnaires to survey participants in AEC industry.

For this study, structured questionnaires were given to 30 professionals in the construction industry. The sample were chosen from professionals already using BIM in their practice. Lagos and environs were selected for the case study because of the unique position of Lagos in Nigerian construction industry. "Lagos has the highest estimated population of 18 million representing 12% out of a national estimate of 150 million with annual growth rate of between 6% and 8% compared to 4 -5% country growth rate and global 2% growth rate. It is the second most populous city in Africa after Cairo in Egypt and estimated to be the fastest-growing city in Africa and the seventh fastest growing in the world (Oshodi., 2010).

Questionnaires were developed using theories identified in the field; Technology acceptance model and Task-technology fit. Technology acceptance model was used to develop questions on acceptance of BIM as a tool for design development; Questions included perceived ease of use, the usefulness of BIM, reasons for adoption or lack of adoption, and level of acceptance for architectural design.

Task Technology Fit model was used to develop questions on the use of BIM as a functional tool in various aspects of the construction industry: quality, time management, presentation of design concepts, conflict resolution, cost estimation, change management, safety, and construction programming.

Questions included the impact of BIM on schematic design stage, impact on post contract stage, factors preventing the adoption of BIM and solution to challenges. Answers from respondents were collected and analysed. Data was collected using Likert scale to rank level of impact of BIM during schematic design and post contract stage using different variables.

Data was analysed using SPSS version 22. Data from questionnaires were imported into the software and analysed. The results from the variables were tabulated and the mean value determined. The mean values were used to determine variables with highest impact on post contract stage of design and schematic stage od design. This method was used because data collected were easily analysed and deductions were extrapolated. It is also accurate and easy to understand.

The test of the reliability of the responses to the study of the impact of BIM on collaboration in schematic design and post contract design stage was determined using standardised Cronbach's Alpha. Analysis of variance (ANOVA) was used to test if there is significant variation in how the respondents rated the items in each section of the instrument.

4. Finding and Discussion

Data from questionnaires were analysed and findings from the study are discussed in this section.

Table 1 shows the reliability analysis of questionnaire on impact of BIM on collaboration in schematic design and post contract design stage

Table 1: Reliability Test Results of Instrument

Instrument	Scale Statistics					Reliability Statistics	Validity Statistics (ANOVA)	
Source	No. of Items	Number of Samples	Mean	SD	CV	Cronbach's Alpha	F-value	P-value
Impact of BIM on Schematic design stage	6	16	26.810	2.040	0.080	0.737	140.904	0.000
Impact of BIM on Post Contract design stage	9	16	38.310	3.610	0.090	0.767	22.735	0.000
Factors Preventing Adoption	9	16	32.190	4.722	0.150	0.760	32.626	0.000

Source: Field Survey, 2015. SD (Standard Deviation). CV (Coefficient of Variation).

The test of the reliability of the responses on the study of the impact of BIM on collaboration in schematic design and post contract design stage, using standardized Cronbach's Alpha is obtained for each section as 0.737, 0.767 and 0.760. These results suggest that the instrument of evaluation is highly reliable judging from the fact that 0.737, 0.767 and 0.76 are more than 0. 70 threshold value, respectively. A reliable coefficient of 0.7 or higher is considered acceptable for internal consistency of the items in the instruments (questionnaires) used for data collection.

These results are supported by the coefficient of variation (CV) values; 0.08, 0.09 and 0.15, which are respectively less than 0.50 threshold value, indicating homogeneity on how the respondents rated the items. Hence, there is an internal consistency of the answers from the respondents, and therefore the data do not violate the assumption of reliability. The result of the analysis revealed that the test is significant at F-value = 140.904, 22.735 and 32.626, $P < 0.05$, respectively. The results suggested no significance variation on the rating of the items by respondents in the instruments. Hence, the reliability of the tools is significant, which validates the adequacy of the instruments.

Table 2: Analysis of Socio-Economic Variables

Variable	Characteristics	Freq.	%	Mean	Total
Address	Within Lagos	12	75.0		
	South West	3	18.8		
	South South	1	6.3		16
Years in Business	1-5 years	5	31.3		
	6-10 years	2	12.5		
	11–15years	6	37.5		
	Over 21 years	3	18.8	10.8	16
Total No of Employees	1-5 staff	8	50.0		
	6-10 staff	6	37.5		
	11–15 staff	1	6.3		
	Over 21 staff	1	6.3	7	16
What kind of projects do you do?	Mostly residential	1	6.3		
	Mostly commercial	1	6.3		
	All Types	14	87.5		16
Indicate if any Building information modelling software is used in your practice?	Yes	16	100.0		16
If yes, which software is used?	Autodesk Revit	13	81.3		
	ArchiCAD	3	18.7		16
Indicate whether an applicant using BIM would be considered for employment before one that does not use it?	No	2	12.5		
	Yes	14	87.5		16

Source: Field Survey 2015

A bulk of the respondents (75%), were from firms within Lagos, 18.8% were from other southwestern states, while 6.3% were from the South region of Nigeria. The highest group of respondents were businesses that had been in operation for 11 – 15 years (37.5%), followed by those between 1 – 5 years (31.3%). 18.8% of the respondents have been in business for over 21 years.

The least number of respondents were those whose business were 6 – 10 years old (12.5%). The respondents cut across the demographics reflecting the views of both those who have been long in practice and those who are relatively new to practice.81.3% of the professionals interviewed use Autodesk Revit in their office while 18.7% use ArchiCAD. The professionals who are not using BIM stated that they would consider staff using BIM for employment before those not using it. This means that they deem BIM to be an important skill.

Question 1: How has the use of BIM solutions improved drawings during the schematic design stage? This evaluates reasons for adoption of BIM amongst stakeholders in the AEC industry and its effect on collaboration amongst stakeholders.

Table 3: Analysis of Impact of BIM on Schematic Design Stage

Variables	Response					Descriptive			
	1	2	3	4	5	Mean	Rank	Relative Index	Extent
Client satisfaction	-	-	-	5	11	4.69	1	1.05	High
Quality of drawings produced	-	-	-	5	11	4.69	1	1.05	High
Time of completion of presentation drawings	-	-	1	6	9	4.50	2	1.01	Medium
Presentation of different concepts of design	-	1	1	3	11	4.50	2	1.01	Medium
Collaboration with other staff in the office	-	-	2	7	7	4.31	3	0.96	Low
Collaboration with other consultants	-	1	3	5	7	4.13	4	0.92	Low
Pooled						4.47		1.00	

Source: Field Survey 2015: No effect (1), Worse (2), Negligible (3), Much (4), Very much (5).

From the results, client satisfaction, quality of drawings produced ranked highest with most of the respondents saying BIM affected it very much. The mean value was 4.69. Time for completion of drawings and presentation of different design concepts were next with a mean value of 4.50. Results also show that the effect of BIM on collaboration is low both with staff in the same office and with consultants from other offices; thereby confirming the need to encourage the more collaborative use of BIM (Table 3).

Question 2: How has the use of BIM solutions improved your drawings during post contract design stage? This evaluates the importance of BIM to stakeholders in the AEC industry using key performance indexes.

Table 4: Analysis of Impact of BIM on Post contract design Stage

Variables	Response					Descriptive			
	1	2	3	4	5	Mean	Rank	Relative Index	Extent
Conflict resolution in drawings	-	-	1	4	11	4.63	1	1.09	High
Construction programming	-	-	2	7	7	4.31	2	1.01	High
Supervision of Jobs	-	-	1	9	6	4.31	2	1.01	High
Quality of completed jobs	-	-	2	7	7	4.31	2	1.01	High
Energy efficiency	-	-	2	7	7	4.31	2	1.01	High
Time of completion	-	-	2	8	6	4.25	3	1.00	Medium
Collaboration with other consultants	-	1	3	5	7	4.13	4	0.97	Low
Estimation of costs	1	-	1	9	5	4.06	5	0.95	Low
Safety	-	-	4	8	4	4.00	6	0.94	Low
Pooled						4.26		1.00	

Source: Field Survey 2015: No effect (1), Worse (2), Negligible (3), Much (4), Very much (5)

Conflict resolution in drawings was the main advantage in post contract stage of design in Table 4 with a mean value of 4.63. This reinforces the statement that BIM improves co-ordination and efficiency during the post-contract design stage (Table 4). Construction programming, supervision of jobs, quality of completed jobs and energy efficiency were also rated high by the respondents with mean values of 4.31, whereas collaboration with other consultants, estimation of costs, and safety was considered as having a low impact on the use of BIM at post contract design stage (Table 4).

Question 3: What premium would you place on these factors as the barriers to adoption of Building information modelling in Lagos, Nigeria? This identifies barriers to adoption of BIM.

Table 5: Analysis of factors preventing Adoption of BIM

Variables	Response					Descriptive			
	1	2	3	4	5	Mean	Rank	Relative Index	Extent
Lack of skilled personnel	-	-	6	8	2	3.75	1	1.05	High
Lack of internet connectivity	2	-	2	8	4	3.75	1	1.05	High
Reluctance of other stake holders to use BIM	-	2	5	5	4	3.69	2	1.03	High
Lack of BIM Object Libraries	-	2	4	7	3	3.69	2	1.03	High
Lack of awareness of technology	1	2	3	5	5	3.69	2	1.03	High
Extra costs involved in hardware, software and developing office procedures	-	3	4	6	3	3.56	3	0.99	Low
Frequent power failures	2	2	2	8	2	3.38	4	0.94	Low
Lack of contractual documents for BIM	1	3	3	7	2	3.38	4	0.94	Low
Fear of change	-	4	6	3	3	3.31	5	0.92	Low
Pooled						3.58		1.00	

Source: Field Survey 2015: for no impact (1), for little critical impact (2), for fairly critical impact (3), critical impact (4), for extremely critical impact (5).

The major factors preventing the adoption of BIM were identified as lack of skilled personnel and lack of internet connectivity with mean values of 3.75(Table 5). The reluctance of other stakeholders, lack of awareness of technology and lack of BIM object libraries were also identified as factors preventing adoption. The cost of hardware/software, frequent power failure, lack of contractual documents and fear of change were rated as having a low impact on the adoption of BIM in Nigeria (Table 5). This was different from studies by Oladapo which identified power supply as the major barrier to adoption of ICT in Nigeria (Oladapo, 2006).

Question 4: What needs to be done in the Nigerian construction industry to encourage efficient utilization of BIM? This identifies factors that will improve adoption and collaboration of BIM.

Table 6: Analysis of solutions to challenges and barriers to Adoption of BIM

Items	Frequency	Percent	Cumulative Percent
No answer	10	62.5	62.5
Policy makers should promote the use through the result of research done in the Institute	1	6.3	68.8
Schools should provide necessary equipment and enforce learning to all students	1	6.3	75.0
Seminars, lectures, demonstrations on the use of BIM	1	6.3	81.3
The provision of basic infrastructure that will promote the use of BIM	1	6.3	87.5
Training and awareness	1	6.3	93.8
Training, adaptation to changes	1	6.3	100.0
Total	16	100.0	

The responses from the open-ended questions indicated the respondents' opinions on how the barriers could be overcome. Among them are the need for more research, for training at various levels and the provision of basic infrastructure that will promote the use of BIM.

4.0 Conclusion

Some solutions to challenges and barriers to the adoption of BIM, especially in the collaborative manner have been identified from the study. Lack of skilled personnel was identified as one of the major barriers to adoption of BIM. This emphasizes the need to incorporate BIM education in our universities. Lack of infrastructure and reluctance of stakeholders to use BIM were also identified as barriers from literature review and from study.

The study identified client satisfaction and improvement in quality of drawings as the major advantage in adoption of BIM during schematic stage of design.

Data from the studies confirms that the main advantage of BIM during post contract stage is conflict resolution. Collaboration with BIM will increase efficiency and quality of construction so awareness needs to be created within the professional bodies.

4.1 Recommendation

It is recommended that BIM training centres be established in universities and schools of higher learning, which will be used for training of AEC professionals in the construction industry. BIM as a course should be introduced in all schools of Architecture Engineering, Quantity Surveying, and other construction disciplines

Nigerian Institute of Architects, Nigerian Institute of Quantity Surveyors and other regulatory bodies in the construction industry need to get involved with BIM and help in its standardization in Nigeria.

The Federal government of Nigeria and other building and construction agencies should enforce the use of BIM by organizing workshops and seminars to educate owners, Architects, Engineers, Contractors and other stakeholders on the uses and advantages of BIM for public and private construction projects in Nigeria. The government can start by making BIM mandatory for all government projects. There is a need for more research on the use of BIM in construction in Nigeria.

For effective collaboration, institutional support from the private offices is very important. The leaders in private firms have to be committed to this. For this to happen, there must be some remuneration for efforts made in investing on new software and training.

References

Abdirad, H and Pishdad-Bozorgi, P. 2014. Developing a framework of metrics to assess collaboration in integrated project delivery retrieval. 50th ASC Annual International Conference Proceedings, Associated Schools of Construction. 26-28 March 2014, Virginia Tech, Blacksburg, VA.

Abubakar M., Ibrahim Y., Kado D. and Bala, K. 2014. Contractor's perception of factors affecting building information modelling in the Nigerian construction industry. Computing in Civil Engineering, ASCE 2014, 167-178.

Adesina, A. A, Ayo C.K. and Ekong U.O. 2008. An empirical investigation of the level of user's acceptance of e-banking in Nigeria: based on technology acceptance model. Journal of Internet banking and commerce.15 (1).

Online http://www.arraydev.com/commerce/JIBC15-1.htm .(April 2012)

Alufohai, A. 2012. Adoption of building information modelling and Nigeria's quest for project cost management, in FIG Working Week 2012, Knowing to manage the territory, protect the environment, evaluate the cultural heritage,6-10 May 2012, Rome, Italy.

Autodesk. 2016. What is BIM? http://www.autodesk.com/solutions/bim/overview. (May 12,2014)

Azhar, S., Hein, M. and Sketo, B. 2011. Building information management benefits, risks, and challenges. Leadership and Management in Engineering, ASCE 2011, 11(3); 241-252

Azhar, S., Khalfan, M. and Maqsood, T. 2012. Building information modelling (BIM): now and beyond. Australasian Journal of Construction Economics and Building, 4:15-28.

Baddeley, M. and Chang, C. 2015. Collaborative Building information modelling (BIM): insights from behavioural economics and incentive theory. RICS Research publication. Online https://researchgate.net/ publication/281243999 (March 2015).

Ballard, G. and Koskela, L. 1998. On the Agenda of design management research, Proceedings of IGLC '98. Guaruja, Brazil

Birx, G. W. 2008. Getting started with Building Information Modelling. The American Institute of Architects - Best Practices, www,ashrae.org (June 2015)

Brewer, W.and Mendelson, M. I. 2003. Methodology and metrics for assessing team effectiveness. The International Journal of Engineering Education, 19: 777-787.

CICRP. 2009. BIM project execution planning guide. The Computer Integrated Construction Research Group, The Pennsylvania State University, PA.

Coates, P., Arayici, Y., Koskela, L., Kagioglou, M., Usher, C., and O'Reilly, K. 2010. The key performance indicators of the BIM implementation process. Paper presented at The International Conference on Computing in Civil and Building Engineering, April 2010, Nottingham, UK.

Davison, R. M., Martinsons, M. G. and Kock, N. 2004. Principles of canonical action research. Information Systems Journal, 14: 65-86.

Deluca, D. 2008. Furthering information systems action research: A post-positivist synthesis of four dialectics. Journal of the Association for Information Systems,

9 (2):48-72.

Dim, N. U., Basili, E. and Okoro, B. 2015. Managing change process with BIM implementation by public and private investors in Nigerian Building industry. Donnish Journal of Engineering and manufacturing technology, 2:001-006.

Eastman, C., Teicholz, P., Sacks, R. and Liston, K. 2011. BIM Handbook, a guide to building information modelling for owners, managers, designers, engineer, and contractors. New Jersey: John Wiley and Sons, Inc.

Egbu, C. and Sidawi, B. 2012. Building information modelling (BIM) implementation and remote construction projects; issues, challenges, and critiques. Journal of information technology in construction, 47: 75-85.

Emmitt, S. 2010. Design management in architecture, engineering, and construction: Origins and trends. Gestão & Tecnologia de Projetos, 5(3).

Farley, A. 2011. Assessing the impacts of building information modelling. The building Economist, June 2011:13-19.

Gianina. LALA (FĂDOR).2014 The Emergence and Development of the Technology Acceptance Model (TAM), International Conference Marketing from information to decision, November 2014:7; 149

Gordon, V. and Holness, P. 2008. BIM gaining momentum. ashrae.org, June 2008: 28-30.

Hassan, A. and Yolles, H. 2009. Building information modelling, a primer. Canadian Consulting Engineer, June/July 2009: 42.

Iversen, J. H., Mathiassen, L., and Nielsen, P. A. 2004. Managing risk in software process improvement: An action research approach. MIS Quarterly, (28)3: 395 – 433.

Khemlani, L. 2007. Top criteria for BIM solutions, a survey conducted by AECbytes. http://www.aecbytes.com/feature/2007/BIMSurveyReport.html. (11 November, 2015)

Lu, W., Zhang, D. and Rowlinson, S. 2013. BIM collaboration: A conceptual model and its characteristics. 29th Annual ARCOM Conference, 2-4 September 2013. Reading, UK: Association of Researchers in Construction Management. 25-34.

Lucas, J. 2015. Managing the facility with lifecycle information. Journal of Current Issues in Media and Telecommunications.7(1):13-35.

Markauskaite, L., Fitzgerald, R., Herrington, J., and Wallace, R. 2011. eResearch in education: An overview and selected resources 17 April 2011. AARE/ARDEN eResearch task group report prepared for the Australian Association for Research in Education.

Markauskaite, L. and Reimann, P. 2014. Editorial: e-Research for education: Applied, methodological and critical perspectives. British Journal of Educational Technology, 45 (3).

Oladapo, A. A. 2006. The impact of ICT on professional practice in the Nigerian construction industry. Electronic Journal for information system in developing countries, 24(2):1-19.

Orlikowski, W. J., and Baroudi, J. J. 1991. Studying information Technology in Organizations: Research approaches and assumptions. Information Systems Research, 2(1) p1-28

Oshodi, L. 2010. Housing population and development in Lagos, Nigeria. Housing and urban development. https://oshlookman.wordpress.com/2010/11/24/housing-situation-in-lagos-nigeria. (20 May 2016)

Rajendran, S. and Clarke, B. 2011. Building information modelling, Safety benefits, and opportunities. Professional Safety, October 2011, www.asse.org, pp 46. (10 October 2015)

Rubenstone, J. 2012. Autodesk steers users toward the cloud with expanded subscription-based services. Engineering News Record, April 16, 2012.

Singh, V., Gu, N. and Wang, X. 2010. A theoretical framework of a BIM-based multi-disciplinary collaboration platform. Automation in Construction 20 (2011) 134–144.

Souza, L., Amorim, S., and Magalhães, A. 2009. Impact from the use of BIM in architectural design offices: Real estate market opportunities, Design Management and Technology 1, I. 2.

Vangen, S. and Huxham, C. 2010. Introducing the theory of collaborative advantage, Emerging perspectives on theory and practice of public governance. London: Routledge, 163-184.

JCBM (2017) 1(2). 11-23

JCBM

University of Cape Town

Journal of Construction Business and Management

http://journals.uct.ac.za/index.php/jcbm

Causes of Errors in Construction Contract Documents in Southwestern, Nigeria

O S. Dosumu[1], G. I. Idoro[2], H. N. Onukwube[3]

Department of Building, University of Lagos, Nigeria[1, 2, 3]

Received 2 November 2016; received in revised form 20 February 2017; accepted 29 March 2017

Abstract

The issue of continual poor project performance in the construction industry remains unresolved, and there is the need for improvement. In view of improving project performance, this study aims at investigating the frequent causes of errors in construction contract documents. A mixed method (questionnaire survey and interview) research approach was used for the study. The respondents for the study (selected with two-stage stratified - random sampling technique) consist of 86 consulting and 98 contracting firms that have been engaged in building projects that have more than one floor between 2012 and 2015. Fifty-one (51) interviews were also conducted with contractors, project managers and consultants on the projects they were involved on and that provided further necessary information for the study. The tools that were used for the analysis of this study include descriptive (sums, frequency and percentages) and inferential (t-test) statistics. The study found that the causes of errors in contract documents comprise of frequent design changes by clients, lack of adequate time to prepare documents and design management experience among others. Based on the findings, it was concluded that the causes of errors in contract documents vary from one state to the other. It was also found that there is a difference in the causes of errors in contract documents based on types of building, services rendered by construction organisations and states in South West, Nigeria. However, there is no significant difference in the causes of errors in contract documents based on procurement method except where there is incomplete documentation or contracting organisations have overlapping activities. The study recommended that the errors identified should always be prevented from occurring if cost and time overrun are to be minimized. Also since most of the causes identified are related to consultants, it was recommended that all designs should go through quality assurance process.

Keywords: Building Projects, Construction, Contract documents, Errors, Project performance.

1. Introduction

Poor project performance remains an unsolved problem in the construction industry, and its occurrence has continually led to the frustration of many clients (Love et al. 2011). It has also led to profit marginalization for contractors, disputes, loss of confidence and reputation for consultants and eventual discouragement of investments in construction projects. Many factors have been traced to poor project performance (mostly measured in terms of cost, time and quality) but notable among them are errors in construction contract documents. To substantiate the gravity of mistakes in contract documents, Okuntade (2014) affirmed that errors in contract documents account for more than 82% of all construction errors committed. Ade-Ojo and Babalola (2013) and Mukaka et al. (2014) also noted that errors in contract documents are the major factors affecting the cost and time performance of building projects.

About eighty-seven (87) causes of errors were attributed to errors in contract documents, some of which include lack of consistency (Norman 1983), unreliable and incompetent staff and acceptance of low design fee (Love et al. 2011) among others. The problem is that many of the studies reported in the literature on errors in contract documents are not empirical aside being conducted outside Nigeria; thereby making it difficult to determine the frequency of occurrence of the causes of

[1] Corresponding Author. Tel: +234 817 329 1721
Email address: osdosumu@unilag.edu.ng
[2] Email address: iroidoro@yahoo.co.uk
[3] Email address: onukwube12345678@yahoo.com

errors in contract documents of construction projects. Without an assessment of the frequent causes of errors in contract documents, it may be difficult to know the errors that need urgent tackling. The effects of such errors on project performance may also be difficult to curtail.

The situation is worse in Nigeria because, despite identifying that errors in contract documents are among the leading causes of poor project performance, studies revealing the causes of errors in contract documents are very scarce. Babalola and Idehen (2011), Olaniyan (2011) and Okuntade (2014) clearly stated that errors in contract documents, design errors and omissions are the major reasons construction projects are plagued with disputes, wastes, variation, project abandonment, and profit marginalization for contractors, loss of confidence and reputation for consultants and eventual discouragement of investment in construction projects among others. Ade-Ojo and Babalola (2013) also noted that errors in contract documents are the reasons for the non-completion of construction projects on time (or abandoned), to cost and quality. What remains unsolved in these studies, however, are the causes of the errors in contract documents that contribute to the identified problems.

From the literature reviewed, there appear to be limited empirical studies on the frequent causes of errors in contract documents. Therefore, there is need to conduct an empirical study with regards to the frequent causes of errors in contract documents because of the important effects they can have on projects and stakeholders. Without a study of this nature, the achievement of successful project performance may be a mirage in the construction industry.

2. Literature Review

It is not only consultants' errors that affect construction project performance; construction errors also take its toll on it. However, this study concentrates on errors in construction contract documents (consultants' errors) because it seems not to be a popular subject of discussion by Nigerian authors and it also appears to be a major area of error in the construction industry that adversely affects project performance in any country. This was substantiated by Mohammed (2007) who noted that project consultants play a major role in project cost overrun due to errors in contract documents.

The research carried out in Australia reveals that ninety-two percent (92%) of the variation in their construction industry were attributable to errors in contract documents and the consultants' team share 60% of the variation (Choy & Sidwell 1991). Diekman and Nelson (1985) also noted that the largest proportion of change orders and modifications originate from the owner (client) or their representatives (consultants) and these account for 46% of claims in federally funded projects. The study conducted by Burati et al. (1992) on nine fast-track industrial construction projects show that while construction deviations average 16% of the total number of deviations, design deviations averaged 78% of the total number of deviations. Hence, the need to determine the frequency of the causes of errors in contract documents on building projects.

Some of the causes linked to errors in contract documents by various researchers in the construction industry include lack of consistency (Norman, 1983), re-use of notes and details of similar projects, wrong assumptions of standard practice, inexperience, lack of clarity and poor interface co-ordination, poor management practices, inadequate quality management, poor communication, absence of well-defined design leadership, unclear project leadership role and lack of design verifications (Palaneeswaran, et al. 2007). Low design fees, clients' briefs, quality control, design time allowances, constructability, quality of staff (Tilley, et al. 2005), unreliable and incompetent staff, acceptance of low design fee (Love et al. 2011), time boxing (Love et al. 2000), planning/programming, stress, repetitive tasks (Shelton, 1999), limited attention, biases, modification of rules (Cheng-Wing & Davey 1998), unavailable data, memory loss, misperception of data, over-reliance on default values and failure to monitor data (Endsley 1999) are other causes of errors in contract documents.

Barkow (2005) identified negligence, lack of adequate design references, and lack of knowledge, poor teamwork, human error, inadequate design checks, poor communications and complexity of task as causes of errors in contract documents. Contradiction of information, untried new technologies, adaptation of technology to human beings, physical and mental conditions (Vrouwenvelder et al. 2009), extra works, delays/disruption, conflicts, incompatibility /inconsistency, omission, inadequate detail/description, insufficient legibility (Long, 2011), motivation, cooperation, (Love & Josephson 2004), carelessness, lack of diligence, ineffective use of computer aided design, unrealistic client demands, low task awareness, overload, fatigue, lack of knowledge of changes in standards and not knowing what is required (Love, et al. 2008) are other causes of consultants' errors. Ortega and Bisgaard (2000) concluded that the causes of errors are engineers and architects inexperience in design and unplanned inspection in contract documents. Tzortzopoulos and Formoso (1999) noted that the causes of errors in construction contract documents are poor communication, lack of adequate documentation, deficient or missing input information, unbalanced resource allocation, lack of coordination between disciplines, erratic decision making, lack of technology and incorrect application of existing knowledge. Other causes of errors pointed out were poor design quality, lack of design standards, lack of constructability of designs, defects of individual specialists, changes introduced by owners and designers, inconsistencies between drawings and specifications, designer with little construction knowledge, non-technical specifications (Alarcon & Mardones 1998), deficient procedures, poor communication between workers, inadequately trained workers, conflicting interest of workers, inadequately labelled equipment and poorly designed equipment (Rooney, et al., 2002).

As a result of the enormity of these causes Mohammed (2007) classified them into management - related causes, consultant – related causes, client - related causes, project characters and industry-related causes. Atkinson (1998) categorized them into primary causes (e.g. self-inspection, education/training), managerial causes (e.g.

delegation of duties, change controlling, concurrent working control, communications) and global causes (e.g. organizational culture, economic pressure, time pressure, political pressure and societal pressure). Barkow (2005) classified them into technical, organizational and management errors. Yates and Lockley (2002) categorized the causes of errors into the design, construction, material, administrative and maintenance errors. The categorization of Love et al. (2009) was practice, task, circumstance, task, organization, system, industry and tool. Cheng-wing and Davey (1998) classified errors into the design, environmental and personnel causes.

From the literature reviewed so far, it appears that the causes of errors in contract documents vary from one country to the other, hence their enormity warrant categorization. Therefore, there is the need to conduct a similar study on the subject to determine the frequent causes of errors in Nigerian contract documents. Dosumu and Iyagba (2013) appraised the factors responsible for errors in construction documents using construction professionals and contractors in Lagos State, Nigeria. The deficiency in the study is that aside responses being based on the general perception of respondents rather than specific projects; the study was based on Lagos state alone. The same procedure is evident in Dosumu and Adenuga (2013) when the causes, effects and remedies of errors in Nigerian construction documents were investigated. It is, therefore, inappropriate to state that the results of the studies are representative of any geopolitical zones in Nigeria not to talk of representing the nation at large. Lagos state is only one out of the thirty-six states in Nigeria. Therefore, a detailed study of the breakdown of causes of errors in contract documents that can be representative of a wider area of Nigeria is required and that is why this study is focusing on a wider area of Southwestern Nigeria.

3. Research Method

This study adopted the mixed (questionnaire survey and interview) method research approach. The research area is South Western, Nigeria. Before the movement of the capital of Nigeria to Abuja, Lagos has thrived as the capital city and the economic hub of the country. During that period, many organizations including those in the construction sector had their head offices in Lagos or neighbouring states. Therefore, for this study, the research area is South-West, Nigeria.

The population of this study consists of contracting and consulting firms in Southwest, Nigeria that was engaged in building projects between 2012 and 2015. Consultants' opinions were required because they prepare the contract documents of construction projects. The views of contractors were required because they make use of the documents prepared by consultants and they discover the errors in them. Years between 2012 and 2015 were selected to ensure that projects used for the study are recent. The list of contracting firms is collated from the Federation of Construction Industry (FOCI) and states tender boards of the six states in Southwest, Nigeria. There were situations where companies appeared in both sources; a unified list was, therefore, prepared to take care of repeatedly listed firms. Hence, 275 contracting firms were collated from the six states in the geopolitical zone.
The consulting firms used for this study are those that were collected from the directories of professional/regulatory bodies which include the Architect Registration Council of Nigeria/Nigerian Institute of Architects (ARCON/NIA), Council of Registered Builders of Nigeria/Nigerian Institute of Building (CORBON/NIOB), Quantity Surveyors Registration Board of Nigeria/ Nigerian Institute of Quantity Surveyors (QSRBN/NIQS) and the Council for the Regulation of Engineering/Nigerian Society of Engineers (COREN/NSE). Hence, the consulting firms used for this study are 128 Building firms, 399 Engineering firms, 136 Quantity Surveying companies and 323 Architectural firms respectively and this brings the total number of consulting firms for this study to 986. The population for this study is 275 building contractors and 986 construction consultants.
The study adopts the formula proposed by the Creative Research System (2001) in calculating the sample size. Thus:

$$SS = \frac{Z^2 \times P \times (1-P)}{C^2} \quad (1)$$

Where: SS = Sample size, Z = Z-value at 95% confidence level (1.96), P = probability of selecting a population member (0.5), C = Margin of error at 95% confidence level (0.05)

Using the formula, the sample size for contracting firms is 161, and that of consulting firms is 275 (36 Building, 103 Engineering, 46 Quantity Surveying and 90 Architectural firms). Hence, the two-stage stratified random sampling technique was used for this study.

Table 1: Population and Sample Size of the Study

Location of project	Contracting firms		Consulting firms							
			Architects		Builders		Engineers		Qty. Surv.	
	POP	SS	POP	SS	POP	SS	POP	SS	POP	SS
Lagos	122	71	120	33	70	20	148	41	54	15
Ogun	61	36	46	13	23	6	71	20	32	9
Oyo	32	19	46	13	16	5	49	14	23	6
Osun	25	15	44	12	11	3	35	10	22	6
Ekiti	14	8	36	10	-	-	36	10	17	5
Ondo	21	12	31	9	8	2	30	8	18	5
Total	**275**	**161**	**323**	**90**	**128**	**36**	**369**	**103**	**166**	**46**

POP = Population, SS = Sample Size, Qty. Surv = Quantity Surveyors

The first stratum was the division of respondents into consulting and contracting firms. The second stage involved stratifying consultants into architectural, building, engineering and quantity surveying firms. Table 1 shows population and sample size distribution of the study.Fifty-one (51) interviews were also conducted with contractors, project managers and consultants on the projects they were involved and can equally identify the causes of errors in the contract documents of such projects. The selection of 51 interviewees was based on the experience, willingness of the experts to be interviewed and execution of the type of projects investigated in this study.

4. Data Presentation and Analysis

The questionnaire for the study was administered on 436 respondents across the South-West part of Nigeria, and only 184 of them were completed, and this gives a response rate of 42.2%. Table 2 shows the details of projects investigated during the interview. A total of 60.8% were executed with traditional procurement method, 29.4% with design and build method and 9.8% adopted the management method. Also, 96.1% of the projects have architectural drawings, 90.2% have structural drawings, 80.4% have M&E drawings, 90.2% have bills of quantities, 51% have specifications, 86.3% have conditions of the contract and 47.1% have other documents.

The 51% reported for the availability of specifications represent material and job specifications. Also, the interview reveals that some specifications are attachments to drawings; however it was gathered that such specifications lack details and precision. Despite the large percentages recorded for most contract documents, it is surprising to find out that some building projects were commenced with only letters of the award. An interviewee noted that he began the construction of a semi-detached twin duplex at Millennium Estate, Lekki Phase II with just the client's brief. Another interviewee commenced a hotel suite at Port-Harcourt with just the conditions of contract, approximate estimate and trade preambles (specifications). A total of 47.1% of the respondents noted that they had other contract documents at the time they were moving to site. Some of the other contract documents include schedule of day work rates, article of agreement, deeds of agreement, soil geotechnical report, program of work, survey plan, letter of award, total quality management plan, bank/ insurance bond, health and safety plan, form of tender, allocation letter, method statement, appendices and trade preambles.

Table 2: Details of Projects Investigated During Interview

Details of projects	Frequency	Percentage (%)
Procurement Method		
Traditional	31	60.8
Design and build	15	29.4
Management (project & management contracting)	5	9.8
Total	**51**	**100.0**
Available contract document (more than one was ticked)		
Architectural drawing	49	96.1
Structural drawing	46	90.2
Mechanical & Electrical drawing	41	80.4
Bill of quantities	46	90.2
Specification	26	51.0
Condition of contract	44	86.3
Other documents	24	47.1

The distribution of respondents according to profession, sector of project involvement, work experience and educational qualification is depicted in Table 3.

Table 3: General Information of Respondents, Organisations and Investigated Building Projects

Respondents' information	Consultant		Contractor		Total	
	Number	%	Number	%	Number	%
Profession of respondents						
Architecture	15	17.4	17	17.3	32	17.4
Civil/Structural engineering	16	18.6	20	20.4	36	19.6
Quantity surveying	30	34.9	26	26.5	56	30.4
Building	15	17.4	28	28.6	43	23.4
Electrical/Mechanical engineering	10	11.7	7	7.2	17	9.2
Sector of project investigated						
Public	43	50.0	49	50.0	92	50.0
Private	43	50.0	49	50.0	92	50.0

Work experience of respondents						
1-5 years	17	19.8	32	32.7	49	26.6
6-10 years	35	40.6	45	45.9	80	43.5
11-15 years	22	25.6	13	13.3	35	19.0
16-20 years	12	14.0	8	8.1	20	10.9
Educational qualification						
OND	3	3.5	2	2.0	5	2.7
HND/B.Sc.	55	64.0	84	85.7	139	75.5
M.Sc.	28	32.5	11	11.3	39	21.2
Ph.D.	0	0.0	1	1.0	1	0.5
Type of building project						
Residential	40	46.5	48	49.0	88	47.8
Institutional	20	23.3	17	17.3	37	20.1
Religious	2	2.3	2	2.0	4	2.2
Commercial	24	27.9	31	31.7	55	29.9
Location of project						
Lagos state	44	51.2	37	37.8	81	44.0
Ogun state	17	19.8	19	19.4	36	19.6
Oyo state	20	23.2	12	12.2	32	17.4
Osun state	3	3.5	10	10.2	13	7.1
Ondo state	0	0.0	12	12.2	12	6.5
Ekiti state	2	2.3	8	8.2	10	5.4
Procurement method						
Traditional	13	15.1	18	18.4	31	16.8
Design and build	26	30.2	40	40.8	66	35.9
Management method	47	54.7	40	40.8	87	47.3
Type of construction						
New	82	95.3	89	90.8	171	92.9
Refurbishment	4	4.7	9	9.2	13	7.1
Total	**86**	**100.0**	**98**	**100.0**	**184**	**100.0**

From Table 3, it is evident that the respondents and their organizations are qualified to give useful information for the study. Table 3 also indicates the general information of the building projects used for this study. The information includes the type of project, location, procurement method and type of construction. Most of the projects used for this study are new works and residential in nature. Also, Lagos state constitutes the supplier of the largest building projects (44%), followed by Ogun (19%) and Oyo state (17.4%) respectively. It is interesting to know that the traditional method of procurement is the least used on the projects used for this study

Table 4 presents the frequency of occurrence of the causes of errors in contract documents.

Table 4: Causes of Errors in Contract Documents According to Services Rendered and Their Test of Difference

Causes of errors	Cons. Mean	Contr. Mean	Total Mean	P Value	Significance	Decision
Design management experience	4.18(1)	3.73 (1)	3.94(1)	0.024	Significant	Reject H_o
Project brief	3.88(3)	3.54 (5)	3.70(2)	0.059	N. significant	Accept H_o
Designer professional education	3.92(2)	3.50 (6)	3.70(3)	0.019	Significant	Reject Ho
Lack of design standards	3.79(5)	3.57 (3)	3.67(4)	0.263	N. significant	Accept H_o
Poor communication among project participants	3.73(7)	3.55 (4)	3.63(5)	0.429	N. significant	Accept H_o
Lack of coordination between disciplines	3.60(15)	3.61 (2)	3.61(6)	0.924	N. significant	Accept H_o
Management organizational structure	3.72(8)	3.49 (7)	3.60(7)	0.237	N. significant	Accept H_o
Lack of consistency between drawing and specification	3.85(4)	3.35(14)	3.59(8)	0.017	Significant	Reject H_o
Carelessness and negligence	3.67(10)	3.45(8)	3.55(9)	0.271	N. significant	Accept H_o
Insufficient fund to create quality documents	3.72(8)	3.36(11)	3.53(10)	0.076	N. significant	Accept H_o
Errors in design assumptions/calculations	3.77(6)	3.27(23)	3.51(11)	0.016	Significant	Reject H_o
Availability and contradictions of design information	3.65(12)	3.36(11)	3.50(12)	0.102	N. significant	Accept H_o
Physical and mental conditions	3.66(11)	3.34(16)	3.49(13)	0.073	N. significant	Accept H_o
Lack of awareness of changes in standards	3.65(12)	3.34(16)	3.48(14)	0.108	N. significant	Accept H_o
Inadequate documentation	3.58(28)	3.36(11)	3.47(15)	0.198	N. significant	Accept H_o
Complexity of design and project	3.59(17)	3.35(14)	3.46(16)	0.274	N. significant	Accept H_o

Identification of project risk	3.60(15)	3.31(19)	3.45(17)	0.612	N. significant	Accept H_o
Inadequate design time	3.43(27)	3.41(9)	3.42(18)	0.917	N. significant	Accept H_o
Lack of motivation	3.65(12)	3.14(29)	3.37(19)	0.004	Significant	Reject H_o
Procurement process	3.55(19)	3.20(26)	3.37(20)	0.062	N. significant	Accept H_o
Unrealistic client demand	3.40(30)	3.32(18)	3.36(21)	0.660	N. significant	Accept H_o
Lack of planning and inspection of project	3.49(22)	3.22(22)	3.35(22)	0.109	N. significant	Accept H_o
Nature of economy	3.51(20)	3.20(26)	3.35(23)	0.096	N. significant	Accept H_o
Attitude of client	3.38(31)	3.29(20)	3.34(24)	0.612	N. Significant	Accept H_o
Transfer of knowledge and experience between designers	3.36(33)	3.29(20)	3.32(25)	0.685	N. significant	Accept H_o
Completeness/contradiction of information	3.51(20)	3.14(29)	3.31(26)	0.028	Significant	Reject H_o
Unclear and ambiguous requirements for design specifications	3.37(32)	3.26(24)	3.31(27)	0.518	N. significant	Accept H_o
Authority approval	3.47(26)	3.16(28)	3.31(28)	0.154	N. significant	Accept H_o
Project cost	3.31(38)	3.28(22)	3.29(29)	0.846	N. significant	Accept H_o
Standard of university education in contract courses	3.43(27)	3.41(9)	3.28(30)	0.103	N. significant	Accept H_o
Fragment nature of industry	3.41(29)	3.13(32)	3.26(31)	0.078	N. significant	Accept H_o
Uniqueness of project	3.35(34)	3.13(32)	3.23(32)	0.289	N. significant	Accept H_o
Low designer salary	3.33(35)	3.13(32)	3.23(33)	0.276	N. significant	Accept H_o
Size of project	3.49(22)	2.99(37)	3.23(34)	0.013	Significant	Reject H_o
Construction start and finish time	3.48(25)	2.99(37)	3.22(35)	0.008	Significant	Reject H_o
Lack of clarity and legibility	3.49(22)	2.89(43)	3.17(36)	0.003	Significant	Reject H_o
Inadequate design staff	3.23(39)	3.11(35)	3.16(37)	0.462	N. significant	Accept H_o
Concurrent /overlapping activities	3.13(41)	3.14(29)	3.14(38)	0.032	Significant	Reject H_o
Amount of work with design organizations	3.32(36)	2.90(41)	3.10(39)	0.944	N. significant	Accept H_o
Personality attitudes	3.32(36)	2.88(44)	3.09(40)	0.023	Significant	Reject H_o
Non-request for certificate of insurance covering design and errors	3.02(43)	3.08(36)	3.06(41)	0.744	N. significant	Accept H_o
Type of client	3.15(40)	2.90(41)	3.02(42)	0.228	N. significant	Accept H_o
Acceptance of low design fees	3.11(42)	2.93(39)	3.01(43)	0.301	N. significant	Accept H_o
Re-use of notes and details of similar projects	2.78(42)	2.92(40)	2.86(44)	0.472	N. significant	Accept H_o
Authority approval	3.47(26)	3.16(28)	3.31(28)	0.154	N. significant	Accept H_o
Project cost	3.31(38)	3.28(22)	3.29(29)	0.846	N. significant	Accept H_o
Standard of university education in contract courses	3.43(27)	3.41(9)	3.28(30)	0.103	N. significant	Accept H_o
Fragment nature of industry	3.41(29)	3.13(32)	3.26(31)	0.078	N. significant	Accept H_o
Uniqueness of project	3.35(34)	3.13(32)	3.23(32)	0.289	N. significant	Accept H_o

Cons = Consultant, Cont = Contractor, < 0.05 = Significant, therefore Reject Ho

According to the consultants, the frequent causes of errors include design management experience (4.18), designer professional education (3.92), project brief (3.88), lack of consistency between drawings and specifications (3.85), lack of design standards (3.79) and among others. The ratings of the contractors are design management experience (3.73), lack of coordination among disciplines (3.61), lack of design standards (3.57), poor communication among project participants (3.55) and project brief (3.54). The two sets of respondents (contractors and consultants) unanimously agreed that the top causes of errors in contract documents are design management experience (3.94), project brief (3.70), designer professional education (3.70), lack of design standards (3.67) and poor communication among project participants (3.63) to mention a few.

Table 4 also tests the difference in the responses of consultants and contractors on the causes of errors in contract documents. This hypothesis was tested with the independent samples t-test and it was found that from the 44 causes of errors investigated, there are significant differences in the causes of errors in contract documents between the consultants and contractors (that is the null hypothesis was rejected, and the alternative was accepted) on eleven (11) of them. Hence, there is a significant difference in the perception of consultants and contractors to causes of error in contract documents in the aspect of design management experience, designer professional education and amount of work with design organizations. This result was not unexpected because consultants and contractors protect different interests on every project and as such, they are bound to vary on issues that conflict their interests. For instance, while contractors would claim that designers have little experience of designing, designers on the hand will blame poor design on inadequate project brief. The result is also consistent with the findings of Mohammed (2007) and Norman (1983). However, re-use of notes and details of similar project, types of client and acceptance of low fees were highly rated as significant by Palaneeswaran et al. (2007), Tilley et al. (2005) and Love et al. (2011) but this result shows that they are not frequent causes of errors in contract documents. Table 5 shows the mean values of the errors in contract documents according to the types of building projects investigated.

Table 5: Causes of Errors in Contract Documents According to Type of Building Projects and Their Test of Difference

Causes of errors	Resi. Mean	Insti. Mean	Relig. Mean	Comm. Mean	Total Mean	P value	Sig.	Decision
Design management experience	3.79	4.31	3.50	3.96	3.94	0.241	N.S	Accept
Project brief	3.53	4.16	4.25	3.62	3.70	0.042	S	Reject
Designer professional education	3.68	3.76	4.00	3.66	3.70	0.938	S	Reject
Lack of design standards	3.36	4.22	4.00	3.75	3.67	0.006	S	Reject
Poor communication among project participants	3.51	4.03	3.75	3.57	3.63	0.372	N.S	Accept
Lack of coordination between disciplines	3.44	4.25	3.25	3.47	3.61	0.016	S	Reject
Management organizational structure	3.64	3.59	3.75	3.53	3.60	0.963	N.S	Accept
Lack of consistency between drawing and specification	3.43	4.00	3.25	3.60	3.59	0.221	N.S	Accept
Carelessness and negligence	3.38	4.00	3.50	3.52	3.55	0.114	N.S	Accept
Insufficient fund to create quality documents	3.47	3.73	3.50	3.51	3.53	0.012	S	Reject
Errors in design assumptions/calculations	3.24	4.11	4.00	3.49	3.51	0.014	S	Reject
Availability and contradictions of design information	3.32	3.65	4.00	3.64	3.50	0.274	N.S	Accept
Physical and mental conditions	3.42	3.62	3.50	3.52	3.49	0.863	N.S	Accept
Lack of awareness of changes in standards	3.34	3.89	3.50	3.43	3.48	0.185	N.S	Accept
Inadequate documentation	3.18	3.84	3.00	3.69	3.47	0.008	S	Reject
Complexity of design and project	3.17	4.08	3.50	3.48	3.46	0.012	S	Reject
Identification of project risk	3.42	3.62	3.00	3.41	3.45	0.700	N.S	Accept
Inadequate design time	3.31	3.64	3.33	3.42	3.42	0.570	N.S	Accept
Lack of motivation	3.25	3.78	3.25	3.31	3.38	0.159	N.S	Accept
Procurement process	3.19	3.62	3.25	3.48	3.37	0.303	N.S	Accept
Unrealistic client demand	3.02	3.86	3.00	3.57	3.36	0.002	S	Reject
Lack of planning and inspection of project	3.29	3.41	3.50	3.38	3.35	0.947	N.S	Accept
Nature of economy	3.15	3.62	4.00	3.43	3.35	0.162	N.S	Accept
Attitude of client	3.14	3.92	3.25	3.25	3.34	0.008	S	Reject
Transfer of knowledge and experience between designers	3.27	3.44	3.75	3.30	3.32	0.768	N.S	Accept
Completeness/contradiction of information	3.27	3.64	3.25	3.16	3.31	0.251	N.S	Accept
Unclear and ambiguous requirements for esign specifications	3.18	3.47	3.75	3.38	3.31	0.425	N.S	Accept
Authority approval	3.02	3.76	3.50	3.43	3.31	0.069	N.S	Accept
Project cost	3.08	3.57	4.25	3.37	3.29	0.102	N.S	Accept
Standard of university education in contract courses	3.22	3.30	2.75	3.40	3.28	0.667	N.S	Accept
Fragment nature of industry	3.19	3.42	3.50	3.24	3.26	0.721	N.S	Accept
Uniqueness of project	3.00	3.56	3.75	3.35	3.23	0.165	N.S	Accept
Low designer salary	3.17	3.35	3.25	3.24	3.23	0.897	N.S	Accept
Size of project	3.09	3.68	3.50	3.11	3.23	0.139	N.S	Accept
Construction start and finish time	3.21	3.31	3.00	3.20	3.22	0.958	N.S	Accept
Lack of clarity and legibility	3.17	3.35	4.00	3.00	3.17	0.399	N.S	Accept
Inadequate design staff	3.18	3.24	3.25	3.08	3.16	0.909	N.S	Accept
Concurrent /overlapping activities	3.20	3.28	3.33	2.92	3.14	0.411	N.S	Accept
Amount of work with design organizations	3.12	3.16	3.25	3.02	3.10	0.948	N.S	Accept
Personality attitudes	2.89	3.70	3.25	2.96	3.09	0.010	S	Reject
Non-request for certificate of insurance covering design and errors	3.05	2.92	3.00	3.07	3.06	0.833	N.S	Accept
Type of client	2.92	3.25	3.25	3.02	3.02	0.668	N.S	Accept
Acceptance of low design fees	2.99	3.08	3.25	2.98	3.01	0.947	N.S	Accept
Re-use of notes and details of similar projects	2.71	2.97	3.00	3.00	2.86	0.561	N.S	Accept

Resi=Residential, Insti=Institutional, Relig=Religious, Comm=Commercial

Table 5 also demonstrates the Analysis of Variance (ANOVA) test conducted to determine if there are differences in the perception of the respondents on the causes of errors in contract documents based on the types of building projects. Ranking among the types of building projects investigated, the factors that cause errors the most in contract documents are design management experience (3.94), project brief (3.70), designers' professional

education (3.70), lack of design standards (3.67), poor communication among project participants (3.63) to mention a few. The descriptive statistics show that many of the causes investigated are frequently occurring. However, the ANOVA test conducted indicates that there are significant differences in eleven (11) of the forty-four (44) causes of errors in contract documents studied. This result was unexpected because it would have been thought that whatever causes an error on one type of project should be capable of doing same on other types of projects. However, justification could still be provided for the result based on the different sizes, procurement route and complexity of projects involved.

Table 6 indicates the causes of errors in contract documents according to the procurement methods investigated in this study.

Table 6: Causes of Errors in Contract Documents According to Procurement Methods and Their Test of Difference

Causes of errors	Trad.	D&B.	P/C management	Total Mean	P value	Sig.	Decision
Design management experience	4.28	3.88	3.87	3.94	0.336	N.S	Accept
Project brief	3.90	3.52	3.77	3.70	0.257	N.S	Accept
Designer professional education	3,69	3.76	3.66	3.70	0.864	N.S	Accept
Lack of design standards	4.03	3.67	3.55	3.67	0.203	N.S	Accept
Poor communication among project participants	4.00	3.60	3.53	3.63	0.340	N.S	Accept
Lack of coordination between disciplines	3.87	3.55	3.55	3.61	0.492	N.S	Accept
Management organizational structure	3.71	3.86	3.36	3.60	0.054	N.S	Accept
Lack of consistency between drawing and specs	4.01	3.50	3.48	3.59	0.87	N.S	Accept
Carelessness and negligence	3.87	3.58	3.42	3.55	0.245	N.S	Accept
Insufficient fund to create quality documents	3.84	3.63	3.36	3.53	0.187	N.S	Accept
Errors in design assumptions/calculations	3.97	3.28	3.51	3.51	0.74	N.S	Accept
Availability and contradictions of design information	3.39	3.70	3.40	3.50	2.56	N.S	Accept
Physical and mental conditions	3.65	3.41	3.51	3.49	0.671	N.S	Accept
Lack of awareness of changes in standards	3.81	3.57	3.30	3.48	0.141	N.S	Accept
Inadequate documentation	3.86	3.11	3.59	3.47	0.005	S	Reject
Complexity of design and project	3.48	3.45	3.46	3.46	0.994	N.S	Accept
Identification of project risk	3.29	3.41	3.53	3.45	0.617	N.S	Accept
Inadequate design time	3.64	3.35	3.38	3.42	0.512	N.S	Accept
Lack of motivation	3.61	3.27	3.27	3.38	0.430	N.S	Accept
Procurement process	3.06	3.52	3.37	3.37	0.271	N.S	Accept
Unrealistic client demand	3.55	3.17	3.43	3.36	0.297	N.S	Accept
Lack of planning and inspection of project	3.47	3.44	3.24	3.35	0.512	N.S	Accept
Nature of economy	3.29	3.22	3.46	3.35	0.504	N.S	Accept
Attitude of client	3.35	3.32	3.34	3.34	0.986	N.S	Accept
Transfer of knowledge and experience between designers	3.29	3.18	3.45	3.32	0.382	N.S	Accept
Completeness/contradiction of information	3.32	3.57	3.16	3.31	0.094	N.S	Accept
Unclear and ambiguous requirements for design specifications	3.80	3.19	3.23	3.31	0.31	N.S	Accept
Authority approval	2.84	3.30	3.48	3.31	0.116	N.S	Accept
Project cost	3.29	3.13	3.41	3.29	0.425	N.S	Accept
Standard of education in contract courses	3.32	3.48	3.13	3.28	0.192	N.S	Accept
Fragmented nature of industry	3.16	3.41	3.19	3.26	0.394	N.S	Accept
Uniqueness of project	3.32	3.24	3.20	3.23	0.915	N.S	Accept
Low designer salary	3.25	3.28	3.19	3.23	0.883	N.S	Accept
Size of project	3.00	3.23	3.30	3.23	0.574	N.S	Accept
Construction start and finish time	3.29	3.19	3.22	3.22	0.932	N.S	Accept
Lack of clarity and legibility	3.65	3.11	3.05	3.17	0.102	N.S	Accept
Inadequate design staff	3.21	3.11	3.19	3.16	0.901	N.S	Accept
Concurrent /overlapping activities	3.31	3.35	2.92	3.14	0.043	S	Reject
Amount of work with design organizations	3.10	3.19	3.03	3.10	0.763	N.S	Accept
Personality attitudes	3.45	3.03	3.00	3.09	0.220	N.S	Accept
Non-request for certificate of insurance covering design and errors	3.48	3.05	2.91	3.06	0.088	N.S	Accept
Type of client	3.32	2.77	3.09	3.02	0.158	N.S	Accept
Acceptance of low design fees	3.33	3.00	2.92	3.01	0.274	N.S	Accept
Re-use of notes and details of similar projects	3.06	2.77	3.09	3.02	0.158	N.S	Accept

Trad=Traditional, D&B=Design and Build, P/C management= Project/construction management
0.05 = Significant = Reject Ho, S = Significant, N.S. = Not Significant

Table 7: Causes of Errors in Contract Documents According to States in South-West, Nigeria

Causes of errors	Ekiti Mean	Ondo Mean	Osun Mean	Oyo Mean	Ogun Mean	Lagos Mean
Project brief	2.90 (16)	4.40 (1)	3.15 (36)	3.56 (15)	3.69 (11)	3.86 (1)
Design management experience	3.20 (9)	3.60 (5)	3.85 (2)	4.41 (2)	4.08 (1)	3.84 (2)
Management organizational structure	3.10 (11)	3.83 (2)	3.08 (40)	3.91 (5)	3.25 (36)	3.74 (3)
Poor communication among project participants	2.50 (33)	3.17 (20)	3.42 (23)	3.64 (12)	4.04 (2)	3.73 (4)
Physical and mental conditions	2.90 (16)	3.00 (25)	3.46 (21)	3.22 (39)	3.53 (20)	3.72 (5)
Lack of coordination between disciplines	2.90 (16)	3.50 (7)	3.69 (7)	3.25 (38)	3.97 (3)	3.68 (6)
Carelessness and negligence	3.10 (11)	3.00 (24)	3.54 (16)	3.28 (37)	3.83 (8)	3.67 (7)
Lack of design standards	3.40 (2)	3.40 (14)	3.77 (3)	3.53 (22)	3.94 (4)	3.66 (8)
Errors in design assumptions/calculations	3.30(3)	2.20 (41)	3.23 (32)	3.53 (19)	3.89 (6)	3.56 (9)
Availability and contradictions of design information	2.90 (16)	3.20 (19)	3.58 (11)	3.34 (35)	3.77 (9)	3.54 (10)
Lack of motivation	2.70 (27)	2.60 (33)	3.15 (35)	3.47 (27)	3.47 (24)	3.52 (11)
Lack of awareness of changes in standards	3.10 (11)	3.40 (13)	3.38 (24)	3.50 (24)	3.61 (14)	3.49 (12)
Lack of consistency between drawing and specification	2.67 (28)	3.00 (23)	3.75 (4)	3.81 (8)	3.94 (4)	3.49 (13)
Designer professional education	3.50 (1)	3.14 (15)	4.15 (1)	4.28 (3)	3.61 (15)	3.49 (14)
Inadequate documentation	3.20 (9)	3.50 (6)	3.54 (14)	3.47 (28)	3.46 (25)	3.49 (15)
Identification of project risk	3.22 (8)	2.80 (29)	3.31 (29)	3.56 (16)	3.56 (19)	3.48 (16)
Inadequate design time	2.56 (32)	3.00 (27)	3.54 (17)	3.92 (4)	3.27 (34)	3.44 (17)
Complexity of design and project	2.80(22)	3.40 (11)	3.69 (8)	3.53 (23)	3.68 (12)	3.40 (18)
Procurement process	2.80 (22)	3.20 (18)	3.75 (6)	3.16 (42)	3.58 (16)	3.39 (19)
Authority approval	2.30 (39)	2.40 (38)	3.33 (28)	3.59 (13)	3.42 (26)	3.37 (20)
Attitude of client	2.80 (22)	3.20 (17)	3.00 (42)	3.87 (6)	3.11 (41)	3.36 (21)
Lack of planning and inspection of project	2.90 (16)	2.60 (31)	3.17 (34)	3.59 (14)	3.56 (17)	3.35 (22)
Unrealistic client demand	2.67 (28)	3.75 (4)	3.15 (37)	3.53 (21)	3.40 (29)	3.34 (23)
Insufficient fund to create quality documents	2.10 (43)	2.80 (28)	3.23 (33)	4.47 (1)	3.86 (7)	3.33 (24)
Unclear and ambiguous requirements for design specifications	2.40 (37)	2.60 (30)	3.08 (39)	3.66 (11)	3.56 (18)	3.30 (25)
Transfer of knowledge and experience between designers	3.30 (3)	3.00 (26)	3.54 (15)	3.20 (40)	3.53 (21)	3.29 (26)
Fragment nature of industry	2.50 (33)	3.40 (8)	3.75 (5)	3.47 (25)	3.03 (42)	3.28 (27)
Amount of work with design organizations	2.50 (33)	1.80 (43)	3.25 (31)	3.16 (41)	3.14 (39)	3.28 (28)
Nature of economy	3.00 (14)	3.40 (9)	3.58 (10)	3.56 (17)	3.36 (31)	3.26 (29)
Project cost	3.30 (3)	3.80 (3)	3.58 (12)	3.31 (36)	3.14 (38)	3.25 (30)
Uniqueness of project	3.30 (3)	3.20 (16)	3.42 (22)	2.84 (43)	3.50 (22)	3.24 (31)
Standard of university education in construction courses	3.25 (6)	3.00 (21)	3.50 (18)	3.45 (29)	3.25 (37)	3.23 (32)
Type of client	2.30 (39)	3.40 (10)	2.67 (44)	3.38 (33)	2.50 (44)	3.22 (33)
Construction start and finish time	2.30 (39)	2.60 (32)	2.77 (43)	3.87 (7)	3.33 (33)	3.19 (34)
Completeness/contradiction of information	2.67 (28)	2.40 (39)	3.25 (30)	3.77 (9)	3.69 (10)	3.15 (35)
Size of project	2.60 (31)	3.00 (22)	3.46 (20)	3.56 (18)	3.25 (35)	3.15 (36)
Low designer salary	3.00 (14)	1.75 (44)	3.50 (19)	3.69 (10)	3.42 (28)	3.09 (37)
Non-request for certificate of insurance covering design and errors	2.20 (42)	3.40 (12)	3.15 (38)	2.81 (44)	3.33 (32)	3.08 (38)
Inadequate design staff	2.90 (16)	2.50 (35)	3.38 (26)	3.34 (34)	3.40 (30)	3.05 (39)
Concurrent /overlapping activities	2.50 (33)	2.50 (34)	3.38 (25)	3.41 (32)	3.42 (27)	3.00 (40)
Personality attitudes	2.80 (22)	2.40 (36)	3.54 (13)	3.42 (31)	3.14 (40)	2.99 (41)
Lack of clarity and legibility	2.33 (38)	2.40 (37)	3.38 (27)	3.47 (26)	3.67 (13)	2.99 (42)
Re-use of notes and details of similar projects	2.00 (44)	3.20 (40)	3.00 (41)	3.53 (20)	2.69 (43)	2.82 (43)
Acceptance of low design fees	2.78 (26)	3.20 (42)	3.62 (9)	3.44 (30)	3.50 (23)	2.64 (44)

The factors with the highest contribution to errors in contract documents (total) based on procurement methods are design management experience (3.94), project brief (3.70), designers' professional education (3.70), lack of design standards (3.67), poor communication among project participants (3.63), lack of coordination among disciplines (3.61), management organisational structure (3.60), carelessness and negligence (3.55) and insufficient fund to create quality documents (3.53) among others. The ANOVA test conducted shows that only inadequate documentation and concurrent/overlapping activities are significantly different within the forty-four (44) causes of

errors in contract documents investigated based on procurement method. The implication of this result is that procurement option will only cause an error when the contract documents are incomplete, and designers do activities concurrently. Contract documents could only be incomplete in design and build option and the traditional method. This could mean that the traditional and design and build methods are more prone to errors that the management method. This could also explain the reason why the industry professionals are campaigning that the management practices should be embraced above other methods.

Table 8: Difference in the Causes of Errors in Contract Documents among the South-Western States

Causes of errors	F cal	Df	P Value	Sig.	Decision
Management organizational structure	1.851	183	0.105	N. significant	Accept H_o
Project brief	2.546	183	0.030	Significant	Reject H_o
Lack of coordination between disciplines	1.579	183	0.168	N. significant	Accept H_o
Poor communication among project participants	1.903	183	0.097	N. significant	Accept H_o
Design management experience	1.746	183	0.126	N. significant	Accept H_o
Designer professional education	2.762	183	0.020	Significant	Reject H_o
Acceptance of low design fees	6.194	183	0.000	Significant	Reject H_o
Inadequate design time	2.542	183	0.030	Significant	Reject H_o
Low designer salary	4.519	183	0.001	Significant	Reject H_o
Inadequate design staff	1.475	183	0.201	N. significant	Accept H_o
Concurrent /overlapping activities	2.453	183	0.036	Significant	Reject H_o
Amount of work with design organization	2.974	183	0.013	Significant	Reject H_o
Availability and contradictions of design information	1.140	183	0.341	N. significant	Accept H_o
Transfer of knowledge and experience between designers	0.548	183	0.739	N. significant	Accept H_o
Physical and mental conditions	1.735	183	0.129	N. significant	Accept H_o
Lack of motivation	1.889	183	0.097	N. significant	Accept H_o
Carelessness and negligence	1.364	183	0.240	N. significant	Accept H_o
Lack of design standards	0.583	183	0.713	N. significant	Accept H_o
Lack of awareness of changes in standards	0.266	183	0.931	N. significant	Accept H_o
Unrealistic client demand	0.955	183	0.447	N. significant	Accept H_o
Inadequate documentation	0.122	183	0.987	N. significant	Accept H_o
Errors in design assumptions/calculation	2.639	183	0.025	Significant	Reject H_o
Lack of consistency between drawing and specifications	1.961	183	0.087	N. significant	Accept H_o
Lack of clarity and legibility	3.090	183	0.011	Significant	Reject H_o
Personality attitudes	1.555	183	0.175	N. significant	Accept H_o
Re-use of notes and details of similar projects	3.395	183	0.006	Significant	Reject H_o
Type of client	2.742	183	0.021	Significant	Reject H_o
Contract start and finish time	3.971	183	0.002	Significant	Reject H_o
Lack of planning and inspection of project	1.543	183	0.179	N. significant	Accept H_o
Identification of project risk	0.800	183	0.551	N. significant	Accept H_o
Attitude of client	2.342	183	0.043	Significant	Reject H_o
Insufficient fund to create quality documents	8.139	183	0.000	Significant	Reject H_o
Non-request for certificate of insurance covering design and errors	1.740	183	0.128	N. significant	Accept H_o
Unclear and ambiguous requirements for design specifications	3.393	183	0.006	Significant	Reject H_o
Completeness/contradiction of information	4.505	183	0.001	Significant	Reject H_o
Uniqueness of project	0.780	183	0.566	N. significant	Accept H_o
Project cost	0.527	183	0.756	N. significant	Accept H_o
Procurement process	1.045	183	0.393	N. significant	Accept H_o
Size of project	1.014	183	0.411	N. significant	Accept H_o
Authority approval	2.083	183	0.070	N. significant	Accept H_o
Complexity of design and project	0.724	183	0.606	N. significant	Accept H_o
Nature of economy	0.500	183	0.776	N. significant	Accept H_o
Standard of university education in contract courses	0.367	183	0.871	N. significant	Accept H_o
Fragment nature of industry	2.215	183	0.055	N. significant	Accept H_o

< 0.05 = Significant, therefore Accept Ho

Table 7 indicates the causes of errors in contract documents based on the states in South-West, Nigeria. Under each state, the mean scores for the investigated variables were recorded with their ranks enclosed in brackets. In Ekiti state, the leading causes of errors in contract documents are designers' professional education

(3.50), lack of design standards (3.40), transfer of knowledge and experience (3.53) among designers. The leading causes of errors in Ondo State are - project brief (4.40), management organisational structure (3.82), project cost (3.80) and unrealistic client demand (3.75). The top causes of errors in Osun State are designer, professional education (4.15), design management experience (3.85), lack of design standard and lack of consistency between drawings (3.77) and specifications (3.75). In Oyo state, the leading causes of errors in contract documents are insufficient fund to create quality documents (4.47), design management experience (4.41), designers' professional education (4.28) and inadequate design time (3.92). In Ogun state, the top causes of errors in contract documents are design management experience (4.08), poor communication among project participants (4.04), lack of coordination among disciplines (3.97), lack of consistency between drawings and specifications (3.94), lack of design standards (3.94) and errors in assumptions/calculations (3.89). In Lagos State, the causes of errors in contract documents are - project brief (3.86), design management experience (3.84), management organisational structure (3.74), poor communication among project participants (3.73), physical and mental condition (3.72) among others. The implication of this analysis is that the causes of errors in contract documents vary from one state to the other. The reason for this variation is not investigated in this study.

Table 8 shows the difference in the causes of errors in contract documents among the South West states in Nigeria. The test shows that out of the 44 causes investigated in this study, there are no significant differences in 27 of them. This indicates that there are significant differences in 17 of the causes of errors investigated.

Table 9: Frequency of the Causes of Error in Contract Documents

Causes of errors in contract documents	Frequency of occurrence	Percentage
Frequent design changes by client	23	22.1
Lack of adequate time to prepare contract documents	18	17.3
Oversight, negligence and laziness	8	7.7
Lack of concentration/ review of contract documents	2	2.0
Use of inexperience designers to prepare contract documents	11	10.6
Lack of proper understanding of clients' brief and designers' specifications	5	4.8
Poor design fee/supervision fee/poor salary to professional staff of designers' organizations	6	5.8
Unprofessionalism (lack of site visitation)	5	4.8
Lack of adequate communication	3	2.9
Incomplete document at the time of tender/finalizing contract (use of provisional sums to cover many work items)	5	4.8
Lack of design coordination	5	4.8
Omission, conflicting documentation and lack of detailed drawing	5	4.8
Poor design documentation/lack of quality focus	4	3.8
Poor supervision by consultants as a result of inexperience and Unprofessionalism	4	3.8
Total number of occurrences	**104**	**100**

This result was quite expected as many of the studies (Mohammed, 2007, Barkow, 2005, Long, 2011) on design errors shows that the causes of errors in contract documents vary from country to country and location to location. This finding only empirically confirmed the assertions.

The interview of contractors, consultants and project managers on 51 building projects as shown in Table 9 indicates that the frequent causes of errors in contract documents are frequent design changes by client (22.1%), lack of adequate time to prepare contract documents (17.3%), use of inexperienced designers to prepare documents (10.6%) and oversight, negligence and carelessness (7.7%). It is important to note that there is an agreement between the interview and questionnaire survey because in both cases, the frequent causes of errors in contract documents are similar. Frequent design changes by clients will send designers back to the drawing board, and the quantity surveyors will also have to prepare the bills of quantities again. When this process occurs frequently, it can lead to a mix-up and depression in some cases. Lack of adequate design time will prompt designers to take short cuts thereby violating rules and procedures of contract documentation which can cause errors.

During the interview session, a respondent discussed that on a particular project, the client got dissatisfied with the agreement signed with the contractor; therefore, the client claimed that it was an error from the designers and as such, he wanted a redesign of documents which led to conflicting documents and delay on the project. Next, to clients changing of design and specifications, 17.3% emphasized that client's put so much pressure on designers during the preparation of contract documents; therefore, the designers become susceptible to errors. Third on the table is the use of inexperienced designers (10.6%) such as Industrial Training (IT) students and non-practicing professionals. The fourth cause identified is the oversight by professionals, negligence and laziness (7.7%). This is followed by payment of poor design/supervision fee to designers' organization which

also leads to payment of poor salary to the professional staff of designer's organizations. Unprofessionalism such as lack of visitation to site before the design is done is rated 4.8%.

Improper and incomplete contract documentation at the time of tender/finalizing the contract; omission, conflicting documents and undetailed drawings, lack of proper/inadequate understanding of clients' brief and designers specification and lack of design coordination all have a representation of 4.8%. The findings of the study were buttressed by interviews which indicate that clients' frequent change of designs and specifications, lack of adequate time to prepare contract documents, use of inexperienced designers, oversight, negligence and laziness are the most frequent causes of errors in contract documents. This result agrees with Barkow (2005), Mohammed (2007), Palaneeswaran et al (2007) and Vrouwenvelder et al (2009) who noted that carelessness, negligence, acceptance of poor design fee, client change of design and specifications, type of client, poor communication, lack of adequate documentation and lack of coordination among disciplines are the major causes of errors in contract documents.

5. Conclusion

Based on the findings of this study, it was concluded that errors in contract documents are frequently caused by clients' change of design and specifications, lack of adequate time to prepare contract documents, use of inexperienced designers to prepare contract documents, oversight, negligence and laziness. Also, there is a significant difference in the causes of errors in contract documents between contractors and consultants. There is also a significant difference in the causes of errors in contract documents from one state to the other in South-West, Nigeria. This means that the causes of errors in contract documents are different across the construction industries of various countries and Nigeria is not an exception. The study also concludes that there is a significant difference in the causes of errors in contract documents based on the type of project. Furthermore, based on procurement method, the study concludes that inadequate contract documentation and concurrent/ overlapping activities are the causes of errors in contract documents

Based on the conclusions, the study recommends that the frequent causes of errors in contract documents which include lack of adequate time to prepare documents, oversight, negligence and laziness, use of inexperienced designers and lack of proper understanding of clients brief must be prevented to minimize cost and time overrun of building projects to the barest minimum. In Nigeria, it is evident from the inferential statistics that the causes of errors in contract documents vary from one state to the other. Therefore, it is recommended that consultants practising in Nigeria will consider the frequent causes identified in this study as the ones to avoid when preparing contract documents for building projects. The causes established in this study particularly are mostly related to the consultants and designers. Therefore, to prevent them, there is need to introduce quality assurance measures in consulting organizations. One of the ways this measure can be introduced is the engagement of the services of professional builders by construction clients into the design team to conduct buildability and maintainability analysis of building projects and then prepares a report on it. This has been the clamour of professional bodies in Nigeria, particularly the Nigerian Institute of Building (NIOB). If this step is not taken, it may be difficult to prevent the occurrence of errors in contract documents. Buildability and maintainability analysis is a core function of professional builders according to the NBC (2006), but it has not been implemented because the code is yet to be passed into law by the national assembly. Therefore, the government of the Federal Republic of Nigeria need to rise and help the construction industry combat the menace of cost and time overrun by passing the National Building Code into law. Also, for every contract document that is prepared, there must be a senior consultant or designer to check and sign the document as a way of accepting responsibility for any error discovered on the document.

ACKNOWLEDGEMENT

I acknowledge the financial support of the Tertiary Education Trust Fund (TETFUND) of Nigeria towards the execution of this work.

References

Ade-Ojo, C.O. and Babalola, A.A. 2013. Cost and time performance of contract projects under the due process reforms in Nigeria. Research Invent: International Journal of Engineering and Science, 3(6): 1-6

Alarcon, L. F. and Mardones, D. A. 1998. Improving the design contract interface In the Proceedings of International Group for Lean Construction (IGLC), Sao Paulo

Babalola, J.A. and Idehen, A.F. 2011. Causes of variation on building projects in Nigeria. In: Laryea, S., Leiringer, R. & Hughes, W. (Eds) Proceedings of West Africa Built Environment Research (WABER) Conference, 19-21 July 2011, Accra, Ghana, 229-236

Barkow, B. 2005. Human factors underlying building failures. National Research Council of Canada, Toronto, Ontario

Buratti, J. L. Farrington, J. J. and Ledbetter, W. B. 1992. Causes of quality deviations in design and contract. Journal of Contract Engineering and Management, 118(1), 34-49

Cheng-Wing, S.L. and Davey, E.C. 1998. Designing to avoid human error consequences. (Online). www.dcs.gla.ac.uk (24th September, 2011)

Choy, W.K. and Sidwell, A.C. 1991. Bills of Quantities continued - Sources of variations in Australian contract contracts. Building Economist, 30 (3): 25-30

Diekmann. J.E. and Nelson, M.C. 1985. Contract claims: Frequency and severity. Journal of Contract Engineering & Management, 111 (1): 74-81

Dosumu, O.S. and Adenuga, O.A. 2013. Causes, effects and remedies of errors in Nigerian construction documents. Organization, Technology and Management in Construction, University of Zagreb, Croatia, 5 (1): 676-686

Dosumu, O. S. and Iyagba, R. A. 2013. An appraisal of factors responsible for errors in Nigerian construction documents. Ethiopian Journal of Environmental Studies and Management, Bahir Dar University, Ethiopia, 6 (1): 49-57

Endsley, M.R. 1999, Situation awareness and human error: Designing to support human performance. In Proceedings of the High Consequence Systems Surety Conference, Albuquerque, NM,

Love, P.E., Davis, P., London, K. and Jasper, T. 2008. Causal modelling of construction disputes. In Proceedings of 24th Annual ARCOM Conference, 1st – 3rd September, 869-878

Love, P.E., Edwards, D.J., Han, S. and Goh, Y.M. 2011. Design error reduction: towards the effective utilization of building information modelling, Research in Engineering Design, 22, 173–187

Mohammed, R.E. 2007. 'An exploratory system dynamics model to investigate the relationships between errors that occur in contract documents in Saudi Arabia and their possible causes'. An unpublished PhD thesis submitted to Heriot-Watt University School of the Built Environment

Mukaka, M.J., Aigbavboa, C.O. and Thwala, W.D. 2014. A theoretical review of the causes and effects of contract projects cost & schedule overrun. Paper presented at the International Conference on Emerging Trend in Computer and Image Processing on 15-16 December 2014 at Pattaya, Thailand

National Building Code. 2006. Federal Republic of Nigeria National Building Code. Lexis Nexis Butterworks, South Africa

Norman, D.A. 1983. Design rules based on analyses of human error. Communications of the ACM, 4 (26); 254-258

Okuntade, T.F. 2014. Effects of faulty contract on building maintenance. International Journal of Technology Enhancements and Emerging Engineering Research 2(3): 73-79

Olaniyan, O.A. 2011. Designing out waste on mass housing contract sites in Minna, Niger state. In: Laryea, S., Leiringer, R. & Hughes, W. (Eds) Proceedings of West Africa Built Environment Research (WABER) Conference, 19-21 July 2011, Accra, Ghana, 315-323

Ortega, I. and Bisgaard, S. 2000. Quality improvement in the construction industry; three systematic approach. Total Quality Management, 11(4): 383-392

Palaneeswaran, E., Ramanathan, M. and Tam, C. 2007. Rework in projects: Learning from errors. Surveying and Built Environment, 18(2): 47-58.

Rooney, J.J., Heuvel, L.N. and Lorenzo, D.K. 2002. Reduce human error. Quality Progress, 27-36

Shelton, C.P. 1999. Human interface/human error. (Online): www.users.ece.cmu.edu (12th September 2012)

Tilley, P.A., Mcfallan, S.L. and Tucker, S.N. 2005. "Design and Documentation Quality and its Impact on the Contract Process". CIB W55 & W65 Joint Triennial Symposium, Cape Town.

Tzortzopoulos, P. and Formoso, C. T. 1999. Considerations on application of lean construction principles to design management. In Proceedings of IGLC, 7, 26-28.

Vrouwenvelder, T., Holicky, M. and Sykora, M. 2009, Modelling of Human Error. Joint Workshop of COST Actions, Ljubljana, Slovenia, 21-22 September 2009, 55-64

Yates, J. K., and Lockley, E. E. 2002. "Documenting and analyzing contract failures." Journal of Contract Engineering and Management, 128(1): 8-17.

JCBM (2017) 1(2). 24-34

JCBM

University of Cape Town

Journal of Construction Business and Management

http://journals.uct.ac.za/index.php/jcbm

Building Quality Condition and Maintenance Cost: The Case of Public Low Income Housing in Abia State, Nigeria

C. P. Ogbu[1]

Department of Quantity Surveying, University of Benin, Nigeria[1].

Received 27 January 2017; received in revised form 3 April 2017 and 11 April 2017; accepted 1 May 2017

Abstract

Maintenance costs of buildings constitute major cost burdens on low-income housing dwellers, which worsens the housing affordability problem. The purpose of this research was to investigate the relationship between physical condition and maintenance cost of low-income housing buildings. The buildings studied were randomly selected from the public low-income housing estates in Ehimiri and Amauba in Umuahia, Abia State. Data were gathered using structured questionnaire and score sheets. The questionnaire elicited responses on the respondents' perception of their buildings' physical conditions. The score sheets were used by trained research assistants to generate information on the physical features of the buildings. Data analyses were carried out using Spearman's correlation. The study found that the element with the highest Relative Condition Index (RCI) is internal walls, while external wall finishes/decoration has the least. Similarly, the element with the highest Quality Index (QI) is electrical services, while internal ceiling finishes/decoration has the least QI. There is no significant relationship between RCI which is based on the respondents' perceptions and QI which is based on the research assistants' scores. The relationship between QI and annual maintenance cost is not significant, whereas the relationship between RCI and annual maintenance cost is significant. The perception of the condition of a building by its occupant, rather than the physical features of the building, is the main driver of maintenance cost. Consequently, low-income housing end users should be allowed to make inputs at the design and planning stages of their buildings.

Keywords: Abia State; Building condition; Low-income housing; Maintenance cost; Quality condition; Quality index.

1. Introduction

Housing is basic to human life. It is a fundamental yardstick for estimating the quality of life of a nation's citizens. Almost every measure of human well-being is connected to housing, be it a measure of health, social, religious or economic factors (Shaw, 2004; Festus and Amos, 2015). The indispensability of housing to humankind makes housing problems a global challenge. These problems are diverse and may take slightly different forms in different climes. Notable problems associated with housing globally include health, affordability, accessibility, quality and maintenance issues (Krieger & Higgins, 2002; El-Haram & Horner, 2002; Quigley & Raphael, 2004). As is often the case, the housing problem of developing countries like Nigeria is more severe, expressing itself in quantitative and qualitative forms (Olayiwola, Adeleye and Ogunshakin, 2005). Quantitatively, the housing problem of Nigeria is that its demand outstrips the supply, and the cost exceeds the customers' willingness to pay (Aribigbola, 2011). Qualitatively, it is agreed that available housing does not meet acceptable quality standards (Coker, Awokola, Olomolaiye, and Booth, 2008). Foreseeably, this status has dire implications for low-income housing users in particular, because the poor quality building could lead to higher maintenance costs.

Aribigbola (2011) explained housing quality as the physical condition of the building and other facilities and services that make living in a particular area conducive. Ilesanmi (2010) also perceived the quality of housing as related to its physical attributes such as the general state of the external finishing including rendering and paints, and the quality of operational elements like doors, windows, ceilings, roofing members and facia boards. Contrariwise, some researchers view quality from the perspective of the

[1] Corresponding Author. Tel: +234-8037346343
Email address: chukwuemeka.ogbu@uniben.edu

perception of the users of the facility (Ibem, 2012; Adeleye, Azeez and Yusuff, 2014; Emankhu & Ubangari, 2015). In this paradigm, the quality of a building will depend, not only on the actual physical condition of the building but on the user's perception of the state of the building. Even with the preponderance of low-income housing research relying on user perceptions, there are still scarce attempts in literature to reconcile these two perspectives.

Irrespective of any researcher's view of building quality, the effect of poor quality building is higher maintenance costs. Maintenance costs can account for a significant portion of a country's construction investments. For instance, maintenance and repair costs amounted to 37 percent of the total construction-related investments made in 2002 in Sweden (Krstić & Marenjak, 2012). At the individual building level, Office for National Statistics (2014) reported that maintenance and repair costs took up 5% of housing expenditure in the UK. This may not be affordable for low-income earners, because the percentage may increase their total housing expenditure beyond 30% of their annual income. Thirty percent is often taken as the upper limit for affordability of housing (Miles, Berens and Weiss, 2003).

Already, a rising trend in the cost of maintenance of buildings in Nigeria has been detected and is blamed on lack of adherence to building standards (Faremi, Adenuga, & Ajayi, 2015). Olusola and Akintayo (2009) maintained that stakeholders accept buildings based on the quality of the workmanship and materials. This is so because the quality of a building is related to its life cycle cost of which maintenance cost is a sizeable portion (Al-Hajj, 1999; Vlachy, 2014).

In Nigeria, the end users of low-income housing seldom make inputs at the pre-construction and construction stages of the project (Ibem, Opoko, Adeboye & Amole, 2013). They often have to live with whatever quality of housing is provided by the housing designers and contractors. In the attempts to reduce the cost of construction, the quality of low-income housing buildings may be compromised between the design and construction stages of procurement (Adejimi, 2005). The designers of the projects attempt to specify cheaper materials ostensibly to make for affordability, while the contractors carry out shoddy workmanship to increase their profit margin. Similarly, due to the excess demand for housing, these housing providers often give minimal attention to building quality with the notion that whatever is provided for the low-income group will be accepted. This concept has not held true in many cases, partly because residents' satisfaction with their housing is strongly correlated with the buildings' features (Mohit, Ibrahim & Rashid, 2010). Low-income housing buildings are frequently defective as a result (Emuze, Shakantu & Wentzel, 2012; Zunguzane, Smallwood and Emuze, 2012; Dwijendra, 2013). Consequently, unregulated building modifications, and sometimes, significant structural alterations have been carried out to improve the quality of low-income housing buildings in Nigeria (Ibem et al., 2013; Ihuah & Eaton, 2013). This compounds the affordability problem by increasing the cost of maintenance of the buildings. These issues lower the public's perception of low-income housing (Husock, 2003; Varady, 2004). Despite this, the effects of building quality on maintenance cost remain inadequately addressed in literature.

The aim of this paper is to investigate the relationship between quality condition of low-income housing buildings and their maintenance costs towards informing providers of the low-income housing about the consequence of their choices on quality. The specific objectives of the research are to compute Relative Condition and Quality Indices (RCI and QI) for a sample of low-income housing buildings and determine the relationships between the indices and the cost of maintenance of the buildings.

Hypothesis 1

There is no significant relationship between RCI and QI of low-income housing buildings in the study area.

Hypothesis 2a

Ho: There is no significant relationship between QI and annual maintenance cost of low-income housing buildings

Hypothesis 2b

Ho: There is no significant relationship between RCI and annual maintenance cost of low-income housing buildings

2.0 Building Quality Condition

The physical condition of a building refers to the state of its fabric. A building is a composite of different elements and materials. The deterioration or damage of an element of a building will diminish its utility – regarding aesthetics, functionality, and value. Building maintenance, therefore, is an act directed at restoring the utility of a building, its component or element. Every maintenance activity will entail one form of impact or the other on the physical condition of the building. It is assumed that residents judge the adequacy or habitability of their buildings based on predefined standards of physical condition (Ilesanmi, 2010). Some studies evaluated cognitive responses to the physical conditions of buildings focusing on issues such as the perceived quality of the buildings and environmental quality (Kane, Heaney & McGreal 2000; Fornara, Bonaiuto & Bonnes 2006; Cold 1993). Ilesanmi (2010) viewed the experience of 'quality' as originating in the interaction between the individual and the building. Van der Voordt and Van Wagen (2005) described quality as the extent to which a product fulfils the requirements set for it, and 'architectonic quality' as an umbrella term, covering various aspects of quality such as aesthetic, functional (building efficiency), symbolic and cultural value. In the low-income housing sense, a resident's perception of the quality of his/her building will be related to how 'fine' it is. Low-income earners are perceivably used to low standards and will ascribe a higher quality to inferior materials that can serve their purposes in line with the views of van der Voordt and Van Wagen (2005).

User evaluation has been the predominant approach to building assessment (Al-Momani, 2003). Satisfaction, attitudes, and preferences are three types of criteria normally used. Although these responses are not mutually exclusive, satisfaction has been more widely investigated as a criterion (Lawrence, 1987; Varady, 2004). The above studies have, however, not investigated the relationship between user satisfaction and maintenance cost of the buildings. Likewise, the question whether user satisfaction

is related to the materials used in the construction of a building requires further literature inputs.

Fang (2006) noted that housing condition is the main measure of residential satisfaction. Thus, there is conceptually a relationship between the physical condition of a building and its user's satisfaction, which requires further literature exploration. Physical conditions of buildings, as stated by Danguah and Afaram (2014), include wall quality, construction quality, roofing, ceiling and windows. According to US Housing and Urban Development (2009), the acceptability of houses depends on the physical condition of all the elements of the building. The present study attempts to depart from the solely constructivist approach, by measuring the quality indices of the buildings, based on the buildings' construction materials and physical condition.

2.1 Maintenance Cost

Maintenance cost refers to the cost of ensuring that a building remains in a habitable condition. It is the total cost required to keep, restore or improve a building in a given period (Faremi, Adenuga, Dada and John, 2016). The incidence of maintenance cost can be as a result of a planned maintenance activity or a cost incurred as a consequence of a breakdown (Al-Najjar, 1999). Al-Najjar (1999) identified three types of maintenance policies, namely, breakdown maintenance, age-based maintenance and condition-based maintenance. Irrespective of the primary cause of the need for maintenance, it will involve altering the elements or fabrics of the building to restore or preserve the owner's or the occupier's requirements. Uzarski and Grussing (2008) explained that as buildings age and endure usage, some defects in building components that negatively affect its performance occur. Ultimately, if these defects were not repaired, it would result in decreased utility from the building. Shah Ali (2009) identified existing building condition, building age, complaint received about building performance, client's request, availability of funding, and safety and health requirements as factors to be considered when making a decision on maintenance cost. In Ali, Kamaruzzaman, Sulaiman and Peng (2010), maintenance cost was depicted as being influenced by the tenant, political, maintenance, building characteristics and other factors. Salleh, Yakin, Ismail and Talib (2016) identified tenant, building characteristics, maintenance, regulation and other factors as affecting the maintenance cost of buildings. Faremi, Adenuga, Dada and John (2016) focused on institutional buildings and found that building age and size are important factors affecting maintenance cost. El-Haram and Horner (2017) grouped the determinants of maintenance cost into building characteristics, tenants, maintenance, political and other factors. Although physical, economic and socio-psychological dimensions of the neighbourhood are also considered parts of housing quality (Galster, 1981), the consistent mention of building condition points to the importance of this factor in relation to maintenance cost.

2.2 Previous Similar Studies

Kain and Quigley (1970) evaluated the physical and environmental qualities of dwelling units in St. Louis, USA. Market prices of the buildings were regressed against the qualitative measures of the physical and environmental qualities of the dwelling units. Part of the findings of the study was that the quality of a house has as much effect on its price as the quantitative aspects such as the number of rooms. This study adopts Kain and Quigley's (1970) approach regarding asking the dwellers to rate the physical conditions of their buildings. Dwellers interact with their buildings. Such interactions produce dispositions and perceptions about the elements of the buildings. The measure of a dwellers' perception of their building, be it good or bad, is an indication of the quality of the building. Kain and Quigley's (1970) study differs from the present study in context – not being low income-specific, and not being based in a developing country. Also, in the present study, rather than relate the quality of the buildings to their rental values, the quality of the buildings is related to their annual maintenance costs. Harris (1976) compared housing quality to housing satisfaction and, similar to the present study, viewed housing quality as being dependent on buildings' characteristics. The study concluded that a significant relationship exists between the two variables, but neither of the variables was related to the maintenance cost of the buildings. Ilesanmi (2010) undertook a post occupancy evaluation of the medium and low-income housing estates in Lagos State, in which measures of the estates' quality of environment were related to the residents' satisfaction with their estates. The study differs from the present study in two ways: in not being peculiar to the buildings, and in not relating the physical state of the buildings to their maintenance costs. Maintenance cost is a major component of the life-cycle cost of the buildings. Even where the cost of acquisition is low (which is the focus of most low-income housing providers), the life-cycle cost can still make the building unaffordable for dwellers. Although Ilesanmi's (2010) study and the present study are focused on Nigeria, the former was based in Lagos State, South-West Nigeria, while the current study is located in Abia State, South-East Nigeria. It is still important to get research feedbacks from the different completed low-income housing buildings in Nigeria, especially regarding quality performance. This study fills this gap by relating the physical characteristics of the buildings (measured by QI), as well as the residents' perception of the features (measured by RCI) to the buildings' maintenance costs.

Olanrewaju and Anifowose (2015) analysed the state of building conditions in Ekiti State, Nigeria, and identified seven major defects in buildings of which peeling and spalling of wall surfaces was said to be significant. The study did not explain whether the state of the buildings was consequential to their cost of maintenance. A similar approach was adopted in this study in that quality indices were computed for the elements of low-income housing buildings. Also, in this study, the relative condition indices of the buildings were calculated to observe whether the perception of building quality by low income housing users is related to the physical conditions of the buildings. Oseghale and Ikpo (2014) evaluated defects in industrial facilities in selected estates in Lagos State and disclosed that industrial buildings' defects result from construction faults, design deficiencies, corrosion, physical aggression, moisture and rodent

attacks. The study noted that over 50% of the maintenance managers in the industrial buildings rated them highly regarding electrical services, external walls, and condition of windows. Although the study did not attempt to relate the ratings to the buildings' maintenance costs, it espoused the perspective that the views of users are relevant to the determination of building quality, which this study corroborates.

3 Methodology

In this research, the physical condition of a building was conceptualized as the physical state of parts of the building that can be seen and touched. These include the walls, roofs, doors and windows, finishes, electrical and plumbing installations, and soakaway/septic tanks. This study was carried out in three low-income housing estates in Umuahia, Abia State, South-East Nigeria namely, Ehimiri, Amauba Phase 1 and Amauba Phase 2. The housing estates were procured through public, private partnership arrangements between the government of Abia State and the private sector (Ibem, 2010; ASO Investment and Development Company, 2011). The number of houses in each estate as obtained from the Abia State Housing and Property Development Corporation is shown in Table 3. A questionnaire and a score sheet were used in the collection of primary data for the study. The questionnaire was administered on a house-to-house basis on occupants/beneficiaries of the low-income housing estates studied, while at the same time, research assistants used the inventory (score) sheets to capture information required for computing quality indices. The administration of questionnaire was done purposively. The reason for using this method was to ensure that copies of the questionnaire were given to knowledgeable adults that are capable of providing accurate data for analysis. Microsoft Excel was used to generate random numbers based on which house numbers were selected for the administration of questionnaires. In all, 305 copies of the questionnaires were distributed as shown in Table 3.

The sample size was obtained using the Yamane (1964) formula for a finite population.

$$n = \frac{N}{1+(N\times e^2)} \qquad (1)$$

Where: n = sample size, N = population size (501), e = coefficient of confidence or margin of error or allowable error or level of significance (0.05). A sample size of 305 was obtained using this process.

This paper adopts the Queensland Department of Housing and Public Works' (2012) classification and definitions of building conditions into 'excellent', 'good', 'fair', 'poor', and 'very poor' (see Table 1). In the questionnaire, the residents of the low-income buildings were asked to rate the elements of their buildings on a scale of 1-5 as shown in Table 1.

Table 1. Definition of Rating/Condition of Buildings

Rating	Status	Definition of Building Condition
5	Excellent	• no defects • as new condition and appearance
4	Good	• minor defects • superficial wear and tear • some deterioration to finishes • major maintenance not required
3	Fair	• average condition • significant defects are evident • worn finishes require maintenance • services are functional but need attention • deferred maintenance work exists
2	Poor	• badly deteriorated • potential structural problems • inferior appearance • major defects • components fail frequently
1	Very Poor	• building has failed • not operational • not viable • unfit for occupancy or normal use • environmental/contamination/pollution issues exist

Department of Housing and Public Works (2012

This approach was adopted based on the belief that the decision to spend on maintenance often depends on the occupier's perception of the state of the building. The Relative Condition Index (RCI) of each of the sub-elements (for all the buildings covered by the study) was computed using Equation 1.

$$RCI = \frac{\sum w}{A\times N} \qquad (2)$$

where w is the rating given to each sub-element by the respondents, ranging from one to five, A is the highest rating (i.e. 5 in this study), and N is the total number of samples.

To obtain the quality indices of the different elements of the buildings, the trained research assistants were given score sheets containing the possible materials used in the

construction of the visible elements of the low-income housing buildings. The materials employed in the visible elements were ranked as shown in Table 2 in the order of their expected life spans.

Table 2. Measurement of Quality Index for Buildings

Building Element	Score	Building Element	Score
Roof		**Internal Floor Finishing**	
Long Span aluminium	5	Vitrified floor tiles	6
Clay dominant	4	Non-vitrified floor tiles	5
'Cameroon' zinc	3	Terrazzo	4
Galvanised Steel Corrugated iron roofing sheets	2	PVC floor tiles	3
Asbestos	1	Broken tiles	2
External Walls		Floor screed	1
225mm thick without cracks	4	**External Wall Finishes & Decor**	
150mm thick without cracks	3	Wall tiles	6
225mm thick with cracks	2	Rendered and painted	5
150mm thick with cracks	1	Rendered but not painted	4
Internal Walls		Partly rendered but not painted	3
225mm thick without cracks	4	Partly rendered and partly painted	2
150mm thick without cracks	3	Not rendered	1
225mm thick with cracks	2	**Internal Wall Finishes & Decor**	
150mm thick with cracks	1	Wall tiles /Rendered and painted	6
External Doors		Rendered and painted only	5
All metal doors	6	Rendered but not painted	4
Metal doors and panel doors	5	Partly rendered but not painted	3
Metal doors and flush doors	4	Partly rendered and partly painted	2
All panel doors	3	Not rendered	1
Panel doors and flush doors	2	**Services: Electrical**	
All flush doors	1	Conduit Wiring	2
Internal Doors		Surface Wiring	1
Metal doors and panel doors	5	**Services: Mechanical/Plumbing**	
Metal doors and flush doors	4	WC toilets operational with water supply	5
All panel doors	3	WC toilets operational with water fetched with buckets	4
Panel doors and flush doors	2	WC toilets available without water supply	3
All flush doors	1	Wash hand basin and sink available	2
Windows		Wash hand basin and sink not available	1
Aluminium sliding/projecting casement windows	4	**External Works: Septic tank and soakaway**	
Metal casement windows	3	Septic tank/soakaway available & neatly finished	3
Louvre windows	2	Septic tank/soakaway available but broken or not plastered	2
Wooden casement windows	1	Soakaway/Septic tank unavailable	1
Internal Ceiling finishing		**External Works: Neighbourhood**	
Pop (Plaster of Paris) ceiling	3	Serene, clean & beautiful neighbourhood	3
PVC ceiling	2	Dirty neighbourhood with bad roads	2
Asbestos ceiling	1	Unsightly neighbourhood (slum)	1
External Ceiling finishing		**External Works: Landscaping**	
Long Span aluminum	3	Clean environment with plants	*3*
PVC ceiling	2	Clean environment but no plants	*2*
Asbestos ceiling	1	Unclean environ & no plants	*1*
External Floor finishing			
Vitrified floor tiles	6		

Non-vitrified floor tiles	5
Terrazzo	4
PVC floor tiles	3
Broken tiles	2
Floor screed	1

Using the scores, the Quality Index (QI) of each of the sub-elements of the buildings was obtained using Equation 2.

$$QI = \frac{\sum a}{N \times q} \qquad (2)$$

where a is the score given to each sub-element by the research assistant based on Table 2, q is the highest score for the element and N is the sample size

Additionally, the questionnaire elicited data on the average annual maintenance costs of the buildings covered by the study. The respondents were asked to state their average annual building maintenance expenditure. Although some of the respondents were tenants, they bear maintenance costs that approximate to those borne by the building owners. In the estates covered by the study, tenants usually rent or lease entire buildings, rather than apartments in the buildings. This makes them be in charge of the buildings, with an agreement to vacate the buildings in good tenantable condition at the end of their stay.

The RCI and QI of the elements of each building were averaged. These averages were related using Spearman's rank correlation since the two datasets were on the ordinal scale. Essentially, this test was to ascertain whether the low-income housing dwellers' perception of the condition of their buildings was related to the quality of the materials used in the construction. The relationships between each of the two indices and the annual maintenance cost of the buildings were likewise investigated using Spearman's rank correlation.

Table 3. Abia State¬ Low Income Housing Estates¬

Housing Estates	No. of houses	No. of Questionnaire shared	No. of Returned Questionnaire
Ehimiri Housing Estate	439	267	187
Amauba Housing Estate Phase 1	26	16	9
Amauba Housing Estate Phase 2	36	22	18
Total	501	305	214

4 Results

4.1 Relative Condition Indices of Elements of the Buildings

Based on the physical condition ratings of the respondents' buildings, the element with the highest RCI was 'internal walls' (RCI=0.78), while 'external wall finishes/decoration' had the lowest (RCI=0.45) (see Table 4). This result is related to the use of predominantly sandcrete blocks in the construction of walls. The low RCI for external wall finishes/decoration shows that the residents have a low opinion of their building's external wall finishes.

Table 4. Relative Condition Indices of Building Elements

BUILDING ELEMENTS	Very Poor	Poor	Fair	Good	Excellent	RCI
Roof						
Roof	4	4	112	84	10	0.69
Walls						
Internal walls	10	25	33	54	92	0.78
External walls	33	52	70	34	25	0.57
Doors/Windows						
Internal doors	55	71	44	21	23	0.49
External doors	23	44	22	36	89	0.72
Windows	12	16	55	72	59	0.74
Finishes and Decoration						
Internal ceiling finishes/decoration	86	32	38	55	3	0.47
External ceiling finishes/decoration	65	41	45	63	0	0.50
Internal wall finishes/decoration	77	23	43	66	5	0.51
External wall finishes/decoration	72	45	65	32	0	0.45
Internal floor finishes/decoration	15	31	72	67	29	0.66
External floor finishes/decoration	66	56	59	33	0	0.46

Services						
Electrical	66	36	56	30	26	0.52
Mechanical/plumbing	21	44	62	56	31	0.63
External Works/Environment						
Septic tank/Soakaway	74	15	21	98	6	0.55
Neighbourhood	22	54	32	54	52	0.66
Lawns/landscaping	67	44	25	55	23	0.53

RCI=Relative Condition Index

4.2 Quality Indices of Elements of the Buildings

The trained research assistants captured the types of construction materials used in the visible elements of the buildings. Quality indices of the buildings' elements computed on the basis of this data are shown in Table 5. The results indicate that the electrical services element of the buildings were in good condition (QI=0.93). The conduit wiring system was used in most of the buildings, which must have contributed to this result. On the contrary, the internal ceiling finishes/decoration sub-element was found to have a low QI (0.49).

Table 5. Quality Indices of Building Elements

BUILDING ELEMENTS	1	2	3	4	5	6	N	QI
Roof								
Roof	0	86	10	0	118	na	214	0.74
Walls								
Internal walls	45	6	152	11	na	na	214	0.65
External walls	33	52	95	34	na	na	214	0.65
Doors/Windows								
Internal doors	27	0	112	21	42	12	214	0.57
External doors	0	0	22	33	54	105	214	0.86
Windows	0	79	0	135	na	na	214	0.54
Finishes and Decoration								
Internal ceiling finishes/decoration internally	112	102	0	na	na	na	214	0.49
External ceiling finishes/decoration	109	24	81	na	na	na	214	0.62
Internal wall finishes/decoration	0	0	15	28	72	99	214	0.87
External wall finishes/decoration	0	0	34	52	128	0	214	0.74
Internal floor finishes/decoration	0	37	5	0	94	78	214	0.80
External floor finishes/decoration	66	60	0	0	76	12	214	0.50
Services								
Electrical	31	183	na	na	na	na	214	0.93
Mechanical/plumbing	0	44	50	45	75	na	214	0.74
External Works/Environment								
Septic tank/Soakaway	0	76	138	na	na	na	214	0.88
Neighbourhood	4	123	87	na	na	na	214	0.80
Lawns/landscaping	61	80	73	na	na	na	214	0.69

QI=Quality Index, na=not applicable

Test of Hypothesis 1

Given the outcomes in Tables 4 and 5, it was hypothesised that there is no significant relationship between the RCI and the QI of low-income housing buildings in the study area. A Spearman's correlation between the residents-rated RCI and the research assistants-scored QI (Table 6) revealed no significant relationship between RCI and QI (p=0.372). Indicatively, residents' perception of the physical condition of their buildings is not related to the quality of materials used in their construction.

Table 6. Spearman's Correlation

			RCI	QI
Spearman's rho	RCI	Correlation Coefficient	1.000	.231
		Sig. (2-tailed)	.	.372
		N	17	17
	QI	Correlation Coefficient	.231	1.000
		Sig. (2-tailed)	.372	.
		N	17	17

Test of Hypothesis 2

Spearman's correlation was used to investigate hypotheses 2a and 2b. The results are shown in Tables 7 and 8. Table 7 indicates that there is an insignificant negative relationship between QI and annual maintenance cost (rs= -0.05, N=214 and p>0.05). On the contrary, Table 8 shows that there is a significant positive relationship between RCI and annual maintenance cost of the buildings (rs= 0.225, N=214 and p<0.05). The sum of ranks for the RCI (370) and QI (221) shows that the annual maintenance cost of low-income housing buildings depends more on the perception of the physical condition of the building by the residents, than on the quality of the building materials.

Table 7. Spearman's Correlation between QI and Annual maintenance cost

			Cost	QI
Spearman's rho	Cost	Correlation Coefficient	1.00	0.05
		Sig. (2-tailed)	.	0.43
		N	214.00	214.00
	QI	Correlation Coefficient	0.05	1.00
		Sig. (2-tailed)	0.43	.
		N	214.00	214.00

Table 8. Spearman's Correlation between RCI and Annual maintenance cost

			RCI	Cost
Spearman's rho	RCI	Correlation Coefficient	1	.225**
		Sig. (2-tailed)	.	0.001
		N	214	214
	Cost	Correlation Coefficient	.225**	1
		Sig. (2-tailed)	0.001	.
		N	214	214

**. Correlation is significant at the 0.01 level (2-tailed).

5.0 Discussion of Results

The findings of this study are to the effect that while the internal walls of low-income housing buildings in Ehimiri and Amauba were perceived to have the highest RCI (0.78), it is electrical services that have the highest QI (0.93). The residents are apparently satisfied with the state of the internal walls of the buildings, while the scoring based on the quality of materials used in the elements of the buildings show that relatively, electrical services have the highest QI (0.93). This type of difference between the opinion expressed by the residents and the actual state of their buildings captured by the QIs led to an insignificant relationship between the two categories of indices used in this study. The external wall finishes and decoration having the least RCI of 0.45 seems to tally with the observation of Olanrewaju and Anifowose (2015) that peeling and spalling of the low-income surface is the predominant defect of buildings in residential buildings in Ekiti State. However, while Olanrewaju and Anifowose (2015) blamed the problem on the use of kerosene cooking stoves in the kitchen areas, the external walls of the buildings covered by this study appear to have been affected by weather and frequent touching of their surfaces. Despite this, it is possible that the low QI obtained for internal ceiling finishes/decoration (QI=0.49) was as a result of the use of kerosene stoves in the kitchens of the buildings.

In a study of the maintenance of industrial buildings, 78% of the respondents were satisfied with the condition of the external walls of the buildings (Oseghale & Ikpo, 2014). This tallies with the present study in which the

external wall element has an RCI=0.57 and QI=0.65. This confirms the expectation that the state of the external walls of a building is independent of the building's type of use. Further, this study points to the possibility of neglect of external wall finishes and decoration in low-income housing (residential) buildings in the research area, even though the external walls themselves are in good condition.

The results indicate that the residents rate the conditions of their buildings higher than the conditions are in reality, as measured by the QI. Thus, although Dwijendra (2013), Emuze, Shakantu and Wentzel (2012) as well as Zunguzane, Smallwood and Emuze (2012) concluded that the quality of low-income houses is often low or defective, the residents of such houses may be having a different view. This suggests that a distinction can be made between actual and perceived building qualities in the context of low-income housing buildings. However, this is at variance with the findings of Harris (1976) and Ilesanmi (2010), whom both found different degrees of significance in the relationship between the physical condition of the buildings they studied and residential satisfaction. It is to be noted that while Harris (1976) included general measures of satisfaction such as 'house comfort' and 'house image', Ilesanmi (2010) measured residential satisfaction using general statements on the user's perception of the entire estate.

Additionally, the QI is not significantly related to the annual maintenance cost of the low-income housing buildings, whereas the RCI is significantly related to it. Suggestively, the amount spent on building maintenance by the residents tends to be directly related to their perception of the condition of the buildings, rather than to the quality of the buildings measured by QI.

6.0 Conclusion

This study investigated the quality condition and maintenance cost of low income housing buildings in Ehimiri and Amauba housing estates, Abia State Nigeria. The study set out to determine whether the quality condition of the fabric of the buildings is related to their maintenance costs. RCI and QI were computed for the elements of the buildings. It was found that internal walls has the highest RCI of 0.78, while external wall finishes/decoration has the lowest RCI of 0.45. The respondents consider the internal walls of their homes to be good but consider the exterior wall finishes/decoration of the buildings to be poor. Contrariwise, it is the electrical services that were found to be of the highest quality (QI=0.93) using the QI metric, while internal ceiling finishes/decoration was found to have the lowest (QI=0.49).

Based on Spearman's correlation, a significant relationship does not exist between the RCI and the QI, indicating that the relative condition of the buildings as perceived by the end users is not related to the quality of materials used in constructing the buildings.

The RCI and QI for each building were each related to the annual cost of maintenance of the buildings. It was found that the RCI, rather than the QI, is significantly related to the cost of maintenance of the buildings. Deductively, the residents' building maintenance cost depends on their perception of the condition of the buildings, and not on the real quality of the building.

The designers of low-income housing buildings should improve on their choice of materials for external wall finishes/decoration and internal ceiling finishes/decorations. Materials with lower life cycle cost and higher maintainability should be preferred.

7.0 Limitation of the Study

During data collection, the users of the low income housing buildings covered by this study were not separated into owner and tenant groups. In view of this, care should be taken in generalizing the findings of the affected sections of this study for either of the two groups.

References

Adejimi, A., 2005, June. Poor building maintenance in Nigeria: Are Architects free from blames. In Being paper presented at the ENHIR international conference on "Housing: New challenges and innovations in tomorrow's cities" in Iceland.

Adeleye, A.O., Azeez, O.T. and Yusuff, O.I., 2014. Perception of Housing Quality by Residents and Non Residents of Ibara Housing Estate, Abeokuta, Ogun State, Nigeria. American Journal of Human Ecology, 3(3), pp.35-42.

Ali, A.S., Kamaruzzaman, S.N., Sulaiman, R. and Cheong Peng, Y., 2010. Factors affecting housing maintenance cost in Malaysia. Journal of Facilities Management, 8(4), pp.285-298.

Al-Hajj, A., 1999. Modeling running and maintenance costs for life cycle costing applications in buildings. Durability of Building Materials & Components, 8, pp.1699-1706.

Al-Momani, A.H., 2003. Housing quality: Implications for design and management. Journal of urban planning and development, 129(4), pp.177-194.

Al-Najjar, B., 1999. Economic criteria to select a cost-effective maintenance policy. Journal of Quality in Maintenance Engineering, 5(3), pp.236-248.

Aribigbola, A., 2011. Housing affordability as a factor in the creation of a sustainable environment in developing world: the example of Akure, Nigeria. Journal of Human Ecology, 35(2), pp.121-131.

ASO Investment and Development Company, 2011. Ochendo Liberation Housing Estate, Amauba Umuahia, Abia State. (online) http://www.aidc.com.ng/ochendoabia.html (March 29, 2017)

Coker, A.O., Awokola, O.S., Olomolaiye, P. and Booth, C., 2008. Challenges of urban housing quality and its associations with neighbourhood environments: Insights and experiences of Ibadan City, Nigeria. Journal of Environmental Health Research, 7(1), pp.21-30.

Cold, B. 1993. Quality in architecture. In B. Farmer, H.J. Louw, H. Louw and A. Napper (eds) Companion to Contemporary Architectural Thought. Taylor & Francis.

Dwijendra, N.K.A., 2013. Quality of affordable housing projects by public and private developers in Indonesia: The case of Sarbagita Metropolitan Bali. Journal of Geography and Regional Planning, 6(3), p.69.

Danquah, J.A. and Afram, S.O., 2014. Residential User Satisfaction of Real Estate Housing in Ghana. International Journal of Civil Engineering, Construction and Management, 1(3), pp.1-21.

Department of Housing and Public Works, 2012. Building Condition Assessment. Brisbane: The State of Queensland (Department of Housing and Public Works). (online) www.hpw.qld.gov.au/SiteCollectionDocuments/MMFBca.pdf (January 10, 2017)

El-Haram, M.A. and Horner, M.W., 2002. Factors affecting housing maintenance cost. Journal of Quality in Maintenance Engineering, 8(2), pp.115-123.

Emankhu, S. E. and Ubangari, A. Y. 2015. Analysis of housing quality in the peripheral area of Lafia town. International Journal of Geography and Regional Planning Research, 1(3), 9-17

Emuze, F.A., Shakantu, W.M. and Wentzel, L., 2012. Factors: Affecting quality of low income houses in a South African Province, Conference 24-26 July 2012 Abuja, Nigeria (Vol. 2, p. 1393).

Fang, Y., 2006. Residential satisfaction, moving intention and moving behaviours: A study of redeveloped neighbourhoods in inner-city Beijing. Housing Studies, 21(5), pp.671-694.

Faremi, O.J., Adenuga, O.A., and Ajayi, O. M. 2015. A study of the cost trend of maintaining high rise buildings in Lagos State, Nigeria. (Online) www.unilag.edu.ng (June 5, 2015)

Faremi, O, Adenuga, O, Dada, M. and John, B. 2016. Factors Affecting Maintenance Cost of Institutional Buildings. (online) unilag.edu.ng/opendoc.php?...Factors%20Affecting%20Maintenance%20Cost%20of…(November 20, 2016)

Festus, I.A. and Amos, I.O., 2015. Housing Policy in Nigeria: An Overview. American International Journal of Contemporary Research, 5(2), p.23.

Fornara, F., Bonaiuto, M. and Bonnes, M., 2006. Perceived hospital environment quality indicators: A study of orthopaedic units. Journal of Environmental Psychology, 26(4), pp.321-334.

Harris, C.M., 1976. MEASUREMENT OF QUALITY IN HOUSING AND ITS RELATIONSHIP TO HOUSING SATISFACTION. Housing Educators Journal, 3(2), pp.7-13.

Husock, H. 2003. How public housing harms cities. City Journal, 3(1) winter. (online) http:www.city-journal.org/html/issue 3-1 (March 6, 2016)

Ibem, E.O., 2012. Residents' perception of the quality of public housing in urban areas in Ogun State, Nigeria. International Journal of Quality & Reliability Management, 29(9), pp.1000-1018.

Ibem, E.O., 2010. An assessment of the role of government agencies in public-private partnerships in housing delivery in Nigeria. Journal of Construction in Developing Countries, 15(2), pp.23-48.

Ibem, E.O., Opoko, A.P., Adeboye, A.B. and Amole, D., 2013. Performance evaluation of residential buildings in public housing estates in Ogun State, Nigeria: Users' satisfaction perspective. Frontiers of Architectural Research, 2(2), pp.178-190.

Ihuah, P.W. and Eaton, D., 2013. A framework for the sustainable management of social (public) housing estates in Nigeria: A pilot study. RICS COBRA.

Ilesanmi, A.O., 2010. Post-occupancy evaluation and residents' satisfaction with public housing in Lagos, Nigeria. Journal of Building Appraisal, 6(2), pp.153-169.

Kain, J.F. and Quigley, J.M., 1970. Measuring the value of housing quality. Journal of the American Statistical Association, 65(330), pp.532-548.

Krieger, J. and Higgins, D.L., 2002. Housing and health: time again for public health action. American journal of public health, 92(5), pp.758-768.

Krstić, H. and Marenjak, S., 2012. Analysis of buildings operation and maintenance costs. Građevinar, 64(04.), pp.293-303.

Mohit, M.A., Ibrahim, M. and Rashid, Y.R., 2010. Assessment of residential satisfaction in newly designed public low-cost housing in Kuala Lumpur, Malaysia. Habitat International, 34(1), pp.18-27.

Kane, G., Heaney, G. and McGreal, S., 2000. Resident participation in the evaluation of external accessibility requirements in housing estates. Facilities, 18(1/2), pp.45-55.

Lawrence, R.J., 1987. Housing, dwellings and homes: Design theory, research and practice (p. 319). (Chichester: Wiley).

Miles M.E., Berens, G. and Weiss, M.A. 2003. Real estate development and process (3rd edition), (Washington DC: Urban Land Institute).

Office for National Statistics 2014. Chapter 2: Housing expenditure. (online) http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/dcp171766_386375.pdf (March 27, 2017).

Olanrewaju, S.B.O. and Anifowose, O.S., 2015. The challenges of building maintenance in Nigeria:(a case study of Ekiti State). European Journal of Educational and Development Psychology, 3(2), pp.30-39.

Olayiwola, L. M., Adeleye, O. and Ogunshakin, L. 2005. Public Housing Delivery in Nigeria: Problems and Challenges. (World Congress on Housing, Transforming Housing Environments through the Design, Pretoria South Africa).

Olusola, B.S. and Akintayo, O., 2009. An assessment of failure of building components in Nigeria. Journal of Building Appraisal, 4(4), pp.279-286.

Oseghale, G.E. and Ikpo, I.J., 2014. An Evaluation of Industrial Facilities Defects in Selected Industrial Estates in Lagos State, Nigeria. Civil Engineering Dimension, 16(2), pp.104-111.

Quigley, J.M. and Raphael, S., 2004. Is housing unaffordable? Why isn't it more affordable? The Journal of Economic Perspectives, 18(1), pp.191-214.Salleh, N.A., Yakin, M.K.A.M., Ismail, K. and Talib, Y., 2016. Preliminary Investigation on The Factors That Influencing the Maintenance Cost of Apartment. In MATEC Web of Conferences (Vol. 66, p. 00046). EDP Sciences.

Shah Ali, A., 2009. Cost decision making in building maintenance practice in Malaysia. Journal of Facilities Management, 7(4), pp.298-306.

Shaw, M., 2004. Housing and public health. Annual. Review of Public Health, 25, pp.397-418.

US Housing and Urban Development, 2009. Housing quality standards. (online) http://www.hud.gov/offices/adm/hudclips/guidebooks/7420.10G/7420g10GUID.pdf (June 23, 2015)

Uzarski, D. and Grussing, M. 2008. Building condition assessment metrics: Best Practices. Infrastructure Reporting and Asset Management: pp. 147-152. doi: 10.1061/9780784409589.ch20

Varady, D.P 2004. Predicting satisfaction in public housing. Journal of Architecture and Planning Research, 21(13): pp.181-192

van der Voordt, D.J.M. and Wegen, H.B., 2005. Architecture in use: an introduction to the programming, design and evaluation of buildings. Routledge.

Vlachy, J., 2014. Using life cycle costing for product management. Management: Journal of Contemporary Management Issues, 19(2), pp.205-218.

Yamane, T. 1964. Statistics: An introductory analysis. (New York, Harper Row Publishers).

Zunguzane, N., Smallwood, J. and Emuze, F., 2012. Perceptions of the quality of low-income houses in South Africa: defects and their cause. Acta Structilia: Journal for the Physical and Development Sciences, 19(1), pp.19-38.

JCBM (2017) 1(2). 35-45

University of Cape Town

Journal of Construction Business and Management

http://journals.uct.ac.za/index.php/jcbm

Drivers of Rural Housing Development in Edo State, Nigeria

T. T. Oladokun[1], M. O. Komolafe[2]

Department of Estate Management, Obafemi Awolowo University[1]
Department of Estate Management, University of Benin[2]

Received 14 October 2016; received in revised form 4 January 2017, 9 April 2017 and 15 April 2017; accepted 12 May 2017

Abstract

This study examined the drivers of housing development in Ebele community area of Benin City, Nigeria. It inquired into the housing finance structures and evaluated factors influencing housing development and infrastructural needs in the rural housing sector. The paper sampled 30 residents from each of the five villages in the study area. Using frequency counts and mean values, the result revealed a considerable gap on the level of satisfaction of the existing housing system. The challenges faced by the rural dwellers were majorly infrastructural deficits and shortage of capital for housing provision since innovative housing finance strategies were lacking. Cultural, ethnic, neighbourhood and infrastructural factors were the most important factors influencing the rural dwellers' housing choice. The study concluded that the cultural values of the people such as kinship and social relations were leading predictors of housing development in Edo state while religion is of secondary importance and therefore recommended their inclusion in any integrated approach to rural housing development.

Keywords: Housing, Housing development, Housing financing, Rural, Rural housing.

1. Background of Study

The housing sector is a significant contributor to the economy of advanced countries. In developed nations like the United States of America and Canada, this sector is responsible for 10% to 20% of the Gross Domestic Product (Deitz, 2015 and Ferreras, 2016). Investment in housing accounts for 15% to 35% of aggregate investment worldwide and approximately 10% of labour force worldwide is employed by this sector (Kolawole, 2015). It is generally accepted that the standard of housing in a nation is an indicator of its extent of economic development standard of living and its height of civilization. The housing sector thus has the potential to generate employment, increase productivity, raise standard of living and alleviate poverty. It also has the capacity to reduce crime rate, insurrections, militancy, and terrorism and substantially address wealth distribution as well as security concerns (Thwala, 2005; Wardrip et al, 2011). It is able to achieve this because investment in housing affects all facets of life through its multiplier effect on economic development. This includes forward linkages to the financial markets and backward linkages to land, building materials, tools, furniture and labour markets (Shuaibu, 2016).

Despite the potency of boosting national development through housing, the Nigerian housing sector has suffered setbacks in various facets and at several stages. According to Okonjo-Iweala (2014) "the housing and construction sector in Nigeria accounts for only about 3 percent of the country's rebased GDP". The country has an extremely low ratio of credit to GDP, and of the little credit provided by banks, only a fraction of it is for mortgages. Despite the size of the nation's economy, mortgage debt to GDP is only about 0.5 percent".

There are lots of housing problems in Nigeria, both in rural areas and urban centres. According to Ibimilua and Ibitoye (2015), the problems in rural areas are centred on qualitative housing (these include problems relating to the physical appearance of the buildings, facilities provided, quality of wall used in the building construction, eminence of the roofing materials, condition of other structural components of the house, and the environmental condition of the house) while that in urban

[1] Corresponding Author. Tel: +234 7030060097
Email address: tundeoladokun@yahoo.com
[2] Email address: markson.komolafe@uniben.edu

areas are quantitative (i.e. inadequate supply of housing, leading to further problem such as squatter settlements, overcrowding and pressure on infrastructure) in nature. According to Wahab (1993), rural housing is incomplete due to inadequate social services. It was further submitted that the social services required for rural housing include electricity, water supply, as well as transportation facilities. On the other hand, urban housing problems include homelessness slum dwelling, squatting and overcrowding.

There is need to particularly focus on the development of housing in the rural areas because a considerable proportion of Nigerians live in the rural areas (Toyobo et al, 2014). According to Okoye (1992) the relationship between the urban and rural areas are symbiotic and if any development strategy must be successful, it must recognize that the phenomenon of rural – urban dichotomy in the national landscape is unacceptable and connotes underdevelopment. Moreover, many of the problems of the urban areas can be traced to shortcomings in the rural areas. The mass exodus into the towns is worrisome. The high costs of urban housing and services, the health hazards of shanty towns, the security and political threat posed by the urban unemployed and the adverse economic implications of rural depopulation – these are all challenges which result from the influx into towns and cities (Omonigho, 2013). Major Nigerian cities grow at annual rates of 5-17.5% and suffer from severe pressures on available resources, such as housing, thereby worsening already bad situations in urban employment, management, service delivery and liveability (Akpomuvie, 2010). Also the wide gap in the development levels between the urban and rural areas in Nigeria seems to be threatening the political and social stability of the country. For example, the massive drift into urban areas and the so called "Big cities" due to low level of development in rural areas is one the basic factors responsible for the sharp reduction in agricultural activities and consequent overreliance on the oil sector in Nigeria. This in turn has resulted in a less stable and less diversified Nigerian economy, springing up several political and social consequences like poverty, crime, employment, etc. (Iwayemi, 2006) Nigerian cities such as Lagos, Port-Harcourt, Kano, Onitsha among others where most immigrants settle are characterized by human traffic, vehicular congestions, environmental pollution, consistent in-migration and spurious expansion of territories to accommodate human additions (Aworemi et al. 2011).. Despite having a considerable proportion of the national population, the rural areas are characterized by pervasive and endemic poverty, manifested by widespread hunger, malnutrition, poor health, inadequate access to formal education, deplorable housing state and various forms of social and political menace. Most of these challenges are not as severe in urban areas when compared to the rural areas. (Akpomuvie, 2010). One way of plummeting these is the improvement in rural housing and rural housing conditions in general. It is being recognized that the problems of our urban centres cannot be solved unless those of the rural areas are solved, or at least contained. A relevant way to tackle the unequal level of development between the two areas is addressing the housing problems in the rural areas. This will enable other developmental activities to spring up. In addition, Gyuse (2009) stated that rural housing serves as an abode or place of habitation as it accommodates most rural small-scale industries like pottery, dyeing, among others. It stimulates employment in the rural areas (Popoola, 1988). Its ability to serve as a place for storage, keeping domesticated animals and foster cohesive sense of belonging among rural dwellers by African countries such as found in the rural areas of Edo State, is noteworthy.

Edo state is one of the states that contribute significantly to GDP in Nigeria. The state currently has the fifth highest internally generated revenue in Nigeria (Vanguard, 2016) and is currently Nigeria's second largest producer of rubber and oil palm (World Bank, 2015). Agriculture is the mainstay of the Edo economy and a large proportion of the state citizens depend on agricultural activities for their income. Included among the crops cultivated in the state are oil palm, rubber, cassava, rice, plantain, yam, sweet potatoes, sugar cane, cashew, groundnuts, tomatoes, cotton, and tobacco. A number of agro-processing businesses in the oil palm and rubber processing industry like Okomu Oil Palm Plc and Presco Nigeria Plc and several agricultural research institutes such as the Nigerian Institute for Oil palm Research (NIFOR) and the Rubber Research Institute of Nigeria (RRIN) are located in the state (World Bank, 2015). Based on its abundant land and water resources, Edo has a great potential to expand agriculture activities and thus improve livelihoods in the state. However, as it applies in most other states in Nigeria, the deplorable state of the rural life, especially the rural housing and resultant migration to urban areas create doubts on the possibility of achieving this since the seat of primary production activities lies in the rural areas.

In order to address the problems in the rural housing in Nigeria, it is pertinent to examine the factors/ forces that influence the development of rural housing. Sustainable housing provision requires proper definition of housing needs, and the participation of the end users to ensure their satisfaction. Without reference to the perceptions and values of the people, most housing programmes often fail. This is because the inhabitants are in the best position to identify their needs, and order their priorities (Ayoola and Amole, 2014). Attitudes towards space, use and organization of space, are all linked to certain factors which are often best understood by the inhabitants themselves. Local settlements have vast understanding of their environment, their local building resources and the ways of making the best uses of them. Thus housing that will be acceptable by the local settlements must have put into consideration the cultural, climatic, and socio-economic circumstances of the people. At the level of planning and decision-making, local participation is indispensable to sustainable housing. In the light of this background, this study intends to investigate the drivers of rural housing development in Edo state, Nigeria taking the end users as the study focus. This is with a view to providing information relevant to arriving at well-targeted policies that will help the government and other stakeholders in effective and efficient prioritization of rural housing development efforts. Literature as regards rural housing in Nigeria has been dominated by housing conditions and implications

on rural health life, evaluation of rural housing problems, relevance of infrastructural facilitates to rural housing development, micro and mortgage financing of rural housing and housing qualities in the rural areas (Ogu, 1994; Toyobo et al, 2014; Ijaiya et al., 2014; Olawepo, 2009; Ogundahunsi and Adejuwon 2014). Literature on the factors influencing rural housing development in Nigeria, despite its importance, is sparse in literature, thus this study comes in to bridge this gap. The study focuses on Edo state due to its rich agricultural and other resources base and the potential contributions these can make to improved livelihood in Nigeria if the rural housing challenges are tackled.

2. Literature Review

Housing, in general, is the process of providing a residential environment made up of shelter, infrastructure and services; to others, it extends beyond this as it represents one of most recognised pointers to a person's standard of living and recognition in the society (Nubi, 2008). Housing in this perspective extends beyond the physical structures to the neighbourhood and infrastructure. Turner (1972) added that it involves land, labour and finance acquisition processes. The housing system determines the full range of inter-relationships between all of the actors (individual and corporate), housing units and institutions involved in the production, consumption and regulation of housing (Bourne, 2007). It encompasses interactions among the organization of the housing market (the institutional structure), the actors (supply & demand), and housing policy, particularly the economic, demographic, political and spatial factors which influence these (Van der Heijden, 2013). An inclusive housing system stimulates adequate housing production, helps produce a mix of housing choice (tenure, location, and quality) and assist those who cannot afford adequate and appropriate housing (Van der Heijden, op cit.). Efficient housing provision is therefore hinged on an inclusive, active and effective housing system.

There are several factors which determine/influence the provision/ development of housing. Aribigbola (2008) pointed out availability of income and stability and effectiveness of existing policies, regulations and practices. Many a times, the low income earners attract less attention by investors hence, majority of the rural dwellers, most of who fall in this category suffer as housing providers pay less attention to their needs.

According to Olotuah (2009) socio-economic circumstances, cultural background, world views, and the political and economic situation of the country are determinants of users' housing needs. In order to capture the needs of the rural populace in housing policies, an in-depth understanding of housing values of the prospective beneficiaries of the policies must be taken into cognisance by the policy makers. Beamish (1989) describes housing values as the preferences and choices that people consider in housing selection. This is in line with Roske (1983)'s definition: "the underlying criteria for choice in housing and other aspects of life". Beyer (1959) came up with four hierarchy of values: economy, family (physical, mental health and family centrism), personal (aesthetics, leisure and equality) and social storage.

Economy- those falling in this category pay more attention to how much they can make economic use of goods and services. Their choices are based on the selling price and good value for money or sound business judgement. Family- factors that foster good family relationships and unity within the family and how they influence the physical and mental well-being of family members are prioritized by this cluster. Personal- those in this category are individualistic and desire independence and self-expression. They take personal view of their physical and social environment. Social- families in this category view housing in terms of its effect on their social status. This cluster is considered upwardly mobile. Deeply subsumed in the social criteria for housing selection are the cultural and ethnic values (Olayiwola et al, 2006; Makinde, 2015). Spencer-Oatey (2008) describes culture a set of basic assumptions and values, orientations to life, beliefs, policies, procedures and behavioral conventions that are shared by a group of people, and that influence (but do not determine) each member's behavior and his/her interpretations of the 'meaning' of other people's behavior. Ethnicity is a term that is used to refer to a wide variety of groups who might share a language, historical origins, religion, identification with a common nation-state, or cultural system (Spencer-Oatey, 2012). The nature of the relationship of a group's ethnicity to its culture will vary greatly depending on a number of other important characteristics. For example, the sharing of cultural traditions and customs, community institutions and establishments, and similar labor market experiences may all act to facilitate the concentration of the members of an ethnic group (Makinde, 2015). Culture, ethnicity, race, nationality and similar other phenomenon are collectively referred to in literature as "Sociocultural factors" (Morris and Winter, 1978; Chiu, 2002; Jiboye, 2004) The satisfaction derived by the inhabitants of a particular housing unit is a reflection of the degree to which they feel in conformity with their socio-cultural background (Jiboye 2008). According to Olayiwola et al, (2006), "If the essence of a house is to be fully appreciated within the context of human habitation, then the need for the preservation and promotion of socio-cultural values through housing design and forms should not be predicated on emotional and overzealous rhetoric, but on the relationship between housing and cultural structures".Lin Shi (2005) also corroborates Beyer (1959)'s hierarchy of value that most households hold hierarchy of values as against just one value. Even within a household, individual members hold different forms of housing values. According to Lindamood & Hanna (1979), households' housing decisions are arrived at by trading off different housing values within the family. Abraham Maslow's hierarchy of needs recognised the unlimited nature and insatiability of human wants. When one is satisfied, another need emerges (Maslow, 1954). Thus a complete satisfaction is impossible. In such situation, the more important values have to be met one after the other and certain trade- offs will be made.

In Abdul (2008), Adeniyi (2007), Bourne (2007) and Chatterjee (2008), availability of finance is noted as a

primary determinant of housing development. Adamu (2007) asserts that housing provision is hinged on effectiveness in land administration. Egunjobi, (2007) makes reference to availability of loan or other form of assistance for building.

Aribigbola (2011) identified the pointers of sustainability in housing provision as housing quality, affordability and social equity and justice in terms of accessibility. In order to achieve sustainability in housing provision there is need for major changes in the society, institutions need to be restructured and management approaches fine-tuned. It requires the appropriate political will based on the conviction of the responsibility of government to its citizens, and the need to create humane and decent environment for dignified living. According to Olotuah and Bobadoye (2009), adequate priority should be given to the housing needs of the population, coupled with a well worked out and coordinated programme to achieve this, if sustainable housing must be realised. Sustainable housing provision is thus subject to such underlying factors as decision making, policy formulation, policy execution and monitoring, social acceptability and economic feasibility. These factors must take into cognizance the bottom-up participatory approach in housing provision involving genuine local participation by people at the grassroots level.

Bello and Olatubara (2014) noted that the social, cultural, environmental, and economic facets of housing should be addressed in an integrated fashion. For example, affordable housing should not be considered only on cost basis; environmental and social issues (including people preferences, lifestyles, and cultural aspirations), as well as economic impacts should not be addressed separately nor ignored. According to the authors, accumulation of vulnerabilities and precarious housing situations results when any dimension of sustainability is ignored. Planning and building housing within an integrated sustainability framework makes it more accessible to low-income rural households and responds to their diverse social and cultural needs. This will have multiple positive outcomes for people's physical and mental health and safety, for economy, and for the built and natural environments. Besides, sustainable houses hold up for a longer time, making them a smart investment for government and other stakeholders.

Several studies have been conducted to inquire into the factors influencing housing development/ housing provision, especially in the rural areas, being the focus of this study. Some of these include Shui et al (2014) which examined the influencing factors on resettled farmer's satisfaction and occupancy under the policy of "the balance between urban construction land increasing and rural construction land decreasing" in Chengdu City, China. The result of the logistic regression carried out revealed that the positive factors that contribute to the famer's satisfaction, include land-rights guarantees, compensation for land consolidation, sewage treatment and the living environment. In contrast, public facilities, commercial service networks and resettled area's maintenance are negative factors for farmer's satisfaction. This study focused majorly on resettled farmers and evaluations were based on a particular rural housing policy. The result therefrom can thus not be generalized on other rural housing planning efforts, especially those not targeted at a particular group.

Essendi and Madise (2014) examined the relationships between perception of development and observed socio-economic, demographic and wellbeing variables in rural Kenya. Using structural equation modeling techniques to analyze data collected from 275 individuals, selected at the individual and household levels, significant relationships were found between perception of development and gender, age, perceived household wellbeing and health risk factors (alcohol use and cigarette smoking). This study concluded that even within the same community, people's perceptions will vary depending on their age, gender, perceived household wellbeing and health risk factors including alcohol use and having ever smoked tobacco products. The study however did not consider other external factors like government legislations, infrastructure etc. and their impact on actual or perceived rural housing development.

Beer and Tually (2012) examined the drivers that influence the characteristics and operation of housing markets and housing affordability in rural and regional areas of Australia. Fifteen case study locations were chosen across a range of regional areas, spanning non-metropolitan population centers through to rural and remote regions. Drawing on ABS Census data and house and unit price data, the study revealed that private rental supply in particular has been under-developed. This is due to a shortage of investors, inappropriate planning regulations and, in some cases, the low wage and high variability labour markets in these regions which do not offer sufficient comfort for investors. Also lack of economies of scale in rural and remote Australia is considered to be a barrier to housing supply. The study, though similar in focus, is however based on a more developed economy which differ in characteristics from an emerging economy like Nigeria.

Jamini et al (2014) reviewed and assessed the factors influencing villagers' level of satisfaction with rural housing in Kermanshah Province, Iran. Using descriptive and analytical survey on rural households selected in four Avramanat Township located in Kermanshah province, it was discovered that the satisfaction level of the rural residents was less than average. In general economic and health factors proved to be the most important factors influencing satisfaction levels in the four areas surveyed. As observed on other existing studies, only a few factors were examined in this study. There are several other factors which define the nature of development in rural housing. This study intends to cover some of these factors.

Ebadi et al (2015) examined the functional changes of the rural settlements of Southwestern Tehran in the Post-Islamic revolution in Iran (1978-2014). Three hundred and seventy four (374) heads of households were sampled on 13 villages and four rural districts using cluster sampling. The results indicated that villages in the Southwest of Tehran during the revolution years were involved mostly in primary functions such as agriculture, animal husbandry and horticulture while the industry and services in rural areas were at the lowest level. The presence of industries, factories and workshops in agricultural lands surrounding villages, low prices of

agricultural lands and the expansion of communication networks have extended various functions including industrial and service functions. The evaluation is time specific and the study was particularly tailored at measuring the impact of the post Islamic revolution.

The study of Jabareen (2005) examined the relationship between culture and housing preferences in Gaza, Palestinian. Relying on Amos Rapoport's framework, the author segregated "culture" into different components of gender-to-face, politics, religion, kinship, and social relations to predict housing preferences in Gaza City. The result of the face-to-face interview revealed that among cultural components, kinship relations and attitudes toward women are likely to be crucial for individual Palestinians seeking new housing.

In the Nigerian property market, Olotua and Babadoye (2009) reviewed the intervention of the public sector in housing in Nigeria and critically examines the impact on the general populace, especially the urban poor. The study discovered that the involvement of the public sector in housing in Nigeria has been more of policy formulation than housing delivery. It asserts that the bottom-up approach, involving the direct participation of the local communities is vital in ensuring sustainability in housing provision. The study is not only targeted majorly at the urban poor, it also focuses mainly on the intervention of the public sector.

Aribigbola (2008) examined the suitability and potential of the policies to addressing housing affordability and shortages as well as the impact of the policy on housing delivery in Akure, Ondo State, Nigeria as a case study. Using structured questionnaire administered on selected residents of the city, the study revealed that the policy has not made much contribution to housing provision. The paper argues that although the policy poses great potentials to improving housing delivery, there is a need to rethink and repackage the policy so that majority can benefit from it. The study also stressed the need to incorporate social housing into the policy to assist the very poor that cannot take care of their housing consumption needs. The study concluded that the approach of leaving housing provision to the vagaries of market forces would not be expected to provide affordable housing especially to the poor. It is also apparent from this study that the focus is on evaluation of existing housing policies and the study area is urban. Inquiry into the factors that will influence rural housing is not directly addressed in this study.

Toyobo et al (2011) assessed the relevance of infrastructural facilities to rural housing development as it is applied to Lagelu local government in Oyo State, Nigeria. The study identified the various rural development programmes embarked upon by the local government, examined the socio economic importance of rural development projects executed by the Lagelu local government and assessed the existing infrastructural facilities in the area. Using descriptive statistical techniques, the findings reveal inadequacy of infrastructural facilities, absence of economic empowerment programme and poor housing quality. The study recommended that appropriate sustainable measures be put forward in order to improve the infrastructural facilities coupled with relevant programmes of reducing poverty in Lagelu local government area. Also, as observed on other studies, this study is evaluative and assessed existing rural development programmes and infrastructural base in the study area.

The above studies and several other existing studies have focused less on the choices and preferences of the rural dwellers in housing development and inquiry into the factors influencing rural housing development based on users' assessment is sparse despite the importance to effective housing provision, especially in the rural areas. This study therefore fills the existing gap in literature, first by evaluating the existing housing system, based on assessment of the rural inhabitants' challenges and level of satisfaction and second, by inquiring into the factors that will influence development in the rural housing, taking into cognizance, the choices and preferences of the rural dwellers in Ebele community, Edo state, Nigeria.

3. Data and Methodology

The study was carried out in Ebele community of Edo State, Nigeria. Ebele village is situated in Igueben Local government of Edo state. Its geographical coordinates are 6^{o} 30' 0" North and 6^{o} 13'0" East. Ebele is surrounded by communities such as Amahor, Ekpon, Ewohinmi, Ewossa, Idunmuodi, Izogen, Ogwa. The communities that make up Ebele are Eguare, Ologhe, Okuta, Idumowu and Okpujie.

The economic mainstay of Ebele include commerce, cottage industry (cloth weaving, basket making, etc.), agriculture, furniture making, wood, etc. In addition, Ebele is also reputed for palm wine tapping and oil palm production. Ebele is one of the major traditional towns in Esan, linking to the Benin kingdom, otherwise known as the Binis like most other Esan communities that are involved in the cottage industry. The population of Ebele appears to be controversial or unknown, however, Igueben Local government of which Ebele is a major constituent part has a population of 69639 according to 2006 population census.

Ebele as a local community has relied on local processing of its agricultural products. Thus, from production to processing to distribution, the economy still relies on manual inputs and implements not sufficient to transform the economic base from subsistence to commercial. Thus, with support, Ebele stand the chance of an industrial revolution in which palm wine, palm oil and industrialization in general can experience a transformation. With its vast land suitable for agriculture, industrial agricultural inputs remain the viable instrument of economic turnaround for the people. This initiative is very likely to spread to the communities contiguous to it showing that the central position that Ebele occupies in the community would not only affect Ebele but its surroundings and neighborhood communities as well.

In recent times, there has been a drift of population, especially the youths, from Ebele community and other villages in the local government into surrounding urban areas in the State in search for employment opportunities and better living conditions. There is therefore particular need to examine the factors that will keep the inhabitants

in the village to enable them explore the opportunities in the rural life. Given the contribution of housing to rural living conditions, inquiry into the factors influencing the rural housing development is pertinent.

For this study, data were collected from the five communities that make up Ebele village. Thirty (30) respondents were selected purposively from each of the five communities, adding up to 150 questionnaire distributed in all. Selection was done to ensure spread across geographical space, living standard, family size, and age groups. Out of the 150 questionnaire distributed, 106 were retrieved. The questionnaire detailed the personal characteristics of the respondents and information relating to the existing housing structure, its performance and the respondents' preference on housing choice in the area.

The data were analysed using frequency counts and mean. Frequency counts were mainly used in analysing information related to the personal characteristics of the respondents and the dwelling units they occupy while mean value was used in analysing those related to the level of satisfaction on the existing housing system, challenges on existing housing structure, housing finance choices, factors influencing the housing development and the infrastructural needs in the housing sector.

The mean values were figured out from the respondents' ratings of the parameters used in measuring the housing characteristics and preferences. The ratings were in five scales (5, representing the highest scale and 1, the least). From the ratings, the mean values for each of the parameters were calculated by multiplying the total frequency of response on each scale with the weight attached. The resultant figures gotten from each scale were added up and divided by the total response on each of the parameters. This is further presented in equation 1 below.

$$Mean\ Value = \frac{\sum_1^5 R \times W}{T} \qquad (1)$$

Where:

R = total number of responses on a particular scale on each parameter

W= Weight attached to each scale (ranging from 1 to 5)

T= Total number of responses on all scales for each parameter

The resultant mean values were then used to rank the parameters where appropriate. The section below details the result of the analysis.

4. Result and Implications

This section is divided into five subsections. The first, reporting the general characteristics of the participant and the dwelling units they occupy. Following this is a general assessment of the existing housing system in the study area. Thereafter, information regarding the housing finance structure of the area is presented. Data on the motivations behind the occupants' housing choices in the area is presented next and the section concludes with implications of the results and conclusions.

4.1 General Characteristics of Participants

Table 1 presents the general characteristics of the participants in the survey. From Table 1, it is evident that the participants are spread across the various adult age categories with majority, between ages 40-60 years. There were no single respondents and majority of the respondents have spent at least 30 years in the locality. Only a few studied beyond secondary school level, 58.5% of the participants do not earn more than N20,000 per month and majority's occupation is farming. Household sizes of the respondents range from 1 to 10 and the modal mode of ownership is self-ownership. This result reveals that the respondents consists majorly of low income middle aged and older adults, majority of whom are illiterate and whose major occupation is farming. From the result, it is also apparent that the respondents have lived in the community a period of time to be able to give relevant information on the housing systems.

Table 1: General characteristics of participants and housing units

Category	Frequency	%
Age		
31-40	12	11.3
41-50	42	39.6
51-60	40	37.7
61-70	12	11.3
Marital status		
Married	90	84.9
Widowed	16	15.1
Number of Years Spent in the Locality		
1-10	4	3.8
11-20	17	16
21-30	8	7.6
31-40	18	16.9
41-50	23	21.7
51-60	28	26.4
61-70	8	7.6
Level of Education		
No Formal Education	12	11.3
Primary Education	36	34.0
Junior Secondary School Certificate	11	10.4
Senior Secondary School Certificate	26	24.5
Adult Education	4	3.8
HND/BSC	17	16.0
Monthly Income in Naira		
1000-10,000	9	8.5
11000-20,000	53	50.0
21,000-30,000	5	4.7
31,000-40,000	16	15.1
41,000-50,000	6	5.7
51,000-60,000	8	7.5
61,000-70,000	9	8.5
Major Occupation		
Farming	72	67.9
Trading	8	7.5
Artisan	4	3.8
Farm Produce Processing	4	3.8
Others	18	17.0
Household Size		
1-5	54	50.9
6-10	52	49.1

Mode of Ownership		
Self-Owned	36	34
Inherited	15	14.2
Rented	29	27.4
Family House	26	24.5
Total	106	100

4.2 ***Level of satisfaction on the existing housing system***

Before examining the factors influencing housing development in the area, the occupants' level of satisfaction was sought first, to be able to detect the gaps to be filled on housing in the area. From Table 2 below, the mean value observed on the level of satisfaction is 3.30. This indicates an average level of satisfaction. Twenty eight (26.4%) expressed total dissatisfaction on the existing housing situation in the study area. This result reveals that a lot of gap can still be filled to optimise the existing level of satisfaction on the housing situation. To prevent further emigration in this area, there is therefore need to improve on the housing condition through strategies tailored especially to the housing preferences of the rural dwellers. In order to further explain the occupants' level of satisfaction, the respondents were asked to indicate and rate (on a five point scale: very severe -5, to not severe-1) the housing challenges they are facing. The housing challenges limiting the occupants' level of satisfaction is as presented in Table 3. The following challenges (in rank order) have been ranked relatively higher: "inadequate infrastructure", "inadequate capital" and "high building cost". High building cost is traceable to poor infrastructure system which accentuates difficulties in transporting building materials. Challenges relating to housing structure, legislative system and public housing are less pronounced in the area. Since only 27.4% of the respondents occupy rented apartments, provision of public housing is less popular as an alternative housing option in the area as most inhabitants occupy self-owned or family houses. From this result, it is apparent that the more pressing challenges centre on infrastructure and availability of fund for housing development. This result is in tandem with African Monitor (2012)'s assertion that inadequate and unreliable infrastructure services are common in the majority of rural communities in Africa. According to Adebayo (2014) the issue of funding is a big challenge on rural housing and other rural development programmes in Nigeria. Sustainable housing should therefore focus on issues relating to affordability and improvement in housing quality through better infrastructure. These housing challenges recorded are peculiar to rural areas (Wahab, 1993; Ibimilua and Ibitoye, 2015) and are traceable to weak rural development structure and less concentration of development effort on rural areas relative to urban areas.

Table 2: Respondents' rating of satisfaction on existing housing system

	Very Satisfactory	**Moderately Satisfactory**	**Slightly Satisfactory**	**Indifferent**	**Not Satisfactory**	**Mean**	**S.D.**	**Total**
Frequency	4	33	24	17	28	3.30	1.266	106
Percentage	3.8%	31.1%	22.6%	16.0%	26.4%			100.0%

Table 3: Challenges on existing housing system

	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max	Rank
				Lower Bound	Upper Bound			
Inadequate infrastructure	4.54	0.692	0.067	4.4	4.67	3	5	1
Inadequate capital to build	4.43	0.895	0.087	4.26	4.61	2	5	2
High building cost	4.19	1.374	0.133	3.92	4.45	1	5	4
Unavailability of building materials in the locality	4.14	0.81	0.079	3.99	4.3	2	5	5
Difficulty in accessing land for building	3.76	1.262	0.123	3.52	4.01	1	5	6
Inadequate expertise to handle desired building style	3.25	1.194	0.116	3.02	3.48	1	5	7
Unaffordable housing structure	3.21	1.426	0.138	2.93	3.48	1	5	8
Complicated legislative system which inhibits flexibility	3.13	1.219	0.118	2.9	3.37	1	5	9
Inaccessible public housing structure	3.12	1.35	0.131	2.91	3.34	1	5	10

Since shortage of capital for housing development is a major challenge to housing in the locality, inquiry into the existing housing finance options in the area is pertinent to solving housing challenges related to housing finance. In order to achieve this, a pilot study was carried out to identify the existing housing finance structure in the area. The result reveals only four major sources. These include personal savings, borrowing from cooperative societies, support from relatives and borrowing from banks. Table 4 below presents the result on extent of use of the alternative housing finance sources in the area. It can be seen from the table that personal savings is the most frequently used, followed by borrowings from cooperative societies and support from relatives. Only a few of the inhabitants borrow from the banks to execute housing projects. This is traceable to the low cost housing being adopted predominantly in the area adopted in the locality and possibly, paucity of other alternative housing

finance options in the locality. This result is in line with Akeju (2007)'s submission that Nigeria is yet to develop a vibrant mortgage market and houses continue to be provided through the tortuous traditional method of buying land and building over some years, which could be an individual's entire life time.To improve on existing housing finance structure, there is need for introduction of better housing finance alternatives, coupled with effective awareness strategy to sensitise the inhabitants on impact on improved housing systems. .

Table 4: Extent of use of alternative housing finance sources in the locality

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Rank
					Lower Bound	Upper Bound			
Personal savings	106	4.64	.928	.090	4.46	4.82	1	5	1
Cooperative/meeting borrowings	106	3.47	1.007	.098	3.28	3.67	1	5	2
Support from relatives	106	3.23	1.132	.110	3.01	3.44	1	5	3
Loan from banks	106	1.63	.735	.071	1.49	1.77	1	4	4

The respondents were asked the factors that will influence housing development in the locality. Table 5 below presents the result of the survey. The result is that cultural and ethnic reasons were perceived most important factors influencing housing development in the area. Other factors that also ranked high include "proximity to place of work", "Proximity to friends and families", "Environmental friendliness of the area", "Accessibility and affordability of the land" and "Availability of better infrastructure". The result reveals that the respondents place high value on socio cultural values even above neighborhood and infrastructural factors. This finding is in consonance with Axton (2013) and Bello and Olatubara (2014) that culture influences housing choices and behaviors. According to FAO (n.d), most rural societies are relatively 'integrated', in the sense that the various components of life (e.g. agricultural and non-agricultural, 'economic', 'social' end 'political', religious and secular) are closely interrelated. Rural people do not easily recognize the distinctions which planners, extension workers and other government officials make between, for example, the responsibilities of different agencies or 'economic' and 'social' planning, because in their own lives all these things affect each other. In line with the findings in Jabareen (2005), cultural values such as kingship and social relations were leading predictors of housing development in Edo state followed closely by religious consideration. Thus, an integrated approach to planning that will meet the yearnings of rural dwellers must not only be limited to the planning point of view (e.g. the 'agricultural' or the 'economic') but take account of other related aspects of kingship, social relations and religion. The implication of this is that whatever form housing development initiatives may take, adequate cognizance must be taken to ensure that the people get satisfaction on matters that border on their culture and ethnicity. Some neighborhood factors, infrastructural and security factors are also deemed to be of priority. Factors deemed less important include "Proximity to recreational activities", "Quietness and serenity of the environment" and "Religious reasons" in rank order.

Table 5: Factors influencing housing development in the locality

	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
				Lower Bound	Upper Bound		
Cultural reasons	4.35	0.479	0.047	4.26	4.44	4	5
Ethnic reasons	4.18	0.629	0.061	4.06	4.3	3	5
Proximity to place of work	4.08	1.066	0.104	3.87	4.28	2	5
Proximity to friends and families	4.08	0.782	0.076	3.93	4.24	3	5
Environmental friendliness of the area	4.07	0.876	0.085	3.9	4.23	2	5
Accessibility and affordability of the land	4.04	0.816	0.079	3.88	4.19	2	5
Availability of better infrastructure	4.04	0.755	0.073	3.89	4.18	3	5
Security reasons	3.81	1.061	0.103	3.61	4.02	2	5
Proximity to neighborhood services	3.44	0.874	0.085	3.28	3.61	2	5
Proximity to market area	3.16	0.852	0.083	3	3.32	2	5
less stringent government regulatory policies	2.95	1.214	0.118	2.72	3.19	1	5
Proximity to recreational activities	2.79	1.185	0.115	2.56	3.02	1	5
Quietness and serenity of the environment	2.71	1.154	0.112	2.49	2.93	1	5
Religious reasons	1.85	0.871	0.085			1	4

In order to further inquire into the occupants' housing choices, the occupants' preference on housing features was also surveyed. Table 6 below presents the result of the survey. From the result, the occupants' preference for

cultural values also played out as "blend with cultural value" also tops the list (mean value of 3.85). This is followed immediately by "bigger housing sizes" and "environmental friendliness of the building systems". The result revealed a low preference for small housing units possibly due to a relatively large family size by a considerable proportion of the respondents (49.1% have family sizes of more than 5 persons).

Table 6: Housing features preferred by occupants in the area

	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
				Lower Bound	Upper Bound		
Blend with cultural value	3.85	0.728	0.071	3.71	3.99	2	5
Bigger housing sizes	3.66	1.032	0.1	3.46	3.86	2	5
Environmental friendliness of the building systems	3.18	0.924	0.09	3.00	3.36	2	5
Better internal facilities/conveniences	2.56	0.967	0.094	2.37	2.74	1	5
Smaller housing sizes	2.25	0.757	0.073	2.11	2.4	1	4

Given the fact that infrastructure is recurrent both on existing housing challenges and housing factors preferred by the occupants, further inquiry on occupants' preference regarding infrastructural features is pertinent to tackling housing challenges through this medium.

Table 7: Infrastructural features preferred by occupants in the area

	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
				Lower Bound	Upper Bound		
Electricity supply	4.27	0.64	0.062	4.15	4.4	3	5
Educational facilities	4.25	0.741	0.072	4.1	4.39	2	5
Health facilities	4.18	0.802	0.078	4.02	4.33	2	5
Transportation facilities	3.8	1.073	0.104	3.6	4.01	2	5
Recreational facilities	3.54	1.016	0.099	3.34	3.73	2	5
Healthy water supply	1.79	0.713	0.069			1	4

Table 7 presents the result on occupants' preference for infrastructural facilities. The result reveals that electricity supply is foremost of the occupants' infrastructural needs. This is followed by educational facilities, health facilities, transportation facilities and recreational facilities. Healthy water supply is the least needed infrastructure in the area. This is attributable to the fact that the inhabitants are used to the use of wells and boreholes. The fact that the mean value on most features is more than 3.5 validates the need for infrastructural facilities in the area

5. Conclusion

The study revealed that ample gaps can be filled on housing development in the rural areas thereby enhancing more balanced development required for sustainable national growth. Existing challenges on rural housing focus on infrastructural and capital shortage. The study also revealed dearth of improved housing finance structure which is partly responsible for the existing rural housing challenges. To improve on the status quo, there is need to step up the existing housing finance structure and strengthen the infrastructural base and social services without playing down on the ethnic and cultural values of the rural life. This will foster the required balance in the rural and urban sectors, thus achieving sustainable national development.

The study had evaluated factors responsible for rural housing development in 5 Villages in Edo state, Nigeria and have established a huge gap in meeting the housing needs of the rural populace. Inspite of the importance of rural areas in enhancing national development, the study found gross dissatisfaction of rural dwellers with the available housing condition. This hangs largely on the inadequacy of infrastructure and high cost of housing development.

In addition, the study found inadequate capital/finance for housing development owing to dependence on personal savings and borrowings from cooperatives societies and family members for finance.

Inspite of this, housing development is driven at rural areas by the need to preserve their cultural beliefs and value which requires indigenes to have a family house built in their place of origin in line with the design and features that are in vogue and in compliance with the acceptable norms of the people of the areas.

A major policy implication is the need for the government to remold the existing housing finance system in line with the cultural beliefs of the rural areas. This should incorporate system that gives them sense of belonging and make them joint owners of the financial institutions. This will not only enhance their access to finance but will also make them work for its success for enhancing effective housing development.

References

Abdul, A.A. (2008). Time Lag in the Development of Urban Residential Plots in Kano Metropolis. An Unpublished M.Sc. Thesis, Geography Department, Bayero University Kano.

Adamu, E.O. (2007). The Private Development of Residential Land Subject to Statutory Title in Makurdi, Benue State, Nigeria. Unpublished M. Sc Thesis. Bayero University, Kano.

Adebayo, A.S. (2014). Local Government and the Challenges of Rural Development in Nigeria (1999 to date). IOSR Journal Of Humanities And Social Science. 19(4): 98-107

Adeniyi, E.O. (2007). Housing and the Construction Industry in Nigeria, Nigerian Institute of Social and Economic Research (NISER) Intec Printers, Ibadan.

African Monitor (2012). Rural Infrastructure in Africa: Unlocking the African Moment. Development Support Monitor - Paper series No.1, 2012.

Akeju A.A. (2007). Challenges to Providing Affordable Housing in Nigeria. Being a Paper Presented at the 2nd Emerging Urban Africa International Conference on Housing Finance in Nigeria, Held at Sehu Yar'adua Center Abuja, October 17-19, 2007.

Akpomuvie O. B. (2010). Self-Help as a Strategy for Rural Development in Nigeria: A Bottom-Up Approach. Journal of Alternative Perspectives in the Social Sciences. 2 (1): 88-111

Akpomuvie, B.O. (2010). Sustainable Rural Development in Nigeria through Microfinance: The Place of Women. African research review. 4 (2): 252-264

Aribigbola A. (2011). Housing Affordability as a Factor in the Creation of Sustainable Environment in Developing World: The example of Akure, Nigeria, Journal of Human Ecology, 35 (2), 121 – 131.

Aribigbola, A. (2008.). Housing Policy Formulation in Developing Countries: Evidence of Programme Implementation from Akure, Ondo State, Nigeria. Journal of Human Ecology, 23(2), 125-134.

Aworemi, J. R, Abdul-Azeez, I. A. & Opoola, N. A. (2011,). An Appraisal of the Factors Influencing Rural-Urban Migration in Some Selected Local Government Areas of Lagos State Nigeria. Journal of Sustainable Development, 4 (3).

Axton, Betz-Hamilton (2013). "How Does Culture Influences Housing Choices and Behaviors of Residents of the Pine Ridge Reservation? Preliminary Results" Proceedings of the Housing Education and Research Association Conference

Ayoola A. and Amole D. (2014). The Value of Housing among the Poor in Ilesa, Osun State Nigeria. Architecture Research. 4(1A): 45-54.

Beamish, J.D, Mc Cray, J.W, Weber, M.J, & Brewer, G. (1989). Housing values of Southern Rural Households (Monograph of S-194 Southern Regional Technical Committee Serial No. 01-89). Auburn, AL: Auburn University.

Beer, A. and Tually, S. (2012). How should government respond to affordability problems in regional and rural housing markets? AHURI Research & Policy Bulletin. Issue 154 May 2012 · ISSN 1445-3428

Bello, I.K. and Olatubara, C.O. (2014). An evaluation of the management of integrated township development in Ogun state. American Journal of Social and Management Sciences. 5 (2): 64-72.

Beyer, G.H. (1959). Housing and Personal Values. Cornell University Ithaca, NY: Housing Research Publication No.3.

Bourne, L.S. (2007) A Geography of Housing. Edward Arnold, London

Chatterjee, E. (2008) Urbanisation Trends and Problems of Urban Housing in Nigeria. Ibadan University Press, Ibadan.

Chiu, R. L. H. (2002). Socio-cultural sustainability of housing: A conceptual exploration; paper presented at the European Network of Housing Research (ENHR) Conference on Housing Cultures—Convergence and Divergence organized by the Europaforum Wien—Centre for Urban Dialogue and European Policy and the ENHR on 1–5 July 2002.

Deitz R. (2015) Housing Share of GDP Holds Constant. Eye on housing. NAHB. Retrieved from http://eyeonhousing.org/2015/03/housing-share-of-gdp-holds-constant/

Ebadi, B., Ghoreishi, M.B. and Hashjin, N.M. (2015). Factors Affecting Functional Changes of Rural Settlements in Southwestern of Tehran in the Post-Islamic Revolution in Iran. Journal of Applied Sciences. 15 (7): 982-990.

Essendi, H. and Madise, N. (2014). Factors Influencing Perception of Development in Rural Kenya: A Structural Equation Modeling Approach. European Journal of research in social sciences. 2(4): 21-36

FAO corporate document repository (n.d) Guidelines on social analysis for rural area development planning. Retrieved from http://www.fao.org/docrep/t1660e/t1660e02.htm

Ferreras J. (2016) Real Estate GDP Now Represents Half Of Canada's Economic Growth. Business Canada. Retrieved from http://www.huffingtonpost.ca/2016/08/02/real-estate-gdp-canada_n_11309192.html.

Ibimilua A. F. and Ibitoye O.A. Housing Policy in Nigeria: An Overview. American International Journal of Contemporary Research. 5(2): 53-59.

Ijaiya, M.A., Lawal, W.A. and Osemene, O.F. (2014) Microfinance and Mortgage Financing In Nigeria: A Rural Experience. International Journal of Economics and Management Sciences. 1(10): 39-44.

Iwayemi, A. (2006). Nigeria's Oil Wealth: the Challenge of Sustainable Development in an Economy Dependent on Non-Renewable Natural Resources. University of Ibadan Postgraduate School 31st Interdisciplinary Research Discourse. Ibadan: University of Ibadan.

Jamini, D., Nori Zamanabadi, S.H., Jamshidi, A., & Ebrahimi, M.S. (2014). Review and assessment of factors influencing villagers' satisfaction with rural housing (Case study: Avramanat region, Kermanshah Province). Journal of Research & Rural Planning, 3(6), 1-15.

Jabaree, Yosef (2005), Culture and Housing Preferences in a Developing city, Environment and Behavior, 37 (1): 134-146.

Jiboye, A. D. (2004). An assessment of the influence of socio-cultural factors on housing quality in Osogbo, Osun State, Nigeria, An unpublished M.Sc. Thesis, Department of Urban and Regional Planning, Obafemi Awolowo University, Ile-Ife.

Kolawole Y. (2015) Housing as tool for economic development. Vanguard. Retrieved from http://www.vanguardngr.com/2015/11/housing-as-tool-for-economic-development/

Lin, Shi (2005). Housing preferences of residents in Stellenbosch, South Africa. An application of the hedonic price model. Unpublished Master Dissertation, University of Stellenbosch, South Africa.

Lindamood, S. & Hanna, SF. (1979). Housing, community and consumers: An introduction. St. Paul Minnesota West publishing company.

Makinde, O.O. (2015). Influences of socio-cultural experiences on residents' satisfaction in Ikorodu low-cost housing estate, Lagos state. Environmental Development Sustainability. 17:173–198

Maslow, A. (1954). Motivation and personality. New York, NY: Harper. pp. 92.

Morris, E. W., & Winter, M. (1978). Housing, family, and society. New York: Wiley.

Nubi, O.T. (2008): Affordable housing delivery in Nigeria. The South African Foundation International Conference and Exhibition. Cape town, October: 1-18.

Ogu V.I. (1994) Rural housing quality in Nigeria: A case study from Imo State. Habitat International. 18 (3). 53-65.

Ogundahunsi D.S. & Adejuwon S.A. (2014) Housing Condition and Health Relationships in Ijeda-Ijesa and Iloko-Ijesa, Osun State, Nigeria. Global Journal of Human-Social Science: B Geography, Geo-Sciences, Environmental Disaster Management. 14 (7): 1-8.

Okonjo-Iweala, N. (2014). Unleashing the Housing Sector in Nigeria and in Africa. Paper presented at the 6th Global Housing Finance Conference World Bank Headquarters, Washington, DC. Wednesday, 28th May, 2014

Olawepo, R.A. (2009) Evaluating Housing Problems through Participatory Rural Appraisal in Lokoja Nigeria. African research review. 3 (1): 77-96

Olayiwola, L. Adeleye, O. and Jiboye, A. (2006) Effect of Socio-Cultural factors on Housing Quality in Osogbo, Nigeria. CIB W107 Construction in Developing Countries International Symposium. "Construction in developing Economies: New Issues and Challenges" 18 – 20 January 2006, Santiago, Chile.

Olotuah, A. O. & Bobadoye, S. A. (2009). Sustainable Housing Provision for the Urban Poor: A Review of Public Sector Intervention in Nigeria. The Built & Human Environment Review, 2, 2009.

Olotuah, A.O. (2009). Demystifying the Nigerian urban housing question, Inaugural Lecture Series 53, Delivered at the Federal University of Technology Akure, March 10.

Omonigho T. O. (2013) Causes and Consequences of Rural-Urban Migration Nigeria: A Case Study of Ogun Waterside Local Government Area of Ogun State, Nigeria. British Journal of Arts and Social Sciences, 16(1): 185-194.

Roske, M.D. (1983). Housing in Transition. New York: Holt, Rinehart and Winston Publications.

Shuaibu, U. (2016) Nigeria: The Imperative of Having Federal Ministry of Housing and Urban Development. Daily Trust, 30th May, 2016. Retrieved from http://allafrica.com/stories/201605301018.html

Shui, W., Bai, J., Zhang, S. and Chen, Y. (2014) Analysis of the Influencing Factors on Resettled Farmer's Satisfaction under the Policy of the Balance between Urban Construction Land Increasing and Rural Construction Land Decreasing: A Case Study of China's Xinjin County in Chengdu City. Sustainability. 6 (1) 8522-8535.

Spencer-Oatey, H. (2008) Culturally Speaking. Culture, Communication and Politeness Theory. 2nd edition. London: Continuum.

Spencer-Oatey, H. (2012). What is culture? A compilation of quotations. GlobalPAD Core Concepts. Available at GlobalPAD Open House

Thwala1, W.D. (2005). Employment Creation through the provision of Low cost housing in South Africa. Proceeding of the World Congress on Housing Transforming Housing Environments through Design. September 27-30, 2005, Pretoria, South Africa.

Toyobo A.E., Muili A.B. and Adetunji M.A. (2014). The relevance infrastructural facilities to rural housing development in Lagelu Local government, Oyo State, Nigeria. International NGO journals. 9 (3): 29 to 34.

Turner, J.F.C. (1972), '' Housing as a Verb'' Freedom to Build, Turner J.F.C., & Fichter R.(Eds.) Collier Macmillan, New York,143-175.

Van der Heijden, H. (2013) West European housing systems in a comparative perspective, Amsterdam: IOS Press.

Vanguard (2016, June 27) IGR: 36 states generate N682bn. Vanguard. Retrieved from http://www.vanguardngr.com/2016/06/igr-36-states-generate-n682bn/

Wahab, K. A. (1993), Industrialisation and Urbanization. Being the Text of a Paper Presented at a Workshop organized by FEDAN/LEAD Nigeria, Lagos.

Wardrip, K. Williams, L and Hague, S. (2011), The Role of Affordable Housing in Creating Jobs and Stimulating Local Economic Development: A Review of the Literature. Washington, DC :Center for Housing Policy. Retrieved from http://www2.nhc.org/media/files/Housing-and-Economic-Development-Report-2011.pdf

World Bank (2015), International Development Association Program Document for a Proposed Development Policy Credit in the Amount of SDR 53.3 Million (US$75 Million Equivalent) to the Federal Republic of Nigeria for a Edo State Fiscal Improvement and Service Delivery Development Policy Operation. Retrieved from http://documents.worldbank.org/curated/en/880091468098970115/text/949940PGD0P151010Box391420B00OUO090.txt

JCBM (2017) 2(1). 46-53

University of Cape Town

Journal of Construction Business and Management

http://journals.uct.ac.za/index.php/jcbm

Human Resource Management in the Nigerian Construction Firms: Practices and Challenges

O. J. Ameh[1], E. I. Daniel[2]

Department of Building, University of Lagos, Nigeria[1]
Department of Construction Management and the Built Environment, Southampton Solent University, United Kingdom[2]

Received 26 October 2016; received in revised form 13 January 2017, 16 March 2017 and 12 April 2017; accepted 20 April 2017

Abstract

Improvement on human resource management is critical to overall productivity and cost effectiveness in the construction industry. This study assesses the current human resource management practices in the Nigerian construction organisation and the challenges confronting it. Questionnaire survey was adopted for data collection while the sampling technique was purposive. Ninety eight human resource managers and construction professionals in two categories of construction organisations (client organisations involved in housing development and contractor organisations) were sampled. The results reveal that due process was followed in the recruitment process but the selections of desired candidates were often hampered by interferences and competitive work conditions. Furthermore, training and development practices were superficial, involving orienting newly recruited employee on facilities for optimum performance rather than developing employee job related competences. Provision of appropriate/modern working tools and equipment and provision of incentives and benefits to staff were the prevailing motivation and labour union practices. Challenges facing human resource management practice in the Nigerian construction industry include high labour turnover, interference at the selection stage, competitive wages and compensation issues among others. Further research is required to assess the impact of identified human resource practices on productivity and project performance.

Keywords: Challenges, Construction firms, Human resource management, Nigeria, Practices.

1. Introduction

The construction industry has been described as a barometer by which economic development of a nation is measured. This is because construction projects provide infrastructure required to drive socio-economic development and contributes to the Gross Domestic Products (GDP) as well as the standard of living of its citizenry. Construction process itself involves various activities with humans as a fundamental factor to the success of these activities (Aguenza and Som, 2012; Maxwell and Farquarson 2008). While it is true that machines have been developed to replace human in carrying out construction tasks (Rotman, 2013), it is also true that the machines cannot operate themselves. They have to be operated by human in order to achieve desired results. However, the low level of mechanization in the construction industry of developing countries leaves it with no option than to heavily rely on Human Resource (HR) for its operations. In the construction industry of developing countries, HR account for significant part of the project cost. Cost of HR includes personnel administration, employee training, communication cost, welfare and compensation for health and safety. It therefore means that an effective Human Resources Management (HRM) will result in highly motivated workforce leading to high productivity, quality improvement and minimizes cost and time overruns.

HRM is a coherent approach to the management of an organisation's most valued assets; this include the people that work collectively in the organisation so as to contribute to the achievement of its objectives. HRM in essence deals with the process of attracting, developing and maintaining a talented and energetic workforce to support organisational objectives. The project oriented nature of construction activities, which is characterised by

[1] Corresponding Author. Tel: +234 8023323711
Email address: oameh@unilag.edu.ng
[2] Email address: emmanuel.daniel@solent.ac.uk

projects that are custom built to client satisfaction, nomadic nature of the labour force, uncertainties associated with the production process among others makes HR policies and practices uniquely different from those of manufacturing, health, and hospitality industries and thus a fundamentally different HRM models (Huemann and Keegan (2007).

Employment in the construction industry is characterised by relatively high rates of labour turnover which manifests in periodic labour shortage (Chan, Clarke and Dainty 2011; Erlick and Grabelsky, 2005 and McGrath-Champ, Rosewarne and Rittau 2011). According to the Institute of Management and Administration (cited in Olsen, Tatun and Defnall 2012), the skilled craftsmen shortage in the industry is not a shortage of workers per se, rather it is a shortage of adequately trained skilled and productive workers available for certain jobs. The growth of Small and Medium Enterprises (SMEs) within the construction industry and the use of labour only sub-contractors have reduced commitment and investment in HR training within the industry (Dainty, Ison and Root 2004, Shafeek, 2016). Labour turnover within the industry is also attributed to migration of skilled intellectuals and technical personnel both from and within developing countries in search of better work condition. According to Wikipedia (2011), Nigeria, Kenya and Ethiopia are the most affected by emigration in Africa. Labour turnover in the industry is believed to be caused by ineffective HRM characterised by poor training or lack of opportunity for training, poor wages and compensation issues, irregularity of the workload, safety issues among others.

There is paucity of literature on HRM practices in the Nigerian construction industry. Adeagbo and Oyemogun's (2014) study focus on identifying the drivers and barriers to human resource development in the local construction firms in Nigeria. Other studies on HRM in Nigeria focus on other industries. For instance, Akinbode and Uweme, (2013) examined HRM practice in private cleaning service outsourcing organisation in Lagos. The focus of their study was on identifying the HR practices peculiar to cleaning services outsourcing organisation and the challenges confronting them. In another study, Oladipo and Abdulkadir (2011) examine the extent to which strategic HRM is practiced in the Nigerian manufacturing sector and the relationship between strategic HRM and organisational performance. Fajana, Owoyemi, Elegbede and Gbajumo-Sheriff (2011) on the other hand examined the influence of Nigeria socio-cultural characteristics on HRM practices.

The poor performance of the Nigerian construction industry in terms of delays in project delivery, cost uncertainty, and quality deficiency has consistently been a source of concern to industry stakeholders and researchers. Despite the existence of a large number of research efforts focused on addressing issues of poor project performance, the problem persist .In view of previous research findings that a positive relationship exist between organisational performance and HRM (Ayanda, Lawal and Ben-Bernerd 2014, Muhammad Masum et al. 2015), the current study therefore focuses on the state of HRM practices in the Nigerian construction industry in order to assess the extent to which construction organizations in Nigeria use various traditional HRM practices with respect to recruitment, selection, training and motivation to increase the performance of the sector as well as the challenges confronting HRM practices in the construction sector.

2. Literature Review

The success of a company or business is directly linked to the performance of the people that work for that business. Since every organisation is made up of people, acquiring their services, developing their skills, motivating them to higher level performance and ensuring that they continue to maintain their commitment to the organisation are essential prerequisite to achieving organisational objectives. The process of making efficient and effective use of HR so that the set goals are achieved is referred to as HRM. There is no general agreement on what constitute HRM practice in literature. Practices that form the core of the various practices proposed for HRM comprise procurement (recruitment and selection), training and development, compensation (remuneration, incentive payment and retirement benefits), and maintenance (work satisfaction, health and safety).

2.1 Review of Research on HRM Practices in the Construction Industry

Zhai, Liu and Fellow (2014) investigated the role of HR practices in enhancing organisational learning in Chinese construction organisation using questionnaire survey and structural equation modelling. The study found that HR practices in Chinese construction organisations involve multidimensional practice of job description, participation, training, staffing, and rewards. Also, HR practice was found to have a significant positive effect on organisational performance.

In the United States construction industry, HRM theory that is currently widely accepted as having profound influence on organisational performance is employee motivation through: worker participation, recognition, team belonging, management and commitment and effective training (Yankov and Kleiner, 2001).

Huemann et al. (2007) developed a simple model of HRM process in project oriented company (inclusive of construction) which is different from mainstream HRM literature. The focus of the model is on employee wellbeing and ethical treatment at the end of the project. In addition to recruitment in mainstream HRM literature, they proposed that project personnel be assigned to project based on specific developmental need, expertise, and experience to work with particular client among others. In addition to employment, they proposed support for career development through on the job training and feedback while engaged on project. Finally, at the end of the project, they proposed three possible ethical treatments for project personnel: immediately assign them to new project, assign them to project starting sometime in the future where their skill will be better utilized, and hold them in abeyance in the absence of any project to be assigned to.

Tabassi and Abu Bakar (2009) explored HRM in construction projects in Iran. They found that training and

motivation of employees are major obstacles to effective use of HRM in Iran. To improve the performance of construction companies, they suggested employing both short-term and long-term training of construction workers at fixed location such as Technical Vocation Training Organisation (TVTO), as well as construction sites and other On the Job Training (OJT) facilities. In addition, they proposed that government should provide incentives or policies that will encourage self-learning through certification of fitness for occupation in the project.

2.2 Challenges of HRM in Construction Organisations

Chan (2005) quoting Thomas (1992) explains that integrating the views and interests of organisation workplace diversity dimensions such as age, ethnicity, ancestry, gender, physical ability/qualities, race, sexual orientation, educational background, geographic location, income, marital status, religious beliefs among others is a challenge in HRM. Chukwuemeka (2006:46) assert that employing a female worker imposes the burden of nursing mothers and its obvious consequences to productivity, including: loss of man hours, absenteeism and outright increase in labour turnover and layoffs. Government policies and legislation is another challenge on HRM. There are legislations on minimum wages, recruitment and selection (bothering on federal character), training and development, compensation, integration and separation of employees from the organisations. Yaro (2014) listed challenges of recruitment in the public service in Nigeria to include: interference by political office holders using sentiments and other primordial consideration in the recruitment process, federal character principle which prescribed ethnic balancing and equal opportunity to applicants from all geopolitical zones and recruitment on the basis of skills and technical abilities alone at the expense of positive attitude and character. These challenges are not limited to public service alone but also construction organisations in Nigeria. Oginni and Afolabi (2012) cited the challenge of "god fatherism" and nepotism taking the place of fairness and meritocracy in recruitment and placement in manufacturing organisations in Nigeria. The study bemoaned the practice of employing people without due process, and where vacancies are dully advertised, the interview is a mere formality. As such the result of most interviews does not count in the selection process.

3. Research Methods

The study was conducted in Lagos, Nigeria. Lagos is adjudged the commercial nerve centre of Nigeria and host a number of construction firms because of the perennial volume of construction activities. The research design adopted was a questionnaire survey because of the need to gather sufficient data from large population for the purpose of generalizing the findings. In addition, Phua (2013) assert that studies that are based on quantitative methods can be replicated and compared. Two categories of construction organisations: client organisations involved in housing development and contractor organisations were purposively selected on the bases of the number of employee engaged and the volume of construction workload. The sample frame comprises HR managers and construction professionals in the two categories of construction organisations. A total of 98 questionnaires were retrieved out of 125 questionnaires administered which represent about 78 percent response rate.

The questionnaire comprises 3 sections. Section A is about demographic profile of the respondents. Section B consists of 44 HRM Practices frequently used in construction firm. The respondents were required to signify the frequency of use of listed HRM practices on a five point Likert scale (i.e. 1 = never, 2 = seldom, 3 = sometimes, 4 = most times and 5 = all the times). Section C is on the challenges of HRM practice in the Nigerian Construction firms rated on a five-point Likert scale (i.e. 1 = strongly disagree, 2 = disagree, 3 = not sure, 4 = agree and 5 = strongly agree).

Descriptive statistics was used to rank the variables in descending order based on the values of mean scores and standard deviation (SD). The variables with lower SD values were ranked higher.

4. Results and Discussion

4.1 Demographic Profile of Respondents

The sample comprised of well-experienced respondents (58.2% had more than 6 years of working experience) in the construction industry. These respondents comprise HR managers for client organisations involved in housing development and construction professionals (architects, builders, engineers) who are construction managers in contracting organisations. Six percent are in executive management position, while 79% are in middle management position. In terms of academic qualification, 75% have first degree or its equivalent (HND). In terms of the number of years the companies that participated in the study have operated in Nigeria, 74.4% had over six years construction experience. This suggests that the construction organisations sampled have diverse years of construction experience involving HRM practices.

4.2 HRM Practices

The study sought the opinion of the respondents on the most frequently used practices in the Nigerian construction firms. The findings from the survey of various HRM practices are discussed below. Due to the word limit imposed by this journal, only the findings on few variables are discussed in detail.

4.2.1 Recruitment and Selection Practices

Recruitment is a set of activities used to attract sufficient job candidates who have the necessary potentials, competencies and traits to fill job needs. Selection on the other hand is the final step in the recruitment process, and involves choosing the candidate(s) that succeed in meeting the recruitment criteria. Fourteen variables representing recruitment and selection practices were identified from literature. The result presented in Table 1 shows that 8 out of 14 of the recruitment and selection practices are used most times. They include; placement of the right staff in the right department for the achievement of company general goals, and screening of candidate for vacant positions. This is consistent with Huemann et al. (2007) proposal for project oriented companies where it

was proposed that project personnel be assigned to project based on specific developmental need, expertise, and experience. This will bring about needed career development and improve productivity. Furthermore, the result indicates that preference for university graduates over polytechnic graduates, recruitments via referrals only, preference for male applicants over female applicants and youth (under 25 years) over older applicants are sometimes used for recruitment and selection of HR in the Nigerian construction firms. This is contrary to the practice in other industries like banking and manufacturing were young applicants (under 25 years) and university graduates are given preferential treatment above their counterpart who are older and had polytechnic education, in terms of job placement, remuneration and career progression. In the construction industry, skills and competencies are rated far higher than the normative paper qualification commonly used for employee selection in most other sector of the economy as reported in Fajana et al. (2011). However, construction experience requirement often advertised does not favour young applicants as the years of work experience requirement are unrealistic.

The finding that preference for male applicant is not often the practice, is quite comforting in view of the age long perception that construction is a male dominated industry and vulnerable to masculine stereotypes. In the banking and hospitality industry, female applicants, particularly beautiful and attractive young single ladies are preferred to attract customers (Adenugba and Ilupeju, 2012)

.

Table1: Recruitment and Selection Practices

HRM Practices	Std. Deviation	Mean	Rank
Placement of right staff into the right department for the achievement of company general goals.	0.664	4.15	1
Screening of candidate for vacant positions	0.750	4.12	2
long term planning for human resources or manpower need of the organisation	0.865	3.93	3
Selection of staff based on quality & skill rather than academic qualification	0.853	3.79	4
Recruitment of staff for company general goal	0.928	3.77	5
Vacancies for staff are advertised internally & externally	0.930	3.58	6
Staff with high reputation are attracted with high salary from other companies	0.922	3.52	7
Conducting job analyses (determining the nature of each employee's job) before assigning them	0.965	3.47	8
Internal advertisement of vacancies for qualified staff	1.016	3.17	9
Foreign trained applicants are given preference over local trained applicants	0.970	3.08	10
University graduates are given preference over polytechnic graduates	1.103	2.98	11
Staff are recruited via referrals only	0.677	2.93	12
Preference are given to male applicants over female applicants	1.178	2.79	13
Young applicants below 25 years are given preference over older applicants	0.891	2.62	14

4.2.2 Training and Development Practices

Training is a planned process through which an organisation facilitates employees' learning of job-related competencies. Fifteen variables on training and development practices were identified from literature (See Table 2).

Table 2: Training and Development Practices

HRM Practices	Std. Deviation	Mean	Rank
New staff are taking through company induction & training	0.632	4.37	1
Orientation and training of newly recruited employees	0.616	4.31	2
Training and development of staff on applicable softwares and tools for achievement of company goals	0.686	4.06	3
Staff are assigned on project based on skill & expertise	0.679	4.05	4
Allow staffs to be moved to another project at completion of a project	0.737	3.95	5
Training and skill development of managers (Leadership training)	0.736	3.93	6
Providing staff with opportunities for career development	0.725	3.9	7
Organising workshops, seminars and trainings to enhance employee skills	0.742	3.84	8
Career/professional advancement is encouraged among staff and necessary support is given	0.8	3.83	9
New staff are assigned to older employee for mentoring	0.677	3.79	10
Staff are engaged on project based on their experience on similar project	0.807	3.68	11
Staff are assigned on project based on availability of personnel	0.924	3.37	12
New staff are immediately assigned to projects	0.873	3.29	13
Staff are made to undergo training while waiting for the company to secure other projects	1.003	2.94	14
Low performing staff are dismissed from work without analysis/warning	1.182	2.06	15

The results presented in Table 2 indicate that training and development practices used most times in the Nigeria construction firms are: inducting and training of newly recruited staff, orienting and training new employee, training on soft wares and use of tools, and assigning staff based on their skill and expertise. The practice of having induction and training for new staff is common practice across almost all sectors (Oakland and Oakland, 2001). This is consistent with Huemann et al. (2007) training proposal but contrary to Tabassi and Abu Bakar (2009) observation of HRM practice in the Iranian construction industry. This finding is unexpected in view of barriers of HR development posed by SMEs, self-employed workers and subcontractors in the construction industry (Adeagbo and Oyemogun, 2014). The survey further revealed that sending staff for training while waiting for the company to secure other projects and disengaging low performing staff without prior warning is rarely the practice in the Nigerian construction firm. Training is the only ways by which technical skills can be transferred. Incurring additional cost on training staff can be offset by encouraging Job rotation and mentoring by experienced employee on the job.

4.2.3 Motivation and Labour Relation Practices

Motivation is external and internal factors that stimulate desire and energy in people to be continually interested and committed to a job or organisational goal. Fifteen variables were identified as motivation and labour relation practices from literature as presented in Table 3. The results indicate that among the practices used most times to motivate staff are provision of appropriate and modern working tools and equipment, providing incentives and benefits to staff, and encouraging team spirit within the organisation. Others include: making provisions for accommodation, feeding, transport and health insurance in staff emolument, recognising and rewarding outstanding performance and regular performance appraisal and rewarding deserving staff. This is consistent with non-financial motivational factors reported in Ameh and Shokumbi (2013) as most effective for enhancing output of skilled and semi-skilled construction workers. The results suggest the use of hygiene factors as proposed by Herzberg in his two factor theory of motivation and physiological and safety needs in Maslow's theory. These factors may not be sufficient to motivate highly skilled employee into higher performance.

Labour relation is aimed at promoting industrial harmony that would boost productivity. The survey indicates that labour relation practices seldom used include: allows employee participation in only establishment-based union, negotiation of Trade unions issues with management and allows employee participation in national trade unions activities. This is reasonable as there is no recognised umbrella body for construction workers in Nigeria. Construction activities are rarely affected by official national strike

Table 3: Motivation and Labour Relation Practices

HRM Practices	Std. Deviation	Mean	Rank
Provision of appropriate / modern working tools and equipment	0.632	4.37	1
Providing incentives and benefits to staff	0.883	4.28	2
Team spirit within the organization is encouraged	0.794	4.27	3
Provision of Accommodation, feeding, transport and health insurance in staff remuneration and compensation	0.717	4.2	4
recognizing Employee outstanding performance and adequately rewarding them	0.953	4.17	5
Performance appraisal of Staff is done regularly and deserving staff are rewarded accordingly.	0.658	4.14	6
Regular review of employee pay/salary in line with economic realities	0.751	3.95	7
Setting general and specific management policy for the company	0.803	3.93	8
Provision of incentive and motivational schemes for employees	0.713	3.92	9
Staff at various levels have access to company's motivation & incentive schemes	0.959	3.87	10
Employee feels secure in their job	0.946	3.63	11
Setting the policy for Collective bargaining, contract negotiation and grievance handling.	1.185	3.44	12
Allows employee participation in only establishment-based union	1.37	2.83	13
Negotiation of Trade unions issues with management	1.322	2.72	14
Allows employee participation in national trade unions activities	1.443	2.66	15

4.3 Challenges Confronting HRM Practices in the Nigeria Construction Firm

Thirty-two challenges grouped under three categories: recruitment and selection, training and development, and motivation and labour relations were identified from mainstream HRM literature.

The result of challenges confronting recruitment and selection practices as presented in Table 4 indicates that competition for globally mobile talents, avoiding high experience labour turnover, reducing the cost per hire, recruiting the right person for a specific position, getting the right candidate for vacancies internally advertised and attracting staff with high reputation from other companies top the list. These challenges bother on issues of recruitment of desired candidate and employee turnover. These findings collaborate Yaro's (2014) study which linked recruitment challenges to primordial issues of ethnicity, nepotism, favoritism among others. The finding is also supported by Madubiko's assertion of 'god fatherism', which restrict the selection of desired employee. Besides the recruitment practice, the issue of employee turnover in search of better work conditions and

other benefits is a big challenge confronting the HRM practice in the Nigeria construction industry. The most appropriate employee may be attracted to the oil and gas companies, banks or academics because of the conducive employment conditions.

Table 4: Challenges Confronting HRM Practice in the Construction Industry

Challenges	Mean	Rank
Recruitment and Selection practices		
Competition for globally mobile talent	4.41	1
Avoiding high experience labour turnover	4.26	2
Reducing the cost per hire	4.26	2
Recruiting the right person for a specific position	4.20	4
Getting the right candidate for Vacancies internally advertised.	4.03	5
Attracting Staff with high reputation from other companies	4.00	6
To represent the interests of employees within the framework of its primary obligation to senior management.	3.99	7
Collecting the right information about jobs to prepare job descriptions.	3.95	8
Making sure employees have the mechanisms required to contest unfair practices	3.85	9
Outsourcing of short and long term employee services	3.54	10
Recruiting staff for specific project only (i.e on short- term bases)	3.53	11
Training and Development practices		
Identifying staff skill gap	4.02	1
Ensuring adequate training not to undermine department's effectiveness	4.01	2
Ensuring employees are doing their best during time of turbulence	3.99	3
Making adequate budget for employee training in dwindling economy	3.96	4
Training and development of staff	3.95	5
Preparing appropriate and well detail job description	3.94	6
Rapid advances in HR technology	3.88	7
Motivation and Labour Relation Practice		
Maintaining company employee salary structure in a competitive labour market	4.04	1
Maintaining good salary band among categories of employee in a competitive labour market	4.03	2
Providing adequate **r**etirement benefit	3.98	3
Clearly defining how management should be treating employees.	3.96	4
Ensuring employees do not commit any unfair labour practices	3.94	5
Motivating sub-ordinates non-financially	3.86	6
Ensuring the company do not commit any unfair labour practices	3.85	7
Maintaining fair salaries among categories of employee	3.84	8
Ensuring th**e** company is not in court because of discriminatory actions	3.84	8
Ensuring there is no conflicts among the sub-ordinates in the organi**s**ation	3.78	10
Setting the policy for **c**ollective bargaining, contract negotiation**,** and grievance handling.	3.76	11
Setting general and specific management policy for organi**s**ation	3.71	12
Ensuring that some employees do **not** think that their salaries are unfair and inequitable relative to others in the organi**s**ation	3.70	13
Allowing participation in only establishment-based union	3.57	14
Negotiating Trade unions issues with management	3.49	15
Staff involvement in national trade unions activities	3.44	16

Challenges confronting training and development practice include; identifying staff skill gap, ensuring adequate training so as not to undermine department effectiveness, and ensuring employees are at their best in times of turbulence among others. Most training takes place on the job site and are horridly done in order not to undermine production and profitability. This account for training inadequacy and contrary to Tabassi and Abu Barkar (2009) suggestion of conducting both short and long term training for employee in location outside the work environment. The appropriate time for training workers is during the period of low activities or while waiting for new jobs.

Furthermore, maintaining employee salary structure, maintaining good salary band among categories of workers, and providing adequate retirement benefits among others were the dominant motivation and labour relation challenges. This may be attributed to the absence of trade unions in construction organisations for collective bargaining. In addition, the growth in construction SMEs which provides competitive services, coupled with the lowest bidder wins syndrome is an impediment to uniform emolument and compensation in the construction industry. This finding unfortunately, account for the high labour turnover reported in Chan et al. 2011 and McGrath-Champ et al. 2011).

5. Conclusions

The aim of this study was to assess the extent to which construction organisations in Nigeria use the various traditional HRM practices to improve the performance of

the industry. The study found that recruitment and selection practices in the construction organisation are distinctly different from those of the manufacturing and banking industry and centres on selection of skilled and technically competent personnel for organisation general goal. The study also revealed that training practices in the construction organisation sampled is superficial, aimed at orienting the new employee to the organisation and the facilities for optimum performance rather than employee skill development. Furthermore, challenges of HRM practices identified in the study are more of socio-cultural issues, and bothers on influence of political office holders and other influential personalities, government policies with regards to recruitment using federal character policy, wages and compensation policies and employee turnover in search of better condition of service.

The major limitation of this study is the purposive sampling technique adopted which limits its generalization. Future research should build on this by using simple random sampling technique. Also, it will be interesting to investigate the impact of identified HRM practices on productivity and cost effectiveness of construction projects.

References

Adeagbo, D.O and Oyemogum, I.M, 2014. Factors influencing human resource development in Nigerian construction industry. In the proceedings of World Sustainable Building Conference, Barcelona, Spain.

Adenugba, A. A. and Ilupeju, C. O. (2012). Working Conditions of Female Marketers in Selected New Generation Banks in Ibadan, Nigeria. JORIND, 10(2), 199-207. Available (on-line) at www.ajol.info/journals/jorind

Aguenza, B.B. and Som, A.P.M. 2012. Motivational Factors of Employee Retention and Engagement in organizations. International Journal of Advances in Management and Economics, 1(6): 88–95.

Akinbode, J. O., and Uwem, L. (2013) Human Resource Management Practices in Private Cleaning Service Outsourcing Organizations in Lagos State, Nigeria. International Journal of Basic and Applied Science, 2(2): 266-275

Alsehaimi, A., Koskela, L. J and Tzortzoponlos, F.P. (2003). Need for alternative research approach in construction management: Case of delay studies. Journal of Management in Engineering, 29(4): 407-413

Ameh, O. J. and Shokumbi, B. B. (2013). Effectiveness of non financial motivational scheme on construction workers output in Nigeria. Ethiopian Journal of Environmental Studies and Management, 6(3), 263-273

Ayanda, A. M., Lawal, O. R. and Ben-Bernard, P. (2014). Effect of human resource management practices on financial performance of banks. Transactional Journal of Science and Technology, 4(2), 1-16

Chan, A. (2005). The challenges of human resource management. Available (on-line) http://eziniearticles.com accessed 4th January, 2017

Chan, P., Clarke, L. and Dainty, A. (2011) The dynamics of migrant employment in construction: can supply of skilled labour ever match demand? In Ruhs and Anderson, B. (eds). Who needs migrant workers? Labour shortages, immigration and public policy, Oxford, Oxford University Press, pp. 225-255

Chukwuemeka, E. O. (2006). Public Administration. Elyn: HRV publishers

Dainty, A.R.J., Ison, S. G and Root, D. S. (2004). Bridging the skill gap: A regionally driven strategy for resolving the construction labour market crisis. Engineering, Construction and Architectural Management, 11(4), 275-283

Erlich, M and Grabelsky, J. (2005) standing at the crossroads: the building trade in the twenty-first century. Labour History 46(4), 421-445

Fajana, S., Owoyemi, O., Elegbede, T., and Gbajumo-Sheriff, M. 2011. Human resource management practices in Nigeria. Journal of Management and Strategy, 2(2): 57-62.

Huemann, M., Keegan, A. and Turner, T. R. (2007). Human resource management in the project – oriented company: A review. International Journal of Project Management, 25, 315-325

Maxwell, G., and Farquarson, L. 2008. Senior managers' perceptions of the practice of human resource management. Employee Relations, 30(3), 304 – 322.

McGrath-Champ, S., Rosewarne, S. and Rittau, Y.(2011): from one skill shortage to the next: The Australian construction industry and geographies of global labour market. Journal of Industrial Relation 53(4):467-485

Muhammad Masum, A. K., Azad, M. A. K., Hoque, K. E. and Beh, L. S. (2015). Domestic bank in Bangladesh could ensure efficiency by improving human resource management practices. PLOS ONE 10(7): e012017.doi:10.1371/Journal.pone.0121017

Oginni, B. O. and Afolabi, G. V. (2012). A study of human resource management practices and labour turnover in the manufacturing organisations in Lagos, Nigeria. IOSR Journal of Business and Management, 5(4):13-19

Oakland, S. and Oakland, J. (2001). Current people management activities in worldclass organisation. Total Quality Management and Business Excellence, 12(6):773-779

Oladipo, J.A, and Abudulkadir, D.S., 2011. Strategic human resource management and organizational performance in the Nigerian manufacturing sector: An empirical investigation. International Journal of Business and Management, 6(9): p46-56.

Olsen, D., Tatum, M. and Defnall, C. (2012). How industrial contractors are handling skilled labour shortages in the United States, 48th ASC Annual International Conference Proceedings, Birmingham City University, UK. April 11-14

Phua, F. T. (2013). Construction management research at the individual level of analysis: current status, gaps and future directions. Construction Management and Economics, 31(2):167-179

Ramanathan, C., Narayanan, S. P. and Idrus, A. B. (2012). Construction delays causing risks on time and

cost=a critical review. Australasian Journal of Construction Economics and Building, 12(1):37-57

Rotman, R (2013) How technology is destroying jobs. MIT Technology Review. available 0n-line www.technologyreview.com/how-technology-is-destroying jobs

Shafeek, H. (2016). The impact of human resource management practices in SMEs. Annals of Faculty of Engineering Hunedoara-International Journal of Engineering, Tome XIV(Fascicule 4), 91-102

Tabassi, A. A. and Abu Bakar, A. H. (2009). Training, motivation, and performance: The case of human resource management in construction projects in Mashhad, Iran. International Journal of Project Management, 27( ), 471-480

Shaw, M. (2001): Pulp and paper projects feels impact from skilled construction labour shortage. Pulp and Paper, 75(9), 44

Yankov, L and Kleiner, B. H. (2001). Human resources issues in the construction industry. Management Resource News, 24(3/4), 101-105

Yaro, I. (2014). Recruitment and selection in the Nigerian public service:Nature, challenges and way forward. British Journal of Economics, Management and Trade, 4(7):1005-1017

Zhai, X., Liu, A. M. M. and Fellows, R. (2014). Role of human resource practices in enhancing organisational learning in Chinese construction organisation. Journal of Management in Engineering, 30(2), 194-20

JCBM (2017) 1(2). 54-63

University of Cape Town

Journal of Construction Business and Management

http://journals.uct.ac.za/index.php/jcbm

Establishing Underlying Structures of Safety Performance Measures Using Factor Analysis of Data on Construction Workers in Gauteng, South Africa

C S. Okoro[1], I. Musonda[2]

Department of Construction Management and Quantity Surveying, University of Johannesburg, South Africa[1, 2]

Received 16 November 2016; received in revised form 14 March 2017; accepted 20 May 2017

Abstract

The health and safety (H&S) of site employees in the construction industry has been overwhelmingly studied for decades. However, there is limited literature, which analyses underlying structures of safety performance measures especially as related to their unhealthy and unsafe eating behaviour. The paper presents findings from an exploratory factor analysis of H&S performance measures. A 10-item questionnaire which was developed after an extensive literature review was used to collect empirical data on safety performance (SP) of construction workers in the Gauteng Province of South Africa. Findings revealed that safety performance of site workers could be reasonably measured by two constructs. The two constructs were clearly defined as trailing and prevailing. The emerged trailing measures were named lagging indicators while the popular ones were designated as leading indicators. The results support extant literature which advocates the use of both leading and lagging safety performance indicators for effectively assessing construction workers' safety performance. The study provides evidence which could be beneficial in the psychometric evaluation of construction workers' safety performance and behaviours on construction sites.

Keywords: Construction workers, Factor analysis, Gauteng, Safety performance.

1. Introduction

The construction industry is laden with accidents and deaths on a poor level despite its positive role in the improvement in the quality of lives of any nation's citizenry through job provision and contribution to Gross Domestic Product (GDP) (Ofori 2012; Okoro et al. 2016). Despite significant reductions of incidents on construction sites in the past several decades, the injuries and fatality rates for construction workers are still higher than other industry sectors (Health and Safety Executive (HSE) 2014; Liu et al. 2015). In South Africa, there were 9858 accidents and 93 fatalities; in 2011, 8099 accidents and 50 fatalities were recorded, and 258 accidents and 56 fatalities in construction were reported in 2012, in the construction sector (Prinsloo 2013). These accidents and deaths, which are sometimes preventable, amount to significant costs to employers, insurance companies and the economy as a whole, with direct and indirect costs such as medical, hospital and rehabilitation expenses, workers' compensation payments, and higher insurance premiums or even loss of insurability, loss in wages, loss of morale, legal costs, training costs, loss of skill/efficiency, administrative time, and costs to repair damaged property (Janackovic et al. 2013; Thepaksorn and Pongpanich 2014). A recent evaluation of costs of construction accidents from 100 construction establishments found that the amount of R10, 087, 350 was expended on direct costs, while R22, 893, 850 was attributed to indirect costs related to accidents and injuries (Pillay 2014). Consequentially, it is paramount to improve the H&S system continually to reduce the costs and increase companies' competitiveness and efficiency (Janackovic et al. 2013; Okoro 2015).

Moreover, attention to construction workers' H&S is vital since they are at the centre of construction activities and as such are indispensable. Construction workers and their employers must make daily decisions about safety at work since it affects and competes with other performance aspects of the construction activities, which can be either

[1] Corresponding Author. Tel: +27738626360
Email address: chiomasokoro@gmail.com
[2] Email address: imusonda@uj.ac.za

related to the task itself (e.g., safety vs. on-time delivery or productivity), or to the worker performing the task (e.g., safety vs. personal discomfort or extra effort) (Huang et al. 2013). Poor safety at work could result from, among other things, workers' unhealthy eating behaviours (Melia and Becerril 2009; Lingard and Turner 2015). Additionally, the nature of construction work predisposes construction workers to hazards which pose a threat to their H&S. Such hazardous conditions may include electrocutions, and structure collapses, extreme heights, machinery failure, welding emissions, lead, unguarded machinery, being struck by heavy construction equipment, silica dust, asbestos, and so forth (ElSafty et al. 2012). Continuous attention to H&S and integrated management of H&S increase operational excellence, profitability and positive safety behaviours. Operational excellence, defined as doing the right thing, the right way, at all times, even when no one is watching, results in enforcement of appropriate systems to encourage safety behaviours, and thus generate long-lasting and authentic effects such as reduction in the occurrence of injuries and deaths, reduction in avoidable expenditure on on-site exigencies, increase in productivity, and in fact, morale and motivation among employees as well as implications of H&S are realised (Janackovic et al. 2013; Liu et al. 2015; Okoro et al. 2016).

Health and safety measurement and management have been given attention in the extant literature (Lin et al. 2009) and in the construction industry specifically (Hinze et al. 2013; Lingard et al. 2013). However, most literature focused on the work environment, managerial and organisational aspects of H&S. Few studies have been devoted to safety performance measures related to the lifestyle behaviours of the workers which have been suggested to be unhealthy (Melia and Becerril 2009). The current study focuses on safety performance measures, which could be related to workers' unhealthy eating behaviours and explores underlying structures of the measures identified from the extant literature. The objective of the present paper is to determine and analyse the underlying structures of safety performance measures relatable to workers' unhealthy eating behaviours, as used in the study. By highlighting the structure of these measures, researchers and construction employers will be aided in assessing and identifying pre- and post-indicators of safety behaviours and performance of construction workers.

2. Literature Review

2.1 Unhealthy eating behaviour

A healthy diet connotes consumption of food from all the different classes of food nutrients (Amare et al. 2012). Eating a variety of adequate and well-balanced nutrient-rich foods gives the body much-needed nutrients for optimal health and well-being (World Health Organisation (WHO) 2014). Unhealthy eating is a lifestyle risk-taking behaviour that impairs judgement and could result in accidents (Melia and Becerril, 2009). Poor nutrition is constantly linked to absenteeism, sickness, and a higher rate of accidents on work sites, and invariably, higher medical costs (Kolver, 2012). Iron and vitamin B deficiencies cause fatigue and tiredness, reduce work capacity and productivity, and lead to impaired cognitive and physical performance (WHO 2006). Skipping meals leads to hypoglycaemia (low blood sugar) and causes shortened attention span, reduced information processing speed and response time, leading to accidents and near-misses.

According to Inoue et al. (2014), health risks related to body mass index (BMI) (obesity/overweight), blood pressure, and glucose and lipid metabolism are a result of unhealthy eating. Obesity and overweight are major public health concerns that threaten occupational safety and health and they have a significant positive association with absenteeism, measured as work loss days or spells of absence in a workforce (Schulte et al. 2007). Furthermore, fatigue can lead to poorer performance on tasks which require attention, cognitive decision-making or high levels of skills, giving rise to increased risks especially in safety-critical tasks (HSE, 2009).

Owing to the physically and mentally demanding nature of their activities, and the inherently unsafe working environment and conditions (handling and operating dangerous plant and equipment), construction workers require proper nutrition to sustain physical strength and stamina, manual dexterity and coordination, mental concentration, alertness and cognition (CLC 2014). Unfortunately, construction workers have poor nutrition and unhealthy eating habits which give rise to the prevalence of illnesses such as diabetes and cardio-metabolic risks (Tiwary et al. 2012; Thepaksorn and Pongpanich 2014). Unhealthy workers, partly as a result of unhealthy eating, have weakened the immune system and unstable physical and mental condition, which makes them susceptible to diseases, depression and mental illness, and thus leading to reduced acuity, inability to make quick astute judgements and increased proneness to injuries and accidents.

2.2 Health and safety performance measurement

According to Lingard et al. (2013), H&S performance improvement cannot be achieved if it cannot be measured. One of the most practical guiding principles of the measurability of safety performance is given in the Australian/ New Zealand Standard, AS/NZS 4804: 2001 Occupational health and safety management systems—General guidelines on principles, systems and supporting techniques (AS/NZS 4804) which defines safety performance as "the measurable results of the occupational health and safety management system related to the organisation's control of health and safety risks, based on its OHS policy, objectives and targets" and measuring performance includes measurement of OHS management activities and results (Dingsdag et al. 2008).

Traditionally, records of accidents, injury and ill-health statistics have been used to measure H&S performance (Musonda 2012). However, it has been argued that measuring H&S performance by the frequency of accidents and injuries is sometimes inappropriate, unreliable and deceptive because gross under-reporting could occur (Musonda 2012). Also, injury rates often do not reflect the potential severity of an event, merely the consequence; they reflect outcomes, not causes (Hinze et al. 2013). Others measures potentially lead to an injury or incident and could reveal the state of

the safety performance of workers in an industry (Biggs et al. 2009). Such measures include, among other things:

Medical treatment beyond first aid

According to ElSafty et al. (2012), an Occupational Safety and Health Administration (OSHA) recordable injury is an occupational injury or illness that requires medical treatment more than simple first aid. First aid involves a particular level of treatment (such as cleaning and covering of wounds, use of non-prescription medication, etc; whereas medical care occurs when an injury or disease requires a higher degree of attention and management to ensure a full recovery, for instance, treatment of fractures, suturing of wounds and prescribing and providing drugs to manage symptoms (Biggs et al. 2009; International Council on Mining and Metals (ICMM) 2014).

Restricted work, days away from work

Other recordable criteria include limited work, days away from work, significant injuries or illnesses diagnosed by a physician and lost work day incidents (ElSafty et al. 2012). Days away from work, restricted duty and transferred duties are related to injuries which are severe enough that workers are away from work, placed on restricted duty or assigned a lighter job because of the injury. Supporting this view, the International Labour Organisation (ILO) 2013) stated that loss of working capacity or inability to perform normal or routine work functions on the next calendar day after an injury reflects poor worker safety performance (ILO 2003). Statistics on the days away from work or on restricted duty due to an injury are useful when analysing how much loss is incurred from injuries (ElSafty et al. 2012). Lost workday or lost time injuries are also helpful in interpreting solutions to lowering the number of injuries and fatalities per year (Dingsdag 2008; ElSafty et al. 2012). Absence from work due to an injury, for more than three consecutive working days, is considered severe and compensable (ILO 2003; Cameron and Duff 2007).

Correct use of personal protective equipment

According to Farooqui et al. (2008), the use of personal protective equipment (PPE) is one of the core practices required for safety on construction sites. It is a performance issue which belongs to self-protection category and can be used to indicate safety performance levels of firms (Farooqui et al. 2008; Biggs et al. 2009; Construction Industry Institute (CII) 2014). Workers face bodily harm when they do not wear PPE (or do not wear PPE correctly). For instance, falls from heights could occur with weak scaffolding and lack of safety belts; cement burns could be sustained without protective gloves and boots while cementing; injuries could be sustained on fingers, eyes, head, or feet due to the absence of PPE, and so on (Farooqui et al..2008).

Prior risk assessment

Another performance issue which is critical is the evaluation of risks involved in a given task before embarking on it. The identification of the tasks, hazards and the risks of a job before work allows for the implementation of protective measures to ensure that work is done safely (Campbell Institute 2014).

Near-misses and reporting of near-misses

Furthermore, near misses or close calls were shown to be indicators of safety performance ((Biggs et al. 2009; Hinze et al. 2013; CII 2014). Reporting of the near-misses and accidents is also crucial in reflecting workers' attitude and commitment to safety at the workplace. However, according to Masood et al. (2014), the workers may be uncertain about reporting accidents or near-misses because sometimes there is no mechanism for compensation for injuries, and they may blame their luck which made them victims of the accident.

The above-discussed indicators relate to construction workers, before or after an incident, and were therefore adopted as the indicators of worker safety performance, in the current study. This suggests that some indicators may be trailing, providing data about incidents after the fact (Hinze et al. 2013), whereas others may be prevailing, potentially leading to an injury or incident (Biggs et al. 2009). These are trailing, and comprehensive measures were incorporated in the current study because according to Atkins (2011), the use of a set of safety performance indicators provides a greater indication of safety performance than concentrating on one measure in isolation (or indeed a small number of random measures). They were also observed to be good safety performance indicators because they are quantifiable, permit statistical inferential procedures and are valid and representative of what was to be measured (workers' safety actions/behaviours or performance) (Roelen and Klompstra 2012). The interpretations were observed to relate to the system and its operational context (precedents and antecedents of unhealthy eating) (Herrera 2012). In other words, the measures were adopted because they were identified from existing literature and observed to be relatable to construction workers' safety performance at work and were approved by the researcher's supervisors.

3. Research Methodology

To achieve the objective of the study, a review of literature related to safety performance of workers in general and construction workers, in particular, was conducted. Various sources including academic and professional journals, books, government reports, newspapers, magazines, theses and dissertations were consulted. A quantitative research design was used in conducting the study due to the statistical nature of the study and the objective which the study set out to establish (the statistical structures of safety performance measures).

3.1 Questionnaire design

A 5-point frequency response Likert-type scale questionnaire was thereafter developed to elicit information on workers' safety performance on construction sites. The identified items related specifically to those measures which could be associated with unhealthy eating, since this was the purpose of the main study. Closed-ended questions were used because they were thought to be easier to respond to in a shorter time than open-ended ones and they allow for

straightforward analysis of data (Hyman and Sierra, 2016).The questionnaire, which consisted of 10 items, was pilot-tested and reviewed thereafter. It was necessary to revise some of the questions to simplify the questions for ease of understanding. The final questionnaire had response categories were assigned 1, 2, 3, 4 and 5, for "on every project", "more than two times", "two times", "once before" and "never", respectively. Therefore, higher scores were meant to represent higher safety performance.

3.2 Data collection

The questionnaire was self-administered to construction workers on building and civil engineering construction sites in Midrand, Samrand, Johannesburg and Centurion. Purposive sampling techniques were used in the study. The participants were selected through heterogeneity and convenience sampling. Heterogeneity sampling, also known as maximum variation sampling, was used to include as many construction settings as possible, in different locations in the Gauteng province of South Africa. This technique was used because the concern was to include diverse views and not about representing the views proportionately (Trochim 2006). However, attention was paid to including workers from different organisations (both building and civil construction companies) to obtain a representative population, which was necessary to improve generalisation (Trochim 2006; Naoum 2007). The respondents were purposively and conveniently sampled. They were purposively selected to include workers who were actively engaged in the physical construction activities as opposed to the site managers and supervisors. This homogeneous group was chosen as they were the most susceptible to poor safety performance on construction sites. Also, workers who were accessible and willing to take part in the study were included (Etikan et al. 2016). A cover letter accompanied the questionnaire to explain the purpose of the study and obtain informed consent. The respondents participated voluntarily and anonymously. Out of a total of 220 questionnaires, 183 were completed, giving a response rate of 83%. The returned questionnaires were used for the empirical analysis.

3.3 Data analysis

Empirical data were analysed using Statistical Package for Social Sciences (SPSS) version 22. The Cronbach's alpha and mean inter-item correlations were used to assess the internal consistency reliability of the scale. Factor analysis using principal axis factoring and oblimin rotation was then conducted to examine underlying structures of the theorised variables. Before the factor analysis, preliminary considerations for the factorability of data were assessed. The sample size requirement of 150+ was met (Pallant 2013). Factorability of data was assessed using the Kaiser-Meyer-Olkin (KMO) and Bartlett's sphericity tests. Missing data were excluded using listwise deletion. Outliers were identified and removed before analysis. The Kaiser's criterion (retaining eigenvalues above 1), scree test (retaining factors above the "breaking point") were used to determine the emerging components or empirical constructs from the principal components analysis.

3.4 Validity and reliability

Various measures were taken to ensure that the variables developed from extant literature (termed theoretical constructs in the current study) and those realised after the factorial analysis (termed empirical constructs) were valid and reliable. Through an extensive and thorough literature review and synthesis, expert reviews and validation as well as pilot-testing, construct validity of the theoretical variables was achieved (Olson 2010). The Cronbach's alpha internal consistency reliability test was used to statistically assess the internal consistency of the ten theoretical variables as well as the two empirical constructs including lagging indicators (comprising absence from work for more than three days due to an injury, medical treatment beyond first aid, restricted work, near-misses, injury and sickness at work, and reporting of accidents) and leading indicators (consisting of risk assessment prior to performing a task, accepting any kind of work regardless of risks involved, and failure to wear PPE).

The resulting values, presented in Table 1, indicated good internal consistency of the constructs. Before factor analysis, the scale was considered to be reliable and representative of what is to be measured, with a good alpha index of 0.83 (Roelen and Klompstra 2012; Pallant 2013). After analysis, the internal consistency reliability of the constructs tested using both the Cronbach's alpha and mean inter-item indices, was equally good. Cronbach's alpha values of above 0.7 indicate acceptable internal consistency reliability and mean inter-item coefficients ranging from 0.2 to 0.4 indicate good internal consistency (Pallant 2013).

.

Table 1: Population and Sample Size of the Study

	Cronbach's alpha	Mean inter-item correlations	Number of items
Lagging measures	0.885	0.530	7
Leading measures	0.763	0.521	3

4. Findings and Discussion

4.1 Demography

Table 2 shows the response rates from the sites which were sampled. The table reveals that the highest number of respondents was obtained from the hospital building site, whereas the lowest number was received from the residential property under renovation.

Table 2: Response Rates from Selected Sites

	Description of setting	Number distributed	Number received	Percentage received
Building	New hospital site (7 two-storey hospital buildings)	75	67	37
	Office property sites (new additions at basement stage)	60	47	26
	Trading centre (new construction)	40	24	13
	Students' residence (new construction)	16	16	9
	Residential property (renovation)	10	10	5
Road	One extension and two maintenance projects	19	19	10
	Total	**220**	**183**	**100**

Table 3 shows the demographic details of the subjects. The highest percentage of respondents was between 25 – 34 years of age. The highest educational qualification was high school certificate. Unskilled workers made up 21% of the respondents; bricklayers made up 16% while electricians made up 21% of the respondents. 10% of the respondents were made up of carpenters and plumbers, respectively, and 15% consisted of other workers including pavers, painters, tiler, bob-cart operator, glass-fitter, manhole specialist and cleaners. Besides, the respondents were also asked to indicate the nature of organisation for which they worked. 48% of the workers reported that they worked for a building construction company. 24% reported that they worked for a general contractor while 18% revealed that they worked for a company that engaged in civil works only.

Table 3: Demographic Characteristics of the Study Sample

Demographic characteristics	Response category	Frequency	Percentage frequency
Age (in years)	24 and below	47	26
	25–34	86	47
	35–44	38	21
	44 and above	12	6
Education	Primary school	58	32
	High school	72	39
	Training College	42	23
	Others	5	3
Specific job on site	Bricklayers	29	16
	Electricians	26	14
	Carpenters	18	10
	Steel-fixers	17	9
	Plumbers	19	10
	Unskilled workers	38	21
	Others (pavers, bobcat operator, glass-fitter, manhole specialist, tiler, painters and cleaners)	27	15
Organization	Building construction	88	48
	Civil engineering	32	18
	General contractor	44	24

4.2 Findings from factor analysis

Before performing the factor analysis, suitability of the data for factor analysis was tested. The KMO value was 0.832, exceeding the recommended value of 0.6 and Bartlett's test of Sphericity reached statistical significance at $p = .000$ ($< .05$), supporting the factorability of the data. The correlation matrix which showed the presence of many coefficients of 0.3 and above also supported the suitability of data for factor analysis.

Factor analysis was thereafter conducted to determine the percentage variance accounted for by each of the ten items. The percentage variability explained by each of the variables is presented in Table 4 and Figure 1. Results in Table 4 further revealed that only two components had eigenvalues above 1 (4.511 and 1.885). The results of the scree test (Figure 2) also supported that only the first two components accounted for approximately 64% of the variance. This means that the two factors together explain most of the variability in the ten original variables and therefore are clearly a good and simpler substitute for all ten variables.

The two components were thereafter rotated to reveal their item-loadings (Table 5). Seven of the factors strongly loaded on the first component, while the remaining three loaded on the second. The two components were then adopted as the empirical constructs.

Table 4: Percentage Variance Explained by the Safety Performance Measures

	Factor	Total	% of Variance	Cumulative %
1	been away from work for more than three days due to an injury	4.511	45.106	45.106
2	been treated medically for injuries (more than simple first aid) on site	1.885	18.851	63.958
3	been asked to do limited work after an injury	.815	8.148	72.106
4	been involved in incidents or near-misses	.710	7.097	79.202
5	been injured at work	.594	5.938	85.141
6	been sick at work	.451	4.506	89.647
7	failed to report an accident or incident	.330	3.297	92.944
8	failed to consider the possible risks in a particular task	.296	2.959	95.903
9	accepted any work, not minding the danger/risk involved	.235	2.353	98.256
10	failed to wear personal protective equipment (PPE)	.174	1.744	100.000

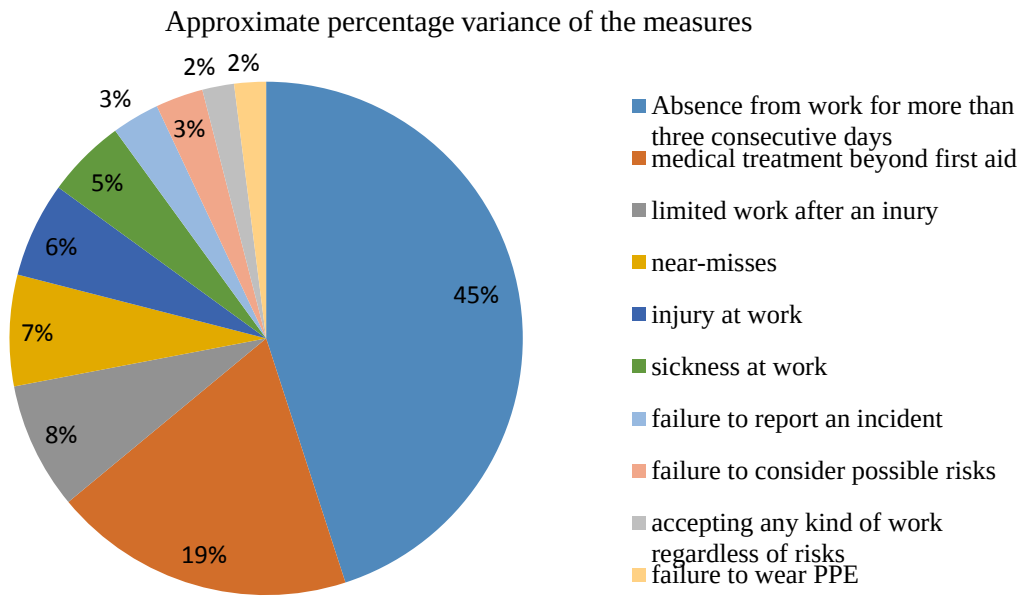

Figure 1: Percentage Variance of the Safety Performance Measures

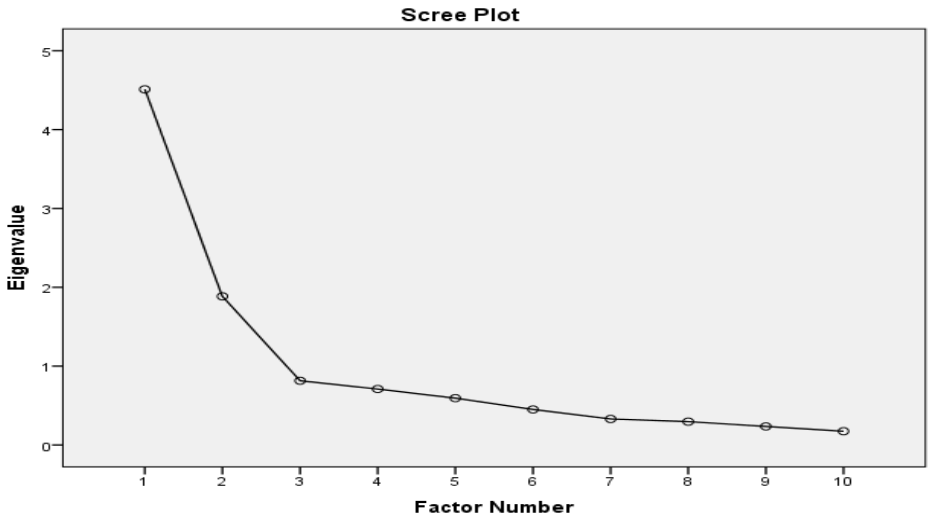

Figure 2: Scree Plot Showing Constructs above the Breaking Point

Table 5: Loading Matrix of the Safety Performance Measures

	Measures	Component 1	Component 2
1	been away from work for more than three days due to an injury	**.946**	-.119
2	been treated medically for injuries (more than simple first aid) on site	**.872**	-.009
3	been asked to do limited work after an injury	**.813**	-.177
4	been involved in incidents or near-misses	**.670**	.011
5	been injured at work	**.651**	.289
6	been sick at work	**.613**	.049
7	failed to report an accident or incident	**.465**	.258
8	failed to consider the possible risks in a particular task	-.073	**.850**
9	accepted any work, not minding the danger/risk involved	-.036	**.704**
10	failed to wear personal protective equipment (PPE)	.124	**.564**

Figures in bold represent the factor loadings

The interpretation of the two components showed that positive measures clumped together and negative measures did the same, consistent with positive and negative schedule scales used in extant literature (Pallant 2013). Hence, the first component with negative items was named lagging indicators, while the second component with positive items was named leading indicators (ICMM 2014). Therefore, a two-factor model emerged from the factorial analysis, as evinced in Figure 3.

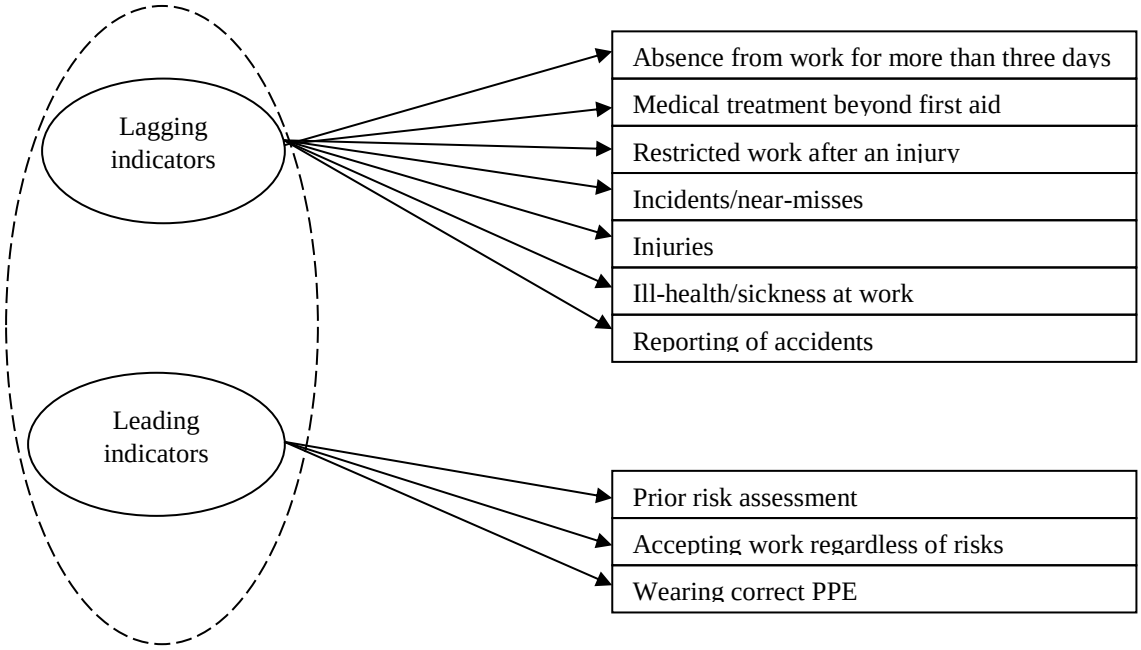

Figure 3: Two-Factor Model of Safety Performance measures

In relation to construction safety performance, general performance measures are leading indicators which provide information that prompt actions to achieve desired outcomes and avoid unwanted outcomes whereas trailing performance measures are lagging indicators that provide safety results, for instance, the extent of worker injuries (Hinze et al. 2013). Differentiating and using both indicators provide a more reliable and accurate measurement of safety performance (Lingard et al. 2013). Leading metrics such as level of risk assessment that a worker might be willing to perform when the opportunity presents itself may be modified by the worker's mental state and if this is poor, probably as a result of unhealthy eating or skipped meals, can lead to the trailing outcomes (such as accidents, near-misses, etcetera). Also, obesity, which could result from poor nutrition, may modify the risk for near-misses and vibration-induced injury (Schulte et al. 2007) and these may go unnoticed for a long time or be mistaken to be as a result of other occupational health and ergonomic issues. Therefore, early identification and management of risky eating behaviours and its consequences should be of great concern.

Leading indicators can be useful in predicting future levels of safety performance, thereby providing information which could guide implementation of interventions to improve and impact positively on the safety process, before any negative (trailing) incidences occur (Hinze et al. 2013). More intensive training programmes and sessions to improve H&S could include nutrition interventions to drive positive change (healthy eating), thereby contributing to a reduction in accidents and injuries due to fatigue, lack of dexterity and acuity

(consequence), with the outcome of being able to continue working, and thus improving quality of life and contributing to GDP.

The study provides support to extant literature which advocates the use of both leading and lagging indicators to measure safety performance in the construction industry. Traditional measures of safety, which are after-the-fact measures that assess safety after injuries occur, have a shortcoming in the sense that it bases measurement on failure of the system (Dingsdag et al. 2008; Farooqui et al. 2012). Pre-emptive actions need to be taken before accidents occur. Leading indicators can help to predict safety levels to engender the necessary pro-active measures before the occurrence of accidents. Therefore, leading indicators should ideally be included in assessing worker safety performance levels. This is even more important for assessing construction worker safety performance to reduce the risks associated with working in an inherently unsafe environment. Also, the attitude and behaviour of construction workers with respect to safety is influenced by their trepidations of risk, safety, rules, procedures and management (Masood et al. 2014). Although leading indicators may be cumbersome to collect and measure, may not directly reflect actual success in preventing injury and disease, and may be subject to random variation (Dingsdag et al. 2008), they are increasingly becoming adopted (Lingard et al. 2013; Hinze et al. 2013). Equal consideration should be given to leading measures.

A combination of both classifications to support behavioural changes can lead to sustainable worker safety levels in the long run. The use and adoption of both should be encouraged to drive H&S continuous improvement (Construction Owners Association of Alberta (COAA) 2011).

5. Conclusion

The study sought to explore the underlying structure of safety performance measures. Safety performance was found to be measured by two components. The components had positive and negative safety performance measures, respectively. They were therefore named leading and lagging measures, accordingly. Lagging and leading measures should, therefore, be used to evaluate and effectively manage safety performance of construction workers.

The study provides evidence which could be useful in psychometric evaluation of construction workers' safety performance and behaviours on construction sites. By highlighting safety performance/behaviours of the workers, construction stakeholders could be enabled to make informed decisions regarding improving H&S performance of the workers, and thus improve the productivity, profits and competitiveness in their establishments.

6. Study limitations and further research

The limitations of the current study warrant mention. Firstly, the study was conducted in only one province in South Africa and may not be generalised to workers in the entire country or other countries. Secondly, although the safety performance measures incorporated in the study were observed to relate to the nutrition context, and approved by experts, they are not exhaustive. However, other studies seeking to evaluate the safety performance of workers could adapt and incorporate these measures. Thirdly, the method of data collection was quantitative. More in-depth information could have been elicited with a follow-up qualitative technique such as interviews. Future studies could, therefore, attempt the study using a different approach to extract more information or determine if different results would be obtained.

7. Acknowledgement

This research was supported by the University of Johannesburg through its Global Excellence and Stature Scholarships. The current paper is part of a recently completed Master's study at the University.

References

Atkins, W. S. (2011). Development of suitable safety performance indicators for level 4 bio-containment facilities: Phase 2. Health and Safety Executive (HSE).

Amare, B., Moges, B., Moges, F., Fantahun, B., Admassu, M., Mulu, A. and Kassu, A. (2012). Nutritional status and dietary intake of urban residents in Gondar, Northwest Ethiopia. BMC Public Health, 12:752.

Biggs, H. C., Dingsdag, D. P., Kirk, P. J. and Cipolla, D. (2009). Safety Culture Research: Leading indicators and the development of safety effectiveness indicator in the construction sector. Proceedings of the 5th International Conference on Knowledge, Technology and Society, 30Jan – 1 Feb. 2009. Huntsville, Alabama: Unites States of America.

Cameron, I. and Duff, R. (2007). A critical review of safety initiatives using goal setting and feedback. Construction Management and Economics, 25(5):495-508.

Campbell Institute. (2014). Practical guide to leading indicators: Metrics, case studies and strategies. National Safety Council: United States of America.

Construction Industry Institute (CII). (2014). Measuring safety performance with active safety leading indicators. CII.

Construction Labour Contractors (CLC). (2014). Construction workers' essential qualities. CLC.

Construction Owners Association of Alberta (COAA). (2011). Workplace health and safety performance improvement guideline: A best practice of the COAA. Canada: COAA.

Dingsdag, Donald P. and Biggs, Herbert C. and Cipolla, Dean. (2008). Safety effectiveness indicators (SEI's): Measuring construction industry safety performance. Proceedings of the Third International Conference of the Cooperative Research Centre (CRC) for Construction Innovation – Clients Driving Innovation: Benefiting from Innovation, Gold Coast, Australia.

ElSafty, A., ElSafty, A. and Malek, M. (2012). Construction safety and occupational health education in

Egypt, the European Union and United States firms. Open Journal of Civil Engineering, 2:174-182.

Etikan I, Musa S. A. and Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. American Journal of Theoretical and Applied Statistics, 5(1): 1-4.

Farooqui, R. U., Arif, F. and Rafeeqi, S. F. A. (2008). Safety performance in construction industry of Pakistan. Proceedings of the First International Conference on Construction in Developing Countries, August 4-5, Karachi, Pakistan.

Health and Safety Executive (HSE). (2009). Reducing error and influencing behaviour. HSE Books.

Health and Safety Executive (HSE). (2014). Statistics on fatal injuries in the workplace in Great Britain. HSE Books.

Herrera, I. A. (2012). Proactive safety performance indicators. Unpublished Doctoral Thesis. Norwegian University of Science and Technology, Norway.

Hinze, J., Thurman, S and Wehle, A. (2013). Leading indicators of construction safety performance. Safety Science, 51(1):23-28.

Huang, Y. Zohar, D., Robertson, M. M., Garabet, A., Lee, J. and Murphy, L. A. (2013). Development and validation of safety climate scales for lone workers using truck drivers as examplar: Transportation research part F. Traffic Psychology and Behaviour, 12:5-19.

Hyman, M. R. and Sierra, J. J. (2016). Open- versus close-ended survey questions. Business Outlook, 14(2): 1–5.

Inoue, M., Minami, M. and Yana, E. (2014). Body mass index, blood pressure, and glucose and lipid metabolism among permanent and fixed-term workers in the manufacturing industry: A cross-sectional study. BMC Public Health, 14:207.

International Council on Mining and Metals (ICMM). (2014). Health and safety performance indicators. ICMM, London: United Kingdom.

International Labour Organization (ILO). (2003). Safety in numbers: Pointers for global safety culture at work. ILO, Geneva.

Janackovic, G. l., Savic, S. M. and Stankovic, M. S. (2013). Selection and ranking of occupational safety indicators based on fuzzy AHP (Analytical Hierarchy Process): A case study in road construction companies. South African Journal of Industrial Engineering, 24(3):175-189.

Kolver, L. (2012). Employers realising the importance of adequate nutrition. Mining Weekly. Creamer Media: South Africa.

Lin, S., Tang, W., Miao, J., Wang, Z and Wang, P. (2008). Safety climate measurement at the workplace in China: A validity and reliability assessment. Safety Science, 46:1037-1046.

Lingard, H and Turner, M. (2015). Improving the health of male, blue collar construction workers: A social, ecological perspective. Construction Management and Economics, 33 (1):18-34.

Lingard, H., Wakefield, R. and Blismas, N. (2013). "If you cannot measure it, you cannot improve it": Measuring health and safety performance in the construction industry. Proceedings of the 19th CIB World Building Congress, 5-9 May, Queensland University of Technology, Brisbane: Queensland.

Liu, H., Jazayeri, E., Dadi, G. B., Maloney, W. F., and Cravey, K. J. (2015). Development of an operational excellence model to improve safety for construction organizations. Proceedings of the 5th International Construction Specialty Conference of the Canadian Society for Civil Engineering, 8-10 June, Vancouver, British Columbia.

Masood, R., Mujtaba, B., Khan, M. A., Mubin, S., Shafique, F. and Zahoor, H. (2014). Investigation for safety performance indicators on construction projects. Sci.Int. (Lahore), 1403-1408,2014

Melia, J. L. and Becerril, M. (2009). Health behaviour and safety in the construction sector. Psicothema, 21(3): p.427+

Musonda, I. (2012). Construction health and safety performance improvement: A client-centred model. Unpublished Doctoral Thesis. University of Johannesburg, South Africa.

Naoum, S. G. (2007). Dissertation research and writing for construction students. 2nd ed. Butterworth-Heinemann, Elsevier Ltd.: United Kingdom.

Ofori, G. (2012). New perspectives on construction in developing countries. Routledge.

Okoro, C. S. (2015). Nutritional quality and health and safety performance in the South African construction industry. Unpublished Master's Dissertation. University of Johannesburg, South Africa.

Okoro, C. S., Musonda, I. and Agumba, J. (2016). A factorial analysis of safety performance measures: A study among construction workers in Gauteng, South Africa. Proceedings of the 9th cidb postgraduate conference, South Africa. 2–4 February 2016. Cape Town: University of Cape Town.

Olson, K. (2010). An examination of questionnaire evaluation by expert reviewers. Field Methods, 22(4):295-318.

Pallant, J. (2013). SPSS survival manual: A step by step guide to data analysis using IBM SPSS. 5th edition. Allen and Unwin, Australia. pp. 101, 193, 199 and 207.

Pillay, K R. (2014). The costs of construction accidents. Master's dissertation. Cape Peninsula University of Technology: South Africa.

Prinsloo, L. (2013). Death and injury stalk construction sites. Business Times. South Africa.

Roelen, A. L. C. and Klompstra, M. B. (2012). The challenges in defining aviation safety performance indicators. Preprint for PSAM II and ESREL, 25-29 June 2012, Helsinki: Finland.

Schulte, P. A., Wagner, G. R., Ostry, A., Blanciforti, L. A., Cutlip, R. G., Krajnak, K. M., Luster, M., Munson, A. E., O'Callaghan, J. P., Parks, C. G., Simeonova, P. P. and Miller, D. B. (2007). Work, obesity and occupational safety and health. American Journal of Public Health, 97(3):428-436.

Thabit, H., Burns, N., Shah, S., Brema, I., Crowley, V., Finnegan, F., Daly, B. and Nolan, J. J. (2013). Prevalence and predictors of diabetes and cardio-metabolic risk among construction workers in Ireland: The construction workers health trust screening study. Diabetes and Vascular Disease Research, 10(4):337-345.

Thepaksorn, P. and Pongpanich, S. (2014). Occupational injuries and illness and associated costs in Thailand. Safety and Health at Work, 5(2): 66-72.

Tiwary, G., Gangopadhyay, P. K. Biswas, S., Nayak, K.., Chatterjee, M. K., Chakraborty, D. and Mukherjee, S. (2012). Socio-economic status of workers in the building and construction industry. Indian Journal of Occupational and Environmental Medicine, 16(2):66-71.

Trochim, W. M. K. (2006). External validity. In Research Methods Knowledge Base. Web Centre for Social Research Methods.

World Health Organisation (WHO). (2006). Evaluating the public significance of micronutrient malnutrition. Part II. In Guidelines on food fortification with micronutrients. pp. 39–42. WHO.

World Health Organisation (WHO). (2014). Health topics: Nutrition. WHO.